M.I.T. ANNUAL CATALOGUES AND BULLETINS
1944/45

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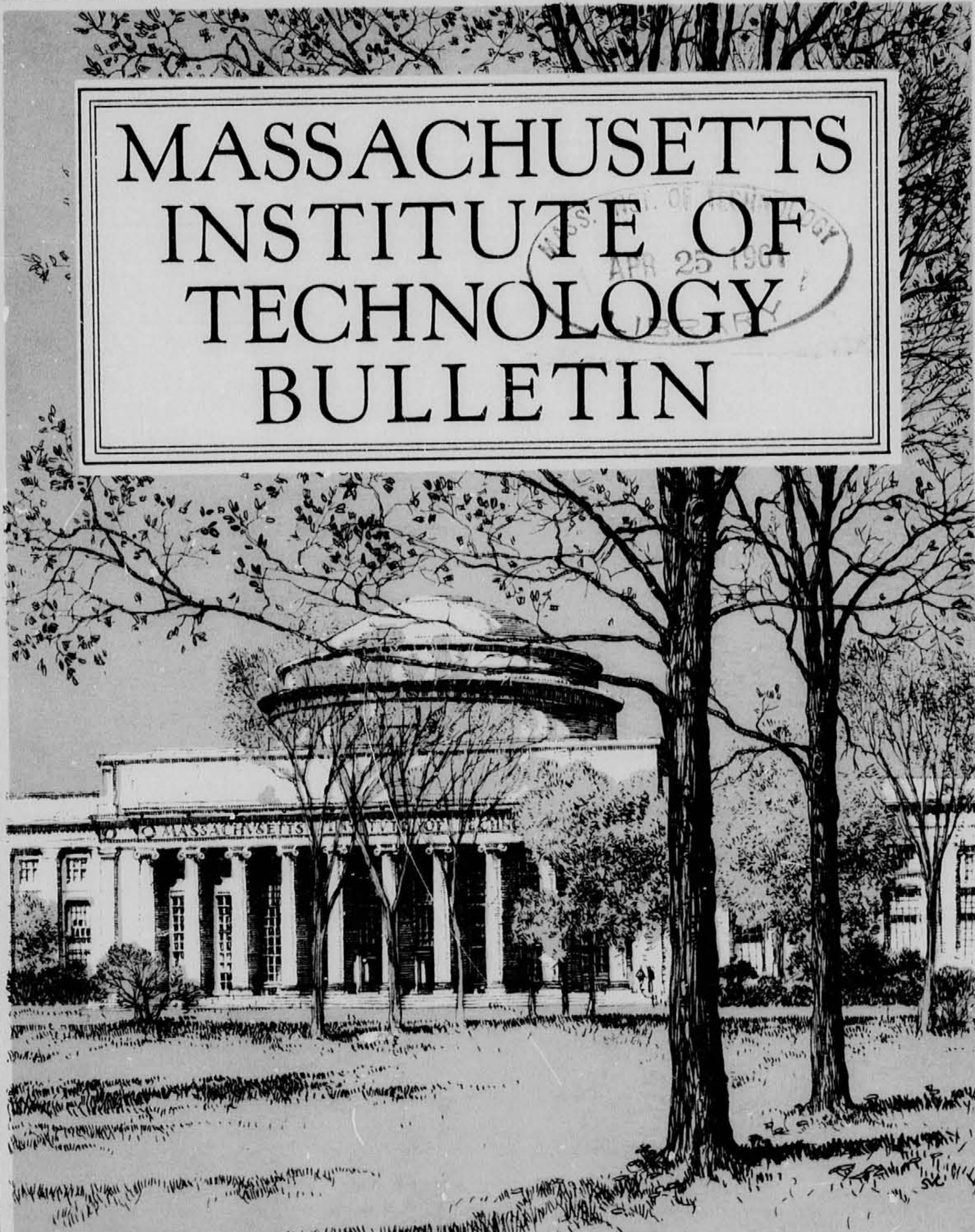
MASSACHUSETTS INSTITUTE OF TECHNOLOGY BULLETIN



VOLUME 79 CATALOGUE ISSUE JUNE 1944 NUMBER 4

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Issues of the Bulletin include the reports of the President and of the Treasurer, the General Catalogue, the Undergraduate Course Schedules, and the Directory of Officers and Students

The Institute reserves the right to make changes in the regulations and courses announced in this Bulletin

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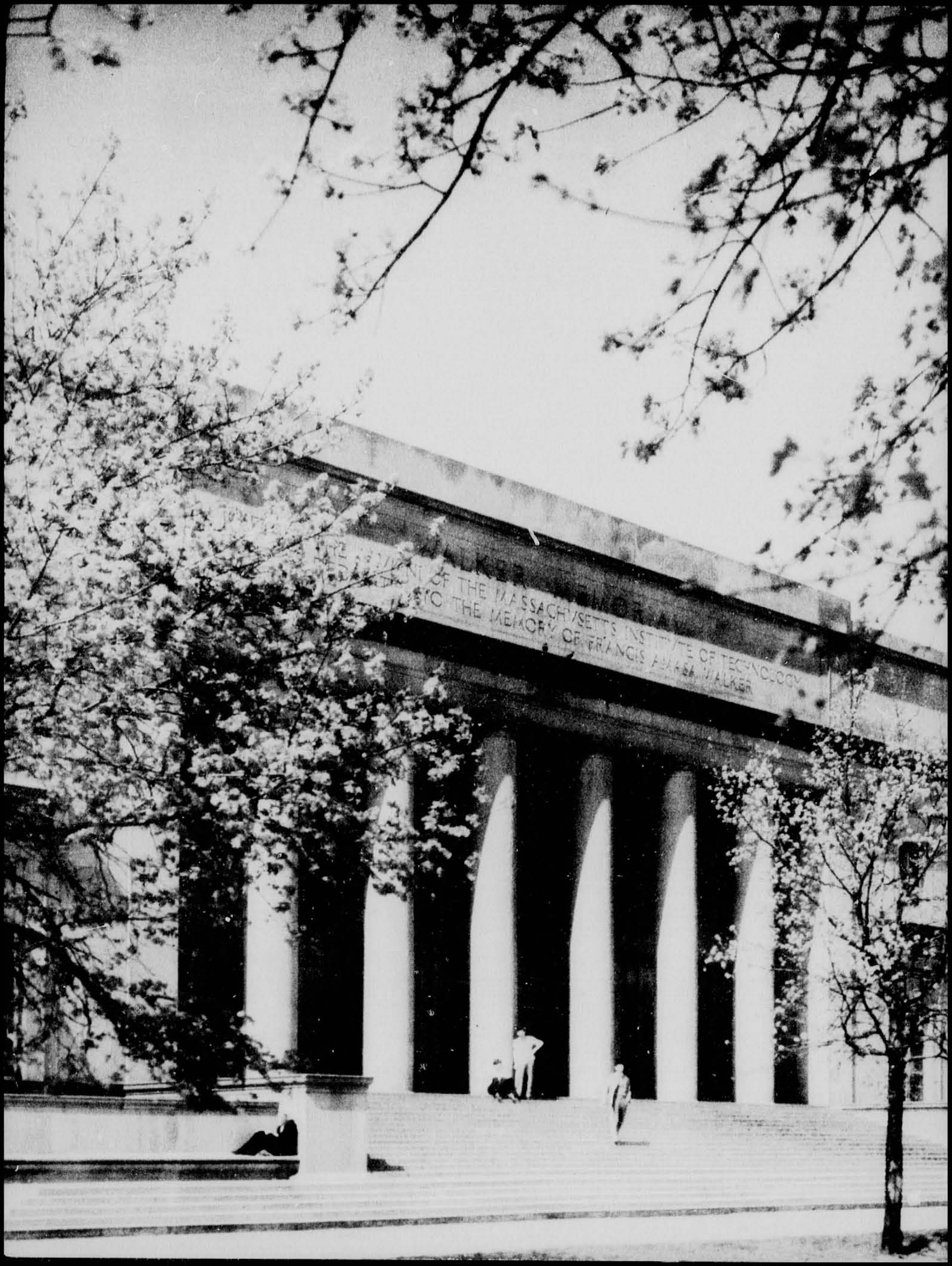
OF THE MASSACHVSETTS INSTITVTE OF TECHNOLOGY

MASSACHUSETTS INSTITUTE OF TECHNOLOGY BULLETIN

VOLUME 79 NUMBER 4

CATALOGUE ISSUE
1944

A Bulletin of Information about the Institute, its Government, Staff, Regulations, Requirements for Admission, Facilities, and Courses of Instruction, both Undergraduate and Graduate

PUBLISHED BY THE INSTITUTE · CAMBRIDGE

CALENDAR

CALENDAR 1944–1945

(Subject to Change)

SUMMER TERM 1944

		1944
Summer Term Begins		July 10
Last Exercises, Summer Term		Oct. 21
Examination Period	Oct. 23 through	Oct. 28

FALL TERM 1944–45

		1944
Fall Term Begins		Nov. 6
		1945
Last Exercises, Fall Term		Feb. 17
Examination Period	Feb. 19 through	Feb. 24

SPRING TERM 1945

		1945
Spring Term Begins		Mar. 5
Last Exercises, Spring Term		June 16
Examination Period	June 18 through	June 23

1944

JANUARY

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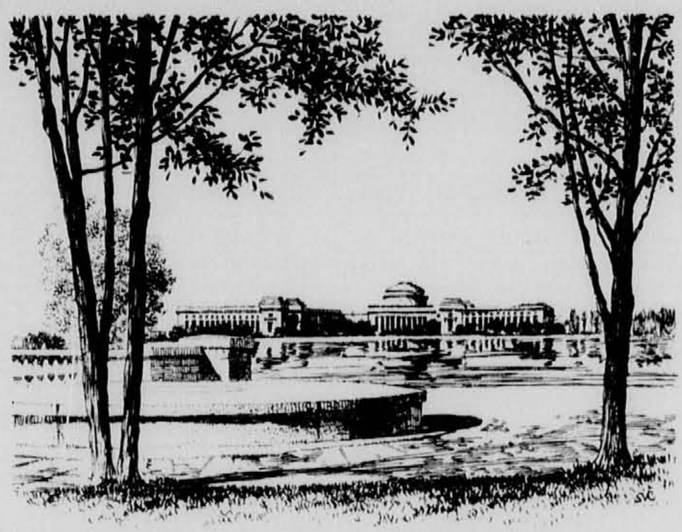

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UNDERGRADUATE COURSES (*Continued*)

THE GRADUATE SCHOOL

SUBJECTS OF INSTRUCTION

APPENDICES

OBJECTIVES AND POLICIES OF THE INSTITUTE

WITH a lively and prophetic vision of the part that science was capable of playing in advancing human welfare William Barton Rogers (1804–1882), geologist and natural philosopher of the University of Virginia, planned and worked for nearly a decade prior to the Civil War for the establishment of a great institute of technology. He selected Boston as the most advantageous location because, as he said, "ever since I have known something of the knowledge-seeking spirit and the intellectual capabilities of the community in and around Boston, I have felt that it was the one most certain to derive the highest benefits from a polytechnic institution. The occupations and interests of the great mass of the people are immediately connected with the applications of physical science, and their quick intelligence has already impressed them with just ideas of the value of scientific teaching in their daily pursuits."

As stated in its charter, granted by the Commonwealth on April 10, 1861, the Institute was established "for the purpose of instituting and maintaining a society of arts, a museum of arts, and a school of industrial science and aiding generally by suitable means the advancement, development, and practical applications of science in connection with arts, agriculture, manufactures and commerce." As its first President, Rogers, aided by far-sighted colleagues, set the Institute squarely on the course laid down in this charter and engendered among the Staff those high ideals of intellectual leadership and public service that have given continuing vitality to the Institute, and that have made it, not the local institution originally planned but one of national and international influence.

Motivated by the pioneering spirit of its founder, the Institute proceeded rapidly to make many seminal contributions to education and industry. It pioneered in extending the laboratory methods of instruction as an indispensable educational technique. It virtually created the modern profession of chemical engineering; its courses in electrical and aeronautical engineering, in applied physics, and in biological engineering were probably the first in the world. It was the first technological institution to recognize and provide for the important place of economics in the training of the engineer.

In attaining its present position, the Institute has constantly kept before it three objectives — the education of men, the advancement of knowledge, and the rendering of service to industry and the nation. It aims to give its students such a combination of humanistic, scientific, and professional training as will fit them to take leading positions in a world in which science, engineering, and architecture are of basic importance. This training is especially planned to prepare students, according to their desires and aptitudes, to become practising engineers or architects, investigators, business executives, or teachers. The useful knowledge and mental discipline gained in this training are, however, so broad and fundamental as to constitute an excellent general preparation for other careers.

Realizing that the Institute trains for life and for citizenship, as well as for a career, its Staff seeks to cultivate in each student a strong character, high ideals and a worthy purpose, as well as a keen intellect.

Along with his professional work, the student at the Institute devotes a large amount of study to the arts of expression, both written and oral. Since a high standard of accomplishment is expected, a student planning to attend the Institute should devote special attention to this aspect of his preparation. This emphasis on expression is a part of a broad program in the humanities which is included in all regular undergraduate curricula and which aims to deepen the student's understanding of himself and his environment. There is also a wholesome regard for those extra-curricular activities which tend to broaden a man's outlook and to give him valuable experience in dealing with people, and these have had the cordial support of Faculty and Administration.

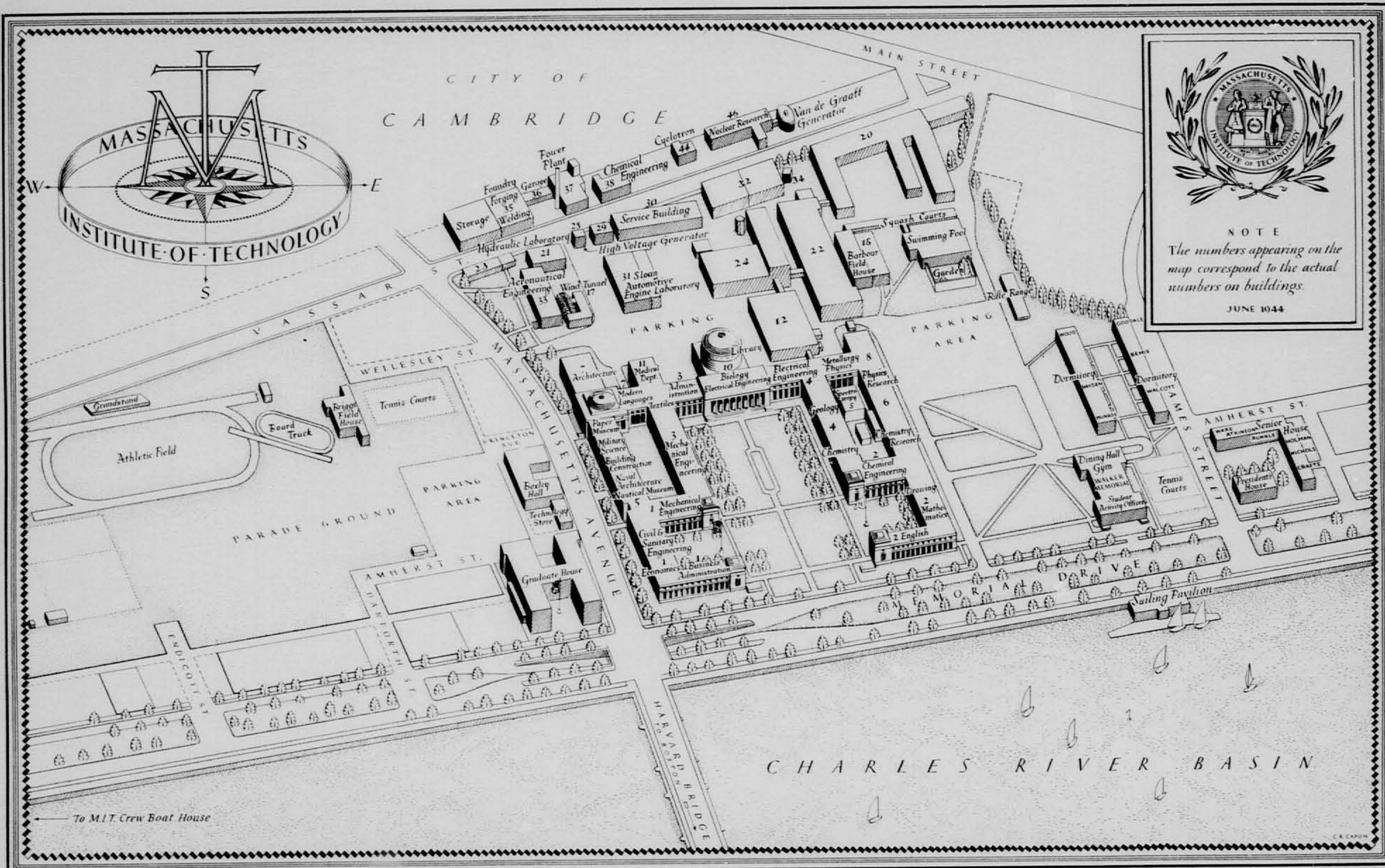
To vitalize its educational procedure and to fulfill its objectives, the Institute is placing increasing emphasis on original research in pure and applied science. Experience has demonstrated that teaching of the highest type, especially in science and its applications, thrives best in an atmosphere of steady progress in the understanding of the subject taught. He who is still a student, who is still himself learning, whether it be new relationships of the most fundamental scientific nature, or sounder and more economical ways of applying scientific knowledge for the promotion of industry and the public welfare, can best guide those about to enter upon a professional career.

Advancement in professional understanding is best acquired by intimate association with creative workers who are, through research, extending the boundaries of their professions. The most striking features of research in science and engineering at the Institute are the spirit of coöperative effort in which it is conducted and the extent to which both undergraduate and graduate students participate in it as an integral part of their educational experience.

All this makes the Institute a place where a man may study, in the true atmosphere of a professional school, those aspects of science, architecture, or engineering for which he is qualified, with opportunity to map out his own path with the aid and counsel of the Staff.

Karl T. Compton

PRESIDENT


MASSACHUSETTS INSTITUTE OF TECHNOLOGY
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CITY OF CAMBRIDGE
MAIN STREET
VASSAR ST.
MASSACHUSETTS AVENUE
WELLESLEY ST.
PRINCETON AVE.
AMHERST ST.
DANFORTH ST.
ENDICOTT ST.
AMES STREET
MEMORIAL DRIVE
HARVARD BRIDGE
TO BOSTON
CHARLES RIVER BASIN
Storage
Foundry
Forging 35 Welding
Garage 36
Power Plant
37
Chemical 38 Engineering
Cyclotron 44
46 Nuclear Research
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Hydraulic Laboratory
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31 Sloan Automotive Engine Laboratory
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Squash Courts
Swimming Pool
Garden
Rifle Range
12
PARKING
PARKING AREA
Library
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Electrical Engineering
Electrical Engineering 4
Metallurgy Physics 8
Physics Research
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Spectroscopy 5
Geology
4
Chemistry
Chemistry Research
2 Chemical Engineering
Drawing
2 Mathematics
2 English
7 Architecture
11 Medical Dept.
3 Administration
Modern Languages
Textiles
Paper Museum
Military Science
Building Construction
Naval Architecture
Nautical Museum
3 Mechanical Engineering
5
1 Mechanical Engineering
Civil & Sanitary Engineering
1 Economics
Business Administration
Dormitory
Dormitory
Walcott
Dining Hall
Gym
Walker Memorial
Student Activity Offices
Tennis Courts
Senior House
President's House
Sailing Pavilion
Grandstand
Briggs Field House
Tennis Courts
Board Track
Athletic Field
PARADE GROUND
PARKING AREA
Bexley Hall
Technology Store
Graduate House
To M.I.T. Crew Boat House
NOTE
The numbers appearing on the map correspond to the actual numbers on buildings.
JUNE 1944
C. R. CAPON

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Karl Taylor Compton

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Horace Sayford Ford

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Pierre Samuel du Pont
Harry Johan Carlson
Gerard Swope
Franklin Warren Hobbs
Joseph Wright Powell
John Edward Aldred
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Walter Humphreys
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John Russell Macomber
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Harlow Shapley
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Willis Rodney Whitney
Gordon S. Rentschler
Vannevar Bush
William Emerson
Ralph Edward Flanders
James Madison Barker
Thomas Charles Desmond
J. Willard Hayden
Louis Shattuck Cates
Marshall Bertrand Dalton
William Stark Newell

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Term expires January, 1946
Charles Eldridge Spencer, Jr.

Term expires January, 1947
Willard Henry Dow

Term expires January, 1948
Phillips Ketchum

Term expires January, 1949
George A. Sloan

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Raymond Stevens

ALUMNI TERM MEMBERS

Term expires June, 1945
Page Golsan
Egbert Charles Hadley
Irving White Wilson

Term expires June, 1946
Edward Pennell Brooks
George Jackson Mead
Robert Erastus Wilson

Term expires June, 1947
Richard Lyon Bowditch
B. Edwin Hutchinson
Duncan Robertson Linsley

Term expires June, 1948
Francis Arthur Barrett
Walter Jay Beadle
Donald Fell Carpenter

Term expires June, 1949
Harold Brown Harvey
William Jason Mixter

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Hon. Fred Tarbell Field, *Chief Justice of the Supreme Court*
Julius Ernest Warren, *Commissioner of Education*

[1] Address correspondence to Massachusetts Institute of Technology.

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Chairman of the Faculty
Bursar
President of the Alumni Association

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Dean of the Graduate School
Dean of Students
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Director of Division of Industrial Coöperation
Chairman of Faculty
Secretary of Faculty
Registrar
Heads of Departments and Professional Courses

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THOMAS P. PITRÉ, *Associate Dean of Students*
ROBERT M. KIMBALL, *Assistant Director of Admissions*

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(Arranged by Departments)

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Professors

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Professor in charge of the Department

RICHARD HARBERT SMITH, PH.D.
Professor of Aeronautical Engineering

CHARLES STARK DRAPER, Sc.D.
Professor of Aeronautical Engineering

OTTO CARL KOPPEN, S.B.
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EDWARD STORY TAYLOR, S.B.
Professor of Aircraft Engines

SHATSWELL OBER, S.B.
Associate Professor of Aeronautical Engineering

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WALTER MCKAY, S.M.
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MANFRED RAUSCHER, Sc.D.
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AUGUSTUS RUDOLPH ROGOWSKI, S.M.
Associate Professor of Aeronautical Engineering

JOHN DEZENDORF TRIMMER, PH.D. (*Absent*)
Assistant Professor of Aeronautical Engineering

DELBAR POULEUR KEILY, S.B.
Assistant Professor of Aeronautical Engineering

JOSEPH BICKNELL, S.M.
Assistant Professor of Aeronautical Engineering

RENE HARCOURT MILLER, B.A.
Assistant Professor of Aeronautical Engineering

Instructors

HOMER RAY OLDFIELD, JR., S.M. (*Absent*)

JOHN ALBERT DOREMUS, IV, S.M.

ROBERT CHANNING SEAMANS, JR., S.M.

PEI-MOO KU, D.I.C.

Research Assistants

LAWRENCE BERNBAUM, S.B.

FREDERIC WHITNEY WATRISS, S.B.

MICHAEL WITUNSKI, S.B.

Assistants

CYRUS HISAYOSHI KANO, S.M.

LEONARD WALTER WEIS, S.B.

ARCHITECTURE

(Including City Planning and Housing)

Professors

WILLIAM WILSON WURSTER, A.B.
Dean of Architecture; Professor of Architecture, in charge of the Department

HENRY LATIMER SEAVER, A.M. *Professor of History*

LAWRENCE BERNHART ANDERSON, M.ARCH.
Associate Professor of Architectural Design

HERBERT LYNES BECKWITH, M.ARCH. (*Absent*)
Associate Professor of Architectural Design

JOHN LYON REID, M.A., M.ARCH. (*Absent*)
Associate Professor of Architecture

ERNEST NAPOLEON GELOTTE, S.B.
Associate Professor of Construction

EDWARD MELVILLE BRIDGE, S.B.
Assistant Professor of Architectural Practice

BISSELL ALDERMAN, M.ARCH. (*Absent*)
Assistant Professor of Architecture

WILLIAM HOSKINS BROWN, M.ARCH. (*Absent*)
Assistant Professor of Architecture

Lecturers

SAMUEL CHAMBERLAIN (*Absent*) *Expressions of Graphic Art*

ELIOT THWING PUTNAM, A.B. *Architectural History*

Instructors

JOHAN SELMER-LARSEN

ROBERT CHARLES DEAN, M.ARCH. (*Absent*)

Assistants

FLORENCE WARD STILES, S.B., *Librarian; Adviser to Women Students*
MARGARET MALL VIGNOLES, A.B., S.B., *Assistant Librarian*

City Planning and Housing

Professors

FREDERICK JOHNSTONE ADAMS, B.ARCH.
Associate Professor of City Planning; in charge of the Course

FLAVEL SHURTLEFF, A.B., LL.B.
Associate Professor of Legislation and Administration

DRAVEAUX BENDER, B.ARCH., M.C.P.
Assistant Professor of City Planning

BIOLOGY AND BIOLOGICAL ENGINEERING

Professors

FRANCIS OTTO SCHMITT, PH.D.
Professor of Biology; in charge of the Department

MURRAY PHILIP HORWOOD, PH.D.
Professor of Bacteriology and Municipal Sanitation

BERNARD EMERSON PROCTOR, PH.D. (*Absent*)
Professor of Food Technology

JOSEPH WARREN HORTON, SC.D. (*Absent*)
Associate Professor of Biological Engineering

CHARLES HENRY BLAKE, PH.D. (*Absent*)
Associate Professor of Zoölogy

JOHN ROBERT LOOFBOUROW, SC.D.
Associate Professor of Biophysics

ROBERT SAMUEL HARRIS, PH.D.
Associate Professor of Biochemistry of Nutrition

MARSHALL WALKER JENNISON, PH.D.
Associate Professor of Bacteriology and Sanitary Biology

RICHARD SCOTT BEAR, PH.D.
Associate Professor of Biophysical Chemistry

IRWIN WHITING SIZER, PH.D.
Associate Professor of Physiology

BERNARD SIDNEY GOULD, PH.D.
Associate Professor of Biochemistry

CECIL GORDON DUNN, PH.D. (*Absent*)
Assistant Professor of Industrial Biology

DAVID FLOYD WAUGH, PH.D.
Assistant Professor of Physical Biology

JOHN COCHRAN SLUDER, PH.D.
Assistant Professor of Food Technology

KURT SIEGFRIED LION, D.ENG.
Assistant Professor of Applied Biophysics

Lecturers

FREDFRICK CONRAD BLANCK, PH.D.
Food Technology

FRANCES STERN, M.A.
Nutrition

Research Associates

ERNEST EARL LOCKHART, PH.D.
CECIL EDWIN HALL, B.SC., M.A.
EDWARD LLOYD DUGGAN, PH.D.
TORSTI PAÏVIÖ SALO, PH.D.

Research Assistants

LOUISE PILLSBURY GUILD, B.S.ED.
MARIE AGNES JAKUS, A.B.
HELEN SCRUFUTIS LOCKHART, B.S.
GERTRUDE NIGHTINGALE, A.B.
MARY KITFIELD NUTTER, B.S.
VIRGINIA MAY SCHULMAN, B.S.
ELIZABETH WEEKS TAPIA, B.A.

Assistants

EUGENE ROBERT LAWRENCE GAUGHRAN, B.A., M.S.
HENRY SHERMAN, A.B.

BUILDING ENGINEERING AND CONSTRUCTION

Professors

WALTER CHARLES VOSS, S.M.
Professor of Building Construction; in charge of the Department

DEAN PEABODY, JR., S.M.
Associate Professor of Structural Design

HOWARD RAYMOND STALEY, S.M.
Assistant Professor of Building Construction

ALBERT GEORGE HENRY DIETZ, SC.D. (*Absent*)
Assistant Professor of Structural Engineering

Assistant

ALBERT JOSEPH O'NEILL, S.B.

BUSINESS AND ENGINEERING ADMINISTRATION

Professors

ERWIN HASKELL SCHELL, S.B.
Professor of Business Management; in charge of the Department

CHARLES HUNTINGTON PORTER, A.B., S.B.
Professor of Accounting

KARL DICKSON FERNSTROM, S.B. (*Absent*)
Professor of Business Management

WYMAN PARKHURST FISKE, M.B.A., LL.B., LITT.D. (*Absent*)
Professor of Accounting; Director of Sponsored Fellowship Program

ALBERT ADAMS SCHAEFER, A.B., LL.B.
Professor of Law and Government; Director of Puerto Rican Fellowship Program

RONALD HERBERT ROBNETT, B.S., M.B.A.
Associate Professor of Accounting

ROSS MCDUFFEE CUNNINGHAM, M.B.A., D.C.S.
Associate Professor of Marketing

GERALD BRUCE TALLMAN, M.B.A., PH.D.
Assistant Professor of Marketing

HERBERT FRANKLIN GOODWIN, S.B.
Assistant Professor of Production Management

Lecturers

FRANKLIN SIMPSON ATWATER, S.B.
ARTHUR WARREN HANSON, A.M., M.B.A.

Assistant

OLIVE BARNARD

CHEMICAL ENGINEERING

(Including the School of Chemical Engineering Practice)

Professors

WALTER GORDON WHITMAN, S.M. (*Absent*)
Professor of Chemical Engineering; in charge of the Department; Director of the School of Chemical Engineering Practice

WARREN KENDALL LEWIS, PH.D., D.SC.
Professor of Chemical Engineering; Executive Officer

WILLIAM HENRY MCADAMS, S.M.
Professor of Chemical Engineering

HOYT CLARKE HOTTEL, B.A., S.M.
Professor of Fuel Engineering; Director, Fuels Research Laboratory

THOMAS KILGORE SHERWOOD, SC.D.
Professor of Chemical Engineering

HAROLD CHRISTIAN WEBER, D.SC.
Professor of Chemical Engineering

EDWIN RICHARD GILLILAND, SC.D. (*Absent*)
Professor of Chemical Engineering

CLARK SHOVE ROBINSON, S.M. (*Absent*)
Associate Professor of Chemical Engineering

ERNST ALFRED HAUSER, PH.D.
Associate Professor of Chemical Engineering

HERMAN PAUL MEISSNER, D.SC.
Associate Professor of Chemical Engineering

ROY POWELL WHITNEY, S.M.
Assistant Professor of Chemical Engineering

CHARLES ANDERSON STOKES, B.S.
Assistant Professor of Chemical Engineering

JOHNSON EDWARD VIVIAN, S.M.
Assistant Professor of Chemical Engineering; Acting Director of School of Chemical Engineering Practice

SCOTT WELLS WALKER, SC.D.
Assistant Professor of Chemical Engineering

GLENN CARBER WILLIAMS, SC.D.
Assistant Professor of Chemical Engineering

WILLIAM CHARLES BAUER, S.M.
Assistant Professor of Chemical Engineering; Executive Officer of School of Chemical Engineering Practice

Instructors

DONALD BEDDOES BROUGHTON, SC.D.
HUGH SUMMERS GRAHAM, B.S.

Research Associates

REE VILMA LE BEAU, PH.D.
IRVING DUBIN, S.M.
ABBOTT BYFIELD, S.M.

Assistants

MURRAY H. EDSON, B.CH.E.
SIDNEY HOWARD GREENFELD, B.CH.E.
JAMES ALLISON LUKER, B.S.
WALTER GRANT MAY, M.SC.
EDWARD WILSON MERRILL, A. B.
PRESTON PARR, JR., M.S.
JAMES BELLAMY WEAVER, S.B.

CHEMISTRY

(Including the Research Laboratories of Physical, Organic, and Inorganic Chemistry)

Professors

FREDERICK GEORGE KEYES, PH.D., SC.D.
Professor of Physical Chemistry; in charge of the Department; Director of the Research Laboratory of Physical Chemistry

LEICESTER FORSYTH HAMILTON, S.B.
Professor of Analytical Chemistry; acting in charge of the Department

MILES STANDISH SHERRILL, PH.D.
Professor of Physical Chemistry, Emeritus; Lecturer

EARL BOWMAN MILLARD, PH.D.
Professor of Physical Chemistry

WALTER CECIL SCHUMB, PH.D.
Professor of Inorganic Chemistry; Director of the Research Laboratory of Inorganic Chemistry

GEORGE SCATCHARD, PH.D.
Professor of Physical Chemistry; Acting Director of Research Laboratory of Physical Chemistry

JAMES ALEXANDER BEATTIE, PH.D.
Professor of Physical Chemistry

AVERY ADRIAN MORTON, PH.D.
Professor of Organic Chemistry; Director of the Research Laboratory of Organic Chemistry

ERNEST HAMLIN HUNTRESS, PH.D
Professor of Organic Chemistry

WILLIS RODNEY WHITNEY, PH.D., SC.D., CH.D.
Non-Resident Professor of Chemical Research

LOUIS HARRIS, PH.D.
Associate Professor of Physical Chemistry

AVERY ALLEN ASHDOWN, PH.D.
Associate Professor of Organic Chemistry; Secretary of the Society of Arts

STEPHEN GERSHOM SIMPSON, PH.D.
Associate Professor of Analytical Chemistry

RALPH CHILLINGWORTH YOUNG, PH.D.
Associate Professor of Inorganic Chemistry

SAMUEL CORNETTE COLLINS, PH.D.
Associate Professor of Physical Chemistry

ARTHUR RANDALL DAVIS, PH.D.
Associate Professor of Inorganic Chemistry

GERHARD DIETRICHSON, PH.D.
Associate Professor of Physical Chemistry

ROBERT CASAD HOCKETT, PH.D. (*Absent*)
Associate Professor of Organic Chemistry

NICHOLAS ATHANASIUS MILAS, PH.D.
Associate Professor of Organic Chemistry

CHARLES MONTGOMERY WAREHAM, S.B.
Associate Professor of Inorganic Chemistry

EDMUND LEE GAMBLE, PH.D.
Assistant Professor of Chemistry

GEORGE GLOVER MARVIN, PH.D.
Assistant Professor of Chemistry

ISADORE AMDUR, PH.D.
Assistant Professor of Chemistry

LAWRENCE JOSEPH HEIDT, PH.D.
Assistant Professor of Chemistry

CLARK CONKLING STEPHENSON, PH.D.
Assistant Professor of Chemistry

ALBERTO FREDERIC THOMPSON, JR., PH.D. (*Absent*)
Assistant Professor of Chemistry

THOMAS ROBINSON PIRIE GIBB, JR., PH.D.
Assistant Professor of Chemistry

JOHN WITHERS IRVINE, JR., PH.D.
Assistant Professor of Chemistry

WALTER HUGO STOCKMAYER, PH.D.
Assistant Professor of Chemistry

WILLIAM MONTGOMERY HEARON, PH.D. (*Absent*)
Assistant Professor of Chemistry

Instructors

THOMAS PALM PITRE, B.A.
JOHN LEONARD OHLSON, PH.D.
ROBERT MOODY SHERMAN, S.B.
DOUGLAS GEORGE BANNERMAN, B.S., M.A.
HEWITT GRENVILLE FLETCHER, JR., PH.D.
SHEPPARD YOUNG TYREE, JR., S.B.
HOWARD IRVING FITZ, LL.B., S.M.

Research Associates

EUGENE RABINOWITCH, PH.D.
ALEXANDER BROWN, PH.D.
MORRIS ZIEF, PH.D.
ALLEN SCATTERGOOD, PH.D.

Research Assistants

JAMES BRADFORD AMES, S.B.
JEAN DAVIDSON BROWN, M.A.
GONZALO CONSTANTINO DOCAL, S.B.
FRANK XAVIER GROSSI, A.B.
ELIZABETH LEE SHEFFIELD, A.M.
REBECCA ELAINE EMILY SPENCER, B.A.
ZELMA WEISS, B.S., M.A.

Teaching Fellows

MURIEL ETHEL TURNER HOLDEN, M.A.
PHYLLIS LOUISE POLLOCK, B.S.
BARBARA FRANCES VAN TASSEL, A.B.

Assistants

HOWARD TASKER EVANS, JR., S.B.
CAROLYN KLEIN FITZ, PH.D.
ROBERT REYNOLD MARSHALL, S.B.
FRANKLIN ELWOOD MORRIS, B.S.
HUGH EDWIN RAMSDEN, S.B.
JOHN GEORGE SCHUDEL, JR., S.B.
KEITH ELDEN WHITMORE, A.B.

CIVIL AND SANITARY ENGINEERING

Professors

JOHN BENSON WILBUR, SC.D.
Professor of Structural Engineering; Acting in charge of the Department

CHARLES BLANEY BREED, S.B.
Professor of Civil Engineering

GEORGE EDMOND RUSSELL, S.B.
Professor of Hydraulics, Emeritus; Lecturer

JOHN BRAZER BABCOCK, 3D, S.B.
Professor of Railway Engineering

WILLIAM EDWARD STANLEY, C.E.
Professor of Sanitary Engineering

WALTER MAXWELL FIFE, S.M.
Associate Professor of Structural Engineering

EUGENE MIRABELLI, S.B.
Associate Professor of Structural Design

JOHN DONALD MITSCH, S.B.
Associate Professor of Structural Engineering

DONALD WOOD TAYLOR, S.M.
Associate Professor of Soil Mechanics

ALEXANDER JAMIESON BONE, S.M.
Assistant Professor of Highway Engineering

ARTHUR CLAUDE RUGE, SC.D.
Assistant Professor of Engineering Seismology

ALLAN THURSTON GIFFORD, S.B.
Assistant Professor of Hydraulic Engineering

CHARLES HEAD NORRIS, SC.D.
Assistant Professor of Structural Engineering

HERMAN JAMES SHEA, S.B.
Assistant Professor of Surveying

Instructors

JOHN LOWE, III, S.M.

CHARLES FRANKLIN PECK, JR., S.M.

Assistants

SING HON LOUIE, B.S.

MILTON MARTIN PLATT, S.B.

ECONOMICS AND SOCIAL SCIENCE

Professors

RALPH EVANS FREEMAN, M.A., B.LITT.
Professor of Economics; in charge of the Department

DONALD SKEELE TUCKER, PH.D.
Professor of Economics

WILLIAM RUPERT MACLAURIN, M.B.A., D.C.S.
Professor of Economics; in charge of the Industrial Relations Section

DOUGLASS VINCENT BROWN, PH.D.
Professor of Industrial Relations

F. ALEXANDER MAGOUN, S.M.
Associate Professor of Human Relations

BRAINERD ALDEN THRESHER, S.B., A.M.
Associate Professor of Economics; Director of Admissions

PAUL PIGORS, PH.D.
Associate Professor of Industrial Relations

RICHARD MERVIN BISSELL, JR., PH.D. (*Absent*)
Associate Professor of Economics

DOUGLAS MURRAY MCGREGOR, PH.D.
Associate Professor of Psychology

HAROLD ADOLPH FREEMAN, S.B.
Associate Professor of Statistics

PAUL ANTHONY SAMUELSON, PH.D.
Associate Professor of Economics

CHARLES ANDREW MYERS, PH.D.
Assistant Professor of Industrial Relations

IRVING KNICKERBOCKER, PH.D.
Assistant Professor of Psychology

Instructors

DANIEL CARLSON VANDERMEULEN, A.B.

ROBERT LYLE BISHOP, A.M.

FINN THEODORE MALM, B.S.

ALEX BAVELAS, B.S., M.A.

MELVIN JAMES SEGAL, PH.D.

Research Assistants

ROSALINE JOYCE HARMAN, A.B.

BARBARA KLINGENHAGEN, A.B.

Teaching Fellow

LAWRENCE ROBERT KLEIN, B.A.

Assistant

BEATRICE ALLEN ROGERS, A.B., B.S.

ELECTRICAL ENGINEERING

Professors

HAROLD LOCKE HAZEN, Sc.D.
Professor of Electrical Engineering; in charge of the Department

CARLTON EVERETT TUCKER, S.B.
Professor of Electrical Engineering; Executive Officer

RALPH RESTIEAUX LAWRENCE, S.B.
Professor of Electrical Machinery, Emeritus; Lecturer

WILLIAM HENRY TIMBIE, A.B.
Professor of Electrical Engineering and Industrial Practice

HERBERT BRISTOL DWIGHT, D.Sc.
Professor of Electrical Machinery

WALDO VINTON LYON, S.B.
Professor of Electrical Machinery

RALPH GORTON HUDSON, S.B.
Professor of Electrical Engineering; in charge of Course IX

RALPH DECKER BENNETT, Ph.D. (*Absent*)
Professor of Electrical Measurements

EDWARD LINDLEY BOWLES, S.M. (*Absent*)
Professor of Electrical Communications

MURRAY FRANK GARDNER, S.M.
Professor of Electrical Engineering

ERNST ADOLPH GUILLEMIN, Ph.D.
Professor of Electrical Communications

CLIFFORD EARL LANSIL, S.B.
Associate Professor of Electrical Engineering

RICHARD DUDLEY FAY, A.B., S.B.
Associate Professor of Electrical Communications

LOUIS FRANK WOODRUFF, S.M. (*Absent*)
Associate Professor of Electric Power Transmission

KARL LELAND WILDES, S.M.
Associate Professor of Electrical Engineering

JAYSON CLAIR BALSBAUGH, S.M.
Associate Professor of Electric Power Production and Distribution

RICHARD HENRY FRAZIER, S.M.
Associate Professor of Electrical Engineering

PARRY MOON, S.M.
Associate Professor of Electrical Engineering

HAROLD EUGENE EDGERTON, Sc.D.
Associate Professor of Electrical Measurements

SAMUEL HAWKS CALDWELL, Sc.D.
Associate Professor of Electrical Engineering

ARTHUR ROBERT VON HIPPEL, Ph.D.
Associate Professor of Electrical Engineering

WILMER LANIER BARROW, Sc.D. (*Absent*)
Associate Professor of Electrical Communications

GORDON STANLEY BROWN, Sc.D.
Associate Professor of Electrical Engineering

JOHN GEORGE TRUMP, Sc.D. (*Absent*)
Associate Professor of Electrical Engineering

TRUMAN STRETCHER GRAY, Sc.D.
Associate Professor of Engineering Electronics

ARTHUR EUGENE FITZGERALD, Sc.D.
Associate Professor of Electrical Engineering

WILLIAM HENRY RADFORD, S.M.
Associate Professor of Electrical Communications

WILLIAM MOTT HALL, Sc.D. (*Absent*)
Assistant Professor of Electrical Communications

CHARLES KINGSLEY, JR., S.M.
Assistant Professor of Electrical Engineering

MALCOLM STRONG MCILROY, E.E.
Assistant Professor of Electrical Engineering

LYMAN MINER DAWES, S.B.
Assistant Professor of Industrial Applications

JAMES EDWARD MULLIGAN, S.M. (*Absent*)
Assistant Professor of Electric Power Production

LAWRENCE BAKER ARGUIMBAU, S.B.
Assistant Professor of Electrical Communications

JAMES ALBERT WOOD, JR., Ph.D.
Assistant Professor of Electrical Engineering

ALBERT CARRUTHERS HALL, Sc.D.
Assistant Professor of Electrical Engineering

Instructors

WILLIAM ROBERT SAYLOR, S.M. (*Non-Resident*)
DONALD PIERCE CAMPBELL, S.M.
JAMES NORTON THURSTON, S.M.

Research Associates

KENNETH JOSEPH GERMESHAUSEN, S.B.
WILCOX PRATT OVERBECK, S.B. (*Absent*)
RICHARD TAYLOR, S.M.
HERBERT EARLE GRIER, S.M.
ROBERT WILLIAM CLOUD, S.M.

Research Assistant

BERNARD THOMAS SVIHEL, B.S.

Assistants

SABAHEDDIN MAHMUT FENMEN, S.M.
JOHN GRIMES LINVILL, A.B., S.B.
WILLIAM KIRBY LINVILL, A.B.
ROBERT PAGE MACK, B.E.
WILLIAM PETER MCNULTY, B.E.
ANDREW WALTER PLONSKY, S.B.

ENGLISH AND HISTORY

Professors

Howard Russell Bartlett, B.S., A.M.
Professor of English and History; in charge of the Department

Penfield Roberts, A.M.
Associate Professor of History

Matthew Richard Copithorne, A.B.
Associate Professor of English

Frederick Gardiner Fassett, Jr., A.M.
Associate Professor of English

Dean Mattison Fuller, A.B.
Associate Professor of English; Director of Dramatics

William Chace Greene, Ph.B., M.A.
Associate Professor of English

Theodore Smith, A.M. (*Absent*)
Associate Professor of History and International Relations

Paul Conant Eaton, S.B., A.M. (*Absent*)
Assistant Professor of English

Walter Francis Urbach, A.M.
Assistant Professor of English

Lynwood Silvester Bryant, A.M.
Assistant Professor of English

George de Santillana, Ph. D.
Assistant Professor of the History of Science

Paul Maynard Chalmers, A.M.
Assistant Professor of English; Assistant Director of Admissions

John Bell Rae, Ph.D.
Assistant Professor of History

Karl Wolfgang Deutsch, Ph.D. (*Absent*)
Assistant Professor of History

Instructors

Ralph Samuel Bates, Ph.D. (*Absent*)
Edward Franklin Perry, A.M.
Theodore Wood, Jr., S.B., A.M. (*Absent*)
Charles Burton Woods, Ph.D.
Stuart Edgerly, A.M.
Sidney Gilbert Morse, Ph.D.
Leslie Mahin Oliver, B.Sc., A.M.
Everett Lamont Getchell, Ph.D.

GEOLOGY

Professors

Warren Judson Mead, Ph.D.
Professor of Geology; in charge of the Department

Frederick Kuhne Morris, Ph.D.
Professor of Geology

Louis Byrne Slichter, Ph.D. (*Absent*)
Professor of Geophysics

Martin Julian Buerger, Ph.D.
Professor of Mineralogy and Crystallography

Walter Harry Newhouse, Ph.D. (*Absent*)
Professor of Economic Geology

Harold Williams Fairbairn, Ph.D.
Associate Professor of Petrology

Robert Rakes Shrock, Ph.D. (*Absent*)
Associate Professor of Geology

Roland Dane Parks, E.M., M.S. (*Absent*)
Assistant Professor of Mineral Industry

Walter Lucius Whitehead, Ph.D. (*Absent*)
Assistant Professor of Geology

Research Associates

Chaim Leib Pekeris, Sc.D. (*Absent*)
Roland Frank Beers, Ph.D.

MATHEMATICS

Professors

Henry Bayard Phillips, Ph.D., LL.D.
Professor of Mathematics; in charge of the Department; Chairman of the Faculty

Frank Lauren Hitchcock, Ph.D.
Professor of Mathematics

Norbert Wiener, Ph.D.
Professor of Mathematics

Philip Franklin, Ph.D.
Professor of Mathematics

Raymond Donald Douglass, Ph.D., Sc.D.
Professor of Mathematics

Dirk Jan Struik, Ph.D.
Professor of Mathematics

Prescott Durand Crout, Ph.D.
Associate Professor of Mathematics

Robert Horton Cameron, Ph.D.
Associate Professor of Mathematics

Norman Levinson, Sc.D.
Associate Professor of Mathematics

George Proctor Wadsworth, Ph.D.
Associate Professor of Mathematics

Samuel Demitry Zeldin, Ph.D.
Assistant Professor of Mathematics

Alfred Hoblitzelle Clifford, Ph.D. (*Absent*)
Assistant Professor of Mathematics

Eric Reissner, Dr. Ing., Ph.D.
Assistant Professor of Mathematics

Francis Begnaud Hildebrand, Ph.D.
Assistant Professor of Mathematics

Raphael Salem, Sc.D.
Assistant Professor of Mathematics

George Brinton Thomas, Jr., Ph.D.
Assistant Professor of Mathematics

Instructors

Philip Russell Wallace, Ph.D. (*Absent*)
Warren Simms Loud, S.B.
Donald Laurence Thomsen, Jr. B.A.
Stephen Harry Crandall, M.E.

Assistant

Lawrence Russell Norwood, A.B.

MECHANICAL ENGINEERING
(Including Textile Technology)

Professors

Jerome Clarke Hunsaker, Sc.D.
Professor in charge of the Department

George Wright Swett, S.B.
Professor of Machine Design; Secretary of the Faculty

Charles Fayette Taylor, Ph.B., M.E.
Professor of Automotive Engineering

Gordon Ball Wilkes, S.B.
Professor of Heat Engineering

Earle Buckingham
Professor of Mechanical Engineering

Alfred Victor de Forest, S.B.
Professor of Mechanical Engineering

Carl Richard Soderberg, S.B.
Professor of Mechanical Engineering

Joseph Henry Keenan, S.B.
Professor of Mechanical Engineering

Charles Winters MacGregor, Ph.D.
Professor of Applied Mechanics

Jacob Pieter Den Hartog, Ph.D. (*Absent*)
Professor of Mechanical Engineering

Theodore Howard Taft, S.B.
Associate Professor of Heat Engineering

Lawrence Southwick Smith, S.B.
Associate Professor of Applied Mechanics

Addison Francis Holmes, S.B.
Associate Professor of Applied Mechanics

Jesse Jennings Eames, S.B.
Associate Professor of Mechanical Engineering

Irving Henry Cowdrey, S.B.
Associate Professor of Testing Materials

William Henry Jones, S.B.
Associate Professor of Heat Engineering

James Holt, S.B.
Associate Professor of Mechanical Engineering

John Moyes Lessells, B.Sc.
Associate Professor of Mechanical Engineering

Arthur Lawrence Townsend, S.B.
Associate Professor of Mechanical Engineering; Acting Director of the Lowell Institute School

Carl Louis Svenson, S.M.
Associate Professor of Heat Engineering

Archibald William Adkins, A.B., S.B.
Associate Professor of Applied Mechanics

Alvin Sloane, B.S.
Associate Professor of Applied Mechanics

Peter Edward Kyle, M.E., S.M.
Associate Professor of Mechanical Engineering

William MacGregor Murray, Sc.D.
Assistant Professor of Mechanical Engineering

John Anthony Hrones, Sc.D.
Assistant Professor of Mechanical Engineering

Christian Ernest Grosser, S.M.
Assistant Professor of Mechanical Engineering

August Ludwig Hesselschwerdt, Jr., S.M.
Assistant Professor of Mechanical Engineering

Brandon Garner Rightmire, Sc.D.
Assistant Professor of Mechanical Engineering

Ascher Herman Shapiro, S.B.
Assistant Professor of Mechanical Engineering

John Edward Arnold, B.A., S.M.
Assistant Professor of Mechanical Engineering

Edward Langdon Bartholomew, Jr., S.M.
Assistant Professor of Mechanical Engineering

Frederick Reuter Evans, M.E., S.M.
Assistant Professor of Mechanical Engineering

Joseph Kaye, Ph.D.
Assistant Professor of Mechanical Engineering

Deane Lent, A.B.
Assistant Professor of Drawing

Edward Reginald Van Driest, Ph.D.
Assistant Professor of Mechanical Engineering

Lecturers

Wayland Solon Bailey, M.S. — *Applied Mechanics*

Albert Edward Whittaker, Ed.M., B.S.
Applied Mechanics and Kinematics

Instructors

Richard Upham Bryant, S.M. (*Absent*)
Lucien Romain Vianey, B.S.
Frank Bellchambers Hays, A.B., M.S. (*Absent*)
Frank John Mehringer, S.M.
Robert Plunkett, S.B. (*Absent*)
Malcolm Sandell Burton, S.M.
Fred Wilson Hunton, B.S.
Harry Majors, Jr., M.S.
James Van Deusen Eppes, B.A., M.S.
John Crocker Fisher, B.A.
Gardner Mason Ketchum, S.M.

Technical Instructors

Arthur Brown English
Robert Butterfield Cheney
Charles Arthur Bulfinch
Ralph John Bowley
Clarence William Christiansen
Frederick Harold Anderson (*Absent*)

Research Associates

John Townsend Burwell, Jr., Ph.D. (*Absent*)
Dean Abner Fales, S.B.

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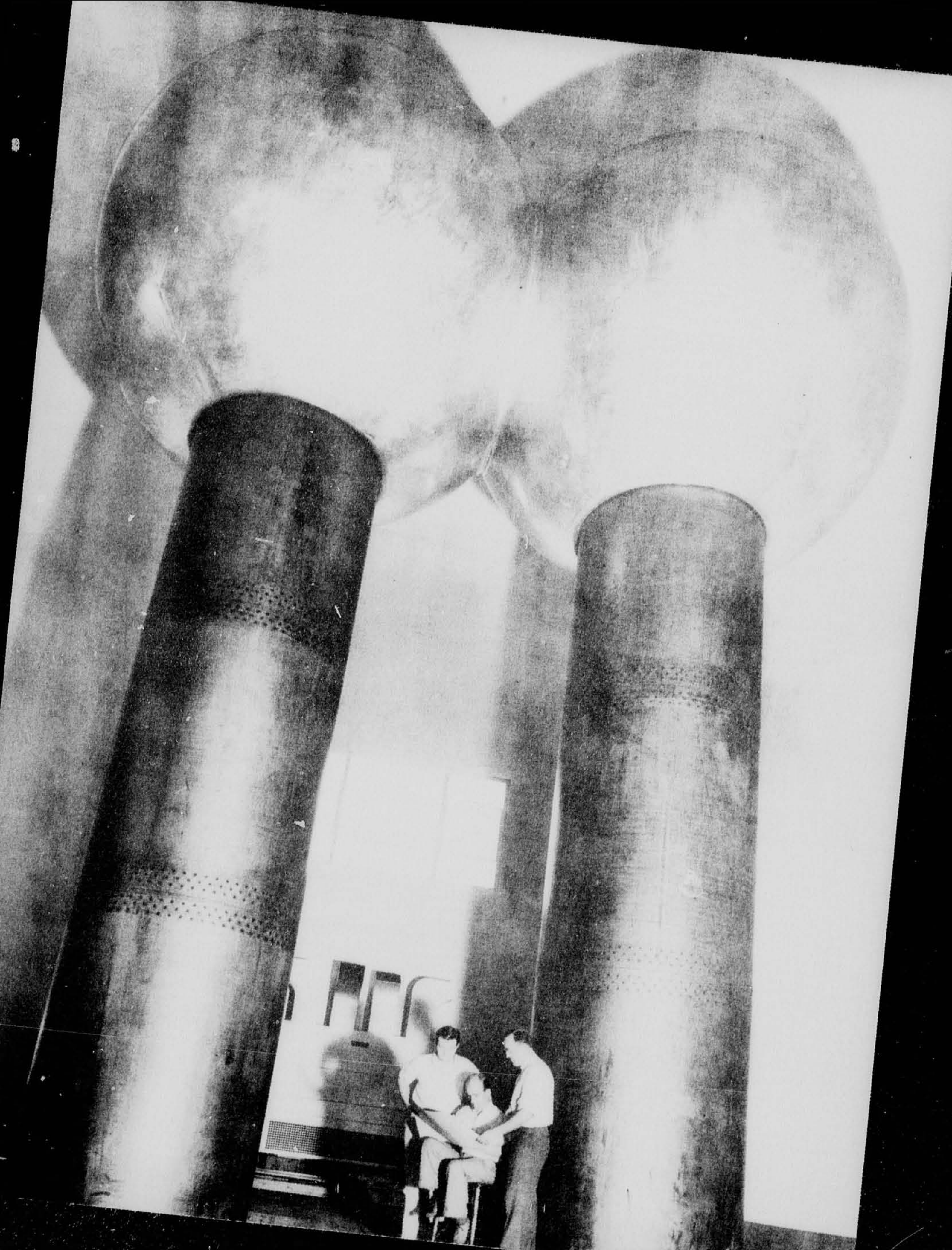
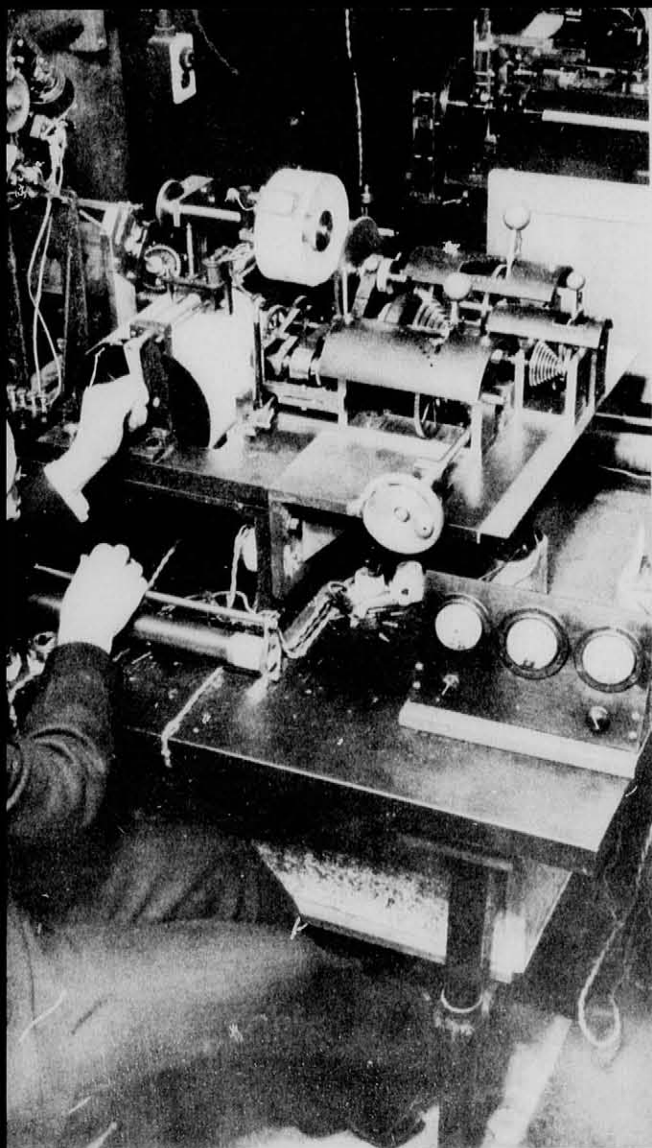
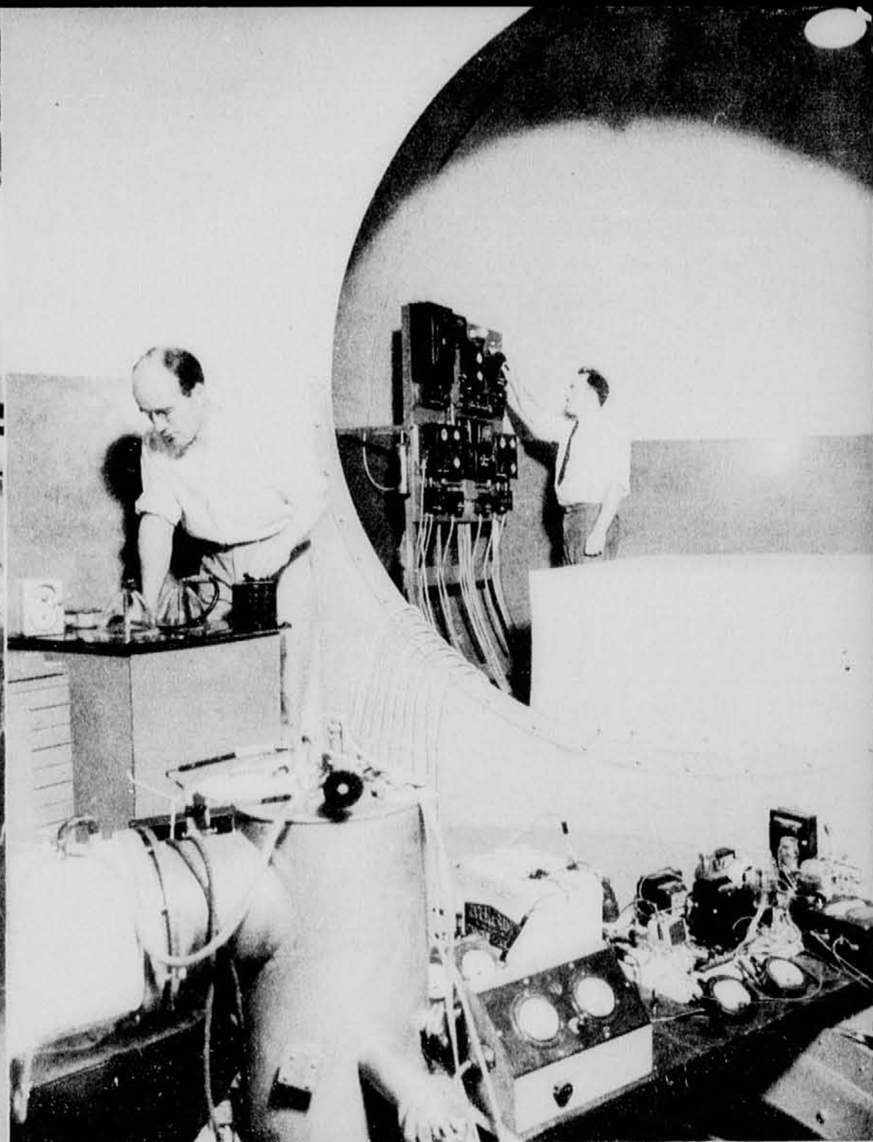
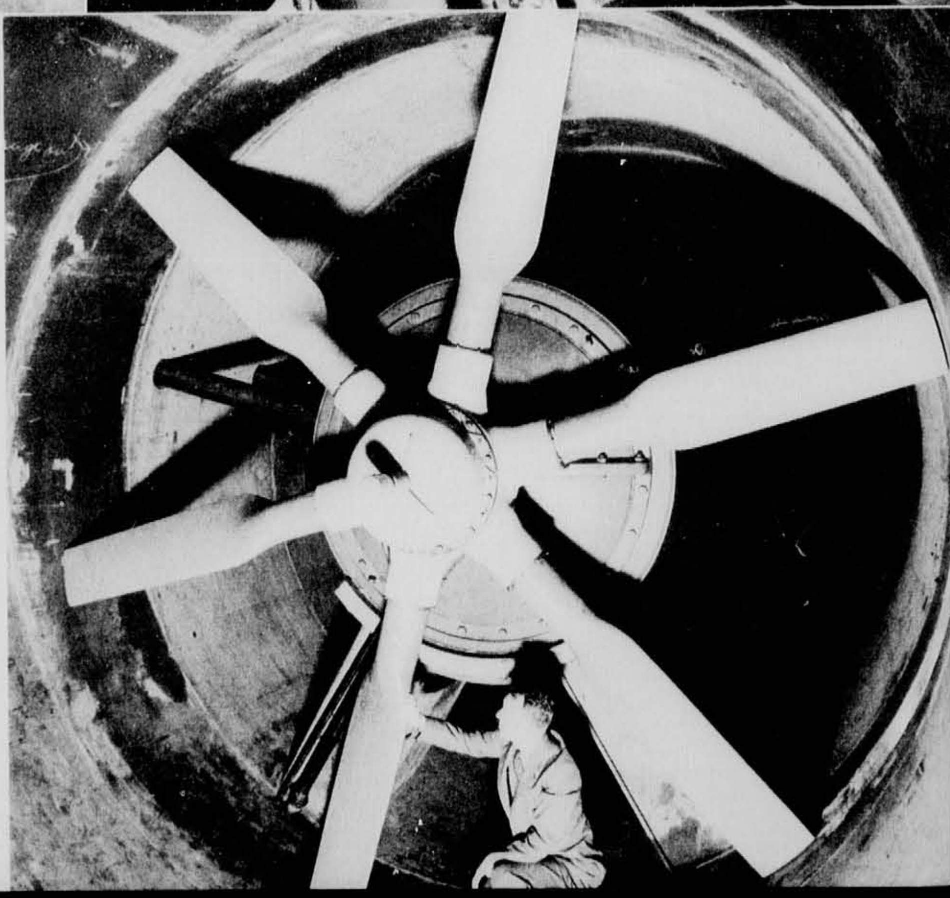






RESEARCH

THE RESEARCH RESOURCES OF THE INSTITUTE ARE NOW DEVOTED TO PROJECTS DESIGNED TO HASTEN VICTORY FOR THE UNITED NATIONS. OUT OF THE ACCELERATED RESEARCHES FOR WAR HAVE COME NEW KNOWLEDGE AND NEW DEVELOPMENTS IN SCIENCE AND ENGINEERING, AND ONE OF THE RICHEST PROMISES OF PEACE IS THE OPPORTUNITY TO APPLY THESE DISCOVERIES FOR THE ADVANCEMENT AND WELL-BEING OF MANKIND.



GENERAL INFORMATION

LOCATION

AFTER occupying for fifty years its site in Boston, the Institute in 1916 moved into a completely new plant located on the Cambridge side of the Charles River Basin. Here, on a tract of eighty acres, extending along the river, are the twenty-five educational buildings and laboratories, infirmary, Walker Memorial (the student union), student houses, and athletic plant, including gymnasium, swimming pool, playing fields, field houses, sailing pavilion, and boat house.

The location of the Institute enables its students to profit from the manifoid cultural advantages to be found in Boston and its environs — an area richly provided with great libraries and museums and other foundations devoted to literature, art, music, and science. Proximity to many large industries affords students ample opportunities to supplement their academic work by plant visits, and other profitable contacts with industry and commerce.

GOVERNMENT AND ADMINISTRATION

In a legal sense the Institute is a body of trustees known as the Corporation which, as provided in its By-Laws, consists "of its Chairman, President, Vice-President, and Treasurer and, if eligible, the President of the Alumni Association *ex officio*, of the *ex officiis* members as provided in the act of the Legislature, of not less than twenty-five nor more than thirty-five life members, of fifteen alumni term members, and of not more than five special term members. . . . No professor, teacher or lecturer, under engagement for compensation to be paid by the Institute, shall be a member of the Corporation."

Three of the alumni term members are nominated annually for five-year terms by ballot of the Alumni Association. The *ex officiis* members provided by the act of the Legislature are the Governor of the Commonwealth, the Chief Justice of the Supreme Court, and the Commissioner of Education.

Four stated meetings of the Corporation are held each year, in October, January, March, and June. Between meetings it functions through its officers, Executive Committee, and other committees on Membership, Finance, Auditing, and its Visiting Committees for the various departments of the school.

The President presides over the Faculty of the Institute, to which body are entrusted by custom all questions relating to educational policies. The Corporation By-Laws provide that the President "shall have the superintendence of the several departments of the Institute, and, subject to the direction of the Executive Committee, shall act as its general executive and administrative officer. . . ."

To aid the President and Treasurer there are other duly appointed officers of administration and instruction. Chief mong the former are the Deans of Engineering, Science, rchitecture, Humanities, the Graduate School, and Students; the Executive Vice-President; the Bursar; and the Director of the Division of Industrial Coöperation. These, together with the Chairman of the Faculty, who is elected by that body, and the President of the Alumni Association, compose the Administrative Council.

The Faculty consists of all Professors, Associate Professors, and Assistant Professors, certain designated Instructors and Research Associates, and the following administrative officers *ex officiis:* the President, Vice-President, Executive Vice-President, the Deans, Director of Admissions, Registrar, Librarian, the Associate Dean of Students, and Assistant Director of Admissions. For its government the Faculty has adopted a set of "Rules and Regulations" which set forth the duties and powers of its Chairman, Secretary, and Assistant Secretary, and of its standing committees which include those on the Graduate School, Undergraduate Courses, Admissions, Petitions, Provisional Students and Discipline, Undergraduate Scholarships, the Courses in General Science and General Engineering, General Studies, the Library, and students of the four undergraduate years.

These "Rules and Regulations" also provide for a system of Registration Officers and for a Faculty Council. The Registration Officers, of whom there is one for each year of each Course above the first year, serve as academic advisers and ensure that each student's particular problems will receive individual consideration. The Faculty Council permits preliminary discussion of questions of major policy by a smaller group prior to their submission for action at the general Faculty meetings.

In order most effectively to administer and to develop the educational and research work of the Institute, and also in order better to coördinate the work of those departments which are naturally similar in outlook, the academic phases of the Institute are divided, as implied above, into the following groups: the Graduate School, the School of Architecture, the School of Science, the School of Engineering, the Division of Humanities, and the Division of Industrial Coöperation.

In the Schools of Architecture, Engineering, and Science are grouped those departments of study which lead to degrees and which embody the primary educational objective of the Institute. In the Division of Humanities are grouped the studies through which students may supplement the cultural values inherent in their scientific and engineering subjects with the broadening discipline of the humanities. The Graduate School coördinates the work leading to advanced degrees in all the departments. In the Division of Industrial Coöperation are centered the organized activities of departments and individual members of the staff whose activities are devoted wholly or in part to the assistance of industry in solving its problems or developing new products and methods.

Although the Institute work is thus divided for administrative purposes, the educational policies remain under the control of the Faculty as a whole.

DEGREES GRANTED

The Institute offers both undergraduate and graduate Courses of Study. The former lead to the degrees of Bachelor of Science (S.B.), Bachelor in Architecture (B.Arch.) or Bachelor in City Planning (B.C.P.); the latter, to the degrees of Master of Science (S.M.), Master in Architecture (M.Arch.), Master in City Planning (M.C.P.), Doctor of Philosophy (Ph.D.), or Doctor of Science (Sc.D.). It also affords to advanced students and to experienced investigators opportunities for the pursuit of original scientific investigations.

COÖPERATIVE ARRANGEMENTS WITH LIBERAL ARTS COLLEGES

Many prospective students of engineering wish to attend a liberal arts college before undertaking their professional training. Two years are generally required to qualify for the S.B. degree in engineering at M. I. T. after graduation from a liberal arts college. The total time and expense of this entire educational program may constitute serious obstacles, especially if the student then continues with post-graduate work, as more and more of the better students are finding it advisable to do.

In order to facilitate the combination of a liberal arts course with education in science and engineering, the Institute has entered into a coöperative arrangement with a selected group of colleges whose work in the prerequisite fields of science and mathematics is of exceptional merit. Under this arrangement, and by properly planning his studies, a student of high standing may pursue a combined five-years' program in which the first three years are spent at the college and the last two at the Institute, leading to the Bachelor's degree from each institution. Thus one year is saved, and the experience and the degrees of both institutions are secured.

A student who wishes to follow this coöperative program is advised to consult the dean or registrar of the college of his selection in regard to his most advantageous schedule of studies. This plan continues in effect under war time conditions; under the plan of year-round operation prevailing both in the colleges and in the Institute, however, completion of the degree requirements may necessitate a period of residence longer than the four terms normally needed.

The following colleges have united with the Institute in this program: Bowdoin College, Miami University, Middlebury College, Ohio Wesleyan University, Reed College, Ripon College, St. Lawrence University, Washington and Jefferson College, College of William and Mary, Williams College, and the College of Wooster.

GENERAL REGULATIONS

Academic Year. Under normal conditions, the exercises of the Institute begin on the last Monday in September and end early in June, exercises being omitted on the following Massachusetts legal holidays: January 1, February 22, April 19, May 30, July 4, Labor Day, October 12, November 11, Thanksgiving Day and December 25.

The Institute has temporarily adopted a continuous basis of operation with three consecutive terms in a year instead of the regular academic year of two terms.

In the undergraduate course schedules the year (first, second, third, fourth, or fifth year) refers to the usual academic year having schedules in the first and second term as shown. Thus a student, on the basis of continuous attendance, would complete the eight terms of a normal four-year schedule in two and two-thirds years.

Registration. At a date specified in the registration instructions, before the opening of each term, the student is required to fill in and present registration forms to the Registrar.

Provisional Admission. All students admitted to subjects without having fulfilled the usual preparation requirements are considered as provisional students in such subjects. Students whose work is generally low, and students readmitted to the Institute after dismissal, or after withdrawal incident to low standing, are considered as provisional in all subjects. Provisional admission to a subject may be cancelled when it becomes evident that the work of the student is unsatisfactory.

A student taking a dependent subject without a clear record in each required preparatory subject may be required to drop that subject at any time if his work is unsatisfactory.

Attendance. After approval of his registration the student must attend all exercises, including the final examinations, in the subjects for which he is registered. Irregular attendance, habitual tardiness, or inattentiveness may lead to probation. With the exception of an interval of one hour in the middle of the day, students are, in general, expected to devote themselves to the work of the school between the hours of 9 A.M. and 5 P.M. There are usually no exercises on Saturday after 1 P.M. Students who withdraw during the term should give advance notification to the Dean of Students and to the Registrar.

Final Examinations. Final examinations are held at the end of each term.

No member of the Instructing Staff is empowered to grant excuse from a final examination. Absence from any final examination is equivalent to a complete failure except as, on presentation in writing of adequate evidence of sickness or other valid reason for the absence, the Dean of Students may permit a student whose term work has been satisfactory to take the ensuing examination in the subject.

Conditions received at the end of a term must be made up by examinations during the succeeding term on Saturday afternoons, the exact dates for these examinations being announced after the term has begun. A student not taking an examination at the time stated forfeits the right to this examination.

The ability of students to continue their subjects is determined in part by means of examinations, but regularity of attendance and faithfulness to daily duties are considered equally essential.

Examinations for Advanced Standing. Registered undergraduate students of all classes, with a cumulative rating of 3.50 and above, may take examinations for advanced standing during the condition examination periods in each term provided that they have never been registered for the subjects, or have never attended classes in the particular subjects. Notice of intention must be filed with the Registrar on the usual petition forms, and must be submitted at least two weeks before the day of the first scheduled examination of the examination period. Endorsement by members of the Faculty is not necessary. The privilege of an examination in a subject which involves laboratory instruction, or drawing, must be approved by the Faculty member in charge.

Health of Students. The Medical Department is completely organized to protect the health of the students. This work is carried out in the Homberg Memorial Infirmary under the supervision of the Medical Director, Dr. George W. Morse. A staff of nine doctors conducts clinics daily, except Sunday.

A graduate nurse is on clinical duty from 8.30 A.M. to 4.30 P.M. and a staff physician is in attendance from 8.30 A.M. to 5 P.M. (Saturday, 8.30 A.M. to 1 P.M.). Any student may receive medical or surgical treatment in the clinics without charge. In connection with these adequate X-ray, physiotherapy and laboratory facilities are maintained.

In addition to the clinics, the Homberg Memorial Infirmary has a hospital equipped to care for thirty-three bed patients. There are six finely appointed, attractive wards, seven private rooms, and a large solarium. The well-equipped kitchen provides excellent food and dietary service. The hospital is open twenty-four hours daily throughout the year with a staff of graduate nurses and a visiting physician. An ambulance, pulmotor and physician are available for emergencies twenty-four hours a day.

The charges are nominal: food, nursing, and medical care in the wards costing one dollar a day, and the same service in a private room is furnished at two dollars a day. After 5 P.M. on week-days (1 P.M. on Saturday) entrance to the second and third floor hospital must be made through the corridor in the basement, leading past the Photographic Department to the elevator.

Every entering male student, undergraduate or graduate, is required to report to the Medical Department for a complete physical and dental examination within six weeks after his matriculation. All other male undergraduates are required to have a physical re-examination each calendar year, an appointment for which should be arranged with the Medical Department.

CONDUCT. It is assumed that students come to the Institute for a serious purpose, and that they will cheerfully conform to such regulations as may be, from time to time, made by the Faculty or Administration. In case of injury to any building, or to furniture, apparatus, or other property of the Institute, the damage will be charged to the student or students known to be immediately concerned: but if the persons who cause the damage are unknown, the cost of repairing it may be assessed equally upon all the students of the school.

Students are expected to behave with decorum, to obey the regulations of the Institute, and to pay due respect to its officers. Conduct inconsistent with general good order, or persistent neglect of work, or failure to respond promptly to official notices, may be followed by dismissal. If the offense be a less serious one, the student may be placed on probation.

It is the aim of the Faculty to administer the discipline of the school so as to maintain the highest standard of integrity. The attempt of any student to present as his own the work of another, or any work which he has not honestly performed, or to pass any examination by improper means, is regarded by the Faculty as a most serious offense, and renders the offender liable to immediate expulsion. The aiding and abetting of a student in any dishonesty is also held to be a grave breach of discipline.

PETITIONS. The Committee on Petitions is the Faculty body through which the student may appeal for special consideration of his individual case. All requests must be submitted in writing on petition blanks which may be obtained at the Information Office, Room 7-111.

ADVISERS. The Dean of Students is the general consulting officer for all students, and coöperates with the President in matters of discipline and general student relations. On request to his office, advisers from the Instructing Staff will be assigned to new students. It is not intended that the advisers shall become, in any sense, guardians of the students assigned to them; nor does the Faculty by this action assume any responsibility for the conduct of students outside the halls of the Institute.

Each student is assigned to a Registration Officer who is a member of the Faculty having responsibility for, and control of, his academic program. The Associate Dean of Students serves as Registration Officer for all first-year students. However, the Deans of Architecture, Engineering and Science act as general consultants to first year students who seek advice relating to their choice of professional Courses.

FEES, DEPOSITS, PAYMENTS, EXPENSES

TUITION FEES. For all students pursuing regular courses, undergraduate or graduate, the tuition fee of $300 per academic term (three terms per year) must be paid *in advance*, the date and hour to be specified in the Registration Instructions issued prior to the opening of the particular term. Special students pay, in general, the full fee; but when a few subjects only are pursued, application for reduction may be made to the Bursar.

Members of the teaching or research staff pursuing programs leading to the Master's or Doctor's degree, taking more than one subject or engaged on research, and on full-time Corporation appointment pay $100, on half-time appointment $150, for each term for which they are registered as proceeding toward the degree. The above fees admit members of the staff working for the Master's or Doctor's degree to all subjects, including thesis work, which are approved by their respective department committees. If they are taking but a single subject and not engaged on thesis or research, the tuition is at the rate of $6 per unit credit, with a minimum fee of $15.

A candidate for the Doctor's degree who has been absent from the Institute and who returns for the final examination on his thesis must register for the examination and pay a fee of $25.

OTHER FEES. A charge of $5 is made for each condition or advanced standing examination taken, and $5 for the removal of each deficiency.

LATE REGISTRATION FINE. A fine of $5 is imposed for late registration or late payment of tuition. Students should note that registration is not complete until tuition fees are paid.

DEPOSITS TO COVER CHEMICAL SUPPLIES, MILITARY UNIFORMS, ETC. All first-year students will be required to make a deposit of $25, from which the costs of chemicals and laboratory supplies, shoes, non-returnable equipment and damage to military uniforms are to be deducted.

All upperclassmen and graduate students taking subjects requiring the use of the Division of Chemical Laboratory Supplies will be required to make a deposit of $25 against which the cost of chemicals and laboratory supplies will be charged.

All deposits must be made at the beginning of the year.

If the total cost of chemicals and supplies used exceeds the amount of this deposit, an additional amount sufficient to cover this excess must be paid.

No refund of deposits will be made during the school year except to students leaving the Institute.

GRADUATE AND UNDERGRADUATE ACTIVITIES. For each civilian student registered, the Institute will appropriate the sum of $3.50 per term to be devoted to the promotion of student life with special reference to the physical and social welfare of the students. No part will be spent for any class function, athletic event, or social entertainment that is not open without charge to every qualified member of the student body in good standing.

These funds will be expended under the general direction of the Institute Committee subject to the approval of the Undergraduate Budget Board appointed by the President.

Subject to modification, funds will be apportioned per term as follows:

Institute Committee	$0.265
Classes	.175
Athletics	2.90
Reserve and Contingent Fund	.16

In addition to the amount made available through the above, the Institute yearly appropriates from its operating budget funds to cover athletic coaching salaries and the maintenance and operation of Walker Memorial, Athletic Fields, the Boat House, Sailing Pavilion, Launches, and Swimming Pool.

PAYMENTS. *No bills are sent.* All payments should be made to D. L. Rhind, Bursar, Massachusetts Institute of Technology, Cambridge, Mass. *Students are advised to make their payments by mail.*

ESTIMATED EXPENSES. An estimate of expenses exclusive of personal expenditures such as transportation, clothing, recreation, etc., is given below:

FOR A PERIOD OF ONE TERM

Tuition	$300
Board	160
Room	100
Books and materials	40
	$600

To assist students desiring to help themselves in meeting their expenses, the Student Employment Bureau is maintained by the Technology Christian Association. It is to be understood, however, that the demands of the Institute curriculum are such as to make it impracticable to devote much time to outside employment, and prospective students are advised to have sufficient funds to cover the expenses of the first year at least. Students from foreign lands, in particular, should clearly understand that the opportunities to secure remunerative employment for them are seriously restricted by their unfamiliarity with the English language and American business customs.

LOANS, SCHOLARSHIPS, FELLOWSHIPS AND PRIZES

See Appendix A for Complete Details

Resources for financial aid to students include: the Technology Loan Fund, available for undergraduate and graduate students; Freshman Competitive and other scholarships open to students entering from secondary schools; undergraduate scholarship aid to upperclassmen; fellowships, and graduate scholarships; Teaching Fellowships, and full- and part-time Assistantships to aid students pursuing work leading to the Master's or Doctor's degree; and prizes.

The extent of these resources is indicated by the facts that, since its establishment in 1930, over 2,500 men have borrowed more than $1,830,000 from the Technology Loan Fund; and that approximately $90,000 and $102,000 are annually available for undergraduate and graduate scholarship aid respectively.

PLACEMENT

Without assuming responsibility of finding employment for graduates, the Institute assists them in their placement problems. Senior and graduate students are offered a program of placement training planned to acquaint them with industrial opportunities and to outline the principles to be observed in seeking employment. The placement training program is approached from the long-range point of view rather than in terms of the first position after graduation, and stress is placed upon the importance of each individual's finding the type of opening for which he is best qualified by reason of his special aptitudes and training.

A Placement Bureau is also maintained by the Institute to assist Technology seniors and alumni in securing positions for which they are particularly fitted, and to aid industry in selecting men for positions requiring engineering or scientific education. For this service there is no charge.

EDUCATIONAL BUILDINGS

The characteristic spirit of the Institute finds its material embodiment in its great educational plant in Cambridge. Here all departments of instruction and research are brought together in a group of conjoined buildings containing over one million square feet of floor space.

This unity and coördination of structure permits flexibility in the allotment of space to the departments and promotes desirable coöperation among the various disciplines. The several sciences and the humanities, by organization and by common housing, are thus members of a single intellectual family at the Institute and the objectives which they pursue, both in teaching and research, are dealt with as coöperative projects, to be studied and solved coöperatively.

LABORATORIES. Another marked characteristic of the Institute from the material point of view is found in its numerous large and well-equipped laboratories. Notable among these are the George Eastman Research Laboratories of Physics and Chemistry, the Spectroscopy Laboratory, the Guggenheim Aeronautical Laboratory, the Wright Brothers Memorial Wind Tunnel, the Pierce Engineering Laboratory, the Sloan Automotive Engine Laboratory, and the Laboratories of Steam and Compressed Air, Refrigeration, Testing Materials, Hydraulics, Gas Engines, Metallurgy, Chemical Engineering, Physical Chemistry, Applied Physics, Electrical Engineering, Biology, Geology, and Mineralogy.

THE LIBRARY. The Institute Library, one of the leading collections in science and engineering in the United States, includes the Central Library and a number of strong branch libraries, containing all together approximately 380,000 volumes. A comprehensive collection of periodicals and society publications, remarkably complete in subjects within the scope of the Institute's programs of study and research, is maintained by the current receipt of over 1,600 periodicals and upwards of 1,900 transactions, yearbooks, and other serials.

The Central Library, on the fifth floor of Building 10 (under the great dome), is easily reached by elevators from the main lobby. Here are located large collections in physics, chemistry, chemical engineering, biology and biological engineering, and mechanical and electrical engineering; also an extensive collection of basic reference books. Especially notable is the Vail Collection in electrical engineering, described further under Electrical Engineering in the Graduate School section.

The Central Library is open on week days during term time from 8.45 A.M. to 9 P.M., except on Saturdays when it is closed at four o'clock. Individual reference service, bibliographical aid, and assistance in the use of the card catalogue are given at the Reference desk and the Vail desk in the Central Library and also in the branch libraries. Seniors, graduate students, and others engaged on theses or other research are granted admission to the stack.

Books and periodicals which the Institute does not own can often be obtained from other libraries, or, in lieu of the actual book, it is generally possible to obtain photostats or microfilm reproductions; the latter may be read in the Library's projector.

The following branch libraries, well organized and in charge of competent librarians, are located near the departments which they serve and supplement the service of the Central Library: Aeronautics (including meteorology), Arthur Rotch (architecture, housing, and city planning), Dewey (civil and mechanical engineering, building construction, naval architecture and marine engineering, economics, social science, industrial relations, and business and engineering administration), Eastman (for graduate students and others doing advanced work in physics, mathematics and chemistry), Lindgren (geology, metallurgy, and ceramics), and Walker Memorial. The last-named, primarily a "browsing library" for recreational reading, contains also the principal collections in history and literature and to some extent serves as a humanities library. The material in all these libraries is listed in the Central Library card catalogue, and telephone interconnection affords a well-integrated service.

A leaflet entitled "A Brief Guide to the Institute Library" is given to all new students.

MUSEUMS. A museum of science, engineering and industry has been growing during the past few years within the main group of buildings. Each department has its own exhibits, along the corridor adjacent to its laboratories and offices; and these exhibits, largely the result of the research or the ingenuity of the staff, broaden and enrich the educational program of the students. In addition, two of the most significant units have ample quarters of their own: the Dard Hunter Paper Museum, containing the most complete collection of handmade paper and paper-making equipment in the world; and the Francis Russell Hart Nautical Museum, containing a magnificent collection of ship models and prints, and the Allan Forbes and Henry P. Kendall whaling collections.

SUMMER SURVEYING CAMP. *(Summer Camp instruction is temporarily suspended as the Institute is now operating on a continuous basis.)* Camp Technology, an admirably located and amply equipped engineering camp is maintained by the Department of Civil and Sanitary Engineering. During the summer session at this camp, students are given field practice by competent instructors and, incidentally, obtain the healthful experience of approximately two months of outdoor life.

The camp is located on the shore of Gardner Lake about eight miles from East Machias, Maine, and, in a direct line, is less than three miles from tidewater.

It comprises about 850 acres of rolling terrain, some of which is wooded, in a region well adapted for carrying out projects in plane, geodetic and route surveying as well as opportunities for hydrographic field work.

Bemis Hall, the headquarters of Camp Technology, has a sightly location on a high bluff overlooking Gardner Lake. In Bemis Hall and other buildings connected with it by covered passages are lounging and dining facilities, lecture, recitation and drafting rooms, office accommodations for the Staff, a store and post office.

Sleeping quarters for students are provided in eight wooden barracks facing the lake. Other structures include a geodetic observatory, a seismograph station, extra space for drafting or classroom usage, and an infirmary which serves as an emergency hospital. A physician is in attendance during the entire camp session.

The Camp is equipped with excellent sanitary facilities, electric light, and a wholesome water supply from driven wells. A baseball field and two tennis courts are located on the Camp property.

THE SOCIETY OF ARTS

The Society of Arts was provided for in the Charter of the Institute. In the early days, the meetings of the Society were given over to public lectures on new inventions and discoveries, followed by general discussions by the audience. Beginning in 1917, the Society has set its course by an annual series of Popular Science Lectures. These discourses, always illustrated, are held in Huntington Hall on one week-end in the months of December, January, February and March. On Friday and Saturday afternoons, invitations are sent to the secondary schools, but Sundays find the audience made up of corporation members, the faculty and the public in general. Because they follow the lines of study and research for which the Institute is known, the lecturers explain many present-day developments in sciences and engineering. During the year 1942–1943 the Society of Arts Lectures were discontinued for the duration of the war.

STUDENT HOUSING

Complete information on housing for graduate and undergraduate students, under present abnormal conditions, giving details regarding applications, allotment of rooms, equipment, rentals, payments and so forth, is presented in Appendix C (Student Housing) of this bulletin. Inquiries and applications for all available accommodations should be addressed to Henry K. Dow, Manager of Undergraduate Dormitories, 3 Ames Street, Cambridge 39. As an emergency measure, accommodations for graduate students are available in a reserved section of the Undergraduate House.

RECREATIONAL FACILITIES

Walker Memorial, built in memory of a late president, General Francis Amasa Walker, is the center of the social activities of the Institute. The building was finished in 1917 at a cost exceeding $500,000, contributed in part by alumni.

On the third floor are a gymnasium with a regulation basketball court, lockers and dressing rooms, offices for the various student activities, and rooms for handball. Below are recreation and reading rooms, and an excellent and growing open-shelf library, and, on the first floor, a large dining hall with cafeteria service at low prices. In the grill room soda fountain service is provided, and private rooms are available for class dinners and gatherings of any Technology organization. In the basement are bowling alleys and a lounge room for the "5:15 Club," composed of commuting students.

Adjacent to this building and the dormitories are tennis courts, Technology's swimming pool building completed in 1940, which contains a deep pool for recreational swimming, and a shallow one for use by "beginners," and other facilities for conducting the recreational program of ten sports.

The Barbour Field House, opened in September, 1934, has, in addition to modern shower and locker facilities, special rooms for visiting teams. Connected with the Field House is a Squash Building containing eight courts.

On the land west of Massachusetts Avenue are fields for soccer, lacrosse, and football; additional tennis courts and a quarter-mile cinder track with a 220-yard straightaway completed in 1939. During the winter, an outdoor board track is provided near Briggs Field House.

A boathouse on the Charles River supplied with indoor rowing machines has also a number of singles and wherries available for students, in addition to the opportunities offered to all undergraduates to learn how to row in an eight-oared shell under competent coaching. The Sailing Pavilion, located on the Charles River in front of Walker Memorial, is the headquarters of the Nautical Association.

Students who wish to pursue or develop hobbies as a recreation have access to the Hobby Shop — a name describing both a physical facility and the group of students brought together by it. Since the shop was opened in 1938, with space and equipment provided by the Institute, it has been doubled in size. All the machines and other tools needed for woodworking, metalworking, and the like, are installed, and equipment for new groups interested in radio, photography, electroplating, and telescope-making, is now being assembled.

UNDERGRADUATE ACTIVITIES

To complement and aid its educational work and to enrich its community life, Technology provides extensive opportunities for students to participate in those extracurricular pursuits — athletic, literary, dramatic, and social — which further the development of character and personality and yield health, pleasure, and friendship. These enterprises are administered by the students themselves, under a well-organized system of student government, which inculcates responsibility, leadership and initiative.

ATHLETICS. The purpose of athletics at the Institute is not to develop highly trained athletes, but rather to encourage all students to participate in some form of physical recreation. Control is vested in the M. I. T. Athletic Association, an undergraduate organization composed of all captains and managers of varsity teams as working members, and assistant managers and officials of class teams as associate members. Funds are secured by undergraduate dues, appropriated by the Institute, but disbursed by the Undergraduate Association. An Advisory Council of Alumni exercises the functions which its name implies.

No attempt is made to concentrate on coaching the few men composing a single varsity team, but instruction is given to all men reporting for a sport. As a corollary to this, the success of a given athletic activity is gauged by the number of men it attracts. Among the activities are: track and field sports, cross country running, rowing, basketball, fencing, golf, lacrosse, swimming, tennis, squash racquets. Class teams are organized informally in football and baseball.

NAUTICAL ASSOCIATION. The Nautical Association offers every student an opportunity to learn sailing. A fleet of forty dinghies, constituting a special Technology class designed by Technology men, three Class B dinghies, and four 24-foot sloops are available for sailing on the Charles River Basin. The Sailing Pavilion, located directly in front of Walker Memorial, provides a large landing float, a rigging and maintenance shop, and storage space.

Sailing activities are under the advisory direction of a member of the faculty assisted by an acting sailing master. The Association sponsors a shore school, offering instruction in the theory of sailing and in the handling and maintenance of yachts.

PUBLICATIONS. Undergraduate publishing activities offer opportunities to broaden contacts and to acquire practical experience in the field of journalism which may in after years prove to be of material value. All work incident to the editing and financing of the publications is carried on by students, with an Alumni Advisory Council available for consultation.

There are four self-supporting undergraduate publications: *The Tech*, the student newspaper; *The Tech Engineering News*, a monthly technical journal; *Technique*, the yearbook; and *Voo Doo*, a comic magazine. *The Tech*, the official undergraduate news organ, is one of the oldest of college newspapers, having been founded in 1881. *The Tech Engineering News* is the undergraduate scientific magazine to the editorial columns of which prominent graduates and professional men, as well as undergraduates, contribute. Quite frequently its articles are quoted in professional technical journals and it has won numerous awards as an outstanding student journal. *Technique* is the yearbook containing pictures and records of seniors and graduate students and, in addition, accounts of all regular undergraduate activities and outstanding social functions of the year.

MUSIC, DRAMA, AND PUBLIC SPEAKING. The Combined Musical Clubs, consisting of the Glee Club, the Concert and Popular Orchestras, and the Chamber Music Society, provide opportunities for training and expression in instrumental and vocal music. The Dramashop produces plays. Members of the Debating Society participate in intercollegiate debates and exhibition contests.

STUDENT PROFESSIONAL SOCIETIES. The Professional Societies, of which there are twelve, hold meetings for the presentation of scientific papers by students, culminating in the presentation of the Stratton Prizes at Commencement.

There are many other societies and activities which bring students of mutual interest together, and which organize social activities. The Junior Prom and Senior Week committees; the class organizations; and organized groups such as Sigma Xi and Tau Beta Pi for scholarship; Gridiron, the journalism society; Scabbard and Blade, the military society; the 5:15 Club, for commuting students; the Radio Society; and a score of other organizations, social and honorary, furnish important adjuncts to student life.

TECHNOLOGY CHRISTIAN ASSOCIATION. This activity aims to be of practical service and to foster among members of the Institute community the ideals of Christian living and active Christian service. It organizes students for social service and religious activity in Metropolitan Boston, maintains a theater ticket service and book exchange, operates the Student Employment Bureau, the Tech Cabin and Freshman Camp, and publishes the Freshman *Handbook*.

THE INSTITUTE COMMITTEE. The activities described above are component parts of the student state — the M. I. T. Undergraduate Association. Over this Association as chief executive presides the Senior Class President who shares with the Institute Committee, a legislative and judicial body representing the four classes and every important student activity, the government of student affairs. Sub-committees of the Institute Committee supervise the finances of undergraduate activities, consider jointly with the Faculty and Administration matters affecting students, administer Walker Memorial, and, by a system of points, control the extent to which any one student may participate in extra-curricular activities.

THE LOWELL INSTITUTE SCHOOL

The Trustee of the Lowell Institute established in 1903 under the auspices of the Massachusetts Institute of Technology, a Free Evening School.

The School comprises, at present, two regular courses — Mechanical Course and Electrical Course each extending over two years, and a number of advanced or supplementary courses of shorter duration.

These courses are intended to bring the systematic study of applied science within the reach of young men who are following industrial pursuits and desire to fit themselves for higher positions.

Circulars giving detailed information regarding the nature of the entrance examinations and other requirements may be obtained by sending a stamped, addressed envelope to Professor Arthur L. Townsend, Acting Director, The Lowell Institute School, Massachusetts Institute of Technology, Cambridge.

REQUIREMENTS FOR ADMISSION

THE WAR PROGRAM

It is expected that during the war, civilian students will continue to be enrolled in substantial numbers, although a considerable part of the Institute's staff and educational facilities is devoted to the training of Army and Navy personnel. Under the war-time program there will be three academic terms per calendar year, beginning on or about the first day of March, July, and November, respectively. The normal four-year course can thus be completed in two years and eight months.

New entering classes are scheduled to begin their courses on March 5, 1945 and about July 1, 1945. Subsequent admission dates will be announced later. Since it is unlikely that a new class can be started at the beginning of every term, applicants should address inquiries on this point to the Director of Admissions.

ADMISSION FROM SECONDARY SCHOOLS

Selection of Applicants. Under the Institute's policy of stabilized enrollment, the size of the First Year class is limited. Since it is expected that the number of applicants will be considerably in excess of the number that can be accepted, the Faculty Committee on Admissions will exercise discretionary powers of selection.

Preference will be accorded applicants whose evidence of academic fitness and of professional promise indicates that they are particularly qualified to pursue Institute Courses with success. It is the desire of the Faculty to admit only those candidates who possess qualities, both of character and intellect, which indicate their adaptability to an academic environment, and which show promise of their development into useful and forceful citizens.

Applicants for admission to the First Year class are expected to have a conference with the Director of Admissions. Office hours are nine to four, Saturdays nine to twelve; it is not necessary to make an appointment in advance. Applicants outside New England are expected to arrange a conference with an alumnus designated by the Director of Admissions. It is recommended that this be done as early as possible in the applicant's final year of secondary school.

The candidate is requested to indicate his tentative choice of professional Course at the time of filing his application. After admission, he may reconsider his choice, and he has the option of changing at any time during the first year. Continuation in a Course after the first year, or a change of Course, will depend upon the student's scholastic record, his apparent aptitudes for the particular field of work, and the facilities available at the Institute.

Academic Preparation. The better high and preparatory schools in the United States, and equivalent schools in other countries will, in general, provide suitable preparation to the student who takes full advantage of the opportunities which such schools afford. The candidate should bear in mind that the wider his intellectual development and the more extensive his attainments, the greater will be the advantages he may expect to gain from study at the Institute. The preparatory course should be a broad one, not confined to technical subjects.

Attention is called particularly to the necessity of thorough preparation in English and mathematics. It is presupposed that a candidate's training in English has been such that he can express his ideas clearly in oral or written form. In mathematics, emphasis should be on thorough mastery of fundamental principles, operations and definitions rather than on covering a wide range of topics.

Each applicant is required to have completed the following specific preparatory subjects; the figures in parentheses represent the usual "unit" rating, a unit being a full year's study in a secondary school subject taken four or five times a week:

English (3)	Physics (1)
Algebra (2)	Trigonometry (½)
Plane Geometry (1)	Solid Geometry (½)

English is normally studied through four years, and this is counted as three units. In some states, algebra is completed in 1½ years; this will satisfy the algebra requirement.

In addition to the above subjects specifically required, the applicant must also have completed seven additional units, or their equivalent, in secondary school studies. No limitations are imposed in the choice of these elective subjects, and in the selection of the entering class the Committee will be guided by the quality of the applicant's work and by his apparent promise on grounds of intellect and character, rather than by his choice of electives. It is nevertheless recommended, though not required, that the elective subjects should include the following:

Chemistry (1)
History (1)
French (3) or German (3)

A year of secondary school chemistry is strongly recommended as preparation for the chemistry course taken by all First Year students at the Institute.

The study of history for at least one year is advisable in order that the student may have a better understanding of contemporary civilization.

No limitations are imposed with regard to languages except that if a language is offered at all, it must total at least two units. When planning his entrance program, a student who intends later to pursue graduate work should consider that French or German (or sometimes both) will be required. There is an extensive scientific or technical literature in these languages, and a student who intends to engage in research or technical design is likely to find a reading knowledge of them useful. Other foreign languages are acceptable for elective credit. Language study is recommended as a part of the student's general education, but the choice of language, except as indicated above, should be guided by the student's own interest, by the educational opportunities open to him, and by his probable future work. Thus a knowledge of Spanish is obviously desirable for those who expect to have contacts with Latin America.

Application Procedure. Evidence of academic preparation is of two kinds: first, the School Report form mentioned below, and second, an entrance examination in mathematics, which may, however, be waived in certain cases.

A Preliminary Application form which may be obtained from the Director of Admissions should be filed as far as possible in advance of the anticipated date of entrance. This insures that the applicant will receive any announcements which may be issued, as well as Final Application forms, at the proper time.

A Final Application form and two personal endorsement forms will be sent at least four months in advance of the date of entrance, to candidates who have filed Preliminary Application forms. At the same time, a School Report form will be sent directly to the principal or headmaster of each secondary school which the applicant has attended, and will be returned by the school directly to the Institute.

A report of his status with respect to admission will be sent to each applicant as soon as possible after the Committee on Admissions has reviewed his completed application.

Entrance Examinations. A satisfactory record in an examination in secondary school mathematics is required, as noted above. This requirement may, however, be waived for a student graduating in the highest fifth of his class in a school which has qualified for this privilege by sending to the Institute a number of graduates whose records at the Institute have been satisfactory. Applicants, except in the State of New York, take the Comprehensive Mathematics Examination given by the College Entrance Examination Board.

This examination is held in June, September, December and April in the principal cities of the United States and in certain foreign centers. A list of the places and dates of examinations is published each year by the Board. Application for the examination must be made by the applicant on a form to be obtained from the College Entrance Examination Board, P. O. Box 592, Princeton, New Jersey. If the application is received sufficiently early, the examination fee is $8. The Board will report the result of the examination directly to the Institute, but not to the candidate. The Committee on Admissions will decide whether the examination grade, taken in conjunction with the applicant's school record, is satisfactory.

Applicants from schools in the State of New York may offer Regents examinations in Intermediate Algebra, Plane Geometry, Solid Geometry and Trigonometry in place of the Comprehensive Mathematics Examination. Only grades of 85 or better will be accepted. The official report of these examinations will be secured by the Institute from the Board of Regents in Albany.

ADMISSION WITH ADVANCED STANDING

Selection of Students. Students who have completed one or more years with high standing at a recognized college, university, engineering school or junior college, and who are entitled to honorable dismissal, may apply for admission by transfer without examination. Their eligibility for admission will be determined by the Committee on Admissions after a review of their academic records. They will be expected in every case to have completed the academic preparation required of students entering the Institute from secondary schools.

Acceptance in a particular Course, for a transfer student entering the third or fourth year, may be contingent upon his first term record at the Institute.

Students who plan to attend another college with the intention of later applying for admission to the Institute should note the Coöperative Plan in effect between the Institute and certain colleges. (See page 26.)

Advanced Credit. Students admitted by transfer may expect to receive advanced credit for subjects of study completed elsewhere which are substantially equivalent to corresponding Institute subjects. A grade above the lowest passing grade is necessary.

All such credits are provisional and become final only after the student has demonstrated his ability to do satisfactory work in the Course of his choice. Students whose records appear not to warrant advanced credit in a subject may be permitted to demonstrate by passing an examination that they are entitled to such credit.

A student in another college contemplating transfer to the Institute should so plan his program of study as to cover the basic subjects of the Course he expects to enter. If in doubt as to the best choice of subjects he should consult the Director of Admissions.

Application Procedure. Early in the last term before his contemplated transfer to the Institute an applicant should submit the following, enclosed in one envelope:

1. Application for Admission with Advanced Standing, indicating all subjects which will have been completed at the time of transfer.
2. Certified transcript of college record to date, including a statement of honorable dismissal or its equivalent. A certified statement covering subjects subsequently taken should be sent as soon as it is available.
3. Catalogue pages describing all subjects which will have been completed; the applicant's name should be written on each page and each subject indicated by a check mark in the margin.

As soon as the applicant's status is determined he will be informed whether or not he is admitted and how much advanced credit he will be granted. In some cases, it may be necessary to defer action until the applicant's final grades are available.

All remaining questions about credits must be settled within two weeks after the opening of the academic year. In these cases, the student should consult the Director of Admissions.

Applicants desiring credit in Electrical Engineering Laboratory should present their reports as well as their college records in that subject.

Applicants seeking admission with advanced standing in Architecture will be graded in Design in accordance with their performance in their first problem.

SPECIAL STUDENTS

Qualified applicants above the usual age, wishing to carry on a special program of study with a clearly defined objective, may be admitted as Special Students. Such students are not candidates for a degree.

A prospective Special Student should first obtain an application form from the Director of Admissions. The application and program of study must be approved by the department in which the major part of his work is to be carried on, and by the Director of Admissions. The applicant must present academic credentials of high quality, or evidence of professional experience such as to justify the expectation that he can profitably undertake the program desired. In the absence of adequate academic preparation, Special Students will be required to take examinations in subjects prerequisite to those in which they wish to register.

Admission of Special Students in Architecture

Applicants desiring admission as special students in Architecture must be college graduates; or must be at least twenty-one years of age, with not less than three years' experience in an architect's office, or have had equivalent and satisfactory preparation. They must register for those subjects which, in the opinion of the Registration Officer, will best complete the students' educational equipment.

The first week of the course in freehand drawing and the first problem in Design will be considered as test exercises to determine the standing of the student. The arrangement of subjects must be approved by the head of the department and satisfactory records obtained in order to continue architectural subjects.

UNDERGRADUATE COURSES OF STUDY

IN the Schools of Architecture, Engineering, and Science the undergraduate may elect any one of the professional Courses of Study listed below. In all of these Courses leading to the Bachelor's degree, options or electives in professional subjects are available, thereby offering the student wide flexibility in the selection of a schedule of subjects best adapted to his special interests, abilities, and objectives.

In order to qualify for continued attendance at the Institute, students must meet the minimum requirements of the scholastic rating system, a full explanation of which is sent to all new students and their parents. The number of second-year students admitted to certain professional Courses is limited.

School of Architecture

ARCHITECTURE, Course IV.
CITY PLANNING, Course IV-B.
CITY PLANNING PRACTICE, Course IV-C.

School of Engineering

AERONAUTICAL ENGINEERING, Course XVI.

BUILDING ENGINEERING AND CONSTRUCTION, Course XVII, with options. Heavy Construction (1), Light Construction (2).

BUSINESS AND ENGINEERING ADMINISTRATION. Course XV, with options in Engineering based on Physical Sciences and on Chemical Sciences.

CHEMICAL ENGINEERING, Course X, and Chemical Engineering Practice, X-B.

CIVIL ENGINEERING, Course I.

ELECTRICAL ENGINEERING, Course VI, with options. Electric Power (1), Illumination Engineering (2), Electrical Communications (3), Electronic Applications (4). Also Coöperative Course in Electrical Engineering, VI-A.

GENERAL ENGINEERING, Course IX-B.

MARINE TRANSPORTATION, Course XIII-C.

MECHANICAL ENGINEERING, Course II. Also Coöperative Course in Mechanical Engineering, II-A.

METALLURGY, Course III, with options. Metallurgy (1), Mineral Dressing (2).

METEOROLOGY, Course XIV.

NAVAL ARCHITECTURE AND MARINE ENGINEERING, Course XIII.

School of Science

BIOLOGY AND BIOLOGICAL ENGINEERING, Course VII, with options. Quantitative Biology (1), Food Technology and Industrial Biology (2). Also Physical Biology, VII-A.

CHEMISTRY, Course V.

GENERAL SCIENCE, Course IX-A.

GEOLOGY, Course XII, with options. Geology (1), Mineral Resources (2).

MATHEMATICS, Course XVIII, with options. Pure Mathematics (1), Applied Mathematics (2), and Industrial Statistics (3).

PHYSICS, Course VIII, with options. General Physics (1), and Applied Physics (2).

These Courses provide a thorough training in the fundamental sciences and in design. They lay far more stress on the development of power to deal effectively and creatively with new problems than on the acquirement of an extensive knowledge of technical specialties and details. Neither the student nor his professor can possibly foresee what special knowledge or technique the student will be called upon to exercise in his professional career. If, however, his education has emphasized the fundamental principles of science and engineering which underlie all specialties, he will be in a position intelligently to attack the variety of specialized problems which he will meet.

In addition to the above, a five-year course in ECONOMICS AND ENGINEERING or ECONOMICS AND NATURAL SCIENCE is offered which leads to the degree of Bachelor of Science in that one of the above professional Courses in which undergraduate work is taken, together with the degree of Master of Science in Economics and Engineering or Economics and Natural Science. For details see the Graduate School section of this Bulletin.

The first year is devoted to such fundamental subjects as physics, chemistry, mathematics, and English. The student, therefore, may change his course of study at any time before the beginning of the second year.

In the second year, Courses (except Architecture) are divided into two general groups, Engineering and Chemistry. In each group certain basic subjects are common to all Courses. In individual Courses the remaining time is given to introductory professional subjects.

Architecture (Course IV) requires five years for the Bachelor's degree. Courses II-A, VI-A, and VII-A are of five years' duration, and lead to the degrees of Bachelor of Science and Master of Science. Courses II-A and VI-A are coöperative courses requiring outside work in industry.

Division of Humanities

The new four-year program in the humanities and social sciences which will be in effect in the near future provides that in addition to customary courses in modern languages students will take one course in this division each year. The work of the first year will be devoted to English with emphasis on written and oral expression. Special provisions are made for students who are ready for advanced work in English and for foreign students who require intensive instruction. The emphasis on written and oral expression will continue throughout the four years. In the second year all students will be given an introductory course in modern history with special reference to the place of the United States in world affairs. On the basis of the preceding courses, especially history in the second year, the third year will be devoted to the social sciences, including economics and psychology. Under this program in the second half of the third year students will be permitted to choose between a limited number of options in the general field of the social sciences.

In their senior year students will be given an opportunity to choose one of four options: (1) the history of science and thought; (2) music and the fine arts; (3) western world literature; or (4) international relations. Each of these four programs will be closely coördinated with the objectives and purposes of those given in the preceding three years. All classes will be held in small sections and constant opportunity will be given for improvement in both written and oral expression.

PROFESSIONAL SUMMER SCHOOLS

(Temporarily discontinued as the Institute is now operating on a continuous basis)

RESERVE OFFICERS' TRAINING CORPS

(Temporarily discontinued)

In coöperation with the War Department of the Federal Government, the Institute maintains the following units in the R. O. T. C.: Coast Artillery, Engineer, Signal, Ordnance and Chemical Warfare.

REQUIREMENTS FOR THE BACHELOR'S DEGREE

To receive the Degree of Bachelor of Science (S.B.), Bachelor in Architecture (B.Arch.) or Bachelor in City Planning (B.C.P.), the student must have attended the Institute not less than one academic year, which must, in general, be that next preceding his graduation. He must have completed satisfactorily the prescribed schedule of his professional course or approved equivalent work.

The ability of the student to perform an original piece of work is considered an important feature of his degree requirements and theses are required in all course schedules. All theses and records of work done in preparation of theses are the permanent property of the Institute, and must not be published, either wholly or in part, except by authorization of the heads of the respective departments.

No degree will be conferred until all dues to the Institute are paid.

SUBJECT NUMBERING SYSTEM

Subjects are grouped and numbered according to the Department under which the instruction is given. A Course is a program of study made up of subjects selected from the several Departments, and leads to a degree in a given field of science or engineering.

Department	Subject Numbers
Civil and Sanitary Engineering	1·00 to 1·99
Mechanical Engineering	2·00 to 2·99
Metallurgy	3·00 to 3·99
Architecture	4·00 to 4·99
Chemistry	5·00 to 5·99
Electrical Engineering	6·00 to 6·99
Biology and Biological Engineering	7·00 to 7·99
Physics	8·00 to 8·99
Chemical Engineering	10·00 to 10·99
Geology	12·00 to 12·99
Naval Architecture and Marine Engineering	13·00 to 13·99
Meteorology	14·00 to 14·99
Business and Engineering Administration	15·00 to 15·99
Aeronautical Engineering	16·00 to 16·99
Building Engineering and Construction	17·00 to 17·99
Graphics	D1 to D99
Economics and Social Science	Ec1 to Ec99
English and History	E1 to E99
General Studies	G1 to G99
Languages	L1 to L99
Mathematics	M1 to M99
Military Science and Tactics	MS1 to MS99

The time given to each subject is expressed in units, one unit representing 15 hours' work. (Units in class are placed first, followed by preparation units.) The units of preparation represent the estimated time for the average student.

One unit of Recitation or Lecture credit is equivalent to one semester hour. Two units of Drawing or Laboratory credit are equivalent to one semester hour.

UNDERGRADUATE COURSE SCHEDULES
FOR NOVEMBER 1944 TO JUNE 1945

During the Fall Term 1944-45 the undergraduate classes of 6-47, 10-46, 2-46, and 6-45 will take first term schedules. During the Spring Term 1945 they will take second term schedules; the classes of 2-47 and 10-47 will take the second year first term schedules.

FIRST YEAR FOR ALL COURSES

First Term	5·01	Chemistry, General	6–4
	8·01	Physics	5–5
	*D11	Engineering Drawing	4–0
	E11	English Composition	3–5
	M11	Calculus	3–6
	†MS11	Military Science	3–0
			24–20
Second Term	5·02	Chemistry, General	6–4
	8·02	Physics	5–5
	*D12	Descriptive Geometry	4–0
	E12	English Composition	3–5
	M12	Calculus	3–6
	†MS12	Military Science	3–0
			24–20

* Students planning to enroll in Course IV, Architecture, should take the above program with the following changes:

First Term	Omit:	D11	Engineering Drawing	4–0
	Add:	4·711	Architectural Drawing	6–0
Second Term	Omit:	D12	Engineering Drawing	4–0
	Add:	4·712	Architectural Drawing	6–0

† First year students entering July 1944 will take MS12 the first term and MS11 the second term.

I. CIVIL AND SANITARY ENGINEERING

THE Course in Civil Engineering provides a training in the fundamental subjects of science and engineering with particular application to the broad field of design, construction, operation, and maintenance of structures and works necessary for modern industry and civilization. These include bridges, buildings, dams, and other fixed structures; hydraulic and sanitary works for water supply and sewerage, water power, river and harbor improvement; and facilities for transportation by railway, highway, water and air.

The undergraduate Course in Civil Engineering includes group electives in Sanitary Engineering designed to give training formerly provided by the separate undergraduate courses in Sanitary Engineering and in Public Health Engineering.

During the first two years, the Course includes the basic subjects of mathematics and science, and surveying, together with other introductory work in the fields of civil and sanitary engineering. In the third and fourth years, considerable time is devoted to structural theory and design, foundation problems, and construction methods, subjects which are essential in all branches of the Civil Engineering profession, and the student has an opportunity for specialization in a particular field.

The Course leads to the degree of Bachelor of Science in Civil Engineering.

(See above for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	1·00	Surveying	2–2
	1·01	Topographical Drawing	4–0
	1·39	Graphic Statics	3–1
	2·00	Applied Mechanics	3–5
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			26–24
Second Term	1·052	Surveying	2–0
	1·12	Astronomy and Spher. Trig.	2–4
	1·21	Rail. and High. Curves	2–2
	2·01	Applied Mechanics	3–5
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			24–26

* Class of 2-47 will take first term schedule during Spring Term 1945.

Third Year (Class of 2-46)*

First Term	1·12	Astronomy and Spher. Trig.	2–4
	1·13	Geodesy	2–3
	2·04	Applied Mechanics	3–5
	2·41	Heat Engineering	4–6
	6·41	Electrical Eng., Fund	3–5
	12·32	Engineering Geology	5–2
	Ec11T	Economic Principles	3–3
			22–28
Second Term	1·35	Roads and Pavements	2–1
	1·40	Structures, Theory	5–4
	1·45	Materials of Construction	2–4
	1·58	Reinf. Concrete Structures, Des.	6–0
	1·62	Hydraulics	4–6
	6·47	Elec. in Industry, App.	4–4
	Ec12T	Industrial Economics	3–3
			26–22

* Students wishing to specialize in Course I(d) Sanitary Engineering should follow the above schedule for third year with the following changes:

First Term	Omit:	1·13, 2·41		
	Add:	1·781	Sanitary Chemistry	4–4
		5·41	Organic Chemistry I	4–3
Second Term	Omit:	1·35		
	Add:	2·371	Testing Materials Lab.	2–1

Fourth Year (Class of 6-45)

(*a*) Water Works and Sewerage; (*b*) Transportation; (*c*) Water Power and Flood Control; (*d*) Sanitary Engineering (see footnote)

First Term	1·271	(*b*) Transportation Engineering	6–5
	1·41	Structures, Theory	3–6
	1·45	Materials of Construction	2–4
	1·481	Soil Mechanics	4–2
	1·501	Bridge Design	8–0
	1·70	(*c*) Hydrology	7–4
	1·75	(*a*) Hydraulic & Sanitary Engineering	3–5
	1·801	(*a*) Hydraulic & Sanitary Design	3–0
		Thesis	2
		General Study	2–2
			46
Second Term	1·272	(*b*) Transportation Engineering	5–4
	1·42	Structures, Theory	3–6
	1·482	Foundations and Embankments	3–4
	1·502	Structural Design	8–0
	1·71	(*c*) Water Power Eng. & Flood Con.	7–3
	1·76	(*a*) Sanitary Engineering	3–4
	1·79	(*a*) Sanitary Design	2–0
	2·687	Hydraulic Laboratory	2–2
		(*a, b*) Thesis	7
		(*c*) Thesis	6
		General Study	6
			50

Schedule arrangements will be made for fourth year students desiring to specialize in Sanitary Engineering.

II. MECHANICAL ENGINEERING

THE Course in Mechanical Engineering is planned to provide a sufficient foundation of basic science applied to engineering methods and techniques, to prepare the graduate to enter any industry dealing with heat, power, materials and machinery. The Course does not attempt to teach current commercial practice nor specialized knowledge of the product of any one industry. On the contrary, graduates are expected to obtain their practical experience by direct service in industry.

During the first two years the fundamental subjects which are the basis of the student's later professional work are studied, viz., mathematics, chemistry, physics, and applied mechanics, a thorough knowledge of which is essential in all branches of mechanical engineering. The student is also trained in elements of the more important mechanical processes in order that he may acquire the knowledge of modern machine tools, foundry practice, forging and welding, necessary for the successful designer of machinery.

The professional work of the third and fourth years includes the study of the mechanics of fluids and of rigid and elastic bodies with applications to design. The study of thermodynamics is applied to heat engineering, and to the analysis and design of power plants, turbines, steam and internal combustion engines, and to refrigeration and air conditioning systems. The materials, especially the metals, commonly employed in mechanical engineering, are the subject of lectures and laboratory exercises planned to correlate physical properties with constitution, heat treatment and working.

In general, instruction by lectures is paralleled by laboratory work in which the student is given opportunity, not only to familiarize himself with materials, engines and machinery, but also to develop his ability to apply theory to the analysis of their characteristics.

The Course leads to the degree of Bachelor of Science in Mechanical Engineering.

Under normal conditions a reading knowledge of German or French is required for admission to the senior year. Due to the war, this requirement has been waived temporarily.

HONORS COURSE

(Admission to the Honors Course is closed for the duration of the war.)

The opportunity will be afforded a limited number of students of superior ability to join an Honors Course group. The selection of members of this group will be made by the Department from students who may wish to avail themselves of the opportunity to pursue a coördinated schedule of studies through the Senior and Graduate years. A single thesis with a minimum of 30 units will be required in the Graduate year and the time allotted to thesis in the Senior year will be available for advanced mathematics or other subjects preparatory to the program of graduate studies. Before registration for the fifth year, the students selected under this plan must have had at least two months industrial employment satisfactory to the Department. A member of the Department will serve as adviser to aid the members of the group in selecting the Senior and Graduate schedules which may be best suited to their individual interests.

The Honors Course leads to the degrees of Bachelor of Science and Master of Science in Mechanical Engineering, awarded simultaneously at the end of the Graduate year.

II. Mechanical Engineering

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·00	Applied Mechanics	3–5
	2·701	Machine Drawing	6–0
	2·851	Machine Tool Lab.	4–0
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			27–21
Second Term	2·01	Applied Mechanics	3–5
	2·30	Engineering Metals	2–2
	2·730	Machine Design	4–2
	2·852	Machine Tool Practice	4–0
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			28–24

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	2·251	Fluid Mechanics	5–3
	2·31	Engineering Materials	5–4
	2·40	Heat Engineering	4–5
	6·18	Electrical Eng., Fund.	4–6
	Ec11T	Economic Principles	3–3
			24–26
Second Term	2·06	Applied Mechanics	3–5
	2·252	Fluid Mechanics	5–3
	2·37	Testing Materials Lab.	4–2
	2·42	Heat Engineering	4–5
	2·680	Engineering Laboratory	4–4
	2·731	Machine Design	4–1
	Ec12T	Industrial Economics	3–3
			27–23

Fourth Year (Class of 6-45)

First Term	2·081	Applied Mechanics	3–5
	2·43	Heat Engineering	3–5
	6·19	Electrical Eng., Fund.	4–6
		General Study	2–2
		General Study	2–2
		Thesis† and Elective‡	14
			48
		Electives	
	2·10	Ordnance Engineering	3–3
	2·32	Engineering Metals	2–3
	2·682	Engineering Laboratory	3–3
	2·732	Machine Design	4–2
	2·791	Automotive Engines	5–3
	2·83	Steam Turbine Engineering	2–4
Second Term	2·082	Applied Mechanics	3–5
	2·551	Power Plant Engineering	3–5
		General Study	2–2
		General Study	2–2
		Thesis† and Elective	22
			46
		Electives	
	2·10	Ordnance Engineering	3–3
	2·34	Metals & Testing, Adv.	3–2
	2·78	Hyd. Power Trans. & Controls, Des.	4–2
	2·782	Mech. Systems, Des.	4–4
	2·792	Automotive Engines	5–3
	2·84	Gas Turbine Engineering	2–4

* Class of 2-47 will take first term schedule during Spring Term 1945.
† Total thesis to be not less than 10 units, not more than 3 units of which are to be in first term.
‡ Either 2·732 or 2·791 (but not both) must be included in elective choice.

II-A. MECHANICAL ENGINEERING

In Coöperation with the General Electric Company and the Boston Edison Company

(During the war students will take the regular Course II schedule. For typical Course II-A schedule, see Catalogue, June 1942, Volume 77, No. 4, or Summer Session 1942, Volume 77, No. 3.)

THE Coöperative Course in Mechanical Engineering affords training for the technical and executive responsibilities of the manufacturing phases of any representative large industry.

The Course covers a period of five years, of which the first two years are identical with those of Course II. The last three years, including the summers, are spent partly at the Institute and partly at the plants of the coöperating companies.

Instruction in the first four years is essentially the same in content as that given in Course II. No omissions are made in the fundamental and professional subjects, and the subjects omitted from the regular Course II curriculum have their counterparts in the program at the works.

The final year of graduate study and research is to be planned for each student in accordance with the requirements of the Graduate School. Training at the plants is planned and carried out with a view to its educational value and is closely correlated with the instruction at the Institute. During the final term at the works much freedom may be exercised in the assignment of students to the research departments of the companies. This is planned to develop special and individual aptitudes of the various men.

The number of students that can be accommodated is limited and, consequently, registration in the Coöperative Course is restricted to students of marked aptitude who have clear records in the first two years of Course II. Admission to the Course is subject to the approval of the Institute and the coöperating companies. College transfer students may be admitted under equivalent conditions as to adequacy of preparation and aptitude.

It is assumed that students who are admitted to the Course with the approval of the Institute and of the coöperating companies will carry the Course through to completion, unless exceptional circumstances prevent. Students at the works are subject to the usual regulations of the Company and receive regular compensation, the total of which approximates the tuition charges for the three years of the Coöperative Course.

The Course leads to the degrees of Bachelor of Science and Master of Science in Mechanical Engineering, awarded simultaneously at the end of the Graduate year.

III. METALLURGY

Including Ceramics

THE Course in Metallurgy provides training in the beneficiation and dressing of ores and minerals, in the production and purification of metals, and in the use of metals and alloys. Although the fields of Metallurgy and Mineral Dressing are differentiated in some industries, it is felt that broad training requires an acquaintance with each branch. As a result the emphasis throughout the four years is laid on the basic sciences of mathematics, physics, chemistry, and economics, and the junior year is devoted almost exclusively to an application of these sciences, and particularly physical chemistry, to the various branches of Metallurgy.

In the senior year two options are offered, one in Metallurgy and the other in Mineral Dressing.

The Metallurgy option covers both process metallurgy, which is concerned primarily with the winning of the metals from ores or concentrates, and the making of steel and other alloys, and physical metallurgy which stresses the physical properties, structures, testing and uses of metals and alloys. The two subdivisions of Metallurgy are so closely interrelated that a sharp separation is undesirable. A limited amount of specialization in one of the two fields is made possible by the freedom of choice in the selection of electives and of a thesis subject in the fourth year.

The Mineral Dressing option is primarily concerned with the mechanical, physical, and chemical preparation of ores, solid fuels, ceramic raw materials and other non-metallic mineral products. This preparation has as its goal the elimination at low cost of the bulky impurities commonly found in raw mineral products, and the production of the valuable content as concentrate.

Both options lead to the degree of Bachelor of Science in Metallurgy.

Ceramics. The instruction and research in Ceramics are mainly intended for graduate work leading to a Master's or Doctor's degree. It is advisable for an undergraduate student interested in this subject to register in Course IX-B, General Engineering, and take as electives, subjects bearing on Ceramics. This procedure will also give an excellent foundation for graduate work. The subjects dealing with Ceramics are intended to give a fundamental training in the usual manufacturing processes as well as in the testing of raw materials and finished ware.

III. Metallurgy

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·854	Machine Tool Laboratory	3–0
	5·11	Qualitative Analysis	7–2
	8·03	Physics	5–5
	12·011	Mineralogy	6–1
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			30–19
Second Term	3·00	Metallurgy, Introduction	3–1
	5·12	Quantitative Analysis	7–2
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
		General Study	6
			49

Third Year (Class of 2-46)

First Term	2·011	Applied Mechanics	3–5
	3·01	Non-Ferrous Metallurgy I	4–4
	3·04	Metallurgical Laboratory	5–0
	3·31	Metallography	5–2
	3·81	Mineral Dressing I	4–2
	5·61	Physical Chemistry I	4–4
	5·612	Physical Chemistry Lab. I	2–0
	Ec11T	Economic Principles	3–3
			30–20
Second Term	2·042	Applied Mechanics	3–5
	2·312	Metal Processing	3–0
	2·50	Heat Measurements	3–1
	3·12	Metal. Iron & Steel	3–4
	3·32	Metallog. & Heat Treat	6–4
	3·82	Mineral Dressing II	4–2
	5·62	Physical Chemistry II	4–4
		General Study	2–2
			28–22

* Class of 2-47 will take first term schedule during Spring Term 1945.

III. Metallurgy Continued

Option 1. Metallurgy

Fourth Year (Class of 6-45)

First Term	2·371	Testing Materials Lab	2–1
	3·20	Metall. Thermodynamics	4–5
	3·33	Metallography, App.	3–2
	3·40	Corrosion & Heat Resist. Alloys	2–4
	6·40	Electrical Eng., Elem.	4–6
		General Study	6
		Elective*	11
			50
Second Term	3·41	Light Alloys	2–4
	3·50	X-ray Metallography	3–3
	6·81	Electrical Eng. Lab.	2–2
	Ec12T	Industrial Economics	3–3
		Thesis	12
		Elective*	15
			49

Option 2. Mineral Dressing

Fourth Year (Class of 6-45)

First Term	3·02	Non-Ferrous Metallurgy II	3–3
	3·20	Metall. Thermodynamics	4–5
	3·83	Mineral Dressing Plant	3–2
	3·86	Comminution	2–3
	3·87	Quant. Mineragraphy	4–0
	5·41	Organic Chemistry I	4–3
	12·91	Mining, Elements	3–5
		General Study	6
			50
Second Term	3·84	Mineral Dressing Practice	2–2
	3·85	Flotation	3–3
	12·40	Economic Geology	3–6
	Ec12T	Industrial Economics	3–3
		Thesis	12
		Elective*	12
			49

* Electives must form a coördinated program of study.

IV. ARCHITECTURE

THE School of Architecture includes Course IV, Architecture; Course IV-B, City Planning; and Course IV-C, City Planning Practice.

The objective of the Course in Architecture is to produce graduates who will be effective and valuable in the planning and execution of all kinds of building projects. The professional contribution includes understanding of the building needs of communities and individuals, ability to analyze accurately the requirements in specific cases, skill in the effective and orderly disposition of building elements on sites and in the organization of interior spaces, coördination of the general plan with a simple and economical structural system, research into best methods and materials of construction, control over proportions and details to achieve effective and eloquent expression and integration of planning with equipment and materials necessary to maintain desired conditions of health, enjoyment, and convenience.

Unusual opportunities are available for fundamental training in the basic sciences underlying building technology, for close contact with outstanding laboratory and research facilities in engineering fields related to architecture, and for understanding of the broad economic and social approach of the city planner.

In recognition of a vital need in the profession for ever greater technical ability and judgment, a newly adopted curriculum in Architecture integrates technical resources with social and cultural needs.

IV. Architecture

(See page 36 for First Year)

Second Year (Classes of 6-47, 10-47)*

First Term	2·011	Applied Mechanics	3–5
	4·721	Architectural Design II	13–2
	8·03	Physics	5–5
	17·71	Materials	3–2
	E21T	U. S. in World History	3–5
	MS21	Military Science	3–0
			30–19
Second Term	2·042	Applied Mechanics	3–5
	4·07	Shop	4–0
	4·722	Architectural Design II	13–2
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	MS22	Military Science	3–0
			32–16

Third Year (Class of 10-46)

First Term	2·661	Heating and Ventilation	2–4
	4·031	Freehand Drawing	4–0
	4·731	Architectural Design III	15–3
	4·811	Structural Analysis	8–0
	17·73	Materials	3–2
	Ec11T	Economic Principles	3–3
			35–12
Second Term	2·662	Heating and Ventilation	2–4
	4·032	Freehand Drawing	4–0
	4·732	Architectural Design III	15–3
	4·812	Structural Analysis	8–0
	17·74	Materials	5–2
	Ec12T	Industrial Economics	3–3
			37–12

Fourth Year (Class of 2-46)

First Term	4·041T	Freehand & Color	6–0
	4·641	City Planning, Principles	2–2
	4·741T	Architectural Design IV	20–4
	8·053	Acoustics	5–3
	Ec83	Urban Sociology	2–4
			35–13
Second Term	1·77	Sanitation	2–4
	4·042T	Freehand & Color	6–0
	4·742T	Architectural Design IV	20–4
	6·16	Electricity	2–4
	6·17	Illumination	2–4
			32–16

Fifth Year (Class of 6-45)

First Term	4·051	Freehand Drawing	6–0
	4·091	Color, Comp., Th. & App.	1–4
	4·481	Europ. Civilization & Art	2–3
	4·53	Professional Relations	1–2
	4·751	Architectural Design V	29–0
			39–9
Second Term	4·052	Freehand Drawing	6–0
	4·092	Color, Comp., Th. & App.	1–4
	4·482	Europ. Civilization & Art	2–3
	4·752	Architectural Design V	14–0
		Thesis	18
			48

* Class of 10-47 will take first term schedule during Spring Term 1945.

IV. Architecture Continued

Fifth Year (In effect June 1945)

First Term	4·051T	Freehand & Color	6–0
	4·451	History of Architecture	3–5
	4·751T	Architectural Design V	20–4
	Ec85	Land Economics	2–5
		Elective	4
			49
Second Term	4·052T	Freehand & Color	6–0
	4·452	History of Architecture	3–5
	Ec88	Building Economics	2–4
		Elective	10
		Thesis	18
			48

IV-B. CITY PLANNING

THE undergraduate Course in City Planning has been developed in response to the need for a curriculum which is oriented to this professional field early in the program and which provides for a synthesis of the economic, sociological, administrative, and engineering aspects of city planning impossible in courses developed from existing curricula in specialized professional fields.

The expansion which has taken place in the social and economic aspects of planning, the development of improved technical procedures, and the rapidity with which planning and zoning legislation has placed new instruments of social control into the hands of local and state governments have greatly increased the scope of professional activity. This fact in its turn has placed a greater responsibility on the planning technician or consultant, who must be well equipped in the methods of social and economic research as well as in the techniques of physical planning.

The curriculum of Course IV-B includes preparatory subjects in engineering and in the natural and social sciences with the object of developing in the student an understanding of basic principles and relationships. The content of the third and fourth years is primarily technical in character with emphasis on the economic and administrative aspects, but with considerable time given to the working out in the drafting room of actual problems in the field of city and regional planning.

A feature of the Course is the close relations maintained between the student group and planning agencies in the Boston metropolitan district, advantage being taken of the many opportunities for evaluating "planning in action." Over a nine-year period, students in the Course in City Planning have developed planning studies in more than forty communities as part of their regular program of instruction, such studies including proposals for zoning, traffic circulation, housing, and rehabilitation, as well as comprehensive plans for future development. While these do not of course take the place of official plans and surveys, the procedure enables a student to carry through a planning project under conditions which approximate those of actual practice.

The Course in City Planning, IV-B, covers four years and leads to the degree of Bachelor in City Planning. Graduates of the Course, if accepted for admission to the Graduate School, should be able to complete the requirements for the degree of Master in City Planning in one year.

IV-B. City Planning

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	4·641	City Planning, Prin.	2–2
	12·321	Engineering Geology	5–2
	Ec11T	Economic Principles	3–3
	Ec83	Urban Sociology	2–4
	E21T	U. S. in World History	3–5
	E35	Reports	2–4
	M21	Calculus	3–6
	MS21	Military Science	3–0
			23–26
Second Term	1·02	Surveying	3–1
	4·672	City Planning Design	10–5
	Ec12T	Industrial Economics	3–3
	Ec32	Economic Statistics, Elem.	3–3
	E22T	U. S. in World History	3–5
	G86	San. Sci. & P. H., Prin.	2–2
	MS22	Military Science	3–0
			27–19

Third Year (Class of 2-46)

First Term	1·34	Municipal Engineering	3–4
	4·59	Government and Public Admin.	2–4
	4·651	Theory & Prac. City Planning	3–3
	4·681	City & Regional Planning	18–0
	15·11	Business Management, Int.	3–3
		Professional Elective	6
			49
Second Term	4·62	Site Plan. and Construction	12–0
	4·652	Theory & Prac. City Planning	3–3
	4·682	City & Regional Planning	12–0
	15·12	Business Management, Int.	3–3
	Ec40	Money and Banking	3–3
		Professional Elective	6
			48

Fourth Year (Class of 6-45)

First Term	4·683	City & Regional Planning	12–0
	15·61	Law of Contracts	3–6
	Ec49	Public Finance	2–5
	Ec85	Land Economics	2–5
		General Study	2–2
		Thesis and Elective	10
			49
Second Term	4·60	Plan. Legislation & Admin.	2–5
	Ec86	Land Economics	4–6
	G38	Public Speaking	3–3
		General Study	2–2
		Thesis and Elective	20
			47

* Class of 2-47 will take first term schedule during Spring Term 1945.

IV-C. CITY PLANNING PRACTICE

(The Course in City Planning Practice has been temporarily discontinued due to the war. For typical Course IV-C schedule, see Catalogue, June 1942, Volume 77, No. 4, or Summer Session 1942, Volume 77, No. 3.)

V. CHEMISTRY

THE main objective of the Course in Chemistry is to provide a general and fundamental education based on science for those who seek the Bachelor's degree and a career in some field in which a sound knowledge of chemistry is important, and for those who wish to go on to graduate study and a professional career in chemistry.

Students receive thorough instruction in the principles of inorganic, analytical, organic, physical, and industrial chemistry, supplemented by instruction in mathematics and physics and in the humanities, including English, history, German, French, and other nonprofessional subjects.

The Course aims to stimulate and develop the research attitude, and the schedule includes the thesis in the fourth year to provide an opportunity for the student to demonstrate his aptitude for creative effort. Throughout the Course, the student has the benefit of counsel by experienced instructors who assist him in selecting electives and aid him in acquiring the education and training necessary for well-balanced and intelligent living.

The Course leads to the degree of Bachelor of Science in Chemistry.

V. CHEMISTRY

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

Second Year

First Term	5·10	Qualitative Analysis	14–4
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			28–20

Second Term	5·12	Quantitative Analysis	7–2
	5·13	Quantitative Analysis	5–2
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
		General Study	2–2
			29–21

NOTE ON LANGUAGE

Language may be substituted for part of the General Study requirement with the approval of the Registration Officer. Students credited with Elementary and Intermediate French may take Elementary German. Students credited with Elementary and Intermediate German may take Elementary French. Students credited with Elementary French and Elementary German may take Intermediate German. Students who present neither French nor German on entrance will take Elementary German.

Third Year (Class of 2-46)

First Term	5·141	Analytical Chemistry	4–1
	5·41	Organic Chemistry I	4–3
	5·414	Organic Preparations	9–0
	5·61	Physical Chemistry I	4–4
	5·611	Physical Chem. Lab. I	4–0
	Ec11T	Economic Principles	3–3
	L31	German, Intermediate	2–3
		Elective	5
			49

* Class of 2-47 will take first term schedule during Spring Term 1945.

Second Term	5·417	Quant. Organic Analysis	4–0
	5·42	Organic Chemistry II	4–2
	5·424	Organic Compounds, Ident.	9–0
	5·62	Physical Chemistry II	4–4
	5·621	Physical Chem. Lab. II	4–0
	5·82	Chemical Literature	1–1
	Ec12T	Industrial Economics	3–3
		General Study	2–2
		Elective	5
			48

NOTE ON THIRD YEAR LANGUAGE

Students who have completed Intermediate German will substitute elective for L31 by petition.

Fourth Year (Class of 6-45)

First Term	5·061	Inorganic Chemistry, Adv.	2–3
	5·43	Organic Chemistry III	3–6
	5·63	Thermodynamics, Int.	3–5
	10·203	Industrial Chemistry	3–4
	E33	Report Writing	2–4
		Thesis	15
			50

Second Term	5·062	Inorganic Chemistry, Adv.	2–3
	5·44	Organic Chemistry IV	3–6
	5·64	Radiation Chem., Int.	2–3
	5·66	Surface & Colloid Chem.	2–3
	10·21	Industrial Chemistry	2–2
		Thesis	16
		General Study	2–2
			48

VI. ELECTRICAL ENGINEERING

THE common objective of the course in Electrical Engineering is to train men for professional, industrial, or commercial careers in progressive applications of present engineering art and in the development of new engineering applications of electrical science. In preparation for such a career, the electrical engineering student must develop a working mastery of the basic sciences of mathematics and physics emphasizing mechanics, thermodynamics and especially electricity and magnetism. On these are built his fundamental professional work in principles of electrical engineering and associated applications. Equally vital to him is the ability to write and speak English effectively. He also needs the elements of chemistry and economics.

Various special features of the Department's work contribute strongly to the development of initiative, judgment, resourcefulness, and responsibility. Emphasis is placed on individual study under staff guidance. Close association among staff and students is considered part of a healthy educational atmosphere. Laboratory work is normally largely of the project type stressing individual experimental investigation under supervision rather than standardized experiments. Small class sections, including students of similar interests and aptitudes, serve to encourage vigorous discussion. The Honors Group Plan requires a large measure of initiative and responsibility in the third and fourth years on the part of accepted candidates. Several Colloquia each year led by outstanding industrial engineers provide case studies in current engineering developments. (The Honors Group Plan and the Colloquia have been suspended for the duration of the war.)

By means of options provision is made for interests in the small-current fields of communications, electronics, measurement, and control, as well as in the large-current

VI. Electrical Engineering Continued

or power field. Additional flexibility to meet the needs of the individual student is provided by permitting him to make substitutions in the curriculum with the permission of the head of the department provided these are well considered and directed toward sound objectives.

Course VI provides three options described below, all identical in their first two years and containing much in common through the last two years. The purpose of differentiation into options is primarily to provide the incentive to accomplishment which comes from emphasis on that portion of the electrical engineering field which arouses a student's special interest. All of these options lead to the degree of Bachelor of Science in Electrical Engineering.

VI. Electrical Engineering

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·00	Applied Mechanics	3–5
	2·853	Machine Tool Laboratory	4–0
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
		General Study	6
			48
Second Term	2·01	Applied Mechanics	3–5
	6·00	Electrical Eng., Prin.	4–6
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			22–26

Option 1. Electric Power

Electric Power provides for professional study emphasizing electrical machinery, power generation, transmission, and distribution. This is a logical preparation for work with heavy apparatus manufacturers, public power utilities, and users of heavy electrical equipment.

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	2·40	Heat Engineering	4–5
	6·01	Electrical Eng., Prin.	5–7
	6·75	Electrical Eng. Lab.	4–5
	Ec11T	Economic Principles	3–3
	M31	Differential Equations	2–4
			21–29
Second Term	2·07	Applied Mechanics	3–5
	2·42	Heat Engineering	4–5
	6·02	Electrical Eng., Prin.	5–7
	6·76	Electrical Eng. Lab.	3–4
	6·77	Electrical Eng. Lab.	4–4
	Ec12T	Industrial Economics	3–3
			22–28

Fourth Year (Class of 6-45)

First Term	1·64	Hydraulics	3–6
	2·686	Engineering Laboratory	3–3
	6·03	Electrical Eng., Prin.	6–8
	6·78	Electrical Eng. Lab.	3–4
		General Study	2–2
		Professional Elective	9
			49
Second Term	6·04	Electrical Eng., Prin.	4–6
	6·79	Electrical Eng. Lab.	4–5
	G12	Seminar in Biography	3–3
		Thesis	9
		General Study	6
		Professional Elective	9
			49

* Class of 2-47 will take first term schedule during Spring Term 1945.

Electives

First Term	6·20	(1, 3) Electronic Control & Meas.	3–6
	6·211	Electricity in Industry, App.	3–6
	6·221	Electric Power Generation	3–6
	6·251	Electric Machine Design	3–6
	‡6·26	Electric Insulation	3–6
	6·281	Wire Communications, Prin.	3–6
	6·80	Electrical Eng. Lab.	Time arr.
Second Term	6·212	Electricity in Industry, App.	3–6
	6·222	Electric Power Generation	3–6
	6·23	(1, 3) Electrical Implementation	3–6
	6·252	Electric Machine Design	3–6
	6·27	Illuminating Eng., Prin.	5–4
	‡6·282	Radio Communications, Prin.	3–6
	6·312	Electrical Communications, Prin.	3–6
	‡6·48	Electrical Equip. Bldgs.	1–2
	6·80	Electrical Eng. Lab.	Time arr.
	8·54	Electromagnetic Theory	3–6
	M77	Vector Analysis	3–6

‡ Not offered November 1944–June 1945.

Option 2. Illumination Engineering

(*Temporarily Discontinued. For typical Option 2 schedule see Catalogue, June 1942, Volume 77, No. 4*)

Illumination Engineering gives particular attention to the scientific basis of vision, color, optical apparatus, and production and good use of illumination. Makers and users of illumination equipment find this rapidly advancing field requires men with such training.

Option 3. Electrical Communications

Electrical Communications embraces a study of the techniques underlying the translation, transmission, reproduction, and recording of intelligence by electrical means. Circuit theory, electronics, electromagnetic theory, and acoustics are basic professional studies. The field of practical application includes also such arts as aids to navigation, automatic control, and others in which the same techniques are essential.

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	6·01	Electrical Eng., Prin.	5–7
	6·75	Electrical Eng. Lab.	4–5
	8·061	Physics, Intermediate	3–4
	Ec11T	Economic Principles	3–3
	M31	Differential Equations	2–4
			20–28
Second Term	6·02	Electrical Eng., Prin.	5–7
	6·30	Electrical Com., Prin.	4–6
	6·76	Electrical Eng. Lab.	3–4
	6·77	Electrical Eng. Lab.	4–4
	8·062	Physics, Intermediate	3–4
	Ec12T	Industrial Economics	3–3
			22–28

Fourth Year (Class of 6-45)

First Term	6·031	Electrical Eng., Prin.	3–4
	6·311	Electrical Com., Prin.	3–5
	6·331	Electrical Com. Lab.	3–3
	6·781	Electrical Eng. Lab.	3–3
	8·05	Vibrations and Sound	3–6
		General Study	2–2
		Professional Elective	9
			49

VI. Electrical Engineering Continued

Second Term	6·32	Electrical Com. Prin.	4–8
	6·332	Electrical Com. Lab.	4–4
	G12	Seminar in Biography	3–3
		Thesis	9
		General Study	6
		Professional Elective	9
			50

Electives Same as for Option 1

Option 4. Electronic Applications

Electronic Applications emphasizes the rapidly increasing use of electrical methods of measurement, control, and implementation in all types of industry and engineering, as the emergence of a field of great future importance. It pays particular attention to electromechanical and electrothermal systems, principles of measurement, and electronic applications.

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	6·01	Electrical Eng., Prin.	5–7
	6·75	Electrical Eng. Lab.	4–5
	8·061	Physics, Intermediate	3–4
	Ec11T	Economic Principles	3–3
	M31	Differential Equations	2–4
			20–28
Second Term	2·07	Applied Mechanics	3–5
	6·02	Electrical Eng., Prin.	5–7
	6·76	Electrical Eng. Lab.	3–4
	6·77	Electrical Eng. Lab.	4–4
	8·062	Physics, Intermediate	3–4
	Ec12T	Industrial Economics	3–3
			21–27

Fourth Year (Class of 6-45)

First Term	2·251	Fluid Mechanics	5–3
	6·031	Electrical Eng., Prin.	3–4
	6·20	Electronic Control & Measurement	3–6
	6·781	Electrical Eng. Lab.	3–3
	6·83	Electronic Eng. Lab.	3–4
		General Study	2–2
		Professional Elective	9
			50
Second Term	6·23	Electrical Implementation	3–6
	6·84	Electrical Implementation Lab.	3–6
	G12	Seminar in Biography	3–3
		Thesis	9
		General Study	6
		Professional Elective	9
			48

Electives Same as for Option 1

VI-A. ELECTRICAL ENGINEERING

Coöperative Course

The students in the Coöperative Course follow the program of one of the options of Course VI with four terms of practical experience in place of two professional electives and fourth year thesis. For typical Course VI-A schedule see Catalogue, June 1942, Volume 77, No. 4, or Summer Session 1942, Volume 77, No. 3.)

THE engineering graduate, before he can take responsibility for important industrial projects, must have an educational background of sound fundamental scientific and economic principles, and in addition, must be acquainted with industrial practices in his specialized field of employment. This interlinking of theory and practice is provided in the Coöperative Course in Electrical Engineering, in which a selected group of students pursues a course of stud and practice which correlates the scientific and engineering principles of the classroom and laboratory with approximately seventy weeks of practical experience in the plants of a particular industry. This educational plan makes it possible for the student to do his "undergraduate" work in industry in parallel with his undergraduate academic studies at the Institute and, at the time of graduation, to be in a position to utilize immediately the more advanced principles studied in the senior and graduate years. The first four years are practically identical in academic content with Course VI and the fifth or final year includes a complete academic year of graduate work subject to the provisions of the Graduate School. The Course leads to the degrees of Bachelor of Science and Master of Science in Electrical Engineering awarded simultaneously at the end of the Graduate year.

Five distinct programs of industrial experience are offered in the following options:

Option 1 — Manufacturing. In coöperation with the General Electric Company.

Option 2. — Public Utilities.

(a) Light and Power. In coöperation with the Boston Edison Company.

(b) Transportation. In coöperation with the Boston Elevated Railway.

Option 3. — Communications.

(a) Wire and Radio. In coöperation with the affiliated companies of the Bell System.

(b) Electronic Apparatus Manufacturing. In coöperation with the General Radio Company.

Option 1 affords training for the technical and executive responsibilities of electrical manufacturing industries. The manufacturing practice is taken in the plants of the General Electric Company in Lynn, Schenectady, Pittsfield and Philadelphia. The earlier assignments deal with manufacturing processes and planning, instrument repair and calibration, and the testing of manufactured products. The later assignments may include research or development projects in the various laboratories.

Option 2 offers experience in the maintenance, operation and administration of a company which furnishes electric light and power or transportation as a public service. Students trained in the plants of the Boston Edison Company work on projects involving the repair and maintenance of lines and equipment, the testing of instruments, insulators and transformers, the handling of customer relations, the operation of generating stations, and the solution of transmission and distribution engineering problems.

The students trained in the plants of the Boston Elevated Railway are assigned to maintenance of way and signals, work in car shops, the operation of surface cars, trains and busses, and act as executive assistants in the General Manager's office.

Option 3 provides practical training for students preparing to enter the field of communications engineering.

Students who obtain their experiencewith the Bell System go first to an operating company, where they work with installers supplying customer service and in telephone exchanges on the installation and maintenance of central office equipment. The second assignment is to the Western Electric Company at Kearny, N.J., where the students work on problems of plant layout, factory processes, and manufacturing economy. The third assignment is to the Bell Telephone Laboratories, where the students usually confine their attention for the whole term to one specific research or development project. The final assignment

VI-A. Electrical Engineering Continued

may be at one of the Bell-System plants mentioned above or may be with one of the other associated companies, at the discretion of the officials of the American Telephone and Telegraph Company, the coördinating organization of the Bell System.

The General Radio Company provides practical experience in the manufacture of electronic apparatus. The first period is spent in the factory, where the student becomes acquainted with shop practices, materials and products of manufacture. The second term is spent in the instrument calibration laboratory, where the students learn to test the behavior of manufactured instruments or of experimental models which may be in the developmental stage. The third term is spent as Junior Engineering Assistant in the development laboratories, and the final term is specially arranged to meet the needs of the individual student.

Candidates for admission to the third year are selected from the second-year class at the Institute, and from transfer students who have completed substantially the equivalent of the first two years of Course VI. Since the Course leads to the Master's degree, acceptance into the coöperative year is made by the Institute on the basis of a promising scholastic record, and by the companies upon personal qualifications which indicate adaptability to the work of the company involved.

Each class is divided into two groups (A and B) which alternate after the second year, one group studying at the Institute in Cambridge while the other group is working at the plants of the coöperating companies.

The men when in training at the plants are subject to the usual company regulations. They receive regular compensation for their work, the total of which approximates the tuition charges for the three years of coöperation. During the practice periods classes are held two evenings a week in electrical engineering and other professional studies, in this way maintaining a continuous study of the principles of electrical engineering, whether at the Institute or at the plant.

On account of the limitations of number and the unitary nature of the training men who are admitted to a course with the approval of both parties are expected to carry it through to completion unless prevented by exceptional circumstances. Also, the companies are expected to continue the course of practical training to completion for the students who have already enrolled, unless industrial conditions arise which minimize the educational value of the engineering practice.

At the conclusion of the course graduates are not obligated to accept employment with the coöperating company, nor is the company obligated to offer such employment.

A reading knowledge of German or French is required for the Master's degree as stated in detail under the Graduate School.

VII. BIOLOGY AND BIOLOGICAL ENGINEERING

THE curriculum in the Biological Sciences is devised to furnish fundamental training in pure and applied biology which may prepare students for careers in professional biology (teaching and research), for medical training, and for work involving the numerous technical applications, particularly in industries concerned with food and nutrition, biochemicals, and fermentation processes. The term Biological Engineering refers to the broad application of the exact scientific and engineering methods to biological problems, particularly in applied fields in the industries. However, stress is also laid on the application of quantitative, analytical methods in the subjects in pure biology, hence particular emphasis is given to those fields which, in the present stage of development, are susceptible of such treatment.

The first two years of both options are devoted to fundamental subjects in mathematics, physics, and chemistry plus introductory biology and studies in the humanities. Specialization begins in the third year and, to cover the ground mentioned above, two options are offered.

OPTION 1. QUANTITATIVE BIOLOGY. This option is designed primarily for students looking forward to careers in experimental biology and medicine. While insuring a sound background in the basic sciences of mathematics, physics and chemistry, and the fundamentals of modern biology, provision is made for a wide choice of electives both in the biological sciences and in the humanities. The option is, therefore, well suited, not only for students wishing to prepare for teaching and research posts in biology, but also for premedical students. Modern medicine is rapidly becoming less empirical and more scientific. It is important, therefore, particularly for those who wish to prepare for medical research, to become acquainted with the quantitative approach to biological phenomena. This option leads to the degree of Bachelor of Science in Quantitative Biology.

OPTION 2. FOOD TECHNOLOGY AND INDUSTRIAL BIOLOGY. The marked technological progress taking place in modern food industries has created a demand for men having thorough knowledge of the basic sciences pertaining to foods, combined with the ability to apply that knowledge in the technical processes of food production, manufacture, storage, and distribution. Increasing emphasis on quality control as it concerns food and food products in manufacture has necessitated the development of new chemical, physical, biological, and microscopic techniques, and the personnel to interpret the significance of such developments in commercial practice.

The undergraduate work in food technology leading to an S.B. degree is planned to provide students with a broad perspective in all the contributory sciences supplemented by the more specific technological aspects which especially concern the food industries, and fit the men for either the laboratory or production branches of such organizations.

This training is equally valuable for those desiring to enter the fermentation industries yielding glycerine, industrial alcohols, solvents, organic acids, or other commercial products of organic origin; the wood preservation industries and others which are concerned with the control of biological agents such as enzymes, and micro-organisms.

Substitutions may be made for certain of the outlined subjects at the discretion of the registration officer when students are intending to continue their studies for an advanced degree or have especial interests in contiguous fields.

The option leads to the degree of Bachelor of Science in Food Technology and Industrial Biology.

VII. OPTION 1. QUANTITATIVE BIOLOGY

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	5.11	Qualitative Analysis	7–2
	7.05	Biology I	8–2
	8.03	Physics	5–5
	F21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			29–20

* Class of 2-47 will take first term schedule during Spring Term 1945.

VII. Biology and Biological Engineering Continued

Second Term	5.12	Quantitative Analysis	7-2
	7.06	Biology II	8-2
	8.04	Physics	6-4
	E22T	U. S. in World History	3-5
	M22	Differential Equations	3-6
	MS22	Military Science	3-0
			30-19

Third Year (Class of 2-46)

First Term	5.41	Organic Chemistry I	4-3
	5.428	Organic Chemistry Lab	9-0
	5.61	Physical Chemistry I	4-4
	5.611	Physical Chemistry Lab. I	4-0
	7.11	Embryology	9-3
	7.14	Comparative Anatomy	9-3
			39-13
Second Term	5.62	Physical Chemistry II	4-4
	5.621	Physical Chemistry Lab. II	4-0
	7.19	Physiology, General	3-3
	7.21	Physiology Lab., Gen.	4-2
	7.31	Biology of Bacteria	7-3
	Ec11T	Economic Principles	3-3
		Language	3-5
			28-20

Fourth Year (Class of 6-45)

First Term	7.03	Genetics	2-4
	7.80	Biochemistry	8-5
	Ec12T	Industrial Economics	3-3
		Thesis	10
		General Study	2-2
		Language	3-5
			47
Second Term		Thesis	10
		Elective†	40
			50

† Not less than 20 units must be chosen from the following subjects:

7.12	Cytology, General	6-2
7.24	Nutrition, Advanced	7-2
7.321	Bacteriology, Advanced	3-4
7.44	Surface Chem. in Biology	6-2
7.81	Enzymology	6-3
7.82	Biochemistry, Advanced	6-3
7.86	Biophysics II	2-2
7.882	Biophysics Lab. II	4-1
7.93	Selected Topics in Biology	Time arr.

VII. Option 2. Food Technology and Industrial Biology

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	5.11	Qualitative Analysis	7-2
	7.05	Biology I	8-2
	8.03	Physics	5-5
	E21T	U. S. in World History	3-5
	M21	Calculus	3-6
	MS21	Military Science	3-0
			29-20
Second Term	5.12	Quantitative Analysis	7-2
	7.06	Biology II	8-2
	7.17	Biology of Food Supplies	3-2
	8.04	Physics	6-4
	E22T	U. S. in World History	3-5
	MS22	Military Science	3-0
		General Study	6
			51

* Class of 2-47 will take first term schedule during Spring Term 1945.

Third Year (Class of 2-46)

First Term	5.41	Organic Chemistry I	4-3
	5.428	Organic Chemistry Lab	9-0
	7.14	Comparative Anatomy	9-3
	7.301	Bacteriology	6-4
	7.701	Technology & Chem. Food Supplies	7-4
			35-14
Second Term	5.141	Analytical Chemistry	4-1
	7.19	Physiology, General	3-3
	7.21	Physiology Lab., General	4-2
	7.302	Bacteriology	6-3
	7.702	Tech. & Chem. Food Supplies	5-3
	10.663	App. Colloid Chem., Int.	2-4
	Ec11T	Economic Principles	3-3
		General Study	2-2
			29-21

Fourth Year (Class of 6-45)

First Term	2.60	Food Engineering	2-2
	7.361	Industrial Microbiology	5-2
	7.711	Technology Food Products	6-4
	7.80	Biochemistry	8-5
	10.31	Chemical Engineering	4-5
	Ec12T	Industrial Economics	3-3
			28-21
Second Term	2.601	Food Engineering	3-3
	7.22	Pers. Hygiene & Nutrition	2-2
	7.362	Industrial Microbiology	4-4
	7.52	Industrial Hygiene	5-3
	7.712	Technology Food Products	6-3
		Thesis	10
		General Study	2-2
			49

VII-A. PHYSICAL BIOLOGY

THE purpose of this course is to prepare students for work of a research character in experimental and applied biology. In the wide range from pure biology to the applications of Biological Engineering in the industries, attractive opportunities await those who have sound training both in biology and in the exact sciences. Graduates may continue their studies toward the doctorate or may expect to find employment in research laboratories and industries dealing with biochemicals, foods, drugs, medical supplies and instrumentation, textiles, leather, baking, canning, and related fields. It is not only efficient but pedagogically desirable for the student to obtain his training in the separate disciplines simultaneously rather than to study physics, chemistry, and mathematics either before or after specializing in biology. Course VII-A makes possible this combination. Subjects in physics and chemistry are taken in each of the first four years, together with substantially the same amount of work in biology, as is required in Course VII, Option 1. These aspects of physical biology are correlated in the Biophysics subjects in the graduate year. Electives in the fourth and fifth years permit the selection, subject to approval of the registration officer, of subjects having a bearing on specialized fields of pure or applied biology such as bacteriology, biochemistry, biophysics, general physiology, nutrition, food technology, industrial fermentations, economic entomology, and others. Training in research methods is provided through the solving of a thesis problem which may be selected in a field of pure or applied biology.

Because of the diversified technical courses of study prescribed in this curriculum each applicant for admission to Course VII-A should interview the registration officer

VII-A. Physical Biology Continued

for this course to determine if he is qualified to undertake the work.

Course VII-A leads to the degrees of Bachelor of Science in Quantitative Biology and Master of Science in Physical Biology.

VII-A. Physical Biology

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	5·11	Qualitative Analysis	7–2
	7·05	Biology I	8–2
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			29–20
Second Term	5·12	Quantitative Analysis	7–2
	7·06	Biology II	8–2
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			30–19

Third Year (Class of 2-46)

First Term	5·41	Organic Chemistry I	4–3
	5·428	Organic Chemistry Lab	9–0
	5·61	Physical Chemistry I	4–4
	5·611	Physical Chemistry Lab. I	4–0
	7·11	Embryology	9–3
	7·14	Comparative Anatomy	9–3
			39–13
Second Term	5·42	Organic Chemistry II	4–2
	5·62	Physical Chemistry II	4–4
	5·621	Physical Chemistry Lab. II	4–0
	7·19	Physiology, General	3–3
	7·21	Physiology Lab., General	4–2
	7·31	Biology of Bacteria	7–3
		Language	3–5
			29–19

Fourth Year (Class of 6-45)

First Term	7·03	Genetics	2–4
	7·80	Biochemistry	8–5
	7·81	Enzymology	6–3
	7·91	Biological Eng. I	6–3
	Ec11T	Economic Principles	3–3
		Language	3–5
			28–23
Second Term	5·426	Organic Compounds, Ident	5–0
	7·92	Biological Eng. II	6–3
	8·311	Atomic Structure	3–5
	8·312	Atomic Structure Lab	3–2
	Ec12T	Industrial Economics	3–3
		General Study	2–2
		Elective	12
			49

Graduate Year

First Term	7·85	Biophysics I	2–2
	7·881	Biophysics Lab. I	4–1
	10·661	Colloid Chemistry, Int	2–4
		Thesis	20
		Elective	13
			48
Second Term	7·86	Biophysics II	2–2
	7·882	Biophysics Lab. II	4–1
	10·662	Colloid Chemistry	2–4
		Thesis	20
		Elective	13
			48

* Class of 2-47 will take first term schedule during Spring Term 1945.

VIII. PHYSICS

PHYSICS in recent years has been one of the most rapidly developing sciences, and at the same time is the basic science for most branches of engineering. The Course in Physics, with its two options, is intended to be sufficiently broad to provide for the needs of those who desire to prepare for graduate work and research in pure physics, either experimental or theoretical, as well as for those who desire to go into work in industrial and applied physics. Students are given a sound fundamental training in the various branches of physics, as well as in mathematics, chemistry, and liberal subjects. Laboratory instruction is given in the more important phases of experimental physics, including modern physics, and training in theoretical physics is provided.

Option 1. General Physics. This option is for students preparing for a career of research and teaching of physics, often after pursuing graduate work. There is thorough training in the classical foundations of physics, but also much work in modern physics, atomic structure, and similar fields in which most of the recent progress of physics has been made. Mathematics and mathematical physics, as well as experimental physics of all types, are stressed. In the third and fourth years considerable elective work is included, some of which may be taken in other departments. Electives are to be chosen in consultation with the registration officer, who can give specific suggestions regarding them. A few types of electives follow:

Experimental or theoretical subjects in physics, such as optics, acoustics, electricity and electronics, X-rays, spectroscopy, and various topics in theoretical physics; mathematical subjects, such as mechanics, analysis, advanced calculus, higher algebra; chemical subjects, such as quantitative analysis, organic chemistry, and physical chemistry.

Option 2. Applied Physics. Physics is fundamental to engineering, and the techniques of physics are tools of great value in many branches of industry. For effective industrial work, however, physics, particularly in its more classical and experimental phases, should be supplemented with chemistry, metallurgy, and electrical engineering, all of which are essential in industrial laboratories. The option in applied physics includes thorough training in these fields, and graduates of the option should have the training needed for a wide variety of industrial openings, while being well prepared at the same time for further graduate study.

Electives are included in the fourth year, some of which may be taken outside the department in fields of scientific or engineering interest. In some cases, minor rearrangements and substitutions of required subjects and electives may be made to fit in with special programs of work. The registration officer should be consulted in regard to such rearrangements.

Both options of Course VIII lead to the degree of Bachelor of Science in Physics.

Option 1. General Physics
Option 2. Applied Physics

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	5·11	Qualitative Analysis	7–2
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
		Language	3–5
			24–23

* Class of 2-47 will take first term schedule during Spring Term 1945.

VIII. Physics Continued

Second Term	2·855	Machine Tool Laboratory	2–0
	6·00	Electrical Eng., Prin.	4–6
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
		Language	3–5
			24–26

Third Year (Class of 2-46)

First Term	6·11	Electrical Eng., Prin.	4–6
	6·82	Electrical Eng. Lab.	2–3
	8·061	Physics, Intermediate	3–4
	8·09	Physical Measurements	3–2
	8·161	Optics	3–6
	8·162	Optical Measurements	3–2
	Ec11T	Economic Principles	3–3
			21–26
Second Term	8·062	Physics, Intermediate	3–4
	8·202	Electronics Laboratory	3–2
	8·311	Atomic Structure	3–5
	8·312	Atomic Structure Lab.	3–2
	Ec12T	Industrial Economics	3–3
	M77	Vector Analysis	3–6
		Elective	9
			49

Fourth Year (Class of 6-45)

First Term	8·11	Experimental Physics	8–4
	8·461	Int. Theoretical Physics I	4–8
		General Study	2–2
		Thesis and Elective	20
			48
Second Term	8·462	Int. Theoretical Physics II	4–8
		General Study	2–2
		Thesis and Elective	32
			48

IX-A. GENERAL SCIENCE

(Administered by a Committee of the Faculty)

THE Course in General Science provides an opportunity for the study of all the fundamental sciences. It is designed to develop in the student a comprehensive sense of the orientation and coördination of science in general. Since one-third of the units required for graduation are elective, opportunity is also offered for specialization in that branch of science in which the student by contact and trial becomes most interested.

The Course occupies a position in the technical school similar to those courses in the university leading to the degree of bachelor of arts. In one case the student acquires a general knowledge of many of the sciences with considerable emphasis upon one. In the university the student graduates with a general knowledge of many of the liberal arts with some degree of specialization in one.

The choice of electives is subject to the approval of the Committee on Course IX and in all cases must follow a definite objective. Substitutions may be made for many of the subjects in the stated schedule if such substitutions afford better preparation for a particular objective. Fifteen units are assigned to the thesis, five in the first term and ten in the second, unless the subject demands an extension. The composite group of science subjects must comprise an amount of scientific training equivalent to that obtained in the standard science Courses.

The Course leads to the degree of Bachelor of Science in General Science.

IX-A. General Science

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	5·11	Qualitative Analysis	7–2
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
		Language‡	3–5
			24–23
Second Term	5·12	Quantitative Analysis	7–2
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
		Language	3–5
			25–22

Third Year (Class of 2-46)

First Term	2·501	Heat Measurements	2–1
	5·41	Organic Chemistry I	4–3
	7·05	Biology I	8–2
	12·011	Mineralogy	6–1
	12·321	Engineering Geology	5–2
	Ec11T	Economic Principles	3–3
		Elective†	6
			46
Second Term	5·418	Organic Preparations	6–0
	Ec12T	Industrial Economics	3–3
		Elective†	35
			47

Fourth Year (Class of 6-45)

First Term		Thesis and Elective†	50
Second Term		Thesis and Elective†	50

* Class of 2-47 will take first term schedule during Spring Term 1945.
†Electives must include a total of not less than 8 units of General Study; 16 units if language is omitted.
‡ Accepted as a General Study.

IX-B. GENERAL ENGINEERING

(Administered by a Committee of the Faculty)

THE Course in General Engineering contains a comprehensive survey of the applications of science to the primary branches of engineering. It is designed to develop in its graduates the ability to visualize and adjust the correlated problems encountered in all fields of engineering. Since nearly one-third of the units required for graduation are elective, opportunity is also provided for specialization in that branch of engineering in which the student by contact and trial becomes most interested.

Standard engineering courses cannot be expected to embrace all of the technical requirements of the industrial world. The demand for new courses in special fields of engineering will constantly arise and the educational opportunity is provided in this Course for their introduction and development.

IX-B. General Engineering Continued

The choice of electives is subject to the approval of the Committee on Course IX and in all cases must follow a definite engineering objective. Substitutions may be made for many of the subjects in the stated schedule if such substitutions afford better preparation for a particular objective. Fifteen units are assigned to the thesis, five in the first term and ten in the second, unless the subject demands an extension. The composite group of engineering subjects must also comprise an amount of professional engineering training equivalent to that obtained in the standard engineering curricula.

The Course leads to the degree of Bachelor of Science in General Engineering.

IX-B. General Engineering

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·00	Applied Mechanics	3–5
	2·701	Machine Drawing	6–0
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
		Elective†	6
			50
Second Term	1·02	Surveying	3–1
	2·01	Applied Mechanics	3–5
	2·854	Machine Tool Laboratory	3–0
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			24–21

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	2·40	Heat Engineering	4–5
	Ec11T	Economic Principles	3–3
		Elective†	24
			47
Second Term	1·401	Structures, Theory	3–5
	1·62	Hydraulics	4–6
	2·42	Heat Engineering	4–5
	6·40	Electrical Eng., Elem.	4–6
	Ec12T	Industrial Economics	3–3
		Elective†	6
			49

Fourth Year (Class of 6-45)

First Term	2·686	Engineering Laboratory	3–3
	6·85	Electrical Eng. Lab.	2–3
		Thesis and Elective†	37
			48
Second Term		Thesis and Elective†	48

* Class of 2-47 will take first term schedule during Spring Term 1945.
†Electives must include a total of not less than 16 units of General Study.

X. CHEMICAL ENGINEERING

THE needs of chemical industry for men competent to develop, design and operate new processes and to improve existing ones require a training which combines knowledge both of the underlying chemical reactions and of the engineering principles basic to design, construction and operation of plant equipment. The Course in Chemical Engineering is planned to afford students broad training in the fundamentals of science, chemistry and engineering.

The work in chemistry, covering inorganic, analytical, physical and organic chemistry, is practically the same as that given to students in chemistry during the first three years, except for some reduction in laboratory requirements. The subjects in mechanical and electrical engineering are intended to supply the fundamentals which are needed by the chemical engineer and the instruction is adapted to his requirements. The work in chemical engineering and in industrial chemistry is of a distinctly professional nature and is designed to develop capacity for original thought. Competent students may make substitutions in the curriculum with approval of the Head of the Department.

A graduate year of the Course, in Chemical Engineering or in Chemical Engineering Practice, provides opportunity for the development, correlation and application of the basic professional subjects.

The Course leads to the degree of Bachelor of Science in Chemical Engineering.

X. Chemical Engineering

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	5·10	Qualitative Analysis	14–4
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			28–20
Second Term	5·12	Quantitative Analysis	7–2
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
		General Study	2–2
		Language	3–5
			27–24

Students will take two terms of Language as outlined below except that those credited with Intermediate German and Elementary French may substitute other studies (including at least four units of General Study):

Students not credited with German will take Elementary German. Students credited with German but not with French will take Elementary French. Students credited with Elementary German and French but not with Intermediate German will take Intermediate German.

Third Year (Class of 2-46)

First Term	5·41	Organic Chemistry I	4–3
	5·416	Organic Preparations	7–0
	5·61	Physical Chemistry I	4–4
	5·612	Physical Chem. Lab. I	2–0
	10·28	Chemical Engineering	4–6
	Ec11T	Economic Principles	3–3
		Language	3–5
			27–21
Second Term	2·011	Applied Mechanics	3–5
	5·42	Organic Chemistry II	4–2
	5·426	Organic Compounds, Ident.	5–0
	5·62	Physical Chemistry II	4–4
	5·622	Physical Chem. Lab. II	2–0
	10·17	Industrial Chemistry	3–2
	10·29	Chemical Engineering	4–5
	Ec12T	Industrial Economics	3–3
			28–21

* Class of 2-47 will take first term schedule during Spring Term 1945.

X. *Chemical Engineering Continued*

Fourth Year (Class of 6-45)

First Term	2·042	Applied Mechanics	3–5
	6·40	Electrical Eng., Elem.	4–6
	6·85	Electrical Eng. Lab.	2–3
	10·18	Industrial Chemistry	4–6
	10·26	Industrial Chemical Lab.	5–1
	10·31	Chemical Engineering	4–5
		Thesis	2
			50
Second Term	2·371	Testing Materials Lab.	2–1
	2·688	Engineering Laboratory	3–3
	10·15	Thesis Reports	2–2
	10·21	Industrial Chemistry	2–2
	10·32	Chemical Engineering	4–5
		Thesis and Prof. Elective	22
			48

The time devoted to Electives must be not less than 8 units and not more than 12 units, the time adjustment being made with the hours assigned to thesis.

X-B. CHEMICAL ENGINEERING PRACTICE

(Temporarily Discontinued)

THE privileges of the School of Chemical Engineering Practice are available for a selected group of undergraduates during the second half of the senior year. Students desiring to take this Course should register in the first term of the fourth year and those accepted will spend the second term at the Field Stations of the School of Chemical Engineering Practice, on the program given below. The nature of the work in the School of Chemical Engineering Practice is described under the section on Chemical Engineering in The Graduate School.

The Course leads to the degree of Bachelor of Science in Chemical Engineering Practice.

XII. GEOLOGY

Due to curtailment of civilian enrollment and the absence of several members of the staff on duties connected with the war effort, instruction in geology will be curtailed temporarily. Undergraduate students who wish to study geology under these conditions may pursue directed reading under the guidance of the resident staff and those prepared to do so may carry on laboratory or field research under staff direction, enrolling in 12·66. Certain undergraduate subjects required by the courses in Civil Engineering and Metallurgy will be continued. For typical Course XII schedule, see Catalogue, June 1942, Volume 77, No. 4, or Summer Session 1942, Volume 77, No. 3.

TWO optional Courses of study are offered in this Department.

OPTION 1. GEOLOGY. This is planned for students who wish to make geology in its theoretical and practical aspects their principal subject of study. An adequate foundation of subjects in physics, chemistry and mathematics is followed by the foundational subjects in geology (general geology and mineralogy), which in turn are followed by more advanced and specialized subjects of the Department.

The option is designed for students seeking a broad general preparation, as well as for those planning to follow one of the several lines of specialization in the field of geology. The schedule of this option is sufficiently flexible to permit an adequate range of specialization by means of substitution of equivalent subjects for those designated, and through the use of electives. Students whose interests and aptitudes have led to a choice of specialization may upon consultation with their major professor arrange a schedule of subjects designed to attain the type of instruction and training desired. The principal lines of specialization are:

General Geology and Stratigraphy. A broad training in general geology, with emphasis on paleontology, stratigraphy, sedimentation, and allied subjects. This line of training gives suitable preparation for academic and professional work in general geology and its applications to coal, petroleum, and natural gas.

Physical and Economic Geology. This line of special interest leads to the application of physics and chemistry to fundamental research in geology, and is intended for those who plan to enter the field of geology as applied to ore deposits and non-metallic resources.

Mineralogy. Students desiring to prepare themselves for specialization and research in the science of mineralogy may arrange a schedule of subjects particularly designed for this purpose.

Geophysics. In recognition of the growing importance of fundamental research in geophysics and of the demand by petroleum and mineral industries, as well as by certain phases of engineering operations, for men trained along the combined lines of physics and geology, this Department is staffed and equipped to provide sound fundamental training in geology and geophysics. The training designed for this objective places special emphasis on physics, mathematics and certain phases of electrical engineering.

Engineering Geology. For students wishing to enter the field of engineering geology a suitable combination of subjects may be chosen from geology and civil engineering.

OPTION 2. MINERAL RESOURCES. Planned to afford a suitable schedule of subjects for students desiring to prepare for professional work in the mineral industries. This schedule of subjects provides a thorough preparation in the fundamentals of mathematics, physics, chemistry, and geology, with emphasis on the economic aspects of mineral resources. The course is made sufficiently flexible, particularly in the last year, for such specialization as the individual student may desire.

Both options of Course XII lead to the degree of Bachelor of Science in Geology.

XIII. NAVAL ARCHITECTURE AND MARINE ENGINEERING

THE Course in Naval Architecture and Marine Engineering is designed to provide the technical training for those who desire to become designers or builders of ships, their machinery and equipment, or to pursue work in allied industries. The first two years are devoted principally to providing a sound engineering foundation on which a successful professional career in the marine field can be based. This work includes the fundamental sciences, mathematics, physics and chemistry, applied mechanics, English, mechanical drawing and shop work. The professional training begins with the second term of the second year. During this term the student is given a broad descriptive course covering the entire field of ship design and construction, first of all to enable him to determine definitely if this is the field of endeavor in which he prefers to work, and secondly, to give him an understanding of the inter-relation of the various professional subjects which are given during the last two years of the course.

Instruction in naval architecture and in marine engineering is given simultaneously until the last term when opportunity for specialization is afforded in the choice of electives. In an undergraduate course of this nature, it is felt that there should not be much specialization because the proper coördination of the design of a ship and the propelling machinery can only be attained when the hull

XIII. Naval Architecture and Marine Engineering Continued

designer has a thorough familiarity with machinery and the engine designer has a similar grasp of the hull problems involved.

The work in hull design begins with theoretical naval architecture and ship design in the third year, and carries through the first term of the fourth year. Machinery design follows heat engineering and continues throughout the remainder of the course. The work in hull design includes buoyancy, stability, seaworthiness, propulsion, arrangements, equipment and structural design. Marine engineering includes the design of steam and internal combustion engines, machinery arrangements and the auxiliary machinery used in marine power plants. The work in the drawing room, which is coördinated with that in the classroom, involves the preparation of calculations and plans involved in the design of a hull and its propelling machinery.

The course leads to the degree of Bachelor of Science in Naval Architecture and Marine Engineering.

XIII. Naval Architecture and Marine Engineering

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·00	Applied Mechanics	3–5
	2·851	Machine Tool Lab.	4–0
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
		General Study	6
			48
Second Term	2·01	Applied Mechanics	3–5
	2·852	Machine Tool Practice	4–0
	8·04	Physics	6–4
	13·40	Ship Construction, Elem.	5–2
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			27–22

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	2·251	Fluid Mechanics	5–3
	2·40	Heat Engineering	4–5
	13·01	Naval Architecture	3–5
	13·34	Ship Design	3–3
	13·41	Naval Arch. Drawing	4–0
	Ec11T	Economic Principles	3–3
			25–24
Second Term	2·06	Applied Mechanics	3–5
	2·42	Heat Engineering	4–5
	2·683	Engineering Laboratory	2–2
	13·02	Naval Architecture	3–5
	13·43	Ship Design	7–0
	13·52	Marine Engineering	4–4
	Ec12T	Industrial Economics	3–3
			26–24

Fourth Year (Class of 6-45)

First Term	2·371	Testing Materials Lab.	2–1
	2·684	Engineering Laboratory	2–2
	6·40	Electrical Eng., Elem.	4–6
	13·45	Ship Design	10–1
	13·54	Marine Engineering	2–3
	13·61	Marine Engineering Design	6–1
		General Study	2–2
		Elective	6
			50
Second Term	2·311	Engineering Materials	5–4
	6·89	Electrical Eng. Lab.	2–2
	13·55	Marine Engineering	2–3
	13·62	Marine Engineering Design	6–1
		General Study	6
		Thesis and Elective	16
			47

* Class of 2-47 will take first term schedule during Spring Term 1945.

XIII-C. MARINE TRANSPORTATION

For the duration of the war students in the Course in Marine Transportation will omit the sea service described below and will therefore complete the requirements for the degree in four years.

(Will not be given unless a sufficient number of students apply)

THIS five-year Course is intended for students who wish to enter the various branches of the shipping industry, or who wish to engage in other fields of marine transportation or allied pursuits, such as marine insurance, admiralty law, and port administration. The Course is a combination of science, engineering, economics, business studies and naval architecture.

It is essential that a student have a certain amount of actual experience aboard ships at sea in order to grasp thoroughly the problems of ship operation before finishing his course of study. It is also deemed necessary that sea experience be obtained before engaging in the various shore activities of a steamship company. For these reasons students in the Course are required to spend a year at sea as part of the requirements for graduation.

A number of American steamship companies coöperate, as far as their facilities will allow, in placing the students at sea as cadets or student observers following the completion of the third year at the Institute. Part of the time at sea ordinarily is spent in the engine room and part on deck. In some cases, it also includes duty in the purser's department. Three months may be spent on the piers in connection with cargo handling.

While at sea the students are assigned regular duties in connection with the operation of the ship for which they receive a moderate amount of pay. The year at sea is considered an integral part of the student's educational program and he is required to make reports on assigned topics in addition to his regular duties on shipboard. Students entering the Institute with the required sea experience can finish the Course in four years by completing certain specified work.

The studies at the Institute are arranged to coördinate with the year at sea. In the second and third year, subjects are given in heat engineering, marine engineering, port facilities and cargo transfer, naval architecture and a foreign language to give the student the proper preparation for the year at sea. During the fifth year the student takes advanced professional studies and approaches these with his practical knowledge gained at sea. Electives are also offered in the fifth year to allow the student to specialize in some phase of marine transportation.

As a thorough knowledge of a ship's power plant is essential to the ship operator who must have a large share in its selection and economic operation, marine engineering is given a prominent place in the Course.

As the handling of ships' cargoes is one of the largest items of expense in connection with ship operation, and also influences the ship's stay in port, special attention is given to this phase of ship management.

The Course leads to the degree of Bachelor of Science in Marine Transportation.

XIII-C. Marine Transportation Continued

XIII-C. Marine Transportation

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·00	Applied Mechanics	3–5
	2·854	Machine Tool Lab.	3–0
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
		Language	3–5
			23–26
Second Term	2·01	Applied Mechanics	3–5
	8·04	Physics	6–4
	15·52	Accounting	4–2
	E22T	U. S. in World History	3–5
	G28	Economic Geography	2–4
	MS22	Military Science	3–0
		Language	3–5
			24–25

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	2·40	Heat Engineering	4–5
	13·01	Naval Architecture	3–5
	13·34	Ship Design	3–3
	13·41	Naval Arch. Drawing	4–0
	Ec11T	Economic Principles	3–3
		Elective	6
			47
Second Term	2·42	Heat Engineering	4–5
	2·685	Engineering Laboratory	4–4
	13·021	Naval Architecture	2–3
	13·52	Marine Engineering	4–4
	13·83	Port Facilities and Cargo Transfer	4–4
	Ec12T	Industrial Economics	3–3
		General Study	2–2
			23–25

Fourth Year (Class of 6-45)

First Term	1·63	Hydraulics	2–3
	6·40	Electrical Eng., Elem.	4–6
	6·89	Electrical Eng. Lab.	2–2
	13·81	Ship Operation	3–6
	15·61	Law of Contracts	3–6
	Ec63	Labor Relations	3–5
		General Study	6
			51
Second Term	13·43	Ship Design	7–0
	13·56	Marine Engineering	3–3
	13·82	Ship Operation	3–6
	Ec54	Corporations	3–3
		Thesis and Elective	18
			46

* Class of 2-47 will take first term schedule during Spring Term 1945.

XIV. METEOROLOGY

THE Faculty has recently approved the offering of an undergraduate four year program in the field of Meteorology leading to the degree of Bachelor of Science in Meteorology. The first year schedule is the same as for all courses and is effective for the class entering in July 1944. The second year schedule will be in effect in March 1945 and the schedules for the third and fourth years will be effective later for the class graduating on the accelerated schedule in February 1947. The full curriculum in Meteorology will be published in the next issue of the catalogue.

(See page 36 for First Year)

Second Year (Class of 2-47)*

First Term	2·00	Applied Mechanics	3–5
	2·851	Machine Tool Lab.	4–0
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	L11	German, Elementary	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			24–26
Second Term	2·01	Applied Mechanics	3–5
	8·04	Physics	6–4
	E22T	U. S. in World History	3–5
	L12	German, Elementary	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			21–25

*Class of 2-47 will take first term schedule during Spring Term 1945. The second term schedule will not be in effect until July 1945.

XV. BUSINESS AND ENGINEERING ADMINISTRATION

THE Course in Business and Engineering Administration provides a special curriculum for men who combine an initial aptitude for engineering with a potential capacity for subsequent managerial responsibilities. It was first established in the conviction that fundamental training in science and engineering inculcates habits of precise thinking which are of value in the study and the practice of business administration. To an ever-increasing extent business is now being based on engineering, science, and the humanities. The successful business man today must coördinate engineering, practical economics, and fundamental personnel relationships.

Students enrolled in Course XV take in their first two years essentially the same basic scientific subjects as do students in the purely engineering Courses. In the third and fourth years, the arrangement of studies provides time for a series of special subjects which deal with the functions of business and economic organization as they bear upon the interests of the stockholder, the employee, the market, the community, the general public and the government. The program of required business subjects is the same for all students; at the beginning of the second year there is a choice between two options, depending upon whether the student desires to base his technical work on the physical or the chemical sciences.

First Option

In Option 1, in which the engineering subjects are based on the physical sciences, the student is offered some latitude as to the particular type of engineering which he desires to study. This flexibility is accomplished by the provision of a number of elective hours in the fourth year and, where necessary to a well coördinated program, by a limited amount of substitution in the third year. For example, some students in Option 1 have arranged to take a substantial amount of work in the field of textiles and in the field of aeronautics.

Second Option

In Option 2, in which the engineering subjects are based on the chemical sciences, the complete series of subjects is prescribed, as all of them are essential to any subsequent program of specialization. Following the preliminary study of physics, chemistry, and mathematics required in the first year, the student electing the Chemical Option undertakes a dependent sequence of technical subjects which begins the coördinated three-year program.

XV. Business and Engineering Administration Continued

Business and Engineering Subjects:

The program of business and economic subjects offered in the undergraduate course covers external as well as internal aspects of management. It aims to encourage an enlightened attitude toward business problems as they relate to economic, sociological, and political trends. Thus it stresses the responsibilities of business to the consumer (in marketing), to the employee (in labor relations), to the investor (in finance), and to other business men (in business law). Although current techniques are discussed, there is no attempt to create narrow trade skills.

First, the student is introduced through the subject of Production to the nature of modern factory operations. Immediately thereafter, he considers the subject of personnel or labor relations. He then undertakes the study of economics, in which he learns the nature of the forces which underlie business phenomena. In his third year he begins his study of business relationships, with marketing and the law of contracts. He also becomes familiar with accounting, and its application to analysis and control. In his last year he studies the more involved relationships in finance as well as the applications of the statistical method. Finally, after the various individual business functions have been studied, a term subject, Industrial problems, serves to provide a coördinated view of business as a whole.

In addition to this basic program, the student is permitted in his fourth year to elect somewhat more advanced work in one or two functional areas, according to his own interests or aptitudes. The thesis, which is undertaken during the last term in residence, is usually chosen within the field of this partial specialization. In the thesis the student demonstrates his capacity to carry through an individual piece of work on his own initiative.

Both options of the Course lead to the degree of Bachelor of Science in Business and Engineering Administration.

For men interested in shipping administration, ship management and other branches of marine transportation the Institute offers a course in Marine Transportation (XIII-C).

Second Term	2·311	Engineering Materials	5–4
	2·41	Heat Engineering	4–6
	6·19	Electrical Eng., Fund.	4–6
	15·81	Marketing	3–6
	Ec12T	Industrial Economics	3–3
	E35	Reports	2–4
			21–29

Fourth Year (Class of 6-45)

First Term	1·63	Hydraulics	2–3
	15·41	Finance	3–6
	Ec63	Labor Relations	3–5
		General Study	6
		Business or Economic Elective	9
		Engineering Elective	13
			50
Second Term	15·92	Industrial Problems	2–6
		Thesis	10
		General Study	2–2
		Business or Economic Elective	18
		Engineering Elective	8
			48

Business and Economic Electives

15·42	Financial Problems	3–6
15·51	Industrial Accounting	5–4
15·62	Law of the Market	3–6
15·63	Industrial Law	3–6
‡15·64	Law of Business Organization	3–6
15·71	Production	3–6
15·72	Technique of Executive Control	3–6
15·73	Management Laboratory	6–3
‡15·76	Mass Production Methods	3–3
15·82	Sales Management	3–6
‡15·83	Marketing Research	3–6
Ec38	Industrial Statistics	3–6
Ec39	Statistical Inference	2–6
‡Ec49	Public Finance	2–5
‡Ec56	Industrial Economics, Problems	3–6
Ec61	Industrial Relations	3–5
‡Ec72	American Government	3–6

‡ Not offered November 1944–June 1945.

XV. Option 1

(Engineering — Based on Physical Sciences)

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·00	Applied Mechanics	3–5
	2·851	Machine Tool Lab.	4–0
	8·03	Physics	5–5
	15·70	Production	3–6
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			24–27
Second Term	2·01	Applied Mechanics	3–5
	8·04	Physics	6–4
	15·30	Personnel Management	3–6
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			21–26

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	6·40	Electrical Eng., Elem.	4–6
	15·50	Accounting	5–4
	15·61	Law of Contracts	3–6
	Ec11T	Economic Principles	3–3
		General Study	6
			48

* Class of 2-47 will take first term schedule during Spring Term 1945.

XV. Option 2

(Engineering — Based on Chemical Sciences)

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	5·11	Qualitative Analysis	7–2
	8·03	Physics	5–5
	15·70	Production	3–6
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			24–24
Second Term	5·12	Quantitative Analysis	7–2
	8·04	Physics	6–4
	15·30	Personnel Management	3–6
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			25–23

Third Year (Class of 2-46)

First Term	5·41	Organic Chemistry I	4–3
	5·61	Physical Chemistry I	4–4
	10·28	Chemical Engineering	4–6
	15·61	Law of Contracts	3–6
	15·81	Marketing	3–6
	Ec11T	Economic Principles	3–3
			21–28

* Class of 2-47 will take first term schedule during Spring Term 1945.

Second Term	5·62	Physical Chemistry II	4–4
	10·17	Industrial Chemistry	3–2
	10·29	Chemical Engineering	4–5
	15·50	Accounting	5–4
	Ec12T	Industrial Economics	3–3
	E35	Reports	2–4
		General Study	2–2
			23–24

Fourth Year (Class of 6-45)

First Term	6·40	Electrical Eng., Elem	4–6
	10·18	Industrial Chemistry	4–6
	10·31	Chemical Engineering	4–5
	15·41	Finance	3–6
	Ec63	Labor Relations	3–5
		General Study	6
			52
Second Term	10·21	Industrial Chemistry	2–2
	10·32	Chemical Engineering	4–5
	15·92	Industrial Problems	2–6
		Thesis	10
		Business or Economic Elective	18
			49

XVI. AERONAUTICAL ENGINEERING

THE primary objective of the Course in Aeronautical Engineering is to provide a sound general training in subjects fundamental to the practice of engineering, and then to familiarize the student with the general principles of flight and with some of the detail of design and construction as applied to the airplane. To this end, the greater part of the first three years of study is devoted to fundamental subjects, most of the strictly professional work being deferred until the fourth year. During the Course, lectures and recitations are supplemented by laboratory and drafting room work.

In general, the professional subjects are directed particularly toward airplane design, but in order that the student may gain some knowledge of other branches of aeronautical activity, he is allowed to elect in the fourth year certain subjects in a related professional field, such as internal combustion engines or meteorology.

The students' Aeronautical Engineering Society, affiliated with the Institute of Aeronautical Sciences, serves to bring its members in touch with professional developments through the National Society and its Journal.

On account of the large number of students who wish to take the Course in Aeronautical Engineering, and on account of limited facilities, it has been found necessary to limit the number admitted to the Course. Applications will be received during the second term of the first year, and notifications of admission or refusal will be issued shortly after the end of the second term of the Freshman year. Toward the end of the second year, a limited number of additional applications will be considered.

The professional work of the fourth year presupposes preparation in theoretical and applied aerodynamics and structures (16·01, 16·02, and 16·10 and 16·20).

The Course leads to the degree of Bachelor of Science in Aeronautical Engineering.

Honors Course

(Admission to the Honors Course is closed for the duration of the war.)

The opportunity will be afforded a limited number of students of superior ability to join an Honors Course group. The selection of members of this group will be made by the Department from students who may wish to avail themselves of the opportunity to pursue a coördinated schedule of studies through the senior and graduate years. A single thesis with a minimum of 30 units will be required in the graduate year and the time allotted to thesis in the senior year will be available for advanced mathematics or other subjects preparatory to the program of graduate studies. A member of the Department will serve as adviser to aid members of the group in selecting the senior and graduate schedules which may be best suited to their individual interests.

The Honors Course leads to the degrees of Bachelor of Science and Master of Science in Aeronautical Engineering, awarded simultaneously at the end of the Graduate year.

Economics and Engineering Course

The five-year course leading to the degree of Master of Science in Economics and Engineering together with the degree of Bachelor of Science in Aeronautical Engineering is described under the Graduate School. This course is open to Juniors in Aeronautical Engineering.

XVI. Aeronautical Engineering

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·00	Applied Mechanics	3–5
	2·311	Engineering Materials	5–4
	8·03	Physics	5–5
	E21T	U. S. in World History	3–5
	M21	Calculus	3–6
	MS21	Military Science	3–0
			22–25
Second Term	2·01	Applied Mechanics	3–5
	2·730	Machine Design	4–2
	2·853	Machine Tool Lab	4–0
	8·04	Physics	6–4
	16·82	Aeronautics	3–1
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			29–23

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	2·40	Heat Engineering	4–5
	2·701	Machine Drawing	6–0
	6·40	Electrical Eng., Elem	4–6
	16·01	Aeronautical Mechanics, Int	6–6
		General Study	2–2
			25–24
Second Term	2·37	Testing Materials Lab	4–2
	2·42	Heat Engineering	4–5
	6·89	Electrical Eng. Lab	2–2
	16·02	Aeronautical Mechanics, Int	6–4
	16·10	Aerodynamics, Applied	3–3
	16·20	Structures	3–5
	Ec11T	Economic Principles	3–3
			25–24

Fourth Year (Class of 6-45)

First Term	2·686	Engineering Laboratory	3–3
	16·11	Airplane Performance	3–3
	16·13	Airplane Stability and Control	4–6
	16·17	Airplane Design Practice	8–0
	16·21	Structures	3–5
	16·62	Aeronautical Laboratory	4–3
		General Study	6
			51
Second Term	16·22	Aircraft Structures	3–5
	16·75	Const. Details Aircraft	7–2
	Ec12T	Industrial Economics	3–3
		General Study	6
		Thesis† and Elective	18
			47

* Class of 2-47 will take first term schedule during Spring Term 1945.
† Thesis not less than 10 units.

XVII. BUILDING ENGINEERING AND CONSTRUCTION

THE objective of the Course in Building Engineering and Construction is to provide sound basic training in the engineering design and construction of buildings. It aims to develop in the student a sound conception of the related problems of the owner, the architect, the engineer, the builder and the materials manufacturer and distributor in the process of planning and erecting buildings, to the end that he may become either a principal or a responsible manager in any of the many varied fields of this great industry.

Slightly more than half of the entire Course is devoted to fundamental and applied science. The strictly professional work is provided in a progressive sequence of correlated subjects in engineering, construction, materials and the economic aspects of the industry.

At the beginning of the third year, the student may choose between two Options, depending upon whether he desires to base his training upon the technical work involved in Heavy Construction or upon the technical and marketing aspects of the field of Light Construction.

Option 1. Heavy Construction

Under this Option, the student is offered professional courses which train him in the structural design, construction and supervision of semi-fireproof and fireproof buildings of so-called heavy construction. Professional subjects in the third and fourth years provide the student opportunity for further specialization in structural design, materials, or construction practice.

Option 2. Light Construction

(Students desiring this option should apply to the Head of the Department)

This Option offers professional training in the planning, engineering, construction, management and marketing of structures and facilities required for housing or shelter. Not only the physical, but the legal and economic aspects of housing construction and engineering are emphasized. Summer coöperative employment is arranged so that the student may obtain intimate first-hand acquaintance with the construction and business problems of the field.

Both Options lead to the degree of Bachelor of Science in Building Engineering and Construction.

XVII. Building Engineering and Construction
Options 1 and 2

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	2·00	Applied Mechanics	3–5
	8·03	Physics	5–5
	17·70	Materials	3–3
	E21T	U. S. in World History	3–5
	G45	Hist. Aspects of Architecture	3–3
	M21	Calculus	3–6
	MS21	Military Science	3–0
			23–27
Second Term	2·01	Applied Mechanics	3–5
	4·78	Planning Principles	3–1
	8·04	Physics	6–4
	17·22	Building Construction	6–2
	E22T	U. S. in World History	3–5
	M22	Differential Equations	3–6
	MS22	Military Science	3–0
			27–23

* Class of 2-47 will take first term schedule during Spring Term 1945.

Option 1. Heavy Construction

Third Year (Class of 2-46)

First Term	2·04	Applied Mechanics	3–5
	2·373	Testing Materials Lab.	5–2
	6·40	Electrical Eng., Elem.	4–6
	6·89	Electrical Eng. Lab.	2–2
	17·31	Building Construction	6–2
	17·71	Materials	3–2
	Ec11T	Economic Principles	3–3
			26–22
Second Term	1·401	Structures, Theory	3–5
	15·52	Accounting	4–2
	17·32	Building Construction	6–2
	17·52	Structural Problems	7–3
	17·72	Materials	3–2
	Ec12T	Industrial Economics	3–3
		General Study	6
			49

Fourth Year (Class of 6-45)

First Term	1·41	Structures, Theory	3–6
	1·481	Soil Mechanics	4–2
	1·63	Hydraulics	2–3
	2·41	Heat Engineering	4–6
	17·53	Structural Design	7–3
	17·73	Materials	3–2
		General Study	2–2
			25–24
Second Term	1·42	Structures, Theory	3–6
	1·482	Foundations & Embankments	3–4
	2·66	Heat., Vent. & Air Cond.	3–5
	17·40	Estim. & Job Manage.	5–1
	17·54	Structural Design	7–3
		Thesis	10
			50

XVIII. MATHEMATICS

THE Institute offers exceptional opportunities for the study of mathematics, either in its theoretical aspects or as applied to scientific and engineering work.

The Course outlined is for students who desire to study more mathematics than is contained in the professional courses. It is well adapted to serve as a preparation for specializing in pure mathematics, in mathematical physics, or in engineering fields requiring proficiency in pure mathematics. The course also offers excellent opportunities for students who wish to major in mathematical statistics, applied statistics or actuarial work.

Any student who has completed satisfactorily the work of the first two years in any of the professional courses in the Institute or their equivalent, provided always that a creditable record has been obtained in mathematics and physics, may be admitted to the third year in this Course.

Option 1. Pure Mathematics

Option 1 is primarily a preparation for a career of research and teaching. Students planning to take this option are required to take subjects related to pure mathematics to fulfill the elective requirement.

Option 2. Applied Mathematics

Option 2 is intended for students possessing mathematical aptitude but interested in technical applications of mathematics rather than in research in pure mathematics. Students planning to take this Option are required to take subjects in applied mathematics and engineering to fulfill the elective requirement.

Option 3. Industrial Statistics

Option 3 is adapted to those preparing for industrial work where the statistical interpretation of data is impor-

XVIII. Mathematics Continued

tant, or for the actuarial profession. Students planning to take this Option are required to take subjects in mathematics and engineering related to statistics to fulfill the elective requirements.

All options lead to the degree of Bachelor of Science in Mathematics.

Option 1. Pure Mathematics
Option 2. Applied Mathematics
Option 3. Industrial Statistics

(See page 36 for First Year)

Second Year (Classes of 10-46, 2-47)*

First Term	8.03	Physics	5-5
	E21T	U. S. in World History	3-5
	M21	Calculus	3-6
	M23	Algebra	3-6
	MS21	Military Science	3-0
		Elective†	8
			47
Second Term	8.04	Physics	6-4
	E22T	U. S. in World History	3-5
	M22	Differential Equations	3-6
	MS22	Military Science	3-0
		Elective†	18
			48

Third Year (Class of 2-46)

First Term	Ec11T	Economic Principles	3-3
		Elective†	40
			46
Second Term	Ec12T	Industrial Economics	3-3
		Elective†	40
			46

Fourth Year (Class of 6-45)

First Term	Thesis and Elective†	48
Second Term	Thesis and Elective†	48

* Class of 2-47 will take first term schedule during Spring Term 1945.
†Electives must include a total of not less than 16 units of General Study or one year of Language plus 8 units of General Study.

RESERVE OFFICERS' TRAINING CORPS

THE general object of the Reserve Officers' Training Corps is to qualify students for positions of leadership in time of national emergency. Since the senior division of the R. O. T. C. has been discontinued for the duration by the War Department, instruction is limited to the Basic Course, consisting of two academic years, and is required of all courses.

Basic Course

All physically fit male students who are citizens of the United States, under twenty-six years of age and who enter the Institute as first-year students, are required to complete satisfactorily the entire basic course, unless exempted therefrom on conscientious grounds as approved by the Faculty. Similarly qualified students who enter in the second year are required to complete the second year of the basic course unless exempted therefrom on conscientious grounds as approved by the Faculty. Students who have received instruction in the R. O. T. C. at another institution under an officer of the Regular Army will receive credit therefor upon presentation of suitable evidence to the Professor of Military Science and Tactics.

For instruction in the first year of the basic course, the students are organized as an infantry regiment. Cadet officers and non-commissioned officers are selected from first-year students who demonstrate especial aptitude for military instruction.

The instruction in the second year of the basic course includes drill. The students are organized as an infantry regiment. Cadet officers and non-commissioned officers are selected from those second year students who best demonstrated leadership in the previous year.

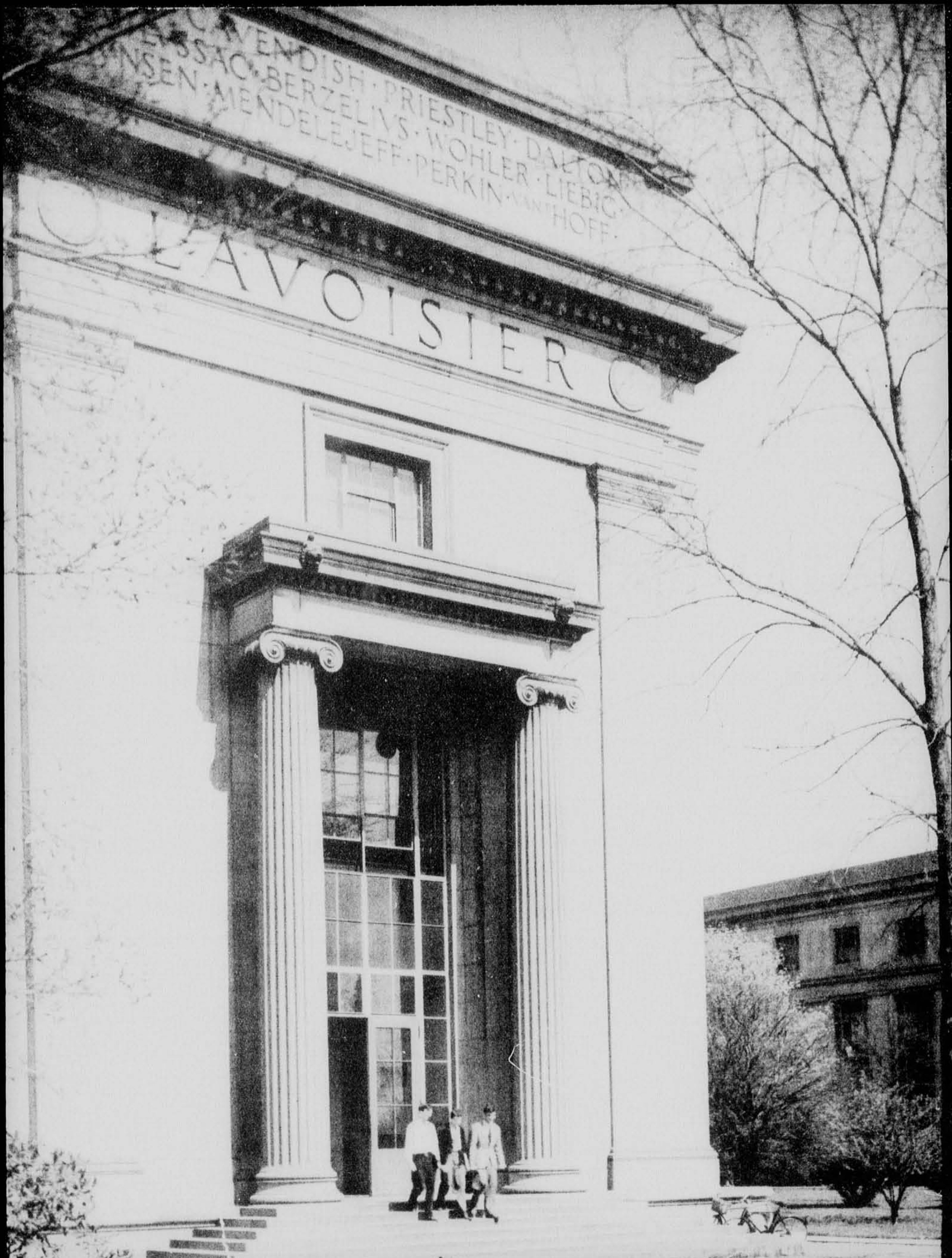
The instruction in the basic course is branch immaterial and is based upon the Military Program prescribed for the Army Specialized Training Program.

First Year

First Term	MS11	Infantry drill, physical drill, and elementary military subjects	3-0
Second Term	MS12	Infantry drill, rifle marksmanship, and elementary military subjects	3-0

Second Year

First Term	MS21	Field and class instruction in military fundamentals	3-0
Second Term	MS22	Map reading and elementary military subjects	3-0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LAVOISIER

THE GRADUATE SCHOOL

ADMINISTRATION OF THE GRADUATE SCHOOL

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DEAN OF THE GRADUATE SCHOOL,* JOHN W. M. BUNKER, PH.D.

COMMITTEE ON THE GRADUATE SCHOOL

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B. A. THRESHER, S.B., A.M., *Director of Admissions, Secretary*

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Associate Professor of Architectural Design

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Professor of Industrial Relations

M. J. BUERGER, PH.D.
Professor of Mineralogy and Crystallography

W. M. FIFE, S.M.
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Professor of Accounting

M. F. GARDNER, S.M.
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Associate Professor of Physiology

J. C. SLATER, PH.D.
Professor of Physics

R. H. SMITH, PH.D.
Professor of Aeronautical Engineering

G. W. SWETT, S.B.
Professor of Machine Design

R. S. WILLIAMS, PH.D.
Professor of Physical Metallurgy

CHAIRMEN† OF DEPARTMENT COMMITTEES ON GRADUATE STUDENTS

Aeronautical Engineering	R. H. SMITH
Architecture	L. B. ANDERSON
Biology and Biological Engineering	I. W. SIZER
Business and Engineering Administration	W. P. FISKE
Chemical Engineering	T. K. SHERWOOD
Chemistry	E. H. HUNTRESS
Civil and Sanitary Engineering	W. M. FIFE
Economics and Social Science	R. E. FREEMAN
Electrical Engineering	H. L. HAZEN
Geology	W. J. MEAD
Mathematics	H. B. PHILLIPS
Mechanical Engineering	G. W. SWETT
Metallurgy	J. T. NORTON
Meteorology	H. C. WILLETT
Naval Architecture and Marine Engineering	H. H. W. KEITH
Physics	J. C. SLATER

* Correspondence regarding work of the Graduate School and graduate scholarships and fellowships should be addressed to the Dean of the Graduate School.

† Inquiries regarding prerequisites for graduate subjects and programs of graduate work in any field of study, should be addressed to the Chairman of the Committee on Graduate Students of the appropriate department.

THE GRADUATE SCHOOL

GENERAL INFORMATION

The Graduate School of the Massachusetts Institute of Technology is a natural development of a policy approved by the Corporation in 1872 and announced in the catalogue of that year as follows: ". . . advanced courses . . . are intended to afford to Bachelors of Science of this Institute — and others of equal attainment — the means of continuing their studies." Its Faculty is the Faculty of the Massachusetts Institute of Technology; its officers are the President of the Institute, the Dean of the Graduate School, and the members of the Committee on the Graduate School comprising a Faculty representative of each department which offers graduate work leading to a higher degree.

DEGREES AWARDED

Upon recommendation by the Faculty, the Corporation may award any of the following advanced degrees:

Doctor of Philosophy, Ph.D.
Doctor of Science, Sc.D.
Master of Science, S.M.
Master in Architecture, M.Arch.
Master in City Planning, M.C.P.

ADMISSION

ADMISSION TO GRADUATE SCHOOL AS GRADUATE STUDENT

To be admitted as a Graduate Student, an applicant must have received a Bachelor's degree in a four years' course of a college, university, or technical school of standing acceptable to the Director of Admissions of the Massachusetts Institute of Technology, and his academic record and other credentials must be such as to indicate that he has the ability to accomplish satisfactorily an approved program of graduate study and research.

For acceptance to work toward a Master's degree, the applicant shall, in addition to the above requirement, have been ranked in the upper two-thirds of his class at graduation; for a Doctorate, in the first third of his class, or have satisfactorily completed the equivalent of requirements for a Master of Science degree in an institution acceptable to the Director of Admissions.

ADMISSION TO GRADUATE SCHOOL AS PROVISIONAL GRADUATE STUDENT

Effective July 10, 1944, admission as a Provisional Graduate Student may be granted to an applicant who, although unable to meet the above requirements for acceptance as a graduate student, *is judged by a Department Committee on Graduate Students probably to be able to pursue successfully graduate studies*, with or without additional preparation in prerequisite subjects.

Provisional Graduate Student status will be changed to that of Graduate Student upon demonstration of ability necessary to pursue successfully graduate studies by completion of either of the following requirements:

(1) Completion with a satisfactory grade in one academic term of not less than 45 units of regular subjects, of which at least 32 units are of "A" classification,

or

(2) Completion with a satisfactory grade in two academic terms of not less than 36 units of "A" subjects.

ADMISSION TO GRADUATE SCHOOL AS SPECIAL STUDENT

A duly qualified applicant who desires to enroll for graduate subjects with a clearly defined objective, but not as an applicant for a degree, may be admitted as a Special Student by approval of the instructors under whom he desires to enroll and of the Director of Admissions.

A report of a Graduate Record Examination if filed with application for admission will receive due consideration.

Application for admission must be filed on forms available upon request from the Director of Admissions, and should be forwarded to him six months, if possible, in advance of the date of desired entrance. Applicants who file requests for admission during their final year of work toward a degree elsewhere may be accepted for admission conditional upon satisfactory completion of such work. Early application is advisable because enrolment in certain departments is limited. Each applicant will be notified promptly of the action taken upon his application for admission.

Correspondence concerning preparation or qualifications for admission should be directed to the Chairman of the appropriate Departmental Committee on Graduate Students (see page 56).

PREREQUISITES FOR GRADUATE WORK

For admission to graduate work the following undergraduate preparation is essential.

MATHEMATICS. The equivalent of this Institute's subjects in mathematics of the first and second undergraduate years, namely Calculus, M11, M12, M21, and Differential Equations, M22, except as specific exception may be stated under requirements peculiar to an individual field of science or engineering, or architecture.

CHEMISTRY. One or more years of college chemistry passed with such grades that it may be accepted as substantially equivalent to this Institute's first-year chemistry, 5·01, 5·02.

PHYSICS. Two or more years of college physics, passed with such grades that it may be accepted as substantially equivalent to the Institute's first and second year physics, 8·01, 8·02, 8·03, and 8·04, except as otherwise specified under requirements peculiar to an individual field of science or engineering, or architecture.

CULTURAL SUBJECTS AND ECONOMICS. Training in English, history, economics and general studies, substantially equivalent to the kind and amount of such subjects included in the undergraduate curricula of this Institute.

PROFESSIONAL SUBJECTS. Professional subjects prerequisite for advanced study as specified by departments hereinafter.

DEFICIENCIES IN PREREQUISITES. Deficiencies in quantity or quality of prerequisite training in professional subjects or otherwise, must be removed before the student may proceed with graduate work dependent thereon.

In exceptional cases, the Committee on the Graduate School will pass upon a proposal for modification of certain specified requirements if initiated by a Department Committee on behalf of an applicant for an advanced degree in a specialized field, and may modify any of the above requirements.

COÖPERATIVE ARRANGEMENT WITH HARVARD UNIVERSITY. Graduate students at the Massachusetts Institute of Technology may enroll, without additional tuition, in "Advanced courses (at Harvard or Radcliffe) other than courses prescribed in undergraduate programs or courses in research," with the consent of the Instructor and of the Dean or Head of the department in which such courses are offered. The agreement provides for a reciprocal arrangement in behalf of Harvard graduate students in respect to courses at the Massachusetts Institute of Technology.

A graduate student at the Institute desiring to avail himself of the above privilege must present to the Dean of the Graduate School from the Chairman of the Committee on Graduate Students of the department in which he is enrolled, a written request therefor, specifying the name and number of the subject desired, and whether it is desired to enroll as listener or for academic credit; the Dean's office will issue to the petitioner certain forms which are to be presented to the appropriate authorities at Harvard University.

THE DEGREE, MASTER OF SCIENCE

The degree MASTER OF SCIENCE is awarded by the Corporation upon recommendation of the Faculty based upon approval of the Committee on the Graduate School upon the satisfactory completion of a course of advanced study and research approved by the department in which the student has been enrolled and complying with the regulations as set forth hereunder, during residence of at least one academic year.

The residence requirement is further defined as comprising at least one academic year of study and research at the Institute including a full schedule (48 units) of such work for one regular term.

Students who complete the requirements for the S.B. degree at this Institute, together with substantial extra advanced credits in graduate subjects, may, upon application, be granted a waiver of the one year's residence requirement and will be recommended for the degree Master of Science upon completion of the requirements therefor.

A graduate of the Institute in the department in which he enrolls for the Master of Science degree, or others with equivalent preparation, may attain that degree in one year. Others with less direct and extensive preparation will require a longer time according to the amount of prerequisites which must be satisfied.

College students desiring to undertake work for an advanced degree at the Institute will find it advantageous to select electives which will satisfy the prerequisites for the advanced work which they intend to undertake. Advice on such electives may be secured by correspondence with the Chairman of the Committee on Graduate Students of the department in which it is desired to enroll. Attention is advised to the statement of professional prerequisites under the appropriate department in the following pages.

Degree Requirements. The degree of Master of Science is awarded upon satisfactory completion of a program of advanced study and research, approved by a department Committee on Graduate Students, which comprises

(1) 72 units of "A" subjects including 20 to 40 units (except where otherwise specified) of thesis.
(2) 24 units of "B" or "A" subjects.
(3) The above 96 units completed with a satisfactory academic rating. (See "Subjects of Instruction Tabulated" for "A" or "B" subjects.)

The degree is awarded with specification of field provided that at least 64 units of "A" subjects (including thesis) in the above program be in a single field of science or engineering. The degree Master of Science, without specification of field, may be awarded for a program of the above specifications in which the "A" subjects of any one field comprise less than 64 units, but the satisfactory academic rating in all 96 units must be maintained, irrespective of diversification of fields.

The requirements set forth immediately above apply equally to the degree S.M. awarded for part of a five-year curriculum even though in such cases certain "B" or "A" subjects have been taken before the fifth year.

The academic rating of a graduate student is compiled from his grades in all subjects of "A" or "B" grade for which he registers, plus credits in "A" or "B" subjects offered in anticipation from undergraduate years at this Institute, or obtained by examination for advanced standing; it does not comprise credits for work completed in other institutions and accepted in lieu of advanced subjects at this Institute.

Credit cannot be granted for thesis work done in absentia, and all thesis work must be done under supervision of a member of the Institute's Staff.

Choice of Field.

The choice of field of specialization, and of subjects elected therein, must be approved by the Committee on Graduate Students of the department in which the student is enrolled. The choice of subjects is not restricted to those offered in a single department; subjects in more than one department may be selected provided that the resultant program is approved as being integrated and well balanced.

MASTER'S DEGREES OTHER THAN THE S.M.

The requirements for the degrees M.Arch., M.C.P. differ only from those for the degree Master of Science in respect to certain prerequisites and in the number of units permitted or required for thesis. They are specified under each appropriate department hereinafter.

THE DOCTORATES

The degrees DOCTOR OF PHILOSOPHY in fields of science (Biology, Chemistry, Geology, Mathematics or Physics) and in Industrial Economics; and DOCTOR OF SCIENCE in fields of applied science or of engineering (Aeronautical Engineering, Biology, Ceramics, Chemistry, Chemical Engineering, Civil Engineering, Electrical Engineering, Geology (including Geophysics), Marine Engineering, Mathematics, Mechanical Engineering, Metallurgy (including Ore Dressing), Meteorology, Naval Architecture, Physics, and Sanitary Engineering, certify to performance of original research of high grade and to creditable completion of an approved program of advanced study.

The advanced study and research must be pursued in the Graduate School for at least two academic years, except in the case of applicants who satisfy the Faculty that they have successfully accomplished at another institution advanced work of a grade equal to that required at this Institute, in which case the period of residence may be reduced to not less than one academic year

The thesis must be carried out under the direction of a member of the Faculty. Work already accomplished elsewhere not under supervision of a member of our Faculty cannot be accepted in partial fulfilment of thesis requirement, nor can credit be granted for thesis work done in absentia.

If at any time a Department Committee on Graduate Students is convinced that one of its applicants for a doctorate has not demonstrated those abilities necessary to meet the requirements for this degree, he may be required to change his registration to that of an applicant for a Master's degree or to discontinue his registration in the Graduate School.

REQUIREMENTS FOR THE DEGREE.

The four basic requirements for the award of a doctorate are as follows:

(1) Completion of a Major program of advanced work
(2) Preparation of a thesis upon original research.
(3) Demonstration of a proficiency in the use of scientific modern languages.
(4) Completion of a Minor program of advanced study.

THE MAJOR REQUIREMENT.

The Major, consisting of advanced study and research may be selected in any field of science or engineering approved by the department in which the student is enrolled. The Thesis will be in this same field. The program of the Major need not necessarily be confined to subjects offered in a single department.

When the Major field involves a program made up of subjects in several departments, there may be appointed a special committee to supervise the applicant's work.

THE LANGUAGE REQUIREMENT.

All candidates for a doctorate must demonstrate to the department of Modern Languages their ability to read scientific literature in English, German, and a third modern language approved by the committee in charge of the student's major work, except that the requirement of a third language may be waived upon the recommendation of that committee in the case of a candidate for the degree Doctor of Science in a field of engineering in which the scientific literature of a third language is unimportant.

THE MINOR REQUIREMENT.

The Minor requirement for the Ph.D. or Sc.D. consists of at least 25 units of credit in some field of science or of engineering other than that wherein the Major lies, more advanced in character than required in the undergraduate curriculum of the department in which the student majors. Subjects elected to satisfy this requirement will usually but not necessarily be offered in some department other than that of the Major; will be selected primarily with the purpose of broadening the student's professional information rather than of improving his proficiency in the field of his specialization; and will be comprised in part at least of "B" or "A" grade subjects.

The approval of the *field* of the Minor must be obtained from the student's Registration Officer; the *program* proposed for the Minor must have the approval of the Chairman of the Committee on Graduate Students of the department in which a plurality of the minor subjects is offered.

EXAMINATIONS FOR THE DOCTORATE.

A general examination upon the field of the Major will be held for each applicant for a doctorate at such time and in such manner as his Department Committee shall approve, except that each examination shall comprise both written and oral parts.

A final oral examination upon the thesis and its field will be held after the thesis has been accepted and tentatively evaluated by the examiners.

An examination upon the field of the Minor may be required, especially if credit for a Minor requirement in whole or in part is granted for work done elsewhere, but usually a record of satisfactory accomplishment in Minor subjects at the Institute satisfies this requirement.

AWARD OF THE DEGREE.

Upon completion of the above requirements, with the approval of the candidate's supervisory committee, and upon recommendation to the Faculty by the Committee on the Graduate School, the degree may be awarded by the Corporation of the Institute.

In conferring the doctorate, the appropriate hood is presented by the Institute to each candidate who receives his degree in person at Commencement; otherwise a hood is not given.

CIVIL AND SANITARY ENGINEERING

ADVANCED work in the Department of Civil and Sanitary Engineering may be pursued to advantage in the fields of Structural Engineering (including Foundation Engineering), Hydraulics, Highway Transportation and Sanitary Engineering.

In Structural Engineering a number of advanced subjects are offered in which modern methods of investigating stresses in complicated structures, both of steel and reinforced concrete, are presented in detail and applied to structures of various types, such as arches, suspension bridges, continuous bridges, frameworks of high buildings and high masonry arched ams. Experimental research has been carried on in the past, and is now being conducted with the object of verifying mathematical investigations and formulas pertaining to such structures, and further research may be profitably made in this field by interested students. The facilities of the laboratory of Structural Analysis are available for experimental research and thesis work in this field as well as for courses in the technique of model studies of structures. Other research work consists of the design and investigation of the economy and suitability of various types of construction for particular structures and investigations of properties of soils which may be of interest in engineering construction. The number of separate graduate subjects offered in Structural Engineering is considerable, and the student wishing to specialize in this subject has a wide field open to him.

In the field of Foundation Engineering, opportunities for research are available in the laboratory of Soil Mechanics, which is well equipped with apparatus of various types for determining the properties of soils.

In the field of Theoretical Hydraulics, advanced work may be pursued covering subject matter not ordinarily included in undergraduate work. The subjects, pipe flow and open channel flow, offer wide fields for exploration, involving varied flow, alternate and critical stages, the hydraulic jump and its utilization as an absorber of energy, wave transmission and the design of transitions.

Advanced work in Highway Transportation affords opportunities for the study of design and construction of highways and airports, and economics of highway transportation.

A course in Vibrations is available for those interested in mechanical vibrations, earthquake-proof construction, and vibration measurement.

Both the Master of Science and the Doctor of Science degrees are offered in the field of Sanitary Engineering following the completion of suitable courses of advanced study and research. Appropriate subjects may be selected in this and other departments of the Institute and at Harvard University. Graduate subjects in this department which specialize in Sanitary Engineering deal with water treatment, treatment and disposal of sewage and other

Civil and Sanitary Engineering Continued

wastes and stream sanitation. Three related subjects are offered in each term dealing respectively with theory, design and laboratory. These subjects are open to properly qualified candidates for advanced degrees in either Sanitary Engineering or Civil Engineering. Facilities are available in the Sanitary Engineering Laboratory and other laboratories of the Institute for research work in Sanitary Engineering.

Undergraduate Prerequisites for Civil Engineering

In addition to the general requirements for all graduate students, candidates for the degree of Master of Science in Civil Engineering must present evidence of training in certain professional studies considered essential for all Civil Engineers and corresponding approximately to the following Institute subjects:

1·00, 1·01, 1·053	Surveying
1·21	Railway and Highway Curves
2·04	Applied Mechanics
1·62	Hydraulics
12·321	Engineering Geology
1·40, 1·41	Theory of Structures
1·501	Bridge Design

He must also present evidence of having had, in addition, sufficient undergraduate training to prepare him for the advanced subjects he wishes to take. The amount of such training should be approximately equivalent to that included in the following Institute subjects:

For (*a*) Structural Engineering
No further requirements

(*b*) Transportation Engineering
1·271, 1·272 Transportation Engineering

(*c*) Water Power and Flood Control
6·41 Fundamentals of Electrical Engineering
1·70 Hydrology
1·71 Water Power Engineering and Flood Control

(*d*) Water Works and Sewerage
1·75 Hydraulic and Sanitary Engineering
1·76 Sanitary Engineering

If a student has not completed, before entering the Institute, the special training in his chosen field of study listed under (*a*), (*b*), (*c*), or (*d*), deficiencies may be made up during attendance at the Institute; all subjects in these lists except the third year subject, Fundamentals of Electrical Engineering, 6·41, may be taken as B subjects and (up to a total of 24 units) counted for credit toward the Master's degree.

Undergraduate Prerequisites for Sanitary Engineering

In addition to the general requirements for all graduate students, candidates for the degree of Master of Science in Sanitary Engineering must present evidence of having had training in certain professional studies considered essential for all Sanitary Engineers, the field covered corresponding approximately to that covered by the following courses at the Institute:

1·053	Surveying
1·40, (1·41)	Theory of Structures
1·62	Hydraulics
2·04	Applied Mechanics
(1·75), (1·76), (1·79)	Sanitary Engineering

If the student has not completed, before entering the Institute, all the subjects in the foregoing list, deficiencies may be made up during attendance at the Institute; those subjects shown in parentheses may be taken as B subjects and (up to a total of 24 units) counted for credit toward the Master's degree.

MECHANICAL ENGINEERING

The Department of Mechanical Engineering offers many opportunities for graduate work leading to the degrees of Master of Science and Doctor of Science in Mechanical Engineering. Advanced study and research may be pursued in one or more of the following fields: applied mechanics, theory of elasticity, vibration, properties of materials, plasticity, photoelasticity, rigid dynamics, fluid mechanics, machine design, automatic machinery, metal processing, theoretical thermodynamics, refrigeration, heat transmission, air conditioning, design of power plants and prime movers, automotive engineering and design, textile technology, and metrology and engineering standards.

Graduate studies in the fields of mathematics, metallurgy and metallography, aerodynamics, hydraulic engineering, and business and engineering administration may be included in the candidate's program.

Requirements for Advanced Degrees

In addition to the general requirements for the Master of Science and Doctor of Science degrees, candidates for the degree of Doctor of Science in the major field of Mechanical Engineering will be required to pass satisfactorily scientific reading tests in two modern languages, one of which must be French or German. There must be included in the major field, graduate studies in mathematics, mechanics and thermodynamics; except that a student wishing to specialize in the field of engineering mechanics may limit his major field of study to graduate subjects in mathematics and mechanics. In general, not less than three years of graduate study are necessary for the Doctor's degree.

Laboratory Equipment

For research there is available the extensive equipment of the Mechanical Engineering Laboratories which include:

A Steam Laboratory, with a variety of engines, turbines, condensers and other equipment.

A Compressed Air Laboratory, with compressors of various capacities.

A Refrigeration Laboratory, with several machines of different types, a number of refrigerator units with considerable auxiliary equipment and a constant-temperature room.

An Air Conditioning Laboratory containing winter, summer, and year-round air conditioning units with auxiliary equipment. A special insulated room for study of lower temperature air conditioning problems.

An Hydraulic Laboratory, with high and low pressure pumps, measuring tanks, flumes, wheel pit and extensive equipment for measurement.

The Sloan Automotive Engine Laboratory, housed in a specially designed building and equipped with a variety of internal combustion engines, eleven dynamometers ranging from 10 to 300 horsepower in capacity, a small high-speed wind tunnel, a dark room, and a machine and instrument shop with complete apparatus for the analysis of combustion, vibration, air flow, etc.

A Lubrication Laboratory equipped for the study of dry and lubricated friction, journal and bearing wear, surface finish and the determination of the physical properties of lubricants.

Mechanical Engineering Continued

A Heat Measurements Laboratory specially equipped for research in pyrometry, thermal conductivity and expansion, specific heat, heat of combustion, and refractories. In addition to furnaces and kilns, the laboratory contains a refrigerating unit and an insulated room which can be cooled to −30° C.

A Power Measurements Laboratory, with a number of dynamometers ranging up to a capacity of 100 horsepower, dynamic balancing machines, and gear testing machines specially arranged for testing power plant transmission devices.

The Engineering Metals Laboratories. (1) The Foundry Laboratory equipped with sand control apparatus, molding equipment, gas and oil fired furnaces and cupolas; (2) the Metal Working Laboratory equipped with forges, drop hammer, forging hammer, rolling mill, punch presses, controlled temperature heating furnaces, and metallographic and physical testing equipment for control tests; (3) the Welding Laboratory equipped with A.C. and D.C. arc welding machines, gas welding and cutting apparatus, and resistance welding machines.

A Testing Materials Laboratory, equipped with testing machines ranging from 10,000 lbs. to 1,000,000 lbs. capacity, impact testing machines, hardness testing machines, and special equipment for testing cement, concrete and road materials, including special storage rooms which can be maintained under constant temperatures ranging from −15° F. to 80° F., and constant humidity ranging from zero to 100 per cent. The laboratory also contains completely equipped photoelastic apparatus, extensometers and special strain measuring devices.

A Materials Research Laboratory for the study of creep, relaxation and plastic flow of metals, combined stress, etc.

A Laboratory for Dynamic Strength of Metals equipped for impact and fatigue experiments and measurement of stress distribution under static and dynamic conditions.

A Textile Laboratory, with a full equipment of textile testing machines capable of varying rates of load application and supplied with autographic recording apparatus; machines for measuring wear, resilience and moisture effects. The laboratory is under moisture control, with automatic humidification apparatus; also a microscopic laboratory for the examination of textiles and textile fibers.

A Machine Tool Laboratory equipped with a large variety of modern machine tools is available for machine work in connection with research, as well as a machine shop, manned by expert machinists.

In addition to the foregoing laboratories, there are available, for research work in physical metallurgy and heat treatment, the extensive laboratories of the Metallurgy Department.

Torpedo Engineering. A graduate course in Torpedo Engineering, leading to the degree of Master of Science in Mechanical Engineering, has been arranged for officers in the United States Navy. Open only to officers designated by the Navy Department.

Army Ordnance. A graduate course leading to the degree of Master of Science, especially arranged for officers in the United States Army. The course is open only to officers designated by the War Department. (Not offered for duration of war.)

Textile Technology

The Institute offers opportunity for advanced study and research in the field of textiles. A Textile Laboratory has been fully equipped with controlled humidification and has excellent facilities for work leading to the degree of Master of Science in Textile Technology.

Graduates of the Institute, or of other institutions which award the Bachelor's degree on the basis of a four years' course essentially equivalent in breadth and training to that offered by the Institute in the fields of Chemical Engineering, Chemistry, Mechanical Engineering, Business and Engineering Administration, Industrial Physics, or General Science and Engineering may obtain the Master's degree in Textile Technology in from one to two years depending upon preparation. Graduates of high standing, of technical schools or textile schools offering less extensive preparation in science or engineering, will, in general require a minimum of two years to fulfill the requirements for the degree.

In general, students desiring to specialize in Textile Technology for a year of graduate study should register for subjects approved by the Department Committee on Graduate Students.

METALLURGY

(Including Mineral Dressing and Ceramics)

Graduate work leading to the degrees of Master of Science and Doctor of Science in the fields of Metallurgy or Ceramics may be pursued along a number of lines. The major divisions are Process Metallurgy, Physical Metallurgy, Mineral Dressing, and Ceramics.

Process Metallurgy deals with the production of metals and alloys from ores or concentrates; Physical Metallurgy with the study of physical properties of metals and their alloys. Mineral Dressing deals with mechanical, physical, and chemical purification and preparation of ores, solid fuels, ceramic raw materials, and other minerals. Ceramics covers pottery, structural clay products, refractories, abrasives, glass, and enamels.

In the Metallurgy laboratories facilities are provided for the roasting and special treatment of ores, the extraction of the metals by wet methods or by furnace smelting, including the electrometallurgical processes, and the study of high temperature equilibria. In addition to various types of smelting furnaces the laboratories are equipped with gas and electric furnaces for the making of alloys in small quantities. A coreless induction furnace with a melting capacity of one hundred and fifty pounds makes possible the production of steel and other alloys on a semi-commercial scale. Equipment is available for detailed metallographic investigation, for heat treatment study and research, as well as for X-ray examination. The latter field is provided for by a lead room in which radiographic studies may be made and by facilities for research in the atomic arrangement in metals. Facilities are available for advanced research in the field of magnetism. Through coöperation with the Department of Mechanical Engineering, physical testing of all sorts is possible.

Opportunity is given for study and research in more specialized subjects as heat and corrosion resisting alloys, the light alloys, and nitriding. Facilities are also available for the study of many of the fundamental physical properties of metallic systems such as electrical and thermal conductivities, magnetic properties and similar topics.

In the Mineral Dressing laboratories facilities are available for the study of crushing, grinding, screening, classification, thickening, filtration, tabling, jigging, electrostatic and magnetic separation of ores, fuels, and minerals. In addition, complete microscope equipment is available for the study of mill products. Special attention has been given to flotation for the study of which a modern laboratory is available. The equipment is designed not only for the study of batch or continuous operations of the various processes, but also for the analysis of the basic physical and chemical phenomena on which the processes rest. Oppor-

Metallurgy Continued

tunity, also, is given to explore new fields in mineral identification and in mineral synthesis.

The field of Ceramics covering as it does pottery, structural clay products, refractories, abrasives, glass and enamels, is a very broad one, but a sound training in the fundamentals of the subject gives a basis for later specialization. The laboratories are equipped with testing apparatus and with machines and kilns for carrying out regular plant processes.

A number of Group A subjects listed in other Courses may be taken for credit in the field of Ceramics. Such for example are:

First	2·53	Heat Measurements	Time arr.
Term	10·70	Principles of Combustion	4–6
	10·74	Furnace Design	3–6
Second	8·28	X-ray Diffraction	2–4
Term	8·29	Quantum Theory of the Solid State	3–6
	10·74	Furnace Design	3–6

ARCHITECTURE

The graduate work leading to a Master's degree is so arranged as to give the student who has completed the multiple requirements of an acceptable undergraduate curriculum an opportunity to devote himself without interruption to his professional work. In long periods of consecutive hours, he is enabled to conduct research under the guidance of the School and with the assistance of Institute specialists in various related fields. This activity is enriched by availability of unusual library and laboratory facilities and by association with graduate students from other backgrounds.

Only those students will be accepted as applicants for the Master's degree in Architecture whose previous performance in the required work, whether at Technology or elsewhere, has shown evidence of unusual ability.

The degree of Master in Architecture is awarded upon the satisfactory completion of a program of 96 units of advanced study, three-quarters of which, or 72 units, are chosen from "A" subjects primarily for graduates, and the remaining 24 units are chosen from "A" subjects, or from "B" subjects open to graduates and undergraduates, and approved by the School of Architecture, followed by the preparation of a thesis. This thesis is to be prepared immediately following the completion of the required courses of study and presented in time for the candidate to file his application on the next degree list.

Graduates from other colleges who desire to obtain the Master's degree in Architecture must present evidence that they have had the essential equivalent of the following undergraduate subjects as prerequisites for graduate work. Deficiencies in these subjects may be removed by taking the subjects at the Institute.

2·011	Applied Mechanics
2·042	Applied Mechanics
4·711	Architectural Drawing
4·712	Architectural Drawing
4·811	Structural Analysis
4·812	Structural Analysis
M11	Calculus

Architectural Design, Thesis Research and Thesis are required graduate subjects. Other subjects required to complete the prescribed units should be elected in consultation with the Registration Officer and subject to the approval of the Dean of the Graduate School.

Cultural Subjects and Economics: It is expected that the applicant shall have a knowledge of English, general and architectural history, economics and general studies similar to that included in the undergradute Courses at the Institute. In case the applicant is unusually deficient in meeting this requirement, he may be required to take these subjects.

The following undergraduate subjects in Architecture are also required, but as these are open to both graduate and undergraduate students they may be elected in part as "B" subjects leading to the Master's degree.

4·051	Freehand Drawing
4·052	Freehand Drawing
4·091	Color, Composition, Theory and Application
4·092	Color, Composition, Theory and Application
4·481	European Civilization and Art
4·482	European Civilization and Art
4·751	Architectural Design V
4·752	Architectural Design V

City Planning

The degree of Master in City Planning is awarded on the completion of 96 units of advanced study, including a thesis of 20 to 40 units. There is no stated curriculum for this degree, the subjects being selected in consultation with the registration officer. The degree is open to:

1. Students graduated with the Institute degree of Bachelor in City Planning, who may expect to complete the requirements in one year.

2. Students graduated from the Institute or other accepted college with the A.B., S.B., or B.Arch., or equivalent degree, whose academic records and background are considered satisfactory as preparation for graduate study in the field of city planning. Such students will normally have to spend two years in residence to qualify for the degree of Master in City Planning.

Graduates of other colleges who desire to obtain the Master's degree in City Planning must present evidence that they have had the essential equivalent of the following undergraduate subjects as prerequisites for graduate work. Deficiencies in these subjects may be removed by taking the subjects at the Institute.

1·02	Surveying
4·641	City Planning, Prin.
Ec83	Urban Sociology
M11	Calculus

The following undergraduate subjects in City Planning are also required, but as these are open to both graduate and undergraduate students they may be elected in part as "B" subjects leading to the Master's degree.

1·34	Municipal Engineering
4·59	Government and Public Administration
4·60	Planning Legislation and Administration
4·62	Site Planning and Construction
4·651	Theory and Practice of City Planning
4·652	Theory and Practice of City Planning
4·683	City and Regional Planning
Ec85	Land Economics

CHEMISTRY

The rise of chemistry in the United States has made it almost necessary for one who looks forward to a life work in the study or application of the science to give more than four years to preparation. For those whose time is limited, a program of work has been arranged which leads to the degree of Master of Science. The requirements are designed to make it possible for the candidate to specialize in any field of particular interest. The program of studies may be chosen with the approval of the Department of Chemistry from the list of senior and graduate studies offered in the Department. For the S.M. degree about one-third of a year is devoted to research. The degree of Doctor of

Chemistry Continued

Philosophy, on the other hand, is awarded to the candidate who has a broad scientific education in the fundamental branches of chemistry, and who has given evidence of the ability to carry on independent research by presenting a thesis which is a definite contribution to scientific knowledge. Attainment of the Master's degree is not prerequisite to a program leading to the doctorate.

Teaching Fellows

The Department appoints a limited number of Teaching Fellows who are candidates for the degree of Doctor of Philosophy in Chemistry. Teaching Fellows serve in the laboratories of the Department, or in such other capacity as may be advisable, on a part time regular schedule throughout the scholastic year. For detailed information in regard to appointments, address correspondence to the Head of the Department. For detailed information in regard to special requirements for the degree of Master of Science with Specification in the Field of Chemistry and the General Requirements for the degree of Doctor of Philosophy in the Field of Chemistry, address correspondence to the Chairman, Committee on Graduate Students, Department of Chemistry.

The Research Laboratory of Physical Chemistry

A considerable portion of the more recent advance in science has been in fields lying between the divisions of science as they were originally established. One of the most important of these developments is physical chemistry, which has come into existence as a result of investigations lying between the previously loosely defined borders of the sciences of physics and chemistry.

There is a demand for men of mature scientific education to serve as investigators and to direct investigational work in industry, in endowed research institutions, in government bureaus and in academic institutions. The numerous industries in particular have nearly all come to realize the desirability and even necessity of supporting fundamental scientific investigations relative to their processes as a basis for future development. In consequence of the benefits already derived from systematic investigation, many industrial research laboratories have been and are being organized. It is universally agreed that graduate work is an essential preparation for positions in connection with these divisions. Since the work involved is of a widely varying nature, a student considering the possibilities in this field of activity should endeavor to pursue an educational course which will give him a broad lasting foundation and a wide scientific perspective. In respect to the latter, physical chemistry with its outlook on two or more fundamental sciences is particularly useful.

Recent research in the Research Laboratory of Physical Chemistry, other than war research, has been concentrated on the following subjects, and the laboratory is especially well, often uniquely, equipped for such research:

- Pressure-volume-temperature relations of gases and liquids.
- The absolute temperature scale.
- Molecular weights of gases by limiting densities.
- Heat capacities and latent heats at low temperatures.
- Properties of gases at low pressures.
- Scattering and other properties of molecular beams.
- Electromotive force in concentration cells, and oxidation-reduction potentials.
- Freezing points of liquid solutions.
- Vapor pressures of liquid solutions.
- Infra-red spectroscopy.
- Precision photometry.
- Kinetics of thermal and photochemical reactions.

The Research Laboratory of Organic Chemistry

Organic chemistry has always provided an ever increasing field for industrial and scientific developments. The great interest stimulated in earlier times in the coal tar chemicals and pharmaceuticals has in more recent years not only been maintained but also extended to petroleum, cellulose, solvents, plastics, and other branches. So great has been this progress that there is an urgent need for adequately informed and competently trained men.

Subjects. Lecture subjects are designed to cover first the fundamental reactions, theories, and structures in organic chemistry. This material is followed by a complate course in which the many special fields such as proteins, dyes, carbohydrates, natural products, resins, and the like are discussed. The aim is to provide a well-rounded study with a good grasp of the essentials in every field touched by the science. Further stimulation is provided by staff participation in presenting important current developments. The students coöperate in presenting their own literature study in Journal Meetings.

Laboratory instruction follows two general lines. One deals with identifying and testing organic compounds, a particularly complete and thorough training in the essentials of characterization being provided; the other stresses laboratory manipulation in which the present day demands on the organic chemist for fine fractionation columns, high vacuum work, skill in micro manipulation, ability to work on a large scale, full understanding of the principles of purification, separation, crystallization, etc. are met. The Massachusetts Institute of Technology was a pioneer in both types of instruction and every effort is being made to insure that this training is maintained at a high level.

Research. Research projects in the Research Laboratory of Organic Chemistry are in the general fields of carbohydrates, cellulose chemistry, heterocyclic compounds, identification studies, organometallic compounds, polymerization, vitamins and other special subjects. Research in these fields is largely suspended except in those cases where there is some relation to the war effort. The laboratory is, of course, unusually well equipped for research work in these and related fields.

The Research Laboratory of Inorganic Chemistry
(Including Analytical Chemistry)

Unmistakable evidence has been observed in recent years of an increased interest in inorganic chemical research, due to a growing realization of the fact that practically unlimited opportunities for further investigation remain in this branch of the science, not only in the chemistry of the less common and the rare elements, but also in the further study of the chemistry of the commoner elements. Much of the recorded work of early investigators has been found to be in need of revision. The availability of modern research tools and the application of precision methods to numerous problems hitherto studied only in a superficial manner, are constantly exposing serious inaccuracies both in the observation and the interpretation of various inorganic phenomena.

The growing availability of certain of the less familiar elements, such as rhenium, columbium, tantalum, zirconium, indium, etc., have made the investigation of the chemistry of such elements of practical importance.

The desirability of devising new methods of analysis, as well as of improving existing methods, has given rise to a number of analytical investigations, among which may be mentioned the determination of zirconium in ores and steels,

Chemistry Continued

the determination of small quantities of selenium in sulfur and in alloy steels, electrometric methods of analysis, and methods of analysis and purification of gas mixtures.

The Laboratory is equipped to carry on a wide variety of inorganic research, including high vacuum technique, operations at high temperatures and at low temperatures, and electrolytic oxidations and reductions. Apparatus for precise determination of melting points at low temperatures is available as an aid in the determination of the purity of volatile substances. X-ray apparatus for the taking of Debye-Scherrer photographs is also available.

Research in nuclear chemistry is facilitated by the possession of a powerful source of neutrons as well as alpha counters.

ELECTRICAL ENGINEERING

The Department of Electrical Engineering offers advanced work leading to the degrees of Doctor of Science and Master of Science. The general rules governing the granting of these degrees are set forth under the general information on the Graduate School, while such special rules as apply to the Department of Electrical Engineering are given below.

All graduate students in the Department who have not had equivalent experience in the preparation and oral presentation of technical papers are required to register for Seminar 6·501, 6·502. In the seminar meetings, papers dealing with the history of the development of various phases of electrical engineering and the influence of these developments upon present practices, are presented and discussed. The student may select his seminar topic so as to utilize the seminar time for examination of the literature relating to the general field of his thesis.

Students working for the Master's degree are expected to devote themselves to a few subjects, not more than three each term, in addition to their seminar and research. The subjects of study are wholly elective, with the exception of Electrical Engineering Seminar and Thesis, and not restricted to those given by the Department of Electrical Engineering; however, the program of study must be well balanced, emphasizing one or more of the mathematical, economic, and experimental aspects of electrical engineering.

The Language requirement for the Master's degree is a reading knowledge of either technical German or French along lines of the student's professional interest. When a choice can be made, German is preferred, as German literature in the field of Electrical Engineering is the more extensive of the two. This requirement may be satisfied by: (1) certificate grade in three years of preparatory school German or French; (2) certificate grade in two years of preparatory school German, and two years of French; (3) by two years of German or French taken at the Institute; (4) by passing a reading test in either German or French.

Graduate study in the Department is considered to include much more than class exercises and assignments pursued in a routine manner. Each student is expected to conceive of his program as a coördinated whole, having as its objective the advancement of his professional preparation. It should provide for a substantial amount of independent and correlative study in current literature and independent investigation in the laboratories. Such independent study and investigation are essential parts of the seminar and thesis requirements, both of which are expected to demonstrate the ability for sound constructive reasoning, and to embody a contribution to the advancement of the art.

Only students who have demonstrated outstanding ability in work of a creative nature are encouraged to go on for the doctorate. Where the records of students entering on graduate work do not yield evidence of this ability, they are usually advised to qualify first for the Master's degree in order to demonstrate this ability. The thesis research for the doctorate is expected to make a substantial and noteworthy contribution in Electrical Engineering or a related field.

Each year a limited number of appointments to assistantships are available to men especially qualified by training and natural endowment for teaching and research. Every effort is made to arrange the assigned work of an assistant so that he can carry approximately forty per cent of a full-time program of study toward an advanced degree. Should his research assignment result in material appropriate for use in a graduate thesis, a research assistant is permitted so to use the material.

In order to be accepted without deficiencies for graduate study in the Department of Electrical Engineering, an applicant must have completed with evidence of more than average capacity, the four fundamental requirements common to all courses, as stated under Prerequisites for Graduate Work, and in addition must have covered substantially the equivalent of the undergraduate professional subjects as offered in one of the options of Course VI. Credit is not usually allowed for preparatory subjects in which the applicant's grades are low. High-grade work in preparatory mathematics and physics is considered to be particularly important.

If the student has deficiencies, the Department Committee on Graduate Study and Research requires that the student remove, ordinarily while in residence, those deficiencies that are deemed important preparation for the graduate study and research that he desires to undertake. If the student is studying for the Master's degree, certain of these deficiencies may be removed by means of "B" subjects, to the extent of the allowable quota of "B" subjects for his degree.

Facilities for Research

The research of the Department is directed by many members of the instructing staff who are actively interested in the general progress of this phase of the Department's activities, and particularly in those researches which lie within their own special fields of endeavor. The available laboratory equipment is extensive, permitting effective work toward the solution of fundamental problems in all of the more important branches of Electrical Engineering.

Applications of high-frequency currents to communications and other problems are advancing rapidly and the Department of Electrical Engineering has for many years had an important place in this advance. Its activities in this field include an extensive program covering measurements in the meter-centimeter region, the generation, propagation and radiation of centimeter waves and the behavior of systems at these wavelengths where circuit conceptions become less and less real and the field conception more and more apparent. A well equipped general ultrahigh-frequency laboratory is available for undergraduate and graduate student use.

A laboratory for the scientific and systematic study of the fundamental properties of automatic control systems is available. Attention is being given to the development of means for stabilizing automatic control systems, to the reduction of the transient and steady-state errors of such control systems, and the development of high-power fast-response output drives.

An important problem, various phases of which have

Electrical Engineering Continued

occupied the attention of the staff, is the study of the fundamental properties of insulation. One research program in this field is directed primarily toward a comprehensive study in terms of atomic physics of the fundamental electrical properties of solid, liquid, and gaseous dielectrics, and in particular dielectric strength, and is approached through the study of the basic electronic and atomic processes taking place in materials under electric stress.

Another program utilizes precise electrical measurements of properties of insulating materials (with emphasis on oils), such as conductivity, dielectric constant, and power factor, in studying the structure of the materials, the mechanism of dielectric loss, and the nature of the deterioration characteristics.

Flash photography, utilizing light sources which furnish illumination of great intensity and extremely brief duration, has been developed to a state permitting technical application in engineering and other fields.

Many problems in engineering and physics are of such complexity that satisfactory progress in their solution is dependent upon machine methods of carrying out mathematical processes. The Differential Analyzer, which was originally developed here, was designed to perform mechanically the necessary operations required in the solution of differential equations. A larger, faster, and more precise Differential Analyzer which performs these necessary operations electrically is in operation. Another machine, the Cinema Integraph, utilizing illumination in its operation, is available for solving integral equations having under the integral sign the product of two functions, one of which has a variable parameter.

A program for the development of X-ray equipment employing potential differences of one to several megavolts, including the associated direct-current generators, has been under way for several years. Incidental to these developments, studies have been made of the design of insulating structures for maximum dielectric strength, and of the dielectric strengths of gases and vapors as functions of pressure.

In the illumination laboratories of the Department, investigations have been made among which are studies of the visual effect of light from sodium lamps, the visibility of objects on highways when various lighting conditions obtain, the elimination of glare by use of polarized light, the reflection characteristics of road surfaces, and the design of reflectors.

The Network Analyzer, used for steady-state and transient power system analysis, is adequate for single-phase representation on a 60-cycle, 200-volt, 1-ampere basis of power systems embodying as many as sixteen generating stations with their loads and interconnecting transmission and distribution circuits. Its measuring equipment is fast and accurate. In addition to its use in research and in connection with class instruction, it is available for the solution of commercial power-system problems. It was built with the coöperation of the General Electric Company.

A special machine-transients laboratory is equipped with motor-generator sets and necessary accessories for the study of transients, both electrical and mechanical, occurring in electrical machines as a result of short circuit, of sudden terminal voltage changes, or of sudden or periodic load changes.

In the engineering electronics laboratory facilities are provided for the study and the semi-automatic construction of various types of vacuum or gas-filled electronic devices.

The various shop facilities of the Department are adequate to care for the maintenance of the existing equipment and the construction of new equipment for carrying on the research of the Department. The student shop, in charge of a competent mechanician, is equipped with all the machine tools necessary for ordinary wood and metal working.

Consideration of the theoretical as well as the experimental aspects of research is essential for rapid and intelligent progress in an advancing art such as Electrical Engineering. The theoretical work of the Department is particularly strong in the fields of circuit theory, transmission line theory and traveling waves, electromagnetic wave propagation in both free and confined space, transient behavior of electrical circuits and mechanical systems, vibrations, acoustics, and electrical machinery.

The Vail Library

A necessary adjunct to all Electrical Engineering Department research is the Vail Library. The original Vail Collection (30,000 volumes), presented to the Department in 1912 through the interest of the late Theodore N. Vail, was combined with other electrical literature in the Institute Library to form the Vail Library which now comprises some 43,000 volumes. The Vail Library is one of the three great Electrical libraries of the world. It contains the works of all writers who have made significant contributions to electrical science and engineering since the time of William Gilbert (1600).

The Vail Library staff gives instruction in library usage and bibliographic research.

BIOLOGY AND BIOLOGICAL ENGINEERING

Graduate work in this department may be selected in one of the fields listed below:

Fields of Study

- Bacteriology
- Basic Biological Science
- Biochemistry
- Biophysics
- Food Technology
- General Physiology
- Microbiology

Degrees Awarded

- Master of Science
- Doctor of Science
- Doctor of Philosophy

Acceptance of Applicants for Advanced Degrees

Only students with superior credentials, offering a substantial equivalent to the professional subjects in the undergraduate curricula of Courses VII or VII-A, may be accepted as applicants for advanced degrees in the department. Satisfactory records of courses in introductory subjects, such as general biology, anatomy, and physiology must also be presented. In case of minor deficiencies in preparatory subjects, petition for advanced standing examinations in the subjects of deficiency may be granted. Previous award of the Master's degree in an appropriate field by an accredited institution will usually be adequate for acceptance of an applicant for a doctorate.

The number of graduate students in any one year is limited by spatial and other considerations.

A student desiring to enter the department as a graduate student must comply with the regulations concerning filing of application with credentials, as set forth under Admission to the Graduate School.

Biology and Biological Engineering Continued

Requirements for the Degree of Doctor of Philosophy or Doctor of Science

In addition to the general requirements for the Doctorates, attention is directed to the essential requirement of satisfactory completion of the Oral and Written Examinations within the department, with the demonstration of scientific competence and breadth of understanding of various phases of biology.

The general examinations are held in two groups. The preliminary group includes fundamentals of general biology, bacteriology, physiology and biochemistry; the other group is the professional examinations which relate particularly to the field of specialization.

Requirements for the Degree of Master of Science

Substantial equivalent of the Course VII or Course VII-A undergraduate curriculum is prerequisite to admission to full standing as a graduate student in this group. The general requirements as listed under the Graduate School should be consulted.

The equivalent of Intermediate French or Intermediate German or Elementary French and Elementary German is required of all applicants for the Master's degree in this Department. This requirement may be satisfied by demonstration that the applicant has a good reading knowledge of scientific French or German or by the completion of the courses outlined above.

The Biological Research Laboratories

The Biological Laboratories offer facilities for advanced work in bacteriology, biochemistry, biophysics, cytology, enzymology, food technology, general physiology, industrial biology, microbiology, and nutrition. Properly prepared graduate students may elect to undertake research in one or more of these fields under guidance of staff members. Included in the program of research in which staff members have a continuing interest, and with which advanced graduate students may hope to become affiliated, are the following:

In bacteriology particular emphasis is laid on physiological and biochemical studies and on the development of quantitative methods of dealing with bacterial processes.

Biochemical studies are concerned with the purification and chemical characterization of substances important in plant and animal growth and metabolism. Among specific problems under investigation may be mentioned the mechanism of fermentation, antibacterial substances, and the purification and chemical characterization of the protein, collagen.

Equipment is available for research in a wide variety of fields of physical biology. Exceptional instrumentation has been assembled for an investigation of the molecular organization of cells, tissues, and their products. Included are X-ray diffraction units, an electron microscope, and polarization optical equipment. For identification of biological substances there is equipment for investigating ultraviolet and visible absorption spectra, Raman, emission, and fluorescence spectra. Studies employing these methods bear importantly on the problem of the mechanism of inflammatory processes, proliferation and neoplasia. There is a well-equipped laboratory for the study of the properties of mono- and polymolecular films. Electrical instrumentation is provided for a study of the biological action of high-frequency electric fields, and ultrasonic radiation.

Physiological investigations include studies of nerve action with the cathode ray oscillograph, of permeability processes by the radioactive tracer method, of cellular metabolism by manometric and volumetric methods, of the action of enzymes, with special reference to their kinetics as related to temperature and oxidation-reduction potential.

In nutritional biochemistry opportunity is offered for research in the composition of foods and tissues and in the biochemical processes involved in nutrition. Among the nutritional factors being studied are natural and synthetic fatty acids, amino acids, and certain vitamins. Particularly timely is the research program on the development of highly nutritious, inexpensive food mixtures for populations in economic distress or made destitute by the war, and on the development of complete rations for armed forces and for post-war feeding.

Graduate work in food technology offers opportunity for advanced study and experimental work in the biological, chemical, and engineering aspects of food production and control. Such work may be combined with courses in business administration, chemical engineering, or other fields of interest.

The Food Technology Laboratories provide facilities for research in the investigation of food processes, packaging, heat treatment, and the development of new food products. Numerous phases of the problems of food refrigeration, including quick freezing, have constituted a part of the food technology research program for several years. An extension of this program has been made possible through the generous coöperation of the Dewey & Almy Chemical Company in making available for joint use their conveniently located, modern and complete food-freezing laboratory, where students may conduct semi-plant scale research on frozen foods.

Research in food technology includes the following: various apsects of food dehydration, processing, plant design, and product control; objective measurements for quality evaluation; packaging research with new materials; effects of sonic vibration on foods; by-products utilization; detergents in food industries; unit-process methods in food manufacture.

PHYSICS

The Department of Physics offers work for the degrees of Master of Science, Doctor of Philosophy and Doctor of Science. No stated curriculum of subjects is required for any of these degrees, but they are to be chosen in consultation with the registration officer, subject to certain broad principles.

Graduate Study and Research Facilities

The courses in the field of pure physics are intended primarily for students intending to go into teaching and fundamental research. As preparation, in addition to a thorough knowledge of mathematics and chemistry, the student is expected to become well trained in both experimental and theoretical physics. Most of the fields of research of active importance in physics at present are well represented at the Institute, and excellent facilities for them are found in the George Eastman Research Laboratories, and the adjoining Spectroscopy Laboratory, and the new laboratories housing the high voltage equipment and the cyclotron.

One of the most active fields of research in physics at present is nuclear physics, and the Institute is well equipped for this type of research. The high voltage electrostatic generator, now widely used in nuclear investigations, was originally developed at the Institute, and the generator formerly located at Round Hill has been entirely reconstructed and installed in Cambridge in connection with a

Physics Continued

well-equipped laboratory, providing a reliable and flexible direct current source and discharge tube, operating at somewhat over two million volts and large current. In addition, a cyclotron of large size, located in a building specially designed for it, is available for physical and biophysical investigations. The Institute has very highly developed facilities for the detection and measurement of nuclear radiation of all sorts, particularly of weak radioactive sources, and is uniquely equipped for determining the age of minerals by radioactive methods, as well as for the application of artificial radioactivity to biological problems.

The Spectroscopy Laboratory provides unique equipment. Communicating with the basement by a corridor, but entirely independent of the main building, and located in a court, this building has been designed particularly to provide constant temperature and freedom from vibration. Included in it are complete Paschen circles for both 35-foot and 21-foot gratings, entered from a common source room; several other grating mountings; and separate rooms for vacuum spectrographs and other pieces of apparatus. These include among other things a 21-foot vacuum spectrograph, microphotometers, and various interferometers for work requiring high resolving power.

The new magnet, used for the production of Zeeman effects, and operating at magnetic fields up to 100,000 gauss, increases greatly the usefulness of the laboratory. The principal researches in progress are investigations of the line spectra of the elements. Developments of automatic methods of measuring and analyzing spectra, in conjunction with unusually fine diffraction gratings, have made possible new standards of precision in wavelength measurement, and analyses of spectra which were not previously attempted.

Experimental problems in electronic phenomena include studies of thermionic and photoelectric emission from metals, and the mechanism of discharge in gases. The X-ray Laboratory is principally concerned with the structure of crystals, as determined by X-ray diffraction. Recently a large part of the research has been concerned with the structure of glasses, other amorphous solids, and liquids. Other work in the structure of solids includes a research program in the properties of dielectrics, including optical, electrical and mechanical behavior, and research in the production of large single crystals. Theoretical research has recently included work in classical physics, as in diffraction problems of sound and light, the architectural acoustics of auditoriums and hydrodynamics and aerodynamics; the theory of gas discharges, and the scattering of atoms and electrons; the theory of metals and the solid state; and the theory of the motion of high speed particles, as in cosmic rays and nuclear processes.

Graduate Study and Research in Applied Physics

The course in the field of applied physics is intended primarily for students intending to go into industrial research in physics or engineering. For such a career, a broad training not only in the more classical and experimental parts of physics, but also in engineering, chemistry, and other subjects is essential. For this reason, a student of applied physics will be expected to do a considerable part of his work in other departments. Some of the more important branches of applied physics, with the type of training available and the research opportunities, are enumerated below. The field of physical properties of matter is one of great commercial importance. The student in this field should have thorough grounding in physics, particularly in X-ray crystal structure and thermodynamics, and in chemistry, especially physical and organic. He should also receive training in some of the following fields (in each case the particular subjects which should be emphasized in other departments are given in parentheses): physical metallurgy; geology (crystallography); mechanical engineering (elasticity, plasticity, strength of materials); civil engineering (soil mechanics). Students in acoustics should study physics (mechanics); electrical engineering (oscillating circuits and vacuum tube devices); the mathematics of vibrations and boundary value problems; and should do advanced work and research in acoustics, conducted jointly by the departments of Physics and Electrical Engineering. In several other fields of the application of mechanics and heat, joint work with other departments can easily be arranged. These include heat measurements, in mechanical engineering; ceramics, in metallurgy; and study of heat engines, hydrodynamics, and aerodynamics, in mechanical engineering and aeronautics. In electricity, particularly in electronics, and in the study of dielectrics, joint programs of study and research with the Electrical Engineering Department can be worked out. The work in applied optics is largely in the Physics Department, including study and research in color measurements, design of optical instruments, and related fields, but the student entering this field, as for research on color problems, should study the chemistry and chemical engineering of dyes, and textile research, while if he expects to enter the motion picture field, he should study physics and electrical engineering as related to oscillating circuits and vacuum tubes, acoustics, and illumination. Geophysics, the application of physical methods to geology, and particularly to prospecting for ores, demands a good foundation in physics, especially electrical measurements; in mathematical physics, particularly elasticity, wave motion, electromagnetic theory; and in geology. Biophysics can be undertaken jointly with the Biology Department, with particular attention to radiation and X-rays in physics, and to biological subjects.

In all of these branches of applied physics, considerable work in other departments is required, and it is very desirable to start the fundamental subjects in these departments as undergraduates. Undergraduates planning to enter applied physics should choose their electives with this in mind.

Requirements for Advanced Degrees

The following special requirements must be met, in addition to the general requirements:

Undergraduate subjects, which may be taken at the Institute or elsewhere, but may not be counted for an advanced degree:

8.062	Intermediate Physics (Electronics)
8.161	Optics
8.311	Atomic Structure
8.511	Thermodynamics and Statistical Mechanics or
5.61	Physical Chemistry I

Undergraduate subjects which may be counted as "B" subjects toward an advanced degree:

8.11	Experimental Physics
8.461, 8.462	Introduction to Theoretical Physics

For the master's degree, a reading knowledge of either French or German is required.

The further requirements for the doctor's degree are: reading examinations in French and German; a Minor of at least 25 units in some other department; a general examination; a thesis; and an examination on the thesis. The student is expected to take graduate subjects to prepare himself for the general examination, but there are no

Physics Continued

stated required subjects. The general examination consists of a written examination, followed by an oral one. The written portion is given in three parts, of three hours each, over a period of two weeks. If his work in the written part is satisfactory, the student will be allowed to take the oral portion of the examination. A student may try the written part as many times as he wishes as long as he does not choose to finish the examination by taking the oral. If he takes the whole examination, written and oral once, and fails, then he will be allowed only one additional trial. These examinations are given once in every term.

The requirements for a doctor's degree in the field of pure physics, tested by the general examination, include a general knowledge of physics of the grade required for a bachelor's degree in Course VIII, Option 1; and a more advanced knowledge of several fields of experimental or theoretical physics.

The requirements for a doctor's degree in the field of applied physics include a general knowedge of physics of the grade required for a bachelor's degree in Course VIII, Option 2; a knowledge of certain fields of science or engineering outside the Physics department, as chemistry, metallurgy, electrical engineering, geology, which have particular bearing on applications of physics; and more advanced knowledge of certain fields of physics or engineering.

CHEMICAL ENGINEERING

Because of the breadth of the field of Chemical Engineering the undergraduate Course must be devoted to training in fundamentals, and strictly professional subjects must be elementary in character. Postgraduate work is therefore of peculiar importance and value to the chemical engineer.

The program for the S.M. Degree, particularly in Chemical Engineering Practice, is usually arranged as a continuation of the broad professional training, although individual schedules may be planned to specialize in a given field. Work for the Sc.D. degree is more specific in character and the Department offers coördinated programs in three fields: Engineering Operations of Chemical Engineering, Applied Chemistry, and Fuel Engineering. Special programs are developed for individual cases.

School of Chemical Engineering Practice
(Temporarily discontinued)

The Department of Chemical Engineering offers a Course leading to the degree of Master of Science in Chemical Engineering Practice (designated as X-A).

In the School of Chemical Engineering Practice a carefully selected group of graduate students who have completed at least four years of undergraduate study at the Institute or elsewhere spend six months at three field stations located at Bangor, Me., Parlin, N. J., and Buffalo, N. Y. At these stations four different concerns open their plants for the instruction of students who at each station are under the direct charge of two members of the Institute staff. Since the time is devoted wholly to their education, students receive no compensation. Their attention is directed chiefly to the application of theory to practice and to the cultivation of resourcefulness and of effectiveness in coöperative effort under industrial conditions.

The field of Chemical Engineering has been divided into a series of unit operations which are studied quantitatively and in detail in the Practice School. Plant investigations are carried out by the students at each of the stations, this work covering two fields: first, investigation of some special phase of one of the unit operations; or second, investigation of some problem of industrial chemistry particularly important at the station in question.

Finally, the School of Chemical Engineering Practice offers exceptional opportunity for graduate engineering research, first by affording an opportunity for comparing laboratory data, formulae, and conclusions with observations on plant apparatus operating under practical working conditions; and second, by extending, from laboratory scale at the Institute to commercial scale in the various plants, the range of investigations possible.

The following program will be taken by men graduating in Chemical Engineering from the Institute.

For twenty-four weeks, from the beginning of the term following graduation, students are at the field stations (10.81, 10.82 and 10.83). They then return to the Institute for intensive work in Chemical Engineering Design (10.53) and thesis until the end of the examination period of the second graduate term. The work of the second term, including thesis, is elective, though subject to the approval of the department registration officer of graduate students.

For graduates in Chemical Engineering from other institutions the usual program of study for the Master's degree involves one school year at the Institute, followed by the seven months in field station work in the Practice School and in the Design Course, 10.53. Graduates in chemistry from other institutions usually require an additional half year. Students are usually not permitted to enter the Practice School until they have spent at least one term at the Institute. The student's program is so dependent on previous training and experience that individuals interested are requested to communicate directly with the Department.

Fields of Study

Engineering Operations. Graduate subjects in the several important unit operations such as heat transmission, distillation, and absorption are offered, emphasizing the engineering phases of the students' professional training.

Applied Chemistry. A group of subjects in Applied Chemistry, such as colloidal chemistry, catalysis and high pressure processes, comprise an integrated program for students whose primary interests are on the side of Industrial Chemistry.

Fuel Engineering. While the important group of industries involving the processing and utilization of fuels demand the training and viewpoint of the chemical engineer, many of their problems can be handled by men who have majored in non-chemical branches of engineering, provided they prepare themselves adequately for fuel engineering work by graduate study. The Department offers a group of subjects on fuel processing and utilization as the core of a program of graduate study in Fuel Engineering, the balance of the work being in science, engineering or economics. The facilities of the Buffalo Station or the School can be utilized for advanced investigations in fuel engineering practice.

Since the program in any of these fields will depend on undergraduate training and industrial experience, any one interested is requested to furnish information permitting individual consideration.

Requirements for Graduate Study

The requirements for graduate study are dependent on the degree to which the student wishes to specialize. The broadest training is required in Chemical Engineering and in Chemical Engineering Practice as it is assumed that the student is preparing himself for any phase of chemical engineering. Students who plan definitely to major in Applied Chemistry or in Fuel Engineering will be expected

Chemical Engineering Continued

to meet requirements in chemistry and in engineering to an extent justified by the field of specialization.

The preparation required above that common to all courses of the Institute is outlined below:

Mathematics: through differential equations, equivalent to the undergraduate M22; Physics: two years of college physics; Chemistry: the substantial equivalent of the undergraduate subjects in Course X; Engineering: (*a*) a one-year problem course in heat engineering or chemical engineering thermodynamics, and (*b*) preparation in applied mechanics or elements of electrical engineering; Chemical Engineering: problem courses in industrial chemistry and in unit operations; Language: elementary French or elementary German; Economics: an introductory course. Graduates in Chemistry or Chemical Engineering may usually remove deficiencies in the above subjects in the course of their graduate programs.

For Chemical Warfare Officers

A special course for Officers of the Chemical Warfare Service, leading to the degree of Master of Science in Chemical Engineering Practice, may be arranged.

GEOLOGY

Due to absence of staff members on work connected with the war effort and anticipated reduction in graduate enrollment, no formal graduate courses will be offered in geology. However, graduate students who may wish to enroll under these temporarily modified conditions may carry on directed reading and study and pursue research work in the departmental laboratories under the direction of the resident staff.

In Geology many opportunities are given to pursue advanced work leading to the Master's and Doctor's degree. One line of work is in Economic Geology, and the student may specialize in mining geology, petroleum geology, hydrology, or geology applied to engineering or geophysics. Or again, he may elect to devote the greater part of his time to geology, mineralogy, petrography and paleontology in their more theoretical aspects as preparation for teaching and research.

The advanced work is facilitated by laboratories provided with modern appliances for work in the various phases of geology, mineralogy, petrography, geophysics, and paleontology. The collections in economic geology are supplied with material from the mining districts of all parts of the world.

Requirements for the Degree of Master of Science

Candidates for the degree of Master of Science in Geology must present approved equivalents for the subjects of the first and second years in keeping with indicated field of special interest. In the field of Geology they must present a record of attainments satisfactory to the Department Committee on Graduate Students.

Requirements for the Degree of Doctor of Philosophy, or Doctor of Science

The preparation of the candidate for the Doctor's degree must be such as to satisfy the Department Committee on Graduate Students that he is qualified to undertake the course of advanced study and research.

Each candidate upon his entrance in the Department is given a preliminary examination which may be partly oral and partly written. This is designed to survey his training and attainments in the field of geology. This preliminary examination precedes the major examination which must be passed at least seven months before the degree is awarded. The Minor requirement should likewise be passed before the major examination.

A reading knowledge of both French and German is required.

Subject to the approval of the Department Committee on Graduate Students, other subjects for which a student has adequate preparation may be elected from the subjects primarily for graduates offered by related departments. A number of advanced subjects in geology and mineralogy, given at Harvard University, are also open to the student.

NAVAL ARCHITECTURE AND MARINE ENGINEERING

Naval Architecture

Opportunity is offered to graduates of courses in Naval Architecture (a) to work for a Master of Science degree in Naval Architecture, in which case the student's program must include certain subjects in this department, or (b) to undertake a course of advanced study in fields allied to ship design and ship construction which will lead to the degree of Master of Science *without specification*. In the latter case the program can include a much broader range of subjects.

In addition to meeting the general requirements for admission to the Graduate School, candidates must have completed the necessary prerequisites for the graduate subjects they wish to pursue.

Marine Engineering

The Department of Naval Architecture and Marine Engineering offers opportunities for graduate work in Marine Engineering leading to the degree of Master of Science in Marine Engineering. Advanced study may be pursued in steam engineering; vibrations of ships and their machinery; propeller design and research; and other fields of marine engineering. The Institute's new propeller testing tunnel is available for research work.

In addition to subjects offered in the Department of Naval Architecture and Marine Engineering, the student may elect subjects closely related to marine engineering given in the Department of Mechanical Engineering, or other departments of the Institute, in making up his program of studies such, for example, as: applied mechanics, hydromechanics, thermodynamics, refrigeration, Diesel engineering, steam turbine engineering, heat transmission, air conditioning, advanced machine design, metallurgy, metallography, and advanced mathematics.

The preparation required for graduate work in Marine Engineering is the equivalent of the Institute's undergraduate course in Naval Architecture and Marine Engineering.

In addition to the general requirements for all graduate students, candidates for the degree of Master of Science in Marine Engineering must meet the approximate equivalent of the following undergraduate subjects:

1.62 or	Hydraulics
2.251	Fluid Mechanics
2.01, 2.04, 2.06	Applied Mechanics
2.40, 2.42	Heat Engineering
2.684	Engineering Laboratory
2.851	Machine Tool Laboratory
6.40, 6.89	Electrical Engineering
13.01, 13.02	Naval Architecture
13.52, 13.55	Marine Engineering
13.62	Marine Engineering Design

Naval Architecture and Marine Engineering Continued

However, students taking 13·75 will not be required to offer 13·02, and graduates in Mechanical Engineering who take 13·75 and 13·76 may substitute courses in machine design, power plant engineering and advanced heat engineering for the marine engineering subjects listed above.

If a student has not had training in all the undergraduate prerequisites listed above before entering upon the work of the graduate year, those listed as "B" subjects may be taken during the graduate year, up to a total of 24 units, and counted as credit towards the Master's degree.

Naval Engineering. A graduate course in Naval Engineering, leading to the degree of Master of Science in Marine Engineering, has been arranged for officers of the United States Navy. (Discontinued for duration of war.)

XIII-A. Naval Construction and Engineering

The Department of Naval Architecture and Marine Engineering offers to United States Naval Officers a graduate Course (XIII-A) of prescribed studies extending over six terms, leading to the degree of Master of Science in Naval Construction and Engineering.

METEOROLOGY

The rapid growth of the aviation industry has produced a demand for professional meteorologists both in the aviation organizations and in the United States Weather Bureau. This stimulus has also awakened interest in other industries whose operations are dependent on the weather, and an expanding future for the science appears to be assured. It is the purpose of this Course to prepare students both for practical work and also for research work in the field of meteorology. Emphasis is placed on the application of physical principles and mathematics to atmospheric processes, as well as on observational, empirical and statistical methods.

In the field of dynamic meteorology the subjects of thermodynamics, hydrodynamics and fluid mechanics are developed with special reference to the atmosphere. In synoptic meteorology these theoretical developments (supplemented by observational, empirical and statistical methods) are applied to the practical problems encountered by the weather forecaster. In the synoptic laboratory the student is taught to decode and plot the daily weather reports, to analyze the weather maps and prepare forecasts, and thus to put in practice the methods presented in the lectures. The facilities of the synoptic laboratory include teletype and radio receivers for the collection of weather data and equipment for the reproduction of weather maps for student instruction and for exchange with other meteorological institutions. A comprehensive file of past data and weather charts is also maintained.

Additional subjects are also offered in meteorological instruments and climatology. The instruction in long-range weathe forecasting is based on the theories and results obtained at the Institute during the last few years. The special physical phenomena of the atmosphere, such as solar and terrestrial radiation, evaporation, condensation and precipitation processes, electricity and atmospheric optics are taken up in other subjects.

The Meteorological Instrument Laboratory contains standard instruments for the measurement and recording of atmospheric phenomena, including instrumentation for pilot balloon, airplane meteorograph and radio meteorograph soundings. Calibration chambers for use over a wide range of pressure, temperature and humidity are available, as well as other special laboratory apparatus.

Laboratory facilities for research in atmospheric condensation and precipitation processes are also available and equipment is at hand for experimental research in other fields of meteorology.

Meteorology Seminars sponsored jointly by Technology, Harvard University and the American Meteorological Society are held weekly during the academic year. At these meetings, recent developments in Meteorology and allied sciences are discussed by guest speakers, members of the staff, and students. Close coöperation is maintained with the Blue Hill Observatory of Harvard University, the Mount Washington Observatory, the Woods Hole Oceanographic Institution, the United States Weather Bureau, the United States Navy and the United States Army Air Forces.

Prospective students must meet the general requirements for admission to the Graduate School and should have specialized in one of the physical sciences or in engineering, with particular emphasis on physics and mathematics. Students with no previous training in meteorology will, in general, have to spend two years in residence to qualify for the Master's degree.

For United States Naval Officers

(Discontinued for duration of war.)

A graduate course leading to the degree of Master of Science in Meteorology for United States Naval Officers who have completed satisfactorily Schedules EL and E2L listed in the United States Naval Academy catalogue of 1939–40, and the summer instruction at United States Naval Air Station, and have completed satisfactorily the one-year schedule under the charge of the Department of Meteorology. (The regular three years of German, French or Spanish taken at Annapolis will be accepted as satisfying the language requirement.)

BUSINESS AND ENGINEERING ADMINISTRATION

Designed to prepare the technical graduate for ultimate executive responsibilities of an important nature, the course leading to the Master's degree in Business and Engineering Administration has for its three primary objectives an appreciation of the social implications of industry, an understanding of the interrelations of business and economics, and a familiarity with managerial as well as technical problems.

Breadth of viewpoint is developed by foundation subjects dealing with the economic, social and political background of business. Facility is stimulated through the study of actual problems encountered in the major fields of management: production, marketing, finance, accounting, law and labor relations. The professional point of view is encouraged by original investigations of contemporary industrial situations, selected because of their unusual interest and value to the individual student. Finally, through the privilege of electing subjects in other departments of the Institute, opportunity is offered for further advance in allied technical areas which have especial bearing upon the student's subsequent industrial activities.

Graduate study in this department presupposes preparation equivalent to that of a graduate of the Course in Business and Engineering Administration. With this preparation the candidate may reasonably expect to

Business and Engineering Administration Continued

complete the requirements for the Master's degree in one year. Without it, graduates from other courses at the Massachusetts Institute of Technology or from non-business courses in other accredited technical schools will undertake a two-year program. The first year of residence is devoted to the satisfying of prerequisites, and any remaining time during that year is assigned to additional subjects chosen from undergraduate electives. The second year is given wholly to graduate work, in accordance with the general requirements for the Master's degree.

Prerequisites to Graduate Study

In addition to satifying undergraduate requirements* for the Master's degree common to all courses, candidates should have taken a substantial number of engineering units similar to those prescribed in the optional groups listed in the undergraduate Course in Business and Engineering Administration. Candidates should also present evidence that they have had the equivalent of the following undergraduate subjects:

15·30	Personnel Management	15·92	Industrial Problems
15·41	Finance	Ec11T	Economic Principles
15·50	Accounting	Ec12T	Industrial Economics
15·61	Law of Contracts	Ec38	Industrial Statistics
15·70	Production	E35	Reports
15·81	Marketing		

and the equivalent of *any three* additional subjects to be selected from "B" subjects (other than those in business or economics in the preceding group).

The second or graduate-year program comprises a selection largely of "A" subjects, and the undertaking of a Master's thesis.

AERONAUTICAL ENGINEERING

Emphasis is laid on individual study and research. Each student must follow a consistent program of work directed toward some particular part of the aeronautical field, such as aerodynamics, design, instrumentation, structures or power plants. Since most phases of the graduate work in Aeronautical Engineering rest heavily upon mathematics and mechanics, aptitude in these subjects is very desirable.

Undergraduate Preparation

The preparation required for graduate work in Aeronautical Engineering is equivalent to that possessed by a graduate of the Massachusetts Institute of Technology in the undergraduate Course in Aeronautical Engineering. With this preparation the candidate may reasonably expect to complete the requirements for the Master's degree in Aeronautical Engineering in one year. Graduates of other engineering courses at the Massachusetts Institute of Technology or from non-aeronautical courses in other accredited engineering schools may register as graduate students but will usually find it necessary to devote a considerable portion of their first year of residence to making up their deficiencies in undergraduate aeronautical subjects, with a second year of strictly graduate work.

In addition to the general requirements for all graduate students, candidates for the degree of Master of Science in Aeronautical Engineering must present evidence of training in certain professional studies considered essential for all aeronautical engineers and corresponding approximately to the following Institute subjects:

2·311	Engineering Materials
2·42	Heat Engineering
2·701	Machine Drawing
16·02	Aeronautical Mechanics, Int.
16·10	Aerodynamics, Applied
16·20	Structures

*M22 Differential Equations is not prerequisite for graduate work in this Department.

Candidates must also present evidence of having had, in addition, sufficient undergraduate training to prepare them for the advanced subjects they wish to take. The amount of such training for groups named should be approximately equivalent to that included in the Institute subjects listed.

Group A. (Aerodynamics): 16·01, 16·02, 16·10, 16·11, 16·13, 16·17, 16·21, 16·62.

Group B. (Aeronautical Design): 16·11, 16·13, 16·14, 16·17, 16·21, 16·22, 16·62, 16·75.

Group C. (Aeronautical Structures): 1·135, 16·11, 16·13, 16·17, 16·21, 16·22.

Group D. (Instrumentation): 1·135, 6·40, 6·89, 16·13, 16·21, 16·22.

Group E. (Aeronautical Powerplants): 2·791, 2·792, 16·11, 16·21, 16·22.

If candidates have not had the special training in their chosen field of study listed under A, B, C, D or E before entering the Institute, they should acquire such training during attendance at the Institute. All subjects in these lists, except 6·40 and 6·89, may be counted as B subjects, along with 16·01 and 16·02 from the basic group, and (up to a total of 24 units), counted for credit toward the Master's degree.

Attention is drawn to the five-year program leading to simultaneous bachelor's and master's degrees, described under the Course XVI Undergraduate schedules.

Requirements for the Doctor's Degree

Special requirements for the degree of Doctor of Science in Aeronautical Engineering beyond the general requirements of the Graduate School are the following:

The student is expected to take graduate subjects in preparation for the general examination and thesis research, but no particular subjects are required. The general examination for the doctorate consists of two parts. The first is a written examination, consisting normally of six questions set to require, on the average, one day each to complete and to be answered with the aid of the student's notes and the library within one week from the date of issue.

The second is a three-hour oral examination following the successful completion of the first. The general examination, Minor and language requirements must be completed before the student is admitted to candidacy for the degree, which must be at least seven months before taking the degree.

For United States Naval Officers
Course Leading to the Degree of Master of Science

The degree of Master of Science will be awarded to United States Naval Officers who have completed satisfactorily Schedules E and E2 listed in the United States Naval Academy catalogue of 1939–40, and the summer instruction at the Naval Aircraft factory, and have completed satisfactorily the one-year schedule in the Department of Aeronautical Engineering. (The regular three years of German, French, or Spanish taken at Annapolis will be accepted as satisfying the language requirement.)

Research Facilities

The principal laboratory is the Wright Brothers Wind Tunnel, capable of air speeds from 40 to 400 miles per hour and permitting a variation of air density from one quarter to four atmospheres. An elliptical test section, *Aeronautical Engineering Continued*

7½ by 10 feet permits the testing of models up to 7½ foot span. The tunnel compressor equipment is adequate for research in compressible flows.

Other laboratory equipment consists of three smaller wind tunnels for model testing and instruction, having test sections 4 by 4 feet square, 5 feet diameter circular and 5 by 7½ feet rectangular, the largest capable of air speeds up to 100 miles per hour. Also, two research tunnels are available. One for boundary layer research is equipped with hot wire amplifier apparatus for turbulence studies, and the other with multiple stage throats for studies requiring low speed air streams essentially free of turbulence.

The Instrumentation Division is equipped with two laboratories. One supplies instruction in the fundamentals of instrumentation, design and testing, with particular emphasis upon the behavior of measuring systems under rapidly changing conditions. In this laboratory there is available apparatus for studying magnetic compasses and gyroscopic aircraft instruments, electrical and mechanical equipment for recording vibration in automotive powerplants, and for application to research problems of various kinds. In the other laboratory, the Vibrations Measurements Laboratory, there are instruments of many types for measuring vibratory displacement, velocity, acceleration and strain. There is also apparatus for both electrical and mechanical calibration which is being used in the development of new vibration-measuring instruments and for the quantitative performance studies of existing units. Courses on the fundamental principles of vibration measurements are based on work in this laboratory.

The Structures Laboratory is equipped for supporting various types of structures not readily adaptable to testing in ordinary testing machines. Loading devices and electrical and mechanical strain gauges are available so that studies of strain distribution under static loadings can be made on structures of types commonly employed in aircraft. By using some of the equipment available in the Vibrations Measurement Laboratory, stress distributions in structures subjected to dynamic loadings can also be investigated. The Structures Laboratory and the Vibrations Measurements Laboratory are operated in close coöperation.

The laboratories of the Mechanical Engineering Department are used for the investigation of mechanical and structural problems. Also, the facilities of the Sloan Automotive Engine Laboratory are available to students in Aeronautical Engineering, as are also the Meteorology, Metallurgy, Photoelastic and other laboratories of the Institute.

Students may also elect subjects given in other departments, but bearing a useful relation to their program of aeronautical studies. Those specializing in aircraft design will, in general, be advised to take advanced work in materials and elasticity; those choosing aerodynamics as their field may advantageously take courses in advanced physics, while those chiefly interested in engines should supplement their aeronautical studies by work in physical chemistry and in dynamics. The selection of such subjects is subject to approval of the registration officer.

ECONOMICS AND SOCIAL SCIENCE

Graduate Work in Economics

A small group of graduate students will be admitted to the Institute as candidates for the degree of Doctor of Philosophy in Industrial Economics. The following admission requirements have been established:

1. *General requirements:* S.B. or A.B. degree with a high academic record from a university of recognized standing.
2. *Course requirements:* Three full-year college subjects in social science chosen from the following: economics, psychology, sociology, and history. (One of these subjects must have been economics, and history subjects to be acceptable must have stressed economic and technical developments.) A knowledge of English similar to that included in the undergraduate curriculum of the Institute. At least one full year course in college mathematics and a year's work in college science.

Deficiencies in certain of these requirements may be removed at the Institute, although this special work may lengthen the necessary period of residence.

In the field of the Major, the candidate will be required to have some understanding of all the fields listed below. The candidate will take a general examination specifically covering at least four of these fields: Economic Theory, Socio-psychological Theory, Industrial Relations, Industrial Organization and Price Policy, Economics of Technological Change, Statistical Method and Theory, Economic History, the State in Relation to Industry.

There is already available at Technology a variety of subjects in the fields comprising this area. More advanced work in particular fields will be offered through the use of "reading and research" subjects taught by the tutorial method.

Following the Institute rules, the candidate for the Ph.D. will be required to take a Minor in a related field. Possibilities include: Business Administration, Biology and Public Health, Mathematics, Mechanical Engineering, Electrical Engineering, Geology, Metallurgy, Chemical Engineering, or any of the other technical subjects in which the student is qualified to participate. It would be expected, for example, that a student writing his thesis on certain economic problems in the textile industry would elect some subjects in textile technology.

The usual requirements with respect to language, residence, the thesis, and the final examination for the degree will apply. It is expected that the work will normally require three years of full-time graduate study and research.

Special significance will be attached to the thesis as a measure of the student's power in the field. For this thesis, which will occupy at least one year, it is expected that the student will select a topic involving considerable field work in industry. Research will be carried on in close collaboration with one or more members of the staff. The number of students accepted will be limited to the few who can be given an individual type of instruction.

Five-Year Course

The five-year course, combining undergraduate and graduate work, leads to the degree of Master of Science either in Economics and Engineering or in Economics and Natural Science. The degree is conferred at the end of the fifth year together with the degree of Bachelor of Science in the professional course in which the student has completed his undergraduate work. The student during the first four years completes his undergraduate requirements and at the same time takes one additional economics or business subject in each term of the third and fourth years. These additional subjects are made possible by omission of the senior thesis, and by means of electives available in the professional course, or by substitution, or by postponement of one or more professional subjects to the fifth year. The major part of the fifth year is devoted to social science subjects, including a thesis which should have an economic as well as an engineering aspect. The usual requirements as to "A" and "B" subjects for the Master's degree apply to this curriculum.

Economics and Social Science Continued

This five-year course is open to graduates of the Institute who may be admitted to the Graduate School and who meet the requirements of the Master's degree based on a program of advanced work as outlined above. It is not open to students in the Course in Architecture or in Business and Engineering Administration, or to graduates of other colleges who come to the Institute to specialize in Economics unless, in addition to the advanced work in Economics, they complete in residence a program of work in one of the departments of engineering or science approved by the Committee on the Graduate School.

The Department of Economics and Social Science also offers instruction to graduates who are studying for advanced degrees in other departments. Such students may, for example, submit economics as their Minor requirements for the doctorate.

MATHEMATICS

The Department of Mathematics offers courses leading to the degrees of Master of Science, Doctor of Philosophy, and Doctor of Science.

The course of each student will be arranged in consultation with the Department. A student who is interested in applied mathematics may also be allowed to select subjects offered in other departments. Before receiving a Graduate Degree in mathematics a student is expected to complete the undergraduate mathematics subjects in Course XVIII, Option 1, or their equivalents.

To obtain the degree of Master of Science the student must elect in each term at least three subjects of advanced mathematics or allied subjects, and fill the remaining time with other electives and thesis.

For the degree of Doctor of Philosophy, the student must fulfill the mathematics requirements for the degree of Bachelor of Science in Course XVIII, Option 1. Each candidate must select a major field of interest — analysis, geometry or applied mathematics — and complete the program of subjects prescribed by the Department as appropriate to this major field. Ordinarily the last year will be spent on research and the completion of the thesis.

Candidates for advanced degrees who work in the field of applied mathematics will be required to follow a course of study covering important aspects of one or more engineering and scientific fields together with a selected sequence of mathematics subjects. Assistance or even collaboration in practical problems in applied mathematics being investigated by members of the staff will constitute an important part of graduate programs. The student working for an advanced degree in applied mathematics thus will be enabled to carry on his research work with any of the members of the staff working in his field in any department of the Institute. His thesis advisers may include experts familiar with these practical problems as well as experts familiar with advanced mathematical techniques.


INSTITUTE OF TECHNOLOG


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DESCRIPTION OF SUBJECTS

The list below is necessarily subject to change due to present conditions

The prerequisites, units of exercise and preparation, and instructors in charge of each subject will be found under "Subjects of Instruction Tabulated"

CIVIL AND SANITARY ENGINEERING

SUBJECTS 1·00 TO 1·99

1·00. SURVEYING. An elementary course in the theory and practice of plane and topographical surveying. Breed and Hosmer's *Principles and Practice of Surveying, Vol. I.*

1·01. TOPOGRAPHICAL DRAWING. A course in making scale drawings, profiles, contour maps, and conventional signs for topography, followed by a study of their application to the solution of engineering problems. Includes elementary field work in plane surveying. Breed and Hosmer's *Principles and Practice of Surveying, Vol. I.*

1·02. SURVEYING. A course in elementary surveying, which includes theory and fieldwork. Breed's *Surveying.*

1·052. SURVEYING. Fieldwork in plane surveying fo students who have taken the theory and practice of surveying in 1·00 and 1·01. Breed and Hosmer's *Principles and Practice of Surveying, Vol. I.*

1·053. SURVEYING. Fieldwork in topographical surveying including the stadia method and the plane table. Determination of position by triangulation. Also includes astronomical observations for the determination of azimuth, time, and latitude. In the drafting room maps are made from the field notes. Breed and Hosmer's *Principles and Practice of Surveying, Vols. I and II;* Hosmer's *Practical Astronomy.* (Not offered Nov. 1944–June 1945.)

1·12. ASTRONOMY AND SPHERICAL TRIGONOMETRY. Supplements 1·00 and 1·01, and is therefore treated from the standpoint of the engineer. Spherical trigonometry covers the principles of the subject sufficiently to serve as a preparation for the work in astronomy. The class work in the latter includes the theory of spherical and practical astronomy. The fieldwork is given in 1·053 and includes the determination of latitude, longitude, time and azimuth with the engineer's transit. Hosmer's *Practical Astronomy.*

1·13. GEODESY. The methods of conducting a geodetic survey are discussed in detail, including the mathematical treatment of base line measurements, triangulation and precise leveling. Hosmer's *Geodesy.*

1·135. INTRODUCTION TO VIBRATION THEORY (B). Basic theory of free and forced vibrations with and without solid and fluid friction. To meet the needs of practical engineering, special emphasis is placed upon the analysis of various vibration measuring devices, accelerographs, frequency meters, etc. The proper interpretation of the results obtained from such devices is studied in detail and attention is given to the principles of design of instruments and recording systems. Practical problems of mechanical vibration and of vibration prevention are discussed.

1·136. VIBRATION PROBLEMS (A). (Not offered Nov. 1944–June 1945.)

1·138. SEISMOLOGICAL LABORATORY (B). (Not offered Nov. 1944–June 1945.)

1·141, 1·142. ADVANCED GEODESY (A). (Not offered Nov. 1944–June 1945.)

1·16. AERIAL SURVEYING (B). A study of the various methods of constructing maps from photographs for engineering purposes, and the methods of making topographic maps from vertical and from oblique photographs. A study is also made of the different methods of control of aerial surveys. The work covered is confined to the methods of producing the maps from the photographs, and does not take up the technical work of photography or of piloting.

1·21. RAILWAY AND HIGHWAY CURVES. A thorough study of the mathematics of curves with applications to location and property lines of railways, highways and waterways. Simple, compound, reversed, spiral and vertical (parabolic) curves are treated. Sufficient fieldwork is given to illustrate the methods of laying out simple curves and spirals. Allen's *Railroad Curves and Earthwork;* Allen's *Field and Office Tables.*

1·25. ENGINEERING CONSTRUCTION (B). Deals primarily with the construction of civil engineering works, such as railways, highways, water power, water supply and similar projects. The subjects covered are estimates and reports, contracts and specifications, methods of economic comparison, financing of engineering projects, engineering organization and duties, acquisition of land, and construction methods including clearing of the site, earth and rock handling, and construction of structures of concrete, steel and timber. Principles are illustrated by studies of typical projects. Particular attention is given to methods of control of concrete mixtures. (Not offered Nov. 1944–June 1945.)

1·26. RAILWAY SIGNALING (B). (Not offered Nov. 1944–June 1945.)

1·271, 1·272. TRANSPORTATION ENGINEERING (B). Transportation by railway and highway with some attention to air and inland water transportation. Subjects treated in the highway field include traffic surveys and traffic control, highway pavement design, construction methods, characteristics of motor vehicles, cost of highway transportation, and economics of highway design, finance, regulation and taxation. In the railroad field subjects covered are maintenance of way, signals, motive power and cars, train resistance and tonnage rating, I.C.C. accounting and regulation, and economics of location and operation. Special attention is given to the coördination of the different forms of inland transportation. Design periods are devoted to problems in highway, railway or airport location and design.

1·301, 1·302. ADVANCED RAILWAY TRANSPORTATION (A). (Not offered Nov. 1944–June 1945.)

1·32. DESIGN OF HARBOR WORKS (A). (Not offered Nov. 1944–June 1945.)

1·34. MUNICIPAL ENGINEERING (B). An elementary subject especially arranged for students in City Planning. It deals with the phases of municipal engineering that must be considered by those responsible for the planning or replanning of towns and cities. Subjects covered include the location, design, construction and maintenance of city streets; a study of urban problems of traffic and transportation; and a brief consideration of municipal systems of drainage, water supply, sewage disposal and other public utilities.

1·35. ROADS AND PAVEMENTS. Principles and practice in the construction and maintenance of highways and city streets, with particular emphasis on pavement types used on highways, streets and airports.

1·371, 1·372. ADVANCED HIGHWAY TRANSPORTATION (A). Study of research results and methods of design, construction, maintenance, operation and economics of highways.

1·38. HIGHWAY DESIGN (B). A design for the improvement of an existing highway by substitution of improved alignment,

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grades and new pavement, and the preparation of an estimate of cost.

1·39. Graphic Statics. Graphic methods of problems dealing with forces and reactions, curves of bending moment and shear and stresses in simple trussed structures. Hudson and Squire's *Elements of Graphic Statics.*

1·40. Theory of Structures. An introductory subject covering outer forces, reactions, moments and shears for fixed and moving loads, the use of influence lines, the design of steel and wooden beams, plate girders, and the analysis of continuous beams by the use of the Equation of Three Moments. Spofford's *Theory of Structures.*

1·401. Theory of Structures. An abridgement of 1·40 for students in Courses IX-[illegible] and XVII. Spofford's *Theory of Structures.*

1·41, 1·42. Theory of Structures (B). An extended subject in continuation of 1·40. It deals with the analysis of the more common structures of wood, steel, and masonry, principally by algebraic methods. First term: statically determinate trusses of various forms including simple end supported trusses, three-hinged arches, cantilevers, bracing, towers, and space frames; also certain types of statically indeterminate structures by approximate methods, such as, building frames under horizontal loading, trusses with multiple web systems, and portal frames. Second term: methods of finding deflections of structures by methods of moment areas, elastic loads, virtual work and Williot diagram. This is followed by a study of methods of solution for stresses in statically indeterminate structures by virtual work, least work, slope deflection, and moment distribution. The structures considered are continuous beams, trusses, building frames and arches.

1·45. Materials of Construction. A study of the more important structural materials, especially timber, concrete and steel, with some attention to other forms of masonry, and certain non-ferrous metals. The characteristics of these materials are considered in relation to their use for construction purposes, both permanent and temporary. Consideration is also given to the principal manufacturing processes, and especially to circumstances affecting the quality and durability of completed structures.

1·481. Soil Mechanics (B). Considerations of physical and mechanical properties which affect soil action in engineering problems; coefficients of permeability, capillarity and compressibility and their application in practical problems relative to seepage, uplift, liquefaction and the settlement of buildings located above buried compressible soil strata. Also reading assignments on soil sampling, excavation, cofferdams and caissons. Laboratory exercises in soil testing.

1·482. Foundations and Embankments (B). Continuation of 1·481 covering shearing strength and bearing capacity and their application in problems relative to stabilities of embankments, cuts, retaining walls, shallow footings and pile foundations. Reading material including types of piles and types of foundations. Special attention given to pressure distribution on retaining walls and footings; to site investigations and selection of sites; to correlation with the closely related field of engineering geology; and to case studies of a wide range of general foundation problems.

1·491. Soil Mechanics (A). A detailed study of those physical and mechanical properties of soil which govern its behavior as an engineering material. Basic soil classifications; studies of the laws of permeability, capillarity and seepage; compressibility and consolidation theory followed by settlement analysis of structures which are founded above compressible soil strata; studies of relationships of stresses, strains, and shearing strengths in cohesive and cohesionless soils; critical densities and the quicksand phenomenon in cohesionless soils. *Mimeographed Notes.*

1·492. Soil Mechanics (A). Specific applications of modern soil research are considered on the basis of the physical studies of 1·491. Stability of slopes and retaining walls; earth and masonry dams, with special reference to stability, seepage, and piping effect; bearing capacity and settlement of foundations; piles and pile groups; frost action; and special types of foundations. *Mimeographed Notes.*

1·493. Soil Mechanics Laboratory (A). Technique of soil testing, including measurements of specific gravity, water content, density and limits of consistency; mechanical analyses; permeability, consolidation and shear tests; various special tests.

1·495, 1·496. Soil Mechanics (A). (Not offered Nov. 1944–June 1945.)

1·501. Bridge Design (B). Shows the relation of the theory of structures to engineering practice through the preparation of designs and drawings for a riveted plate girder railway bridge, a welded girder bridge and a steel truss highway bridge. Emphasis is laid on the development of careful, systematic and practical habits of computation.

1·502. Structural Design (B). An extension of 1·501 including the design of a wooden roof truss, a reinforced concrete highway bridge, a reinforced concrete retaining wall, and a steel truss continuous over two spans. Also an analysis for a reinforced concrete arch.

1·521, 1·522. Structural Laboratory (A). Covers by lectures, conferences, assigned reading and laboratory work, the theory and practice of structural analysis by the use of models. The fundamentals of the entire field are discussed first, and later work is arranged to cover fields of special interest to individual students. Time will be arranged to suit these individual requirements.

1·541, 1·542. Advanced Reinforced Concrete Design (A). First term: a more advanced treatment of the subject matter handled in 1·58, designed for graduate students from other colleges who have already had some training in this field. A complete design for an interior bay of a typical factory building, illustrating design of floors of various types, columns, footings, etc. Second term: a continuation of 1·541, dealing with more difficult types of concrete structures, such as the rigid frame bridge, domes, tanks and similar structures.

1·551, 1·552. Advanced Structural Design (A). A study of problems met by the designing engineer, such as choice of type, economics, design, erection methods, with special reference to indeterminate structures, such as high buildings, arches, suspension bridges, and continuous trusses.

1·561, 1·562. Advanced Structural Theory (A). A study of the basic theorems underlying the analysis of statically indeterminate structures, and the methods of applying these theorems in the analysis of such structures, computation of deflections by various methods, secondary stress analysis.

1·571, 1·572. Statically Indeterminate Structures (A). A detailed study of certain types of indeterminate structures such as continuous and suspension bridges, high building frames, arches, arched dams.

1·58. Design of Reinforced Concrete Structures (B). The elementary principles of reinforced concrete with the consideration of methods and rules used in design of concrete structures.

1·59. Concrete Research (A). (Not offered Nov. 1944–June 1945.)

1·62. Hydraulics. Basically, a fundamental course in the mechanics of compressible and incompressible fluids with emphasis placed on hydraulics. Includes statics, kinetics, dynamics, hydraulic turbines and centrifugal pumps. The flow of water through orifices, nozzles, weirs, pipes and open channels is emphasized, but the flow of other fluids is included. Russell's *Hydraulics, Fifth Edition.*

1·63. Hydraulics. Comprises the essentials of 1·62 but turbines and pumps are omitted, and the treatment of pipe-flow and open channels is abbreviated. Russell's *Hydraulics, Fifth Edition.*

1·64. Hydraulics. Comprises the essentials of 1·62 but the treatment of pipe-flow and open channels is abbreviated. Russell's *Hydraulics, Fifth Edition.*

1·66. Advanced Hydraulics (A). An elaboration of subjects fundamentally treated in 1·62 and, in addition, studies in the advanced field of theory and practice. Subjects included are: general fluid flow in pipes; open channels with special reference to non-uniform flow, alternate stages, critical stage,

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surface curves, hydraulic jump, transitions and wave formations. Russell's *Hydraulics, Fifth Edition; and professional papers.*

1·681. Theory of Models (A). (Not offered Nov. 1944–June 1945.)

1·682. River Hydraulic Laboratory (A). (Not offered Nov. 1944–June 1945.)

1·69. River Engineering (A) (Not offered Nov. 1944–June 1945.)

1·70. Hydrology (B). A study of the basic theory of the occurrence and distribution of water on the surface of the earth. The subject includes: precipitation, run-off, infiltration, water losses and their relations, analysis of stream flow data, and frequency and magnitude of flood flows and the effect of reservoirs in reducing them. Classroom work is supplemented by supervised problems of applied hydrology in the drafting room. Barrows' *Water Power Engineering.*

1·701. Hydrology (B). An abridgement of 1·70 including the theory, but omitting the practical application in the drafting room. Barrows' *Water Power Engineering.*

1·71. Water Power Engineering and Flood Control (B). A study of the problems involved in the location, design, construction and economics of hydroelectric developments as a foundation for practice in this field, or for the advanced studies of the graduate year. It includes estimates of water power from stream flow data, theory and practice of hydraulic turbines, elements of design of dam, waterway and power house, cost and value of water power and flood control, including flood damages and the selection and planning of reservoirs for flood control. Supplemented by drafting room exercises with reports and problems of design. Barrows' *Water Power Engineering.*

1·711. Water Power Engineering and Flood Control (B). An abridgement of 1·71 including the theory but omitting the practical design work in the drafting room. Barrows' *Water Power Engineering.*

1·731, 1·732. Advanced Water Power Engineering (A). (Not offered Nov. 1944–June 1945.)

1·75. Hydraulic and Sanitary Engineering (B). A comprehensive study of the principles of water supply engineering, which includes rainfall and run-off, consumption of water, surface and ground water supplies, dams and impounding reservoirs, supply and distribution works, principles of treatment of water, and design of treatment works. Opportunities for group inspection of nearby water works construction and water treatment works are included.

1·76. Sanitary Engineering (B). A study of the principles of design of sanitary sewers and storm drains, including methods for estimating the quantity of sewage and storm water run-off and methods of design and construction of sewage collecting systems and appurtenances. This is followed by a study of the principles of sewage treatment and the design and construction of treatment works. Opportunities are offered for group inspection of nearby sewage works.

1·77. Sanitation. Survey of public and individual water supply and purification methods; uses of water in buildings, cooking, washing, bathing, swimming, waste disposal, fire protection, processing; elementary hydraulics as applied to plumbing fixtures and supply, waste, and vent piping; layout problems. Health aspects of water supply, of sewage, refuse, and garbage disposal, of insect and rodent protection. Public and individual methods of disposal and treatment. Surface and ground water drainage problems.

1·781. Sanitary Chemistry. The physical chemistry of water and its impurities; solutions, suspensions, colloids, and chemical equilibria.

1·79. Sanitary Design (B). The design of a sanitary intercepting sewer for a small community followed by the design of a system of storm drains for a small area.

1·801. Hydraulic and Sanitary Design (B). An investigation for and report on a gravity water supply for a small community.

1·811. Advanced Sanitary Engineering (A). A comprehensive study of the principles of modern water treatment engineering, including coagulation, sedimentation, filtration, sterilization, softening, corrosion, and removal of tastes and odors. Opportunities are offered for group inspection of nearby treatment works.

1·812. Advanced Sanitary Engineering (A). A comprehensive study of the principles of modern sewage treatment engineering, including screening, removal of grit, sedimentation, removal of colloids and stabilization by contact surfaces and by aeration with activated sludge, chlorination [illegible]age, digestion, treatment and disposal of sludge, and collection and utilization of gas. Opportunities are offered for group inspection of nearby sewage works.

1·821, 1·822. Sanitary Engineering Laboratory (A). Lectures, conferences, assigned readings, and laboratory studies of water, sewage and industrial wastes and methods of treatment. Time will be arranged to suit individual requirements.

1·851, 1·852. Advanced Water Power Design (A). (Not offered Nov. 1944–June 1945.)

1·881. Sanitary Design, Advanced (A). The design of a modern water treatment plant to effect the proper treatment of a given water for domestic and industrial consumption. Conducted in parallel with 1·811.

1·882. Sanitary Design, Advanced (A). The design of a modern sewage treatment plant to effect the proper treatment of a given raw sewage. Conducted in parallel with 1·812.

The following subject is offered as a General Study. For description see Division of General Studies.

G22. Development of Transportation.

MECHANICAL ENGINEERING

Subjects 2·00 to 2·99

2·00, 2·01. Applied Mechanics. *Statics:* Analysis of force systems in two and three dimensions, laws of equilibrium, analysis of simple frames and machine structures, cables and chains, friction, distributed forces, centers of gravity, the principle of virtual work. *Strength of materials:* Stress and strain in tension and compression, the tension test, Hooke's law statically indeterminate cases, strain energy. *Kinematics,* Velocities and accelerations of various types of mechanisms. *Dynamics:* Rectilinear and curvilinear translation of particles and rigid bodies, rotation of rigid bodies about fixed axes, moments and products of inertia of rigid bodies, application to engineering problems.

2·011. Applied Mechanics. Abridged from 2·00 and 2·01.

2·04. Applied Mechanics. *Strength of Materials.* Elementary analysis of stress and strain in two dimensions, shear stresses and torsion of circular bars, riveted joints, stress concentration, cases of simple loading of thin rings, cylinders and spheres, the theory of bending, including shearing forces and bending moments, the distribution of normal and shearing stresses, the differential equation of the elastic curve and different methods for the determination of slopes and deflections, column theory, working stresses. Applications to important engineering problems. Timoshenko and McCullough, *Elements of Strength of Materials.*

2·041. Applied Mechanics. A somewhat more comprehensive treatment of the subject matter covered by 2·04, with laboratory exercises. (For U. S. Naval Officers only.)

2·042. Applied Mechanics. Similar to 2·04, arranged for students taking the short preparatory courses.

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2·06. Applied Mechanics. *Dynamics.* Plane motion of rigid bodies, relative motion with application of Coriolis accelerations, the principal of virtual work, and d'Alembert's principle, momentum and energy, introduction to vibrations of simple systems. Application to important engineering problems, such as balancing and vibration of rotating and reciprocating machinery, methods of measuring power, governors, etc. Timoshenko and Young, *Engineering Mechanics.*

2·061. Applied Mechanics. A more comprehensive treatment of the subject matter covered by 2·06. (For U. S. Naval Officers only.)

2·07. Applied Mechanics. Similar to 2·06. Arranged for students in Course VI with emphasis on electromechanical systems.

2·081. Applied Mechanics (B). *Strength of Materials.* Study of problems of mechanical strength in engineering. Review of stress and strain at a point in two dimensions, the torsion problem with description of membrane analogy, review of bending with application to composite beams, beams on elastic foundations, plates and sheets, curved beams and thick cylinders, strain energy methods, failure of metals under stress, plastic flow, creep, fatigue, influence of stress concentration and working stresses. Miscellaneous applications to problems of industry, such as steam piping, rotating machinery, railroad tracks, turbine buckets, etc.

2·082. Applied Mechanics (B). *Dynamics.* A study of dynamical problems in engineering. Vibrations of simple systems, free and forced motion with damping, nature of damping and internal friction, self-excited motions. Vibration of systems with several degrees of freedom, normal modes and frequencies, approximate methods. Torsional vibration. Vibration isolation. Vibration dampers. Control problems. Rotation of rigid bodies about a point with applications to gyroscopic problems A brief review of the historical development of mechanics, with emphasis on the significance of the basic principles. Application to important engineering problems in power and marine engineering, automotive engineering, aeronautics, railroads, etc.

2·10. Ordnance Engineering (B). Lectures and calculations on gun design, including stresses and strains in built-up and wire-wrapped guns; the design of recoil and counter recoil mechanisms.

2·11. Industrial Plant Engineering (B). (Not offered Nov. 1944–June 1945.)

2·121. Applied Photoelasticity (B). Instruction and practice in the use of commercial photoelastic apparatus with applications in the analysis of common engineering problems in two and three dimensions, together with lectures on modern photoelastic theory, materials, and methods.

2·125. Research in Photoelasticity (A). Opportunity is afforded graduate students to apply photoelasticity to the solution of special problems, or to take part in current development of photoelastic theory and technique.

2·141, 2·142. Advanced Dynamics in Mechanical Engineering (A). (Not offered Nov. 1944–June 1945.)

2·211, 2·212. Advanced Mechanical Engineering Problems (A). Analytical treatment of advanced problems in mechanical engineering, with emphasis on topics which have figured in recent industrial developments, and which impose limitations on further progress.

2·221. Plasticity (A). Mechanics of the plastic state of materials with particular emphasis on engineering applications. Mohr's representation of stress and strain in both two and three dimensions. Theories of strength in relation to design. Choice of working stresses under combined stress. New developments in stress-reduction in area relations for metals. General laws of plastic flow as applied to torsion, bars under combined stress, rotating discs, the cold working of tubes under internal pressure, etc.

2·222. Advanced Plasticity Problems (A). Continuation of 2·221 with practical applications to a number of modern engineering problems. The bending, deflection, and buckling of bars and tubes in the plastic state. Creep of both metals and non-metals at normal and elevated temperatures. Relaxation of stresses in bolted flanged connections, and in other design applications. Residual stresses as determined from calculation and experiment. The rolling, drawing, and extrusion of metals. Plastic flow problems in the field of synthetic plastics. Special problems are chosen in consultation with the instructor, and some laboratory work is included.

2·223. Plasticity Research (A). Experimental and theoretical investigations are carried through in the general field of the plasticity of engineering materials.

2·251. Fluid Mechanics. The following fundamentals are taken up: physical properties of fluids, hydrostatics, continuity, Euler's equations, steady flow energy equation, momentum equation, dimensional analysis. Applications to: flow in pipes and fittings, hydraulic machinery.

2·252. Fluid Mechanics. Continuation of 2·251. Potential flow, circulation theory of lift, boundary layers, drag, heat transfer between solids and fluids, lubrication.

2·256. Fluid Mechanics (B). Physical properties of fluids, hydrostatics, kinematics and continuity, dynamics of ideal and of viscous fluids, dimensional analysis and physical similarity, potential flow and circulation, flow in pipes, boundary layers, single airfoils and a series of airfoils, hydraulic machinery, lubrication, heat transfer.

2·258. Hydraulic Transmission and Control (B). Review of principles of fluid mechanics and application to basic problems, such as: Leakage, flow in pipes, orifices and valves; elasticity of fluid and piping. Current practice in the application of hydraulic pumps and motors, control devices and auxiliaries. Analysis of typical hydraulic circuits. (Primarily for students in Electrical Engineering.)

2·271. Hydromechanics (A). (Not offered Nov. 1944–June 1945.)

2·30. Engineering Metals. A study of the principles involved in the production of cast metal parts. Lectures cover pig iron, ferrous and non-ferrous alloying, centrifugal casting, die casting, casting design, and inspection methods. Laboratory work consists of demonstration practice and reports on hand and machine molding, core making and testing, sand testing, cupola operation, oil and gas furnace melting of ferrous and non-ferrous metals, permanent mold casting, and the testing of cast metals. *Metal Castings,* Campbell.

2·31. Engineering Materials. A study of the manufacture, treatment, properties, and uses of wrought ferrous and non-ferrous metals, and the more important non-metallic engineering materials. Includes the manufacture of wrought iron and steel, wrought non-ferrous metals, hot and cold working processes and equipment, effect of alloys and heat treatment, fatigue, high temperature effects, corrosion, physical properties, metal working calculations; and properties and uses of timber, cements, concrete, protective coatings, rubber, glass, mechanical fabrics, and plastics. *Engineering Materials,* White.

2·311. Engineering Materials. A consolidation of the material covered in 2·30, 2·31, and 2·32 to suit the requirements of a shorter course on the subject of materials and metal processing for other than mechanical engineering students. *Engineering Materials,* White.

2·312. Metal Processing. A brief subject covering casting, hot and cold working, and welding of metals. Arranged for students in metallurgy.

2·32. Engineering Metals. A study of the fundamentals of the welding processes as applied to manufacturing and construction, and their influence on metals. Processes include manual and automatic A.C. and D.C. arc welding; oxy-acetylene welding; spot, seam, butt, and flash resistance welding; gas cutting, flame machining, and hard surfacing. Emphasis is placed on the general problem of design for welding and on the effect of welding procedure on the properties of welded joints. *Welding and its Applications,* Rossi.

2·34. Advanced Metals and Testing (B). A study of mechanical properties of metals and their determination and the photoelastic method of stress analysis. Under mechanical properties and tests the subjects covered are tensile tests, creep fatigue, impact, wear, and temperature effects. In fatigue the effects of size, speed, stress concentration, corrosion, and frettage corrosion are discussed and also empirical relations for

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adapting laboratory data to design; while the work in photoelasticity embraces the study of stress distribution in two-dimensional models. Laboratory exercises are designed to illustrate some of the more important aspects covered in the lectures and to indicate the methods commonly used in making experimental stress analyses.

2·37. TESTING MATERIALS LABORATORY. Laboratory methods for the determination of the physical properties of engineering materials and their behavior under stress. The usual methods are supplemented by stress analysis through strain determination and photoelastic methods, tests at abnormal temperatures, special hardness tests. Fabrics testing, X-ray examination and research problems are included in the lecture material. *Materials Testing*, Cowdrey and Adams.

2·371. TESTING MATERIALS LABORATORY. Methods of making physical tests to determine the properties of the more common engineering materials and a study of their behavior under stress. *Materials Testing*, Cowdrey and Adams.

2·372. TESTING MATERIALS LABORATORY. Covers the material of 2·371 with the additional time devoted to concrete proportioning and testing. The laboratory work will be supplemented by discussions of testing methods and apparatus.

2·373. TESTING MATERIALS LABORATORY. Covers the material of 2·371, and in addition a three-hour period per week is devoted to the study of cement and concrete. Especially adapted to Course XVII.

2·40. HEAT ENGINEERING. The First Law of Thermodynamics and internal energy. The properties of liquids, vapors, and gases. The Second Law of Thermodynamics, the temperature scale and entropy. Applications to closed systems and to fluids in steady flow. Steady-state heat transfer through resistances in series and between flowing streams. *Thermodynamics*, Keenan; *Steam Tables*, Keenan and Keyes.

2·402. HEAT ENGINEERING. First and second laws of Thermodynamics, with applications to the properties of gases, vapors and mixtures. The laws governing the flow of gases and vapors, with applications to boilers, nozzles, orifices, throttle valves, calorimeters, steam engines, steam turbines, gas engines and gas turbines. Steady-state heat transfer through resistances in series and between flowing streams. Laboratory classes will supplement the lectures. *Thermodynamics*, Keenan, *Steam Tables*, Keenan and Keyes. (For U. S. Naval Officers only.)

2·402T. HEAT ENGINEERING. Same as 2·402, omitting laboratory. (For U. S. Naval Officers only.)

2·41. HEAT ENGINEERING. A brief study of the fundamental laws and conceptions of engineering thermodynamics; the physical properties of gases, saturated and superheated vapors and their application to thermodynamic problems including the use of steam tables and charts; the laws governing the flow of gases and vapors and their use in heat engineering; elementary steam turbine theory and practice; theoretical vapor cycles; the reciprocating steam engine; theoretical gas cycles and the internal combustion engine; theory and practice of gas compression; steam boilers, accessories and the elementary principles of combustion. A brief discussion of the principles of refrigeration, heat transmission and humidity problems. In connection with the applications, the principal apparatus and machines involved will be briefly discussed.

2·42. HEAT ENGINEERING. Reciprocating engines and turbines, power-plant cycles, the air standard cycle of the internal combustion engine, gas mixtures and internal combustion engines, mixtures of air and water vapor, and an introduction to the thermodynamics of chemistry. *Thermodynamics*, Keenan; *Steam Tables*, Keenan and Keyes.

2·422. HEAT ENGINEERING. The application of the laws governing the flow of gases, vapors and mixtures in power plant cycles, air conditioning, air compressors and refrigerating compressors. Comparison of the freon, carbon dioxide, water and air compression refrigeration cycles. Elementary discussion of absorption refrigeration systems. *Thermodynamics*, Keenan; *Steam Tables*, Keenan and Keyes. (For U. S. Naval Officers only.)

2·43. HEAT ENGINEERING (B). Review of first and second laws of thermodynamics, compressors, refrigeration cycles. The design of apparatus for heat transfer by conduction, convection and radiation. *Thermodynamics*, Keenan; *Heat Transmission*, McAdams.

2·44. HEAT ENGINEERING (B). (Not offered Nov. 1944–June 1945.)

2·45. ADVANCED ENGINEERING THERMODYNAMICS (A). The first and second laws of thermodynamics, their application to fixed mass and steady flow processes and to the determination of the properties of fluids. An introduction to the thermodynamics of solutions and chemical reactions and a study of the equilibrium of a pure substance. *Thermodynamics*, Keenan.

2·451. ADVANCED PROBLEMS IN ENGINEERING THERMODYNAMICS (A). (Not offered Nov. 1944–June 1945.)

2·461. ADVANCED REFRIGERATION (A). (Not offered Nov. 1944–June 1945.)

2·50. HEAT MEASUREMENTS. Laboratory exercises in the practice of heat measurements, including various types of temperature measuring instruments, heat of combustion and heat transfer. Lectures on the theory of temperature measurement, heat transfer and heat insulating materials.

2·501. HEAT MEASUREMENTS. Same as 2·50, omitting the lectures.

2·53. HEAT MEASUREMENTS (A). Selected experiments with laboratory investigation of problems connected with the industrial application of heat such as thermal conductivity, thermal expansion, specific heat, ceramics, etc.

2·551. POWER PLANT ENGINEERING (B). The production and use of steam for the generation of power, including a study of the fundamental types of steam boilers, fuel burning equipment, prime movers and their allied apparatus. The fundamentals of the Diesel and hydraulic power plant are included.

2·57. POWER PLANTS, ADVANCED (A). (Not offered Nov. 1944–June 1945.)

2·58. HEAT ENGINEERING IN INDUSTRIAL PLANTS (B). (Not offered Nov. 1944–June 1945.)

2·59. TORPEDOES (B). Deals with the utilization of energy in the power plant of a torpedo. Includes the thermodynamics of gas and vapor mixtures, the laws of combustion of gaseous mixtures, heat losses, and the laws of heat transmission. The principle of the flow of fluids is applied to the calculation of the time required to decrease the pressure in the air tank, to design gas turbine nozzles and to determine the power developed in the turbine. (For U. S. Naval Officers only.)

2·60, 2·601. FOOD ENGINEERING. (Not offered Nov. 1944–June 1945.)

2·621. REFRIGERATION ENGINEERING (B). (Not offered Nov. 1944–June 1945.)

2·622. REFRIGERATION ENGINEERING (B). Refrigeration at more than one level. Low temperature refrigeration. A study of the operation of various types of compressors, evaporators, condensers, and automatic controls used in commercial refrigerating systems. Heat flow problems in condensers and evaporators. Theory and calculation of size of cooling towers. Application of refrigeration in the manufacture of water ice, eutectic ice and dry ice.

2·64. REFRIGERATION ENGINEERING (A). (Not offered Nov. 1944–June 1945.)

2·66. HEATING, VENTILATION AND AIR CONDITIONING (B). Study and calculation of load, direct and indirect heating systems, heating boilers and water heaters, ventilation and the fundamentals of air conditioning.

2·661. HEATING AND VENTILATION. A study of the thermal balance in the human body in relation to the thermal balance in a surrounding building enclosure. Thermal relationships of the building to climate and weather. Insulation of the building to provide a suitable enclosure. Techniques of heating, heat generation and their control.

Mechanical Engineering Continued

2·662. Heating and Ventilation. A continuation of 2·661 to study ventilation and its techniques together with a discussion of the fundamental problem and techniques of cooling for comfort.

2·671. Air Conditioning, Advanced (A). A study of the psychrometric and comfort data with application to air conditioning problems. Typical air conditioning equipment and controls will be studied with their application to various types of problems.

2·672. Heating and Ventilation Design (A). (Not offered Nov. 1944–June 1945.)

2·680. Engineering Laboratory. The use and calibration of instruments used in mechanical engineering; the use of metering devices for air, steam, and water; the practice of heat measurements including heat of combustion of fuel and heat transfer; experimental studies involving the use of steam engines, steam turbine driven pumps, steam pumps, steam specialties, stationary internal combustion engines, an air blower and a single stage air compressor.

2·682. Engineering Laboratory (B). A continuation of 2·680 with equipment such as the following: an air washer for humidity control, a two-stage air compressor, the M. I. T. power and heating plant, heat exchangers, a hydraulic turbine, and a refrigeration machine.

2·683. Engineering Laboratory. Similar to part of 2·680.

2·684. Engineering Laboratory. Continuation of 2·683.

2·685. Engineering Laboratory. A combination of 2·683 and 2·684.

2·686, 2·688. Engineering Laboratory. Similar to 2·680. The exercises assigned to the several Courses differ somewhat according to the several fields of interest.

2·687. Hydraulic Laboratory. Supplements classroom theory and includes exercises upon orifices, nozzles, wiers, pipes, hydraulic turbines, centrifugal pumps, and other hydraulic equipment.

2·691. Refrigeration Laboratory (B). (Not offered Nov. 1944–June 1945.)

2·692. Air Conditioning Laboratory (B). (Not offered Nov. 1944–June 1945.)

2·693. Advanced Refrigeration and Air Conditioning Laboratory (A). (Not offered Nov. 1944–June 1945.)

2·701. Machine Drawing. Engineering drafting room procedure and technique in the production of working drawings of machinery. *Working Drawings of Machinery*, James, Mackenzie and Sloane.

2·72. Machine Design. Discussion of the theories of common mechanisms, with their application in design. Includes wrapping connectors, screws, spur and bevel gears, worm gearing, shafts, bearings, etc. Materials, forms and proportions of parts, friction and efficiencies are included. (For U. S. Naval Officers only.)

2·730. Machine Design. Lectures and drafting-room exercises covering the kinematic design of the basic mechanisms. Serves as an introductory course in machine design by application of the fundamentals of kinematics to geometric design. *Engineering Kinematics*, Sloane.

2·731. Machine Design. Discussion and design of machine elements with special reference to the selection of materials, proportions of parts and the economies of manufacture and assembly. Includes frames, fastenings, flat plates, tanks, and applications to machine frames, gearing and shafting.

2·732. Machine Design (B). A continuation of 2·731, including bearings, theory of lubrication, shaft connectors, all forms of gears, flywheels, etc. The work culminates in the complete engineering design of a comprehensive machine.

2·751, 2·752. Machine Design, Advanced (A). (Not offered Nov. 1944–June 1945.)

2·761, 2·762. Machine Design. Subjects especially arranged and adapted to the needs of specialists in torpedo design. (For U. S. Naval Officers only.)

2·78. Design of Hydraulic Power Transmissions and Controls (B). Discussion of theory of displacement hydraulics and of current practice in design and application of displacement type hydraulic machinery to problems involving controlled speed, torque, power, pressure, and servo or "follow-up" operation. Working circuits will be analyzed for performance characteristics and problems assigned to design systems for accomplishing functions commonly required in industrial operations.

2·782. Design of Mechanical Systems (B). Discussion and design of mechanical systems involving the application of hydraulic, pneumatic, and electronic equipment. Consideration of simple closed cycle control systems. The reduction of machine vibrations. Applications of the principle of similitude to machine design problems.

2·79. Automotive Dynamics (B). (Not offered Nov. 1944–June 1945.)

2·791. Automotive Engines (B). A study of the fundamentals of the internal combustion engine, including capacity, efficiency, thermodynamics and combustion. Lectures and assigned reading are supplemented by laboratory work. *The Internal Combustion Engine*, Taylor and Taylor.

2·792. Automotive Engines (B). A continuation of 2·791. Fuels, lubricants, cooling, carburetion, distribution, ignition, friction and supercharging are studied. Lectures and reading are supplemented by laboratory exercises. *The Internal Combustion Engine*, Taylor and Taylor.

2·793. Automotive Engine Design (B). (Not offered Nov. 1944–June 1945.)

2·794. Automotive Engine Design (B). (Not offered Nov. 1944–June 1945.)

2·797. Automotive Engines (B). Same as 2·791, omitting laboratory exercises.

2·798. Automotive Engines (B). Same as 2·792, omitting laboratory exercises.

2·801, 2·802. Advanced Automotive Engine Problems (A). Individual work in research or design by properly qualified graduate students. Problems are selected in consultation with the Instructor, and the hours are arranged to suit the individual case.

2·805T. Diesel Engines (A). A study of the fundamentals of the compression-ignition engine, including considerations of the charging process, fuel injection, combustion, cooling fuels, and lubrication. Critical examination of existing types from both the design and operation viewpoints is included.

2·83. Steam Turbine Engineering (B). Thermodynamics, hydrodynamics, and mechanics applied to problems in steam turbine engineering.

2·84. Gas Turbine Engineering (B). A comparative study of gas turbine processes. Design of the flow path for compressor and turbine. Stress analysis of the rotor. Stability and critical speed. Design of regenerator.

2·851. Machine Tool Laboratory. A course in the use and application of machine tools. Includes laying-out work, filing, scraping machine parts, drilling, reaming, counterboring and tapping, tool grinding, straight and taper turning, screw cutting, milling, cylindrical and surface grinding and chucking. Special attention is given to the cutting angles and adjustments of cutting tools and cutting speeds for each material worked. *Advanced Machine Work*, Smith.

2·852. Machine Tool Practice. A continuation of 2·851. Includes fundamentals of tool making, hardening and tempering, gear cutting, thread milling and generating, planing and shaping, turret lathe and automatic screw machine practice, grinding and lapping, broaching, precision measuring, time study and production manufacturing processes. *Advanced Machine Work*, Smith.

2·853. Machine Tool Laboratory. Laying-out work, grinding tools, chipping cast-iron, filing and fitting cast-iron and steel machine parts, alignment and babbitting of bearings, drilling, reaming, counterboring and tapping, grinding drills, soldering. General machine work, including centering straight and taper turning and fitting, screw cutting, chucking, finishing, drilling, tapping, cylindrical grinding, plain and index milling and gear cutting.

Mechanical Engineering Continued

2·854. Machine Tool Laboratory. Covers parts of 2·851 and 2·852 with instruction in other mechanical processes. *Advanced Machine Work*, Smith.

2·855. Elementary Machine Tool Laboratory. An abridgment of 2·853 especially adapted to the requirements of experimental physicists. Emphasizes the use of precision tools and hand operations necessary in experimental work.

2·871. Manufacturing Engineering (B). (Not offered Nov. 1944–June 1945.)

2·872. Preparation for Manufacturing (B). (Not offered Nov. 1944–June 1945.)

2·88. Metrology and Dimensional Engineering Standardization (A). (Not offered Nov. 1944–June 1945.)

2·901, 2·902. Principles of Fabric Structure (B). Discussion of the properties of fibers as related to the properties of yarns and fabrics; properties of yarns as related to fabrics; construction and finishing of fabrics to produce certain desirable characteristics in these materials. Includes material dealing with principles of woven fabric structure together with the formation of knitted, braided, twisted, and felted materials.

2·903. Elements of Textile Manufacturing (B). Deals with the production and properties of textile raw materials and with the operations basic to the manufacture of cotton, wool, silk, flax, jute and rayon.

2·904. Principles of Textile Manufacturing (B). Continuation of 2·903 covering the combination of operations such as blending, carding, combing, drafting, twisting, etc., into processes as for cotton, woolen, worsted, spun and thrown filament, and bast fiber materials. Involves mill organization studies and plant inspections.

2·905, 2·906. Textile Technical Analysis (A). Deals with the physical determinations of strength, stretch, moisture regain, twist and various mechanical properties of interest to the yarn and fabric technician. The formulation and proper presentation of the data, precision of measurements, graphical interpretation of data, the variable factors which influence textile testing results, and the outlining of present trends in the textile research in this country and abroad are included.

2·907, 2·908. Textile Microscopy (A). Application of optical and microscopical equipment to technical analysis of textiles. Lectures and laboratory on the types of equipment, their use and the technique of textile microanalysis for fiber, yarn and fabric. Opportunity is offered for intensive research on projects involving quantitative determinations; development of technique; application of photomicrography, polarized light, fluorescence, swelling technique, etc., to textile microscopy. Schwarz, *Textiles and the Microscope*. *Library References*.

2·911. Textile Testing Laboratory (A). Opportunity is afforded for the student to operate standard textile-testing equipment and to obtain practical experience in the field covered by the lectures of 2·905.

2·912. Textile Research Laboratory (A). Studies of the variable factors influencing textile tests with opportunity to carry out one or more individual research problems in the physical or optical analysis of textiles.

2·913, 2·914. Textile Technology Seminar (A). Opportunity is afforded for students and staff members to present critical discussions of important problems in fiber technology, textile analysis and textile microscopy together with reviews of the current literature, and the results of researches in these fields at the Institute.

2·951 to 2·954. Works subjects normally in Coöperative Course in Mechanical Engineering. (Not offered Nov. 1944–June 1945. See Catalogue issue, June 1942, for descriptions.)

2·991, 2·992. Mechanical Engineering Seminar (A). (Not offered Nov. 1944–June 1945.)

METALLURGY

Subjects 3·00 to 3·99

3·00. Introduction to Metallurgy. A series of exercises illustrating the processing of an ore, its reduction and the examination of the resulting metal.

3·01. Non-Ferrous Metallurgy I. Deals mainly with copper, lead and zinc, covering the extraction of the metal from ores and concentrates by pyro-, hydro-, and electrometallurgical methods and the refining of the crude products. The more general application of such fundamental operations as roasting, sintering, smelting, leaching, etc., is also touched upon. The work of 3·04 is closely coördinated with this subject. Hayward, *Outline of Metallurgical Practice*.

3·02. Non-Ferrous Metallurgy II. Continues the work of 3·01 treating the non-ferrous metals not covered there. Hayward, *Outline of Metallurgical Practice*.

3·03. Non-Ferrous Metallurgy III (B). Designed for men who wish special work in some phase of non-ferrous metallurgy. The time may be spent in part in the laboratory, drafting room and library. Each student is allowed to select his own field and will work alone or in collaboration with others. One seminar per week will be arranged for reporting individual progress and to allow general discussion.

3·04. Metallurgical Laboratory. The roasting, sintering, smelting and leaching of copper and lead ores are carried out, together with the refining and desilverizing of copper and lead. Practice in the use of various types of electric furnaces is obtained. The production of steel, ferroalloys, calcium carbide, etc. by electrothermic methods and other pyrometallurgical and electrochemical processes are studied.

3·041. Electric Furnaces (B). Intended for fourth year and graduate students who desire to obtain some acquaintance with electric furnace operation, without having had any previous training in applied electrochemistry. Thompson, *Theoretical and Applied Electrochemistry and Neostyled Notes*.

3·05. General Metallurgy (B). Treats of fuels, refractories, fluxes and slags and their relation to the entire field of process metallurgy. Fundamental principles of roasting, smelting and refining are discussed together with charge calculations, thermal balances and materials balances. Hofman, *General Metallurgy*; Hayward, *An Outline of Metallurgical Practice*.

3·06. Advanced Non-Ferrous Metallurgy (A). For graduate students who have had fundamental courses in non-ferrous metallurgy and wish to continue the study of one or more of the metals. Latitude is allowed in the choice of subject and the time may be adjusted to suit the requirements of the work, which may be a combination of library studies and conferences with laboratory work if desired. The work is confined to production and refining.

3·07. Metallurgy of Common Metals. (Not offered Nov. 1944–June 1945.)

3·08. Advanced General Metallurgy (A). Fuels, refractories and the principles of roasting and smelting are studied with greater thoroughness than is possible in the undergraduate courses. A critical analysis is made of the manner in which these principles are carried out in present practice and suggested improvements are discussed.

3·09. Advanced Metallurgical Calculations (A) (Not offered Nov. 1944–June 1945.)

3·10. Metallurgical Plant Visits. (Not offered Nov. 1944–June 1945.)

3·12. Metallurgy: Iron and Steel. The production of wrought iron, pig iron, steel and alloy steels is considered in detail. Special attention is paid to the design and engineering operations incident to iron and steel manufacture and to the economic advantages of the various processes. Lectures are supplemented by plant visits which are covered by subsequent reports and seminars. Stoughton, *Metallurgy of Iron*

Metallurgy Continued

and Steel; Camp and Francis, *Making, Shaping and Treating of Steel.*

3·15, 3·16. METALLURGY: IRON AND STEEL, ADVANCED (A). (Not offered Nov. 1944–June 1945.)

3·17, 3·18. METALLURGICAL PLANT DESIGN (A). (Not offered Nov. 1944–June 1945.)

3·19. METALLURGICAL PLANTS (B). (Not offered Nov. 1944–June 1945.)

3·20. METALLURGICAL THERMODYNAMICS (B). A short course in thermodynamics emphasizing those portions which are especially useful in metallurgical operation. The free energies of substances at elevated temperatures and the activities of metals in solid and liquid alloys are used in interpreting a number of metallurgical phenomena and in determining the feasibility and limitations of a variety of metallurgical processes.

3·21. PRINCIPLES OF STEEL MAKING (B). The reactions which are of importance in the manufacture of steel are studied from the viewpoint of physical chemistry. These include reduction of ore, reactions of liquid iron and steel with slags and gases and the chemical effects of alloys and deoxidizing agents. The influence of melting and refining methods upon the properties of the finished product is included.

3·22. FIRE ASSAYING. The sampling of ore and bullion, the assaying of ores for gold, silver and lead, and of bullions, solutions, matte and miscellaneous furnace products. The fire assay of copper, tin, mercury and platinum is briefly discussed. Typical ores, bullions and solutions are used for analysis; the important standard methods are covered. Stress is laid upon the accuracy of results and the neatness of work and of notes. Bugbee, *Fire Assaying.*

3·23. ADVANCED FIRE ASSAYING (A). (Not offered Nov. 1944–June 1945.)

3·30. METALLOGRAPHY. (Not offered Nov. 1944–June 1945.)

3·31. METALLOGRAPHY. An intensive study of the nonferrous metals and alloys, the construction and interpretation of equilibrium diagrams and the relations between the constitution of alloys and their physical properties. The phenomena of plastic deformation, recrystallization, and grain growth are discussed in considerable detail. Laboratory practice is included. Williams and Homerberg, *Principles of Metallography.*

3·32. METALLOGRAPHY AND HEAT TREATMENT. A continuation of 3·31 in which iron, carbon and alloy steels, and cast iron are studied.

3·33. APPLICATIONS OF METALLOGRAPHY (B). Lectures and laboratory conferences designed to familiarize the student with the applications of metallography to industrial problems. In the laboratory the microstructures of normal and defective commercial alloys are examined and discussed. The lectures are devoted to a critical résumé of the fundamentals of modern physical metallurgy which is essential to the proper interpretation of the microstructures.

3·34, 3·35. ADVANCED PHYSICAL METALLURGY (A). A critical discussion of various subjects falling within the general field of physical metallurgy, such as stable and metastable alloy systems, ternary phase diagrams, diffusion, phase transformations and precipitation phenomena, theories of metal hardening, and the physics of hardenability. Particular attention is paid to the more recent publications on these topics. Students must register for at least six units per term. Additional time may be elected for advanced research problems. (Not offered Nov. 1944–June 1945.)

3·38, 3·39. ADVANCED PHYSICAL METALLURGY. A study of the fundamental properties of metals and alloys with particular reference to materials used in torpedo construction. (For U. S. Naval Officers only.)

3·391, 3·392. PROPERTIES OF METALS. A study of the metallurgical properties of metals and alloys with particular reference to materials used in ship construction. Such topics as the making, microstructure, processing, heat treatment, joining and corrosion resistance of non-ferrous and ferrous alloys are considered. (For XIII-A only.)

3·40. CORROSION AND HEAT RESISTING ALLOYS (B). A study of metals and alloys with respect to corrosion and heat resistance, including a discussion of inter-crystalline failure, corrosion protection, creep and selection of materials.

3·41. LIGHT ALLOYS (B). A detailed study of the structure, properties, heat treatment and uses of alloys of aluminum, magnesium and beryllium.

3·42. POWDER METALLURGY (B). The physical and chemical methods for the production of metal powders are considered. The pressing and annealing of alloy powder compacts and the resulting properties of the finished compact are stressed. Problems of adhesion, diffusion, recrystallization and grain growth as they apply to this field are treated in detail. Present industrial applications of powder products are included.

3·422. POWDER METALLURGY LABORATORY (B). Laboratory work and conferences to familiarize the student with powder metallurgy practice and its application to industrial problems.

3·50. X-RAY METALLOGRAPHY (B). Deals with the use of X-rays in the study of metals. Includes radiographic examination of metal parts, as well as the X-ray diffraction study of the atomic and granular structures of metals, and their relations.

3·51. PHYSICS OF METALS (B). A discussion of the modern theories of the metallic state resulting from a study of the physical properties of metals.

3·52. ADVANCED PHYSICS OF METALS (A). A discussion of various problems of the crystalline metallic state and the dependence of physical properties upon structure. Experimental methods of obtaining information in this field are considered. Laboratory work in the form of short research problems is available.

3·55. WELDING METALLURGY (B). Deals with the metallurgical processes involved in welding; namely, casting, physical and process metallurgy in relation to the heat distribution during welding. Includes considerations on mechanical properties of welds, and discussion of shrinkage stresses in welds.

3·60. FERROMAGNETISM (A). (Not offered Nov. 1944–June 1945.)

3·61. ATOMIC ARRANGEMENTS IN ALLOYS (A). (Not offered Nov. 1944–June 1945.)

3·62, 3·63. SPECIAL PROBLEMS IN METALLURGY (A). Designed to meet the needs of graduate students who wish to carry out a minor investigation in one of the special branches of Metallurgy. Subject and hours arranged to fit individual requirements. Open only to graduate students properly qualified in the special field.

3·65. THEORY OF THE SOLID STATE (B). (Not offered Nov. 1944–June 1945.)

3·70. CERAMICS. An introduction to the more advanced ceramic subjects. The selection of ceramic materials, molding, drying and burning are taken up, as well as the physical properties of finished products. Commercial processes are carried out on a small scale. (Not offered Nov. 1944–June 1945.)

3·71. OPTICAL CERAMICS (B). Primarily a laboratory subject in which the methods of petrography are applied to the study of ceramic products and raw materials, such as clay, cement, glass, porcelain, refractories, etc., (Not offered Nov. 1944–June 1945.)

3·73. FUNDAMENTAL CERAMIC PROCESSES (A). Covers the theory and practice of forming, drying and burning of clay articles, such as white wares, refractories, terra cotta, etc. The principles involved in the manufacture and use of glass, cements and abrasives are also discussed. The principles of kiln and furnace design are discussed and practical examples are analyzed. (Not offered Nov. 1944–June 1945.)

3·74. PHYSICAL PROPERTIES OF CERAMIC PRODUCTS (A). Includes the various methods of determining the properties of finished ceramic articles. The influence of manufacturing methods on these properties is taken up in order to bring out effective methods of control. (Not offered Nov. 1944–June 1945.)

Metallurgy Continued

3·75, 3·76. Special Problems in Ceramics (A). For graduate students who desire to do advanced work in this field on some topic not specifically covered elsewhere. The student makes his own choice of topic and the allotment of time. The latter may be devoted to lectures, conferences, assigned readings, or laboratory work. (Not offered Nov. 1944–June 1945.)

3·81. Mineral Dressing I. An introduction to the dressing of minerals, ores, and coals, from the unit-process point of view, with emphasis on the physical, chemical and economic principles involved. The processes studied include crushing, grinding, screening, classification, gravity concentration, flotation, amalgamation, magnetic separation, thickening, filtration, and sintering as well as other processes of lesser importance. Gaudin, *Principles of Mineral Dressing.*

3·82. Mineral Dressing II. A continuation of 3·81.

3·83. Mineral Dressing Plant (B). A detailed study of mineral dressing apparatus and equipment for the various processes studied in 3·81 and 3·82. Richards and Locke, *Textbook of Ore Dressing.*

3·84. Mineral Dressing Practice (B). Deals with principles of arrangement, location, and operation of mills; also with mill costs, general economics of dressing operations, typical flowsheets, and fundamentals of design. Richards and Locke, *Textbook of Ore Dressing.*

3·85. Flotation (B). A study of the flotation process and of its applications to ores, minerals and coals. Gaudin, *Flotation.*

3·86. Comminution (B). A study of the fundamentals of crushing and grinding. Consideration is given to the characteristic properties of the products obtained.

3·87. Quantitative Mineragraphy (B). The mineralogical study of ores and minerals from the point of view of their dressing or subsequent processing. The ores or minerals are studied in polished section, thin section, as loose grains or as polished briquettes. The emphasis is on the quantitative and dimensional aspects of textural and structural relationships.

3·88. Ore Testing (B). Practice in choosing concentration methods for specific ore samples, in developing laboratory dressing technique, and in preparing reports.

3·89. Mineral Dressing Design (A). The working out of a specific problem in mill design, covering the development of the quantitative flowsheet and the drawing up of specifications for, and the general arrangement of the equipment. Taggart, *Handbook of Ore Dressing.*

3·90. Advanced Mineral Dressing (A). Topics selected according to the needs of the students are discussed informally. Examples of suitable topics are afforded by the following fields: application of fluid mechanics to gravity concentration, of physical chemistry to flotation, of colloid chemistry to flocculation and thickening, of elasticity and plasticity to comminution.

3·901. Advanced Mineral Dressing Laboratory (A). A laboratory study of an ore, a process, or a machine in the field of mineral dressing.

3·902. Advanced Mineral Dressing Laboratory (A). A continuation of 3·901.

3·91. Mineral Dressing Seminar (A). Selected topics are presented by the students in the field of Mineral Dressing.

ARCHITECTURE

Subjects 4·00 to 4·99

4·031, 4·032. Freehand Drawing. Problems in the understanding of form and space, their coördination, and their graphic expression. Basic figure construction and anatomy; rapid drawing direct from the human figure. Eight weeks' work at the Boston Museum of Fine Arts in studying and analyzing the design of architectural and sculptural forms.

4·041T, 4·042T. Freehand and Color. The selection and use of appropriate graphic techniques for study in, and representation of, building materials and other elements of architectural design. Four weeks o each term are spent in figure sketching.

4·051, 4·052. Freehand Drawing (B). A continuation of 4·042. More advanced problems in design and materials with special reference to architectural application and in collaboration with subjects in Color and Architectural Design. Attention is given to graphic expression of the relationship of building to land. A limited part of each term is spent in advanced figure drawing.

4·051T, 4·052T. Freehand and Color (B). (Not offered Nov. 1944–June 1945.)

4·053, 4·054. Freehand Drawing (A). A continuation of 4·052. Problems are fitted to the needs of the individual student and are of an advanced nature. Open only to graduate students or others who demonstrate fitness for advanced work.

4.07 Shop. Working experience with commonly used materials to develop familiarity with their qualities and the influence of these qualities on their application in design. Instruction is offered in the use of hand and power tools to inculcate techniques required in future subjects for making quick and accurate architectural models or full-scale furniture designs.

4·091, 4·092. Color: Composition, Theory and Application (B). Advanced problems in the application of color in architecture.

4·10. Architectural Illumination. Solution of small problems in architectural design chosen to illustrate the influence of illumination requirements on architectural form. Collaborative work with professional students of architecture on advanced problems involving illumination in buildings.

4·451, 4·452. History of Architecture. (Not offered Nov. 1944–June 1945.)

4·481, 4·482. European Civilization and Art: the Eighteenth Century and Modern Culture (B). Constitutes a history of culture, mainly that of Europe. The main currents of science and philosophy are considered; but emphasis is upon literature, sculpture and painting. Lectures, readings, and reports.

4·491, 4·492. European Civilization and Art (A). Selected topics in the history of culture. Supervised study, with conferences, readings, and reports but without lecture hours, for graduate students.

4·52. Office Practice (A). Office practice in the office of a city or regional planning agency, the work required in research or design being of an advanced nature.

4·53. Professional Relations (B). The ethical, business and legal relations of the architect with clients, contractors, engineers, with his professional organizations, and with the community in which he practices.

4·541, 4·542. Housing Seminar (A). (Not offered Nov. 1944–June 1945.)

4·59. Government and Public Administration (B). Structure of local and state governments; powers and duties of local authorities; general survey of the field of public administration, including the relationship of administrative agencies to the legislative and judicial branches of government; general principles of municipal finance; long-term programming and financing of public works. (Not offered Nov. 1944–June 1945.)

4·60. Planning Legislation and Administration (B). Survey of past and present legislation relating to city planning and housing; general powers and duties of local authorities; typical acts relating to planning and housing in the United States and abroad; modern tendencies in legislation; other legal aspects of planning, such as zoning laws, building codes, *Architecture Continued*

private deed restrictions, etc. Administrative problems of planning commissions and zoning boards of appeal; organization and administration of planning projects in state, county, region, and city; getting citizen and official interest and sanction.

4·62. Site Planning and Construction (B). A subject primarily for students in City Planning, in which problems in site planning are studied with emphasis on the relations to physical conditions, landscape construction, and costs. Problems dealt with include the use of contour maps, layout of roads, pedestrian circulation, grouping of buildings, surface and subsurface drainage, utilities, community services, efficiency of land use, details of construction and costs of management (public and private). The major portion of the subject is devoted to the preparation of site and utility plans for a specific project.

4·641. City Planning, Principles. The historical background of the modern city planning movement is presented in a series of lectures. The subject deals with the evolution of the modern city and the relation of architecture and engineering to problems of city development and civic design, concluding with a discussion of fundamental principles of city and regional planning. *Outline of Town and City Planning*, Thomas Adams.

4·651, 4·652. Theory and Practice of City Planning (B). Advanced problems of city and regional planning are studied, together with modern methods of dealing with them. Collateral reading, written reports, and round table discussions are essential features of the subject.

4·661, 4·662. City Planning Research (A). Selected topics in the field of city and regional planning. Supervised study, with conferences, readings, and reports but without lecture hours, for graduate students.

4·672. City Planning Design. Research into the social, economic, and physical structure of a community, followed by the design of functional elements such as areas for residence, commerce, and recreation.

4·681. City and Regional Planning (B). The practical application of city and regional planning theory to towns cities, and regions, including problems of replanning and redevelopment in existing communities. Individual problems are supplemented by group projects worked out in collaboration, and preliminary and final reports are considered essential accompaniments to each developed study.

4·682. City and Regional Planning (B). A continuation of 4·681.

4·683. City and Regional Planning (B). A continuation of 4·682.

4·691. City and Regional Planning, Advanced (A). A continuation of the undergraduate subject 4·683.

4·692. City and Regional Planning, Advanced (A). A continuation of 4·691.

4·711. Architectural Drawing. A study of the fundamental concepts of descriptive geometry and their application to architectural problems. Training in the methods of architectural perspective and shades and shadows.

4·712. Architectural Drawing. A survey of the types of drawings required in architectural practice. Training in the selection, development and execution of drawings which will adequately describe architectural projects. Drawings and lettering are required to be of a satisfactory professional standard.

4·721, 4·722. Architectural Design II. Investigation of requirements and determination of solutions for building problems selected from many fields of human activity (habitation, education, health, recreation, government, religion, industry, merchandising, and transportation). Attention is given to the relationship of buildings to physical and social environment, to the technique of organizing spaces of different kinds in relation to each other, to climate and orientation, and to the selection of appropriate materials and construction. Individual and collaborative work.

4·731, 4·732. Architectural Design III. A continuation of the planning studies initiated in the previous year. At least one problem in each term will be carried to an advanced stage of analysis to give facility in the adaptation of a building to its site, to apply structural methods and calculations, and to investigate typical details such as windows, copings, stairways. Numerous short problems will be given to emphasize methods of dealing with specific conditions in planning or the use of materials.

4·741T, 4·742T. Architectural Design IV. Consolidation of previous design experience. Problems affording an opportunity to study particular conditions encountered in larger buildings, such as: circulation, control, and safety of crowds, accommodations for vehicles and freight, and the use of elevators, and special equipment. In the second term one problem will be presented in detail, with studies of structure, assembly of materials, heating and ventilating, sanitation, acoustics, electricity, and illumination.

4·751, 4·752. Architectural Design V (B). A sequence of problems emphasizing basic community needs in housing, recreational, commercial, and educational categories, and inviting speculation as to the future possibilities for adequate solutions to these problems. Disposition of groups of buildings on new sites with analysis of economic considerations.

4·751T. Architectural Design V (B). (Not offered Nov. 1944–June 1945.)

4·761, 4·762. Architectural Design VI (A). Research, development of program, and design of buildings with particular attention to thorough consideration of social, economic, and technical influences and the integration of these factors in the solution of the problem. Site plans are considered in their architectural and engineering aspects, and collaborative projects with graduate students in City Planning are encouraged.

4·78. Planning Principles. A study of the principles underlying all good planning such as the logical relation to one another of the different parts of a building, the arrangement of proper lighting and circulation, axial development and balance. (Not offered Nov. 1944–June 1945.)

4·811. Structural Analysis. Methods of analysis in the design of elementary architectural structures and the application of these methods to a problem in architectural design. Consideration of loads, in the design of simple and continuous beams, columns and details of assembly. The analysis of a simple roof truss. W. H. Lawrence, *Notes on the Analysis and Design of Elementary Structures* and *Mimeograph Notes.*

4·812. Structural Analysis. A continuation of 4·811 including the analysis of building types, the design of a steel framing and plate girder. The analysis and design of elementary reinforced concrete floor systems, beams, column, and footings. The application to a problem in design. *Mimeograph Notes.*

4·91. Industrial Design. (Not offered Nov. 1944–June 1945.)

4·92. Industrial Design. (Not offered Nov. 1944–June 1945.)

4·98. Thesis Research (A). To enable the student to make an investigation leading to his choice of a thesis problem subject and organize the essential data into a complete statement of his program for this exercise.

The following subjects are offered as General Studies:

G45. Historical Aspects of Architecture. (Not offered Nov. 1944–June 1945.)

G64. Fine Arts.

G65. Expressions of Graphic Art.

G66. The Arts of the Book. (Not offered Nov. 1944–June 1945.)

CHEMISTRY

SUBJECTS 5·00 TO 5·99

INORGANIC CHEMISTRY

UNDERGRADUATE SUBJECTS

5·01, 5·02. CHEMISTRY, GENERAL. The fundamental principles of chemical science and the descriptive chemistry of the more common elements and their important compounds. Publication by M. I. T. Staff, *General Chemistry;* Latimer and Hildebrand, *Reference Book of Inorganic Chemistry.*

5·061, 5·062. INORGANIC CHEMISTRY, ADVANCED (B). Presents in a correlative manner the physical and chemical properties of the elements and compounds. The attempt is made to systematize as far as possible the facts of inorganic chemistry with the aid of a comparatively small number of generalizations. Time is devoted to the discussion of recent theoretical and experimental investigations in this field.

GRADUATE SUBJECTS

5·071, 5·072. SEMINAR IN INORGANIC CHEMISTRY (A). Special topics in inorganic chemistry such as the chemistry of the less common elements, the more complex reactions of the more common elements, reactions in nonaqueous solvents, and the application of modern research tools to inorganic investigation.

5·08. ADVANCED INORGANIC LABORATORY (A). Intended to acquaint the student with typical research methods, including such procedures as the employment of high vacuum technique, the conduct of operations in inert atmospheres and in non-aqueous media, the isolation of compounds of the rarer elements, etc. In all cases reference to the original literature is required for experimental details.

ANALYTICAL CHEMISTRY

UNDERGRADUATE SUBJECTS

5·10. QUALITATIVE ANALYSIS. Analysis of solutions, simple substances and industrial products such as minerals, pigments, slags and alloys.

5·11. QUALITATIVE ANALYSIS. Abridgment of 5·10.

5·12. QUANTITATIVE ANALYSIS. Volumetric and gravimetric analysis, illustrating the more important typical processes. Special attention is given to manipulation, stoichiometry and modern theories of solution.

5·13. QUANTITATIVE ANALYSIS. Continuation of 5·12. A correlative study of the Analytical Chemistry for the identification and determination of the more common constituents. Analysis of silicates, minerals, ores and alloys including electrolytic and electrometric methods, and when possible, an original study of some special analytical problem. Gas Analysis.

5·141. ANALYTICAL CHEMISTRY. Instrumental methods of analysis. Chemical applications of the microscope, including microchemical qualitative analysis, spot tests, and the identification of crystalline material by the polarizing microscope. Use of the spectrograph, spectrophotometer, polariscope, polarograph, colorimeter, and refractometer.

5·35. APPLIED CHEMISTRY. The theoretical principles underlying the causes of corrosion and preventive measures by means of protective coatings.

ORGANIC CHEMISTRY

UNDERGRADUATE SUBJECTS

5·41. ORGANIC CHEMISTRY I. The fundamental principles of the chemistry of the carbon compounds, based on a study of important substances of the aliphatic, aromatic, and heterocyclic divisions.

5·414, 5·416, 5·418. ORGANIC PREPARATIONS. Laboratory practice in standard techniques of synthetic organic chemistry. (Correlative with Organic Chemistry I 5·41.)

5·417. QUANTITATIVE ORGANIC ANALYSIS. Determinations of carbon, hydrogen, nitrogen, halogens and sulfur by semi-micro methods of analysis; conferences and discussions.

5·42. ORGANIC CHEMISTRY II. Amplification and extension of 5·41.

5·424, 5·426. IDENTIFICATION OF ORGANIC COMPOUNDS. Theory and practice in systematic methods of organic qualitative analysis. (A special experimental problem is also included in 5·424.)

5·428. ORGANIC CHEMISTRY LABORATORY. Preparations, class reactions and identification of typical organic compounds.

5·43. ORGANIC CHEMISTRY III (B). Systematic consideration of the fundamental organic chemistry of the more important classes of compounds containing nitrogen or sulfur from a viewpoint more mature than is possible during the first year course. The topics usually considered include nitro- nitroso- and azido compounds, nitroparaffins, azo-, hydrazo-, azoxy-, and diazo compounds, amines, quaternary ammonium salts, urea, thiourea and guanidine cyanogen, etc., together with related and associated topics.

5·44. ORGANIC CHEMISTRY IV (B). Fundamental Organic Chemistry of the processes and products of selected industries. The chemistry of synthetic rubber, resins, plastics, fibers and other appropriate associated substances.

GRADUATE SUBJECTS

5·51. FUNCTIONAL GROUPS IN ORGANIC CHEMISTRY (A). A broad survey of methods for introducing the various functional groups into organic molecules and of the characteristic reactions of such groups, with particular reference to the influence of environmental factors in each of these aspects of organic chemistry.

5·52. MECHANISM, STRUCTURE, AND REACTIVITY IN ORGANIC CHEMISTRY (A). Factors, both chemical and physical, which contribute to knowledge in the above fields are discussed.

5·53. SPECIAL TOPICS IN ORGANIC CHEMISTRY (A). The chemistry of terpenes, natural resins, heterocyclic compounds and dyes are discussed by members of the staff. (Not offered Nov. 1944–June 1945.)

5·54. SPECIAL TOPICS IN ORGANIC CHEMISTRY (A). The chemistry of carbohydrates, cellulose, hormones, vitamins, proteins, tannins and rubber are discussed by members of the staff. (Not offered Nov. 1944–June 1945.)

5·55. IDENTIFICATION OF ORGANIC COMPOUNDS (A). The study of systematic methods of organic qualitative analysis including treatment both of individual compounds and mixtures.

5·581, 5·582. ADVANCED ORGANIC LABORATORY (A). Experiments on fractionation, molecular distillation, chromatographic adsorption, micro manipulation, with organic synthesis of an advanced nature. The purpose is to insure a well-rounded knowledge of all types of micro and macro manipulation.

5·591, 5·592. RECENT ADVANCES IN ORGANIC CHEMISTRY. (Not offered Nov. 1944–June 1945.)

PHYSICAL CHEMISTRY

UNDERGRADUATE SUBJECTS

5·61. PHYSICAL CHEMISTRY I. Pressure-volume relations of gases; properties of liquids; general properties of solutions; transference; conductance; laws of thermodynamics; thermochemistry; chemical equilibrium. Millard, *Physical Chemistry for Colleges.*

5·611. PHYSICAL CHEMISTRY LABORATORY I. Laboratory coördinated with the topics of 5·61.

5·612. PHYSICAL CHEMISTRY LABORATORY I. Abridgment of 5·611.

5·62. PHYSICAL CHEMISTRY II. Continuation of 5·61. Chemical equilibrium, phase equilibrium, kinetics of chemical reactions; free energy of chemical changes; electromotive force of cells.

Chemistry Continued

5·621. Physical Chemistry Laboratory II. Laboratory coördinated with the topics of 5·62.

5·622. Physical Chemistry Laboratory II. Abridgment of 5·621.

5·63. Introduction to Thermodynamics (B). Units; fundamental ideas; first law and applications; second law and applications; uses of the thermodynamic functions; ideal and real gases and gas mixtures; chemical equilibrium, univarient systems; ideal and real solutions; voltaic cells; free energy calculations. Noyes and Sherrill, *An Advanced Course in Instruction in Chemical Principles.*

5·64. Introduction to Radiation Chemistry (B). Deflection of charged particles; the identification of isotopes; X-ray spectra and optical spectra of atoms; atomic structure and periodic table; elementary quantum mechanics.

5·642. Radiation Chemistry (A). Introduction to molecular structure. Correlation of spectra with molecular structure and reactivity.

5·66. Surface and Colloid Chemistry (B). Structure of surfaces; surface and interfacial tensions: adsorption electrokinetic effects; types of colloids, and methods for preparation and purification; methods for studying size, shape and structure of the colloidal particle; applications to natural and synthetic colloidal systems.

GRADUATE SUBJECTS

5·71, 5·72. Physical Chemistry (A). For graduate students who have not had the equivalent of 5·61 and 5·62. Noyes and Sherrill, *An Advanced Course of Instruction in Chemical Principles.*

5·741. Advanced Radiation Chemistry (A). (Not offered Nov. 1944–June 1945.)

5·742. Statistical Mechanics (A). Statistical Mechanics and the theory of intermolecular forces with applications to the equation of state problem. (Not offered Nov. 1944–June 1945.)

5·75, 5·76. Chemical Thermodynamics (A). The development of the general thermodynamic theory from the first and second laws. The application of the theory to homogeneous and heterogeneous systems in which chemical reactions may take place. Text: Gibbs' *Thermodynamics* and *Mimeographed Notes.* (Not offered Nov. 1944–June 1945.)

5·77. Kinetic Theory (A). Development of the kinetic theory of gases from the modern standpoint. Statistical mechanics and wave mechanics necessary for the treatment of gases are presented. Kennard, *Kinetic Theory of Gases.*

SPECIAL TOPICS IN CHEMISTRY

5·82. Chemical Literature. Methods of using the journals, books and indexes.

RESEARCH

5·90. Special Problems in Chemistry (A). Directed research and study of special chemical problems. For graduate students only.

5·911, 5·912. Journal Meeting in Inorganic Chemistry (A). (Not offered Nov. 1944–June 1945.)

5·921, 5·922. Journal Meeting in Organic Chemistry. (Not offered Nov. 1944–June 1945.)

5·931, 5·932. Seminar in Physical Chemistry. (Not offered Nov. 1944–June 1945.)

Research (A). Research for any of the advanced degrees in inorganic (including analytical), organic or physical chemistry.

Thesis. Minor researches to test ability to do work of an original character. Written reports and conferences are required and a formal record must be presented for acceptance. The student may select a problem in inorganic, analytical, organic or physical chemistry.

ELECTRICAL ENGINEERING

Subjects 6·00 to 6·99

6·00. Principles of Electrical Engineering. Relation of linear circuit theory to field theory; calculation of circuit parameters; study of resistance networks; transient and steady-state behavior of simple circuits having suddenly-impressed constant or sinusoidal voltages or currents; association of engineering ideas and applications with the treatment of principles as far as is feasible. *Electric Circuits* by members of the Department Staff.

6·01. Principles of Electrical Engineering. Study of steady-state and transient behavior of linear multi-branch circuits having suddenly-impressed sinusoidal voltages or currents; use of complex function loci; properties of polyphase circuits; simple electromechanically coupled systems; steady-state and transient behavior of simple circuits containing nonlinear elements; properties of magnetic materials; magnetic circuits; association of engineering ideas and applications with the treatment of principles as far as is feasible. *Electric Circuits* and *Magnetic Circuits and Transformers* by members of the Department Staff.

6·02. Principles of Electrical Engineering. Transformers for power and communication circuits; engineering electronics including the internal phenomena of vacuum and gas tubes, and the analysis of circuits containing such tubes; single-phase and polyphase rectifiers, amplifiers, oscillators, modulators, and demodulators. *Magnetic Circuits and Transformers* and *Applied Electronics* by members of the Department Staff.

6·03. Principles of Electrical Engineering. Polyphase synchronous and induction machines, single-phase alternating-current motors, synchronous converter. Lawrence, *Principles of Alternating Current Machinery, Third Edition.*

6·031. Principles of Electrical Engineering. Rotating magnetic fields, synchronous motors and generators, synchronous converter, polyphase and single-phase induction machines. Lawrence, *Principles of Alternating-Current Machinery, Third Edition.*

6·04. Principles of Electrical Engineering (B). A general survey of transmission-line problems, calculation of line constants, short-line solutions, skin effect, corona, insulator stresses and insulation breakdown, hyperbolic-function solution of long-line problems, graphical methods, circle diagrams, transients, system stability, solution of networks. Woodruff, *Principles of Electric Power Transmission, 2d Edition.*

6·11. Principles of Electrical Engineering. Brief discussion of vacuum-tube characteristics and a treatment of elementary circuits containing such tubes. Detailed consideration is given to audio-frequency amplifiers followed by a short discussion of tuned amplifiers, oscillators and the application of nonlinear elements in modulation and detection. Elementary theory and study of the operating characteristics of motors, generators, and power transformers.

6·16. Electricity. Electricity rate structures and schedules; wires and safe wiring practice; d-c and a-c generators; transformers; electronic devices and rectifiers; d-c and a-c motors; motor control equipment; batteries. This subject treats the foregoing equipment as components of the modern building and the principles involved as the concern of the designer. Applications in heating, ventilating, air-conditioning, lighting, refrigeration, elevators, conveyers, communications, signal systems, protection of person and property, therapeutics and other services to occupants of the buildings are studied as separate or combined devices. Elevators are treated as a traffic problem in vertical transportation.

Electrical Engineering Continued

6·17. Illumination. A study of the design of lighting systems for best seeing. Photometric units and measurements, properties of the eye, characteristics of lamps and luminaires, daylight.

6·18. Fundamentals of Electrical Engineering. Fundamental principles of electric and magnetic circuits and the application of these principles to the theory and performance of direct- and alternating-current machines. Presentation of the basic elements common to the electrical field, illustrated and amplified by association with engineering applications laid out as the first part of a two-term program with electronic and other aspects of electrical engineering considered during the second term subject. Classroom instruction is supplemented by experimental work in the electrical-engineering laboratories.

6·19. Fundamentals of Electrical Engineering. A continuation of the two-term program begun in 6·18 or 6·41. Specific topics considered are electron-tube parameters and equivalent circuits, the theory of simple amplifier, oscillator, rectifier, photoelectric-cell, and gas-filled-tube circuits, and a brief survey of electrical-measurement and -control techniques. Classroom instruction is supplemented by experimental work in the electrical engineering laboratories. H. J. Reich, *Principles of Electron Tubes.*

6·20. Electronic Control and Measurement (B) Analysis and design principles of electronic devices for control and measurement in engineering, as applied to phototube devices, voltage regulators, water-level controls, spot-welder controls, sensitive wattmeters, voltmeters, ohmmeters, high-speed recording instruments, stroboscopes, flash-photography apparatus, etc., The treatment of such applications leads to a detailed consideration of the following subjects: grid current and its effect in high-impedance circuits; amplifiers with direct, resistance-capacitance, push-pull, and degenerative coupling; methods of frequency conversion to facilitate amplification or measurement; trigger circuits; and negative-resistance oscillators. The importance of the nonlinear properties of electron tubes either as limitations or as useful characteristics is emphasized.

6·211. Applications of Electricity in Industry (B) A scientific basis for modern applications of electricity in industry. Sources of energy. Analysis of power production in United States. Choice of system. Elements of electrical energy costs. Distribution of energy within the plant. Principles of electric heating, including energy conversion to heat, heat transfer, heating and cooling of metals, resistance heating, arc furnaces, low-frequency and high-frequency induction furnaces.

6·212. Applications of Electricity in Industry (B). Mechanical, thermionic and photo-electric applications. Duty cycles. Operating characteristics of motors. Controller design and application, including types, methods of acceleration and retardation, protective devices. Essentials of connecting motor to load. Principles of moving fluids and solids. Problems in the application of motors, electron tubes and photo-electric cells.

6·221, 6·222. Electric Power Generation (B). The economics and technique of electric power generation. The study of the generating station as a unitary instrument for the conversion of energy. Generation with an appropriate degree of reliability at minimum total cost. The effect of the characteristics of the load curve on cost of generation. Thermal efficiency and commercial economy of various heat cycles. The general layout of the generating station. The calculation of fault currents and the operation of protective devices. The division of load among generating units for minimum cost. The interrelation between steam and hydro generation. By-product generation. Joint operation of industrial and central-station plants. Energy storage systems.

6·23. Electrical Implementation (B). Principles underlying electrical methods of measurement, operation, and control in problems involving devices, processes, and systems of nonelectrical as well as electrical nature. Comprehensive case studies selected from such topics as dynamic performance of electromechanical systems of moving-conductor, moving-iron, piezoelectric and magneto-strictive types; electrothermal systems; elementary theory of automatic control; switching systems; the design point of view, including the use of physical similitude, the optimizing of performance, and the minimizing of costs. Emphasis is placed upon the use of electric-circuit analogies and models.

6·251. Electric Machinery Design (B). Transformers and induction motors. Materials of construction, methods of construction, calculation of electrical characteristics, eddy-current losses in the windings, and the influence of various factors of design on manufacture and operation of machines.

6·252. Electric Machinery Design (B). Design of synchronous and direct-current machines. A continuation of 6·251 but also complete within the term.

6·26. Electric Insulation (B). (Not offered Nov. 1944–June 1945.)

6·27. Principles of Illuminating Engineering. An introductory and broad survey of the whole field of illuminating engineering. Classroom work, problems, and laboratory investigations dealing with light sources, photometric units and measurements, vision, and lighting design. A foundation for advanced subjects. Moon, *The Scientific Basis of Illuminating Engineering.*

6·281. Principles of Wire Communications (B). Electrical transmission characteristics, as a function of frequency, of long lines with distributed constants in the steady state, distortion and its correction, communications transformers, insertion loss, networks, loading, filters, balancing networks, repeaters and carrier-current systems.

6·282. Principles of Radio Communications (B). (Not offered Nov. 1944–June 1945.)

6·294. Radio Engineering (B). (For selected United States Naval Officers only.)

6·30. Principles of Electrical Communications. Provides those basic circuit theory principles which are fundamental to the needs arising in the solution of communications problems. Topics include Fourier series and Fourier integral analysis, an introduction to network synthesis, and the application of these principles to the analysis and design of typical circuit elements such as coupling networks, filters, and corrective networks.

6·311. Principles of Electrical Communications (B). Theory and applications of vacuum tubes and their associated circuits as elements of communications systems. Nonlinear operation of tubes, amplifiers, feedback systems, oscillators, amplitude and frequency modulators, demodulators, converters, and power supplies. Cathode-ray tubes and circuits. Brief consideration of typical radio transmitters and receivers.

6·312. Principles of Electrical Communications (B). Detailed studies of various radio communications systems. Analysis of transmitters and receivers for amplitude and frequency modulation services with particular reference to design problems. Short-wave transmitters and receivers. Ultrahigh-frequency generators including velocity-modulation devices and magnetrons.

6·32. Principles of Electrical Communications (B). The steady-state behavior of lines, cables, and related lumped networks, including a discussion of the use of such circuit elements in ultrahigh-frequency techniques. An elementary treatment of electromagnetic wave propagation phenomena, leading to the discussion of various forms of transmission lines as wave guides. The circuit and radiation characteristics of antennas and antenna arrays.

6·331, 6·332. Electrical Communications Laboratory. Study of experimental methods in the solution of communications problems. Theory and use of modern laboratory instruments. Study of vacuum tubes and their circuits, artificial lines, and other networks, radio frequency and acoustical measurements. Correlation of physical behavior and theory of operation. Practice in designing and constructing components of communications systems.

6·34. Electrical Communications Laboratory (B). Special undergraduate work in vacuum-tube circuits, audio-,

Electrical Engineering Continued

radio-, and ultrahigh-frequency measurements and acoustics arranged to meet the needs of the individual. Opportunity is provided for acquiring experience in design, construction, and testing of components of communications systems.

6·40. Elements of Electrical Engineering. Applications of the general principles of the electric and magnetic circuit and electronics to the generation, distribution and utilization of direct- and alternating-current power. Applications are based upon modern industrial problems involving motor drive, illumination, automatic control, rectification, measurement and communication with continuous attention to the economic justification for each solution. Hudson, *Engineering Electricity, Third Edition.*

6·41. Fundamentals of Electrical Engineering. Fundamental principles of electric and magnetic circuits and the application of these principles to the theory and performance of direct- and alternating-current machines. Presentation of the basic elements common to the electrical field, illustrated and amplified by association with engineering applications. Laid out as the first part of a two-term program with electronic and other aspects of electrical engineering considered during the second term subject; it is the same as 6·18 except that laboratory work is not given concurrently.

6·43. Electrical Engineering. Fundamental theory of direct-current and magnetic circuits, magnetic and electric fields. Fundamentals and characteristics of direct-current machinery, with emphasis on the selection of machinery and control equipment as affected by torque requirements and duty cycles imposed by the load. Timbie and Bush, *Principles of Electrical Engineering, Third Edition;* Kloeffler, Brenneman, and Kerchner, *Direct-Current Machinery.*

6·44. Electrical Engineering. Continuation of the subject matter of 6·43 on direct-current machinery, with experimental work in the Electrical Machinery Laboratory. Fundamental theory of alternating-current circuits, with comprehensive problems illustrating the theory and its applications. Kloeffler, Brenneman, and Kerchner, *Direct-Current Machinery;* Lawrence, *Principles of Alternating Currents, Second Edition; Instructions for Students in Electrical Engineering Laboratories, Eleventh Edition.*

6·45. Electrical Engineering. Theory and characteristics of transformers, synchronous machines, and induction machines, with emphasis on the selection of alternating-current machinery and control equipment as affected by torque requirements and duty cycles imposed by the load. Combines classroom and laboratory instruction. Lawrence, *Principles of Alternating-Current Machinery, Third Edition; Instructions for Students in Electrical Engineering Laboratories, Eleventh Edition.*

6·46. Electrical Engineering. Elementary theory of electronic devices and their applications in circuits for measurement and control purposes, with emphasis on amplifiers and rectified-power supplies. Classroom instruction supplemented by laboratory experiments. *Applied Electronics* by members of the Department Staff.

6·47. Applications of Electricity in Industry. Considerations governing the choice, application, and economics of distribution and use of electrical energy in industry. The operating characteristics of motors and their control as governed by mechanical, electrical, or electronic methods. The elements of industrial lighting, electric welding, and electric furnaces are discussed so far as time permits. The application of electrical principles to instrumentation in other engineering fields is presented.

6·48. Electrical Equipment of Buildings. (Not offered Nov. 1944–June 1945.)

6·49. Instrument Electricity (B). (Not offered Nov. 1944–June 1945.)

6·501, 6·502. Electrical Engineering Seminar (A). Designed to give graduate students experience in the preparation and presentation of technical papers, and to present to the students and staff of the Department, both at the meetings and by means of the file of completed Seminar papers which is maintained in the Vail Library, the history of developments which are of special interest to electrical engineers.

6·511. Electric Power Circuits (A). The theory of symmetrical components and application to electric power systems operating under unbalanced conditions. The theory of equivalent circuits with application to component parts of power networks. Calculation of resistance, inductance and capacitance of transmission lines for currents of the different sequences. Analysis of single and multiple faults. A comprehensive treatment of electric power systems in the steady state. Reference Books: Lyon, *Applications of Symmetrical Components;* Wagner and Evans, *Symmetrical Components.*

6·512. Electric Power Circuits (A). (Not offered Nov. 1944–June 1945.)

6·515. Power Systems Laboratory (A). Power-network analysis using the network analyzer (an alternating-current calculating board). Problems include those relating to steady-state operation; to symmetrical and unsymmetrical faults; and to steady-state and transient stability. Problems are preferably submitted by the student.

6·516. Power System Analysis (A). Studies of the technical problems which arise in the operation of major transmission systems and in planning for system expansion and interconnection. Theoretical aspects of the problems are discussed in the classroom and the methods of analysis developed are applied to the study of representative modern power systems on the M.I.T. Network Analyzer. Problems which naturally arise are concerned with both normal steady-state operation and operation during and immediately following fault conditions. Typical examples are: steady-state power and reactive-power flow and its control in large systems; voltage regulation and the maintenance of voltage levels; interconnection of generating units within a station and its effect on system reliability and on relaying and circuit-breaker duties; steady-state and transient stability and power limits and their effects on system operation and design; frequency variations and tie-line power swings; and the action and effects of governors, excitation systems, and damper windings.

6·521, 6·522. Advanced Alternating-Current Machinery (A). Analysis of the more intricate electrical problems met in the operation of alternating-current machinery. Problems discussed include: The effect of unbalanced conditions on the operation of synchronous and induction machines; eddy currents in laminations, solid rotors, and the conductors of direct-current and alternating-current machines; electromagnetic field problems; harmonic analysis of the magnetic density existing in the air gap of synchronous and induction machines and its effect on the generated e.m.f., the torque, and on vibration; transient conditions due to the sudden alteration of the electric circuits or to the sudden applications of the shaft load of synchronous and induction machines, particularly the effect of sudden short circuit on the current and torque and the conditions arising during pulling into step and phase swinging. Facilities are available in the machine-transients laboratory for supplementary experimental work.

6·531, 6·532. Power System Economics (A). (Not offered Nov. 1944–June 1945.)

6·541, 6·542. Electric Power Generation (A). (Not offered Nov. 1944–June 1945.)

6·551, 6·552. Railroad Electric Traction (A). (Not offered Nov. 1944–June 1945.)

6·561, 6·562. Advanced Network Theory (A). A discussion of the methods of network synthesis and their applications to the design of networks for prescribed driving-point or transfer characteristics including such networks as wave filters, attenuation or phase equalizers, coupling networks for wide-band or feedback amplifiers, etc. The theoretical development begins with an enlargement of the more elementary methods of network analysis out of which are established the properties of physical driving-point impedance functions and the necessary conditions for the physical realizability of a prescribed impedance or of a set of impedance functions characterizing a network with several terminal-pairs. The discussion of synthesis procedures includes a variety of methods pertinent to the design of nondissipative and dissipative networks with one and two terminal-pairs, with consideration of various methods of obtaining equivalent networks and of the collaterally useful concept of duality. Some time is spent

Electrical Engineering Continued

discussing pertinent properties of analytic functions of a complex variable.

6.571, 6.572. Principles of Illuminating Engineering (A). (Not offered Nov. 1944–June 1945.)

6.58. Transients in Linear Systems (A). Formulation from physical considerations, of differential equations of circuit and field problems in electrical, mechanical, thermal, and acoustical systems which permit of linear treatment; analogies; mathematical studies of transient disturbances in these systems, using the Laplace transformation method (a method which includes the Heaviside operational calculus). Requisite background in complex variable theory is supplied.

6.585. Applications of Integral Equations in Electrical Engineering (A). Applications of integral equations to various problems in electrical engineering, such as problems of electrostatics, skin effect, interreflections of radiant energy, and vibrations. Particular attention devoted to the solution of integral equations by approximating the kernel and by use of various numerical and graphical methods.

6.586. Engineering Applications of Field Theory (A). Engineering treatment of methods for the solution of Laplace's equation and their practical applications. Provides a supplement to the usual electric-circuit theory (one space dimension) by developing methods for two and three dimensions. Byerly, *Fourier Series and Spherical Harmonics.*

6.59. Communications Laboratory (A). A graduate laboratory subject in communications in which the student carries out work on a substantial problem or selected group of problems in consultation with a member of the staff who is particularly qualified in the field. The student is expected to show a mature independence of attack and investigatory ability. His work is guided by conferences, with opportunity for detailed criticism and discussion.

6.60. Mathematical Analysis by Mechanical Methods (A). A study of computation procedures and the mechanical methods developed for performing them. General principles are developed and illustrated by existing equipment. Emphasis is placed on the methods adapted to the treatment of important problems where ordinary processes are extremely laborious.

6.601. Mechanized Mathematics Laboratory (A). Examination and demonstration of the operating principles of a variety of computing mechanisms. The operating performance and adjustment are studied experimentally on computing mechanisms which are of particular interest to fire control officers. (For U. S. Naval Officers only.)

6.605. Servomechanisms (A). A unified treatment of the dynamical principles of closed-cycle automatic control systems with emphasis on the quantitative study of system behavior. Stability requirements, transient and steady state response to arbitrary forcing function, and the transfer loci method of predicting design data are given systematic coördination.

6.606. Servomechanisms (A). An applied treatment of servomechanism theory embodying analysis and quantitative design of a number of automatic control systems. Electric, hydraulic, electro-electronic, and electro-hydraulic servomechanisms are investigated with the aid of supporting applied electronics, electrical machinery, fluid mechanics, and fluid machinery theory as applied to servomechanisms. Along with the theory is the laboratory program in which quantitative measurements and evaluations are made of servomechanisms.

6.607. Servomechanisms Laboratory (A). An advanced Servomechanisms Laboratory program suited to comprehensive quantitative investigation of design and test of closed-cycle systems. The program will vary to meet particular needs of the student. More profound problems are recommended in comparison to unrelated minor studies.

6.61. Generation and Utilization of Super-Voltages (A). (Not offered Nov. 1944–June 1945.)

6.62. Principles of Electrical Communications (A). (Not offered Nov. 1944–June 1945.)

6.621, 6.622. Radio Lines, Antennas and Propagation (A). Treats those parts of the radio system that effect transmission of energy between transmitting apparatus and receiving apparatus. First term — theory and application of radio frequency wave guides of various types, including coaxial and hollow pipe, as energy conductors and circuit elements. Second term — theory and practice of antennas for broadcast, short wave, and microwave services, including applications to air navigation. Engineering aspects of radio wave propagation. General principles are derived from electromagnetic theory, followed by application to practical problems. (Not offered Nov. 1944–June 1945.)

6.627. Patents and Their Relation to Science and Engineering (A). (Not offered Nov. 1944–June 1945.)

6.628. The Patent Background of Electrical Communications in the United States (A). (Not offered Nov. 1944–June 1945.)

6.631. Engineering Electronics (A). The electrokinetic theory of gases, including free paths, mobility, diffusion, ionization, recombination and space-charge effects. Potential distributions between electrodes immersed in a gas, and theory and characteristics of glow, spark and arc discharges. Application to rectifiers, grid-controlled arc tubes, circuit breakers and lightning arresters. Cobine, *Gaseous Conductors.*

6.632. Engineering Electronics (A). Engineering application of electronic apparatus. Current, voltage, and energy considerations in circuit interruption involving arcs. Mercury arc rectifiers and associated circuits. Electric welding arc. Inversion and other special applications. Cobine, *Gaseous Conductors.*

6.64. Applications of Atomic Physics in Electrical Engineering (A). (Not offered Nov. 1944–June 1945.)

6.651, 6.652. Electric Power Distribution (A). The theoretical principles of electric power distribution. The distribution system in theory. Calculation of power-system short-circuit transients. Limitation of short-circuit currents, maintenance of voltage, and the control and transfer of power. Theory of electric power cables, dielectric properties, calculation and limitation of sheath currents. Low-voltage and medium-voltage distribution networks. Interlacing of primary cables, load division and transformer spacing. Theory of relays, methods of obtaining selectivity and their applications. Load characteristics, economic problems in electric distribution, allocation of demand costs, determination of cost of energy loss and rate structures.

6.661, 6.662. Principles of Electric Machine Development (A). Studies of various types of electric machines and apparatus and calculation of their characteristics. Eddy-current loss in rectangular wire windings in transformers and generators. Theory of measurement of core loss with poor wave form. Allowable overloads for transformers. Heat resistivity, free convection and radiation. Slot harmonics in induction motors and choice of slot numbers. Reactance and temperature rise of bus-bars. Inductance, magnetic field strength and mechanical force of round coils in air. Flux-plotting. Usual methods of calculation including the potential method. Graphical flux-plotting. Unbalanced magnetic pull in rotating machines. Eddy currents in round wires, tubular conductors and induction furnaces and solutions by means of Bessel functions.

6.671, 6.672. Vibrations (A). The theory of vibration of mechanical systems including certain acoustical and hydraulic problems. The complex-notation method will be generally used. (Students from other courses will be given a short preliminary instruction in this method while the Electrical Engineering students are working on more purely electrical problems. Thereafter the two groups will be united.) Forced, transient, and self-induced vibration. Single and multiple degrees of freedom. Analogies between electrical and mechanical systems. Nonlinear systems. Application to mechanical devices, machines, and structures. Vibration measurements and corrections. The use and limitations of models, mechanical and electrical. Noise in machines, its causes and control. The control of temperature oscillations. The tide and an analysis of tidal power possibilities. Stresses in bus-bars and bus-bar supports. Inertia effects in high-speed mechanisms. (Not offered Nov. 1944–June 1945.)

M.I.T. ANNUAL CATALOGUES AND BULLETINS
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02
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02

Electrical Engineering Continued

6·68. Special Problems in Electrical Engineering (A). Provides an opportunity for individual study, under a staff member, of advanced subjects related to Electrical Engineering not otherwise included in the curriculum. The program is laid out to suit individual requirements by the student and staff members interested, subject to the approval of the professor in charge.

6·681. Special Problems in Fire Control (A). (Open to selected United States Naval Officers only.)

6·69. Sound in Electrical Communications (A). (Not offered Nov. 1944–June 1945.)

6·73. Electrical Measurements Laboratory. Advanced (A). Advanced work of the nature of that given in 6·75, and 6·76, the choice of problems being suited to the individual student.

6·74. Advanced Electrical Engineering Laboratory (A). Laid out in accordance with the needs of the individual student, special problems on direct and alternating-current machinery being selected.

6·75. Electrical Engineering Laboratory. Choice of work by the student, subject to the counsel of his instructor from a broad selection of topics having to do with the measurement of the properties of linear circuit elements, and the transient and steady state behavior of circuits made up of such elements. *Instructions for Students in the Electrical Engineering Laboratories, Eleventh Edition*, 1943.

6·76. Electrical Engineering Laboratory. Choice of work by the student, subject to counsel of his instructor, from a broad selection of topics having to do with the measurement of the properties of non-linear circuit elements, including electronic devices, and the behavior of circuits in which such devices are used.

6·77. Electrical Engineering Laboratory. Characteristics and fundamentals of direct-current machinery. Ricker and Tucker, *Electrical Engineering Laboratory Experiments, Fourth Edition;* Kloeffler, Brenneman, and Kerchner, *Direct-Current Machinery; Instructions for Students in Electrical Engineering Laboratories, Eleventh Edition*, 1943.

6·78. Electrical Engineering Laboratory. Polyphase circuits, symmetrical phase components, transformer, synchronous generator, synchronous motor, three-phase induction motor. Ricker and Tucker, *Electrical Engineering Laboratory Experiments, Fourth Edition; Instructions for Students in Electrical Engineering Laboratories, Eleventh Edition*, 1943.

6·781. Electrical Engineering Laboratory. Polyphase circuits, symmetrical phase components, power transformer, synchronous generator, synchronous motor, single-phase and three-phase induction motors, and power rectifiers. *Textbooks same as for* 6·78.

6·79. Electrical Engineering Laboratory. Characteristics of single-phase induction motors, synchronous converters and power rectifiers, special purpose alternating-current machinery, characteristics of power transmission lines. *Textbooks same as for* 6·78.

6·80. Electrical Engineering Laboratory (B). For Electrical Engineering students who desire work in addition to that included in any one of subjects 6·75, 6·76, 6·77, 6·78 or 6·79, and for any other students requiring a special program. Arranged to suit the requirements of the individual student.

6·81. Electrical Engineering Laboratory. Choice of work from a broad selection of topics dealing with methods of measurement of the electrical and magnetic properties of metals. *Instructions for Students in the Electrical Engineering Laboratories, Eleventh Edition*, 1943.

6·82. Electrical Engineering Laboratory. Experiments designed to illustrate the operating characteristics of common types of direct- and alternating-current motors and generators and transformers; experiments with elementary vacuum and gaseous-tube circuits. Ricker and Tucker, *Electrical Engineering Laboratory Experiments, Fourth Edition; Instructions for Students in Electrical Engineering Laboratory, Eleventh Edition*, 1943.

6·83. Electronic Engineering Laboratory. Choice of work by the student, subject to the counsel of his instructor, from a broad selection of topics having to do with the application of electronic devices to measurement and control purposes in engineering. Amplifiers, voltmeters, trigger circuits, relaxation and phase-shift oscillators, voltage regulators, phototube devices, and thyratron applications are included.

6·84. Electrical Implementation Laboratory. Choice of work by the student, subject to the counsel of his instructor, from a broad selection of the topics listed for 6·23.

6·85. Electrical Engineering Laboratory. Ten exercises designed to familiarize students with the elements of electrical measurements and with the characteristics and fundamental principles of operation of the ordinary types of electrical machinery and control apparatus. Ricker and Tucker, *Electrical Engineering Laboratory Experiments, Fourth Edition: Instructions for Students in Electrical Engineering Laboratories, Eleventh Edition*, 1943.

6·89. Electrical Engineering Laboratory. Eight laboratory exercises similar in subject matter to those of 6·85. *Textbooks same as for* 6·85.

6·901 to **6·904.** Manufacturing Practice. These subjects cover the manufacturing work taken by the coöperative students at the plants of the General Electric Company in Lynn, Schenectady, Pittsfield and Philadelphia.

6·911 to **6·914.** Public Utility Practice. These subjects are given at the Boston Edison Company.

6·951 to **6·954.** Electronic Apparatus Manufacturing Practice. These subjects cover the shop, laboratory, and engineering experience of the coöperative students in the plants of the General Radio Company, Cambridge.

BIOLOGY AND BIOLOGICAL ENGINEERING

Subjects 7·00 to 7·99

7·03. Genetics (B). Advanced lectures and recitations in general biology designed to acquaint the student with the principal theories and hypotheses which have played an important part in the development of biological science, and particularly of those which underlie the more fruitful research work of the present day. The two major problems discussed are heredity and ecology. Sinnott and Dunn, *Principles of Genetics*.

7·05. Biology I. Discussion of general biology of protoplasm and the methods used in the study of plants and animals; further discussion of single celled plants, their morphology, growth, development and physiology with laboratory exercises. Introduction to the elements of bacteriological methods. Study of invertebrates of medical importance, such as flukes, tapeworms, roundworms, and certain insects.

7·06. Biology II. A continuation of Biology I, dealing primarily with the anatomy and physiology of vertebrates, with laboratory dissections and some histology. Elementary embryology and the theories of evolution and genetics are also considered.

7·11. Embryology. Classroom and laboratory work on the development of animals from the germ cells to the organ systems.

7·12. General Cytology (A). The fundamental cytology of mitosis, meiosis, spermatogenesis, and genetic mechanics, together with the morphology of secretory, excretory, contractile, absorptive, and conducting cells will be discussed. Particular attention will be given to an understanding of the activities of cells and cell structures in physical chemical

Biology and Biological Engineering Continued

terms. Methods of modern cytology will be applied in the laboratory with emphasis placed on the study of living material.

7·14. Comparative Anatomy. Covers the fundamentals of comparative gross anatomy of vertebrates and the essential histology of the organs. The structures will be partly dissected out by students and partly demonstrated by the instructor. Classification and general zoölogy of the vertebrates are also considered.

7·17. Biology of Food Supplies. A consideration of the growth, structure, and physiology of important food animals and crop plants, in relation to their utilization by man. Special attention is given to those animals, particularly invertebrates, which injure or infest food supplies. Robbins and Ramaley, *Plants Useful to Man*. (Not offered Nov. 1944–June 1945.)

7·18. Technical Aspects of Entomology (A). (Not offered Nov. 1944–June 1945.)

7·19. General Physiology. Lectures dealing with the physical and chemical properties of protoplasm and with basic physiological phenomena common to all plant and animal cells. In addition, the fundamental principles underlying the function of selected organs are studied.

7·21. General Physiology Laboratory. Exercises illustrating the application of physical chemical principles and methods in physiology. In addition, experimental methods of studying fundamental physiological phenomena including cell permeability, tissue respiration, contractibility, irritability, secretion, and excretion.

7·22. Personal Hygiene and Nutrition (B). Consideration of personal health and disease, their conditions and causes; exercise, work, play, oral hygiene, hygiene of clothing, of the feet, of the alimentary canal, mental hygiene, etc. Special attention is given to diet from the standpoint of the science of nutrition. (Not offered Nov. 1944–June 1945.)

7·23. Applied Nutrition (A). First portion of the subject is concerned with the nutritional requirements from infancy to old age and with the clinical methods by which these requirements are determined. The results of studies on population groups are studied to show the effects of malnutrition and undernutrition on the one hand, and the effects of adequate and optimal nutrition on the other. The final third of the term is devoted to practical field work in applied nutrition at the Food Clinic of the Boston Dispensary. Individual case studies are made with normal and malnourished children and the practical difficulties in securing adequate dietaries for various types of children under poor social conditions are given consideration.

7·24. Advanced Nutrition (A). Considers the chemical, biological, physical and clinical methods for measuring or assaying substances and elements of nutritional importance, such as vitamins, minerals, and amino-acids. Methods for the detection of clinical and sub-clinical nutritional deficiencies, quantitatively and qualitatively, employing modern instrumentation and procedures, are examined.

7·301. Bacteriology (General). Fundamental consideration of the biology, biochemistry, and biophysics of bacteria with particular emphasis on the study of selected types. Laboratory work will also include the use of various methods for studying bacteria and studies to determine the effect of physical and chemical agents on bacteria. Zinsser and Bayne-Jones, *A Textbook of Bacteriology.*

7·302. Bacteriology (Sanitary) (B). Considers the qualitative and quantitative distribution of bacteria in air, water, sewage, shellfish, milk, and dairy products and their relationship to sanitation and public health. In the laboratory particular emphasis is placed on the isolation and identification of type organisms used as indices of pollution and on the methods and interpretation of the bacteriological examinations. Prescott and Winslow, *Elements of Water Bacteriology;* Hammer, *Dairy Bacteriology; Standard Methods of Water Analysis; Standard Methods for the Examination of Dairy Products.*

7·31. Biology of Bacteria. A study of bacteriology as a biologic science, stressing the fundamental principles and pure science aspects of the subject. Laboratory work includes the basic techniques for studying bacteria, with the use of selected types. Salle, *Fundamental Principles of Bacteriology.*

7·321, 7·322. Advanced Bacteriology (A). Reports and discussions on bacterial physiology and growth, including nutrition, energetics, respiration and anaerobiosis, growth factors, temperature effects, bacterial variation, and the use of statistical measurements in quantitative bacteriology. In the second term, laboratory problems and demonstrations may include bacterial dissociation, filtration techniques, viruses, and special problems.

7·361. Industrial Microbiology. A broad survey of the theory and practice involved in fermentation processes, and the industrial and economic applications of microbiology in agriculture and the manufacture of biochemical preparations. Industrial alcohol, vinegar, acetone, butyl alcohol, glycerin, fermentation acids, and the applications in the leather and food industries are especially considered. (Not offered Nov. 1944–June 1945.)

7·362. Industrial Microbiology (B). A continuation of the preceding with more detailed laboratory investigation on a semi-commercial scale. (Not offered Nov. 1944–June 1945.)

7·371, 7·372. Advanced Industrial Microbiology (A). (Not offered Nov. 1944–June 1945.)

7·39. Bacteriology of Foods (A). (Not offered Nov. 1944–June 1945.)

7·41. Chemistry of Water. Chemical examination of potable and of polluted waters, with lectures on the significance of the results. American Public Health Association, *Standard Methods of Water Analysis;* Theroux, Eldridge and Mallmann, *Analysis of Water and Sewage.*

7·44. Surface Chemistry in Biology (A). Discussion of the special properties of interfaces as exemplified by mono- and polymolecular films, leading to an understanding of interfacial phenomena in cells and tissues. The laboratory work will entail application of the techniques of surface chemistry to problems of current importance.

7·52. Industrial Hygiene (B). The maintenance and the effectiveness of the worker with a consideration of factory sanitation, industrial fatigue, occupational accidents, industrial poisoning, dust control, ventilation, and health administration in industry. Each student is assigned work in the detection and estimation of toxic substances or in the investigation of some industrial health problem according to his individual needs. (Not offered Nov. 1944–June 1945.)

7·56. Principles of Sanitation (B). Lectures, problems and field work in the relationship of the environment to the public health, including air, water, sewage, milk, food supplies, insects, rodents, housing, public buildings, and other similar factors.

7·591. Public Health Engineering (A). Lectures, discussions, laboratory and field work dealing with the various activities of the public health engineer, such as sources and modes of infection, epidemiological procedures in water, milk, food and insect-borne diseases; rural sanitation; sanitation of swimming pools and summer camps; street cleaning and refuse collection and disposal; sanitation of foods, food stores, and restaurants; housing; school sanitation; the principles of air conditioning and other atmospheric problems in relation to health and comfort.

7·592. Public Health Engineering (A). Lectures, discussions, laboratory and field work dealing with water supplies and their purification; sewage and its treatment; milk supplies and their production, sanitation, and supervision; and the safeguarding of shellfish.

7·701, 7·702. Technology and Chemistry of Food Supplies. Lectures, discussions, and reports on the chemical composition, production, consumption, statistics, and methods of treatment of food materials. The general commercial methods of production and handling of raw foods, such as milk, eggs, meats, cereals and other vegetable food supplies, and their preparation for commercial distribution or for later manufacturing processes will be discussed in detail. The fundamental principles involved in physical processes such as refrigeration, dehydration, and salting, and the microbiology

Biology and Biological Engineering Continued

and chemistry of the processes is studied. The laboratory work includes numerous exercises involving the chemical analysis of various foods and food products. Prescott and Proctor, *Food Technology;* Woodman, *Food Analysis.* (Not offered Nov. 1944–June 1945.)

7·711. Technology of Food Products (B). Lectures, reports and laboratory experiments in the methods of food preservation and manufacture. Semi-plant scale operations in dehydration. The production of fruit juices and concentrates, canning processes, and quick-freezing of various foods included. Cruess, *Commercial Fruit and Vegetable Products;* Tanner, *The Microbiology of Foods.* (Not offered Nov. 1944–June 1945.)

7·712. Technology of Food Products (B). A continuation of 7·711 with particular reference to the products and technological processes of the meat-packing industry, fisheries, dairy products, and special technical procedures involving heat penetration, sterilization, and packaging. Tressler and Evers, *The Freezing Preservation of Fruits, Fruit Juices and Vegetables.* (Not offered Nov. 1944–June 1945.)

7·721, 7·722. Advanced Food Technology (A). (Not offered Nov. 1944–June 1945.)

7·80. Biochemistry (B). Primarily a laboratory subject with experiments designed to illustrate basic principles of biochemical procedure as applied in various fields. The laboratory work does not lay emphasis upon clinical aspects of physiological chemistry. Lectures cover the nature of chemical processes in plants and animals with special attention to the metabolism of foodstuffs and the nature of protoplasms.

7·81. Enzymology (A). Lectures, recitations, and reports with laboratory work on quantitative study of enzyme reactions, their products, and the conditions governing activity.

7·82. Advanced Biochemistry (A). Technique for biochemical analyses and bio-assays, based on the recent literature. Discussions, reports, and laboratory problems.

7·831, 7·832. Chemistry of Micro-organisms (A). A laboratory course which emphasizes the quantitative aspects of the metabolic activities of micro-organisms. Special problems in the general biochemistry of the yeasts, molds, and bacteria are investigated and the student is acquainted with many of the analytical and research methods now in use in various laboratories. Isolation and identification of various metabolic products, metabolic balance sheets, and respiration studies are included.

7·85. Biophysics I (A). Optical methods useful in biochemical and biological research. Techniques used in photography, spectrography, microscopy (including ultra-violet and electron microscopy), polarization optics, and X-ray diffraction.

7·86. Biophysics II (A). Isotopic tracers, surface chemistry, the ultracentrifuge, electrophoresis, and other physical equipment and techniques applicable to biological and biochemical problems. Biological effects of radiant energy.

7·87. Spectroscopy of Biological Materials (A). (Not offered Nov. 1944–June 1945.)

7·871. Spectroscopy of Biological Materials Laboratory (A). (Not offered Nov. 1944–June 1945.)

7·881. Biophysics Laboratory I (A). Laboratory to accompany Biophysics I.

7·882. Biophysics Laboratory II (A). Laboratory to accompany Biophysics II.

7·91, 7·92(B). Biological Engineering I and II. These subjects deal with the principles of electrical instrumentation of use in the biological sciences including research and industrial biology and certain aspects of medical science. In 7·91 a foundation is provided for an understanding of the principles of electrical measurements and the construction and operation of electrical instruments. The work of 7·92 deals primarily with the principles of electronics and electronic devices, including amplifiers, oscillographs, photoelectric cells, X-ray tubes, and dosimeters.

7·93. Selected Topics in Biology (A). Class work in various fields of biology not covered by the regular subjects of instruction.

7·941, 7·942. Research Problems (A). Directed research by graduate students in a field of biological science, but not contributory to the thesis.

The following subjects are offered as General Studies. For description of subjects see Division of General Studies.

G86. Principles of Sanitary Science and Public Health.

G88. From Molecule to Man.

PHYSICS

Subjects 8·00 to 8·99

GENERAL PHYSICS

8·01. Physics (Mechanics). Lectures, recitations, supervised problem and laboratory work devoted to a study of the fundamental laws of point and rigid body mechanics. Free use is made of elementary calculus.

8·012. Physics (College Transfer). Given during the first term for those college transfer students who already have been allowed partial credit for 8·01 and 8·02 on the basis of a substantial course in general physics taken prior to their transfer. The subject is not to be taken by any student under requirement to take or to repeat 8·01 and 8·02. It is designed to supplement the transfer student's training in amount necessary to cover the requirements of 8·01 and 8·02. Free use is made of calculus.

8·02. Physics (Mechanics and Heat). Lectures, laboratory and recitations. The subject is divided into two parts: (*a*) Mechanics of continuous media preceded by a study of gravitational field of force and orbital motion. (*b*) The first and second laws of thermodynamics and elementary kinetic theory of gases.

8·03. Physics (Electricity). An introduction to the fundamental laws of electricity and magnetism and their applications. Electrostatics, steady currents and magnetic fields, and time-varying electric and magnetic fields comprise the principal topics. The work is quantitative throughout and free use is made of calculus, both in the theory and applications.

8·034. Physics (College Transfer). Given during the second term for those college transfer students who already have been allowed partial credit for 8·03 and 8·04 on the basis of a substantial course in general physics taken prior to their transfer. The subject is not to be taken by any student under requirement to take or to repeat 8·03 and 8·04. It is designed to supplement the student's training in amount necessary to cover the requirements of 8·03 and 8·04. Free use is made of calculus.

8·04. Physics (Electricity, Optics and Modern Physics). A continuation of 8·03, approximately one-third of the course bringing to a conclusion the study of electricity. The discussion of electromagnetic waves leads to optics, which is devoted to both geometrical and physical optics. The quantitative character of 8·03 is continued and free use is made of calculus.

8·05. Vibrations and Sound (B). The first part of the subject is a study of the dynamics of vibrating bodies; coupled oscillators, strings, membranes and plates. The second part is a study of the transmission and radiation of sound. The properties of loud speakers and microphones are treated, and the characteristics of speech and hearing are discussed.

8·051. Special Problems in Acoustics (A). An advanced problem in acoustics or vibrations with assigned reading and consultations.

8·052. Experimental Acoustics (B). A laboratory subject in acoustics, including measurements on acoustical

Physics Continued

absorbing materials, calibration of loudspeakers and microphones, recording and analysis of noise, vibration analysis, and experiments in supersonics and in physiological acoustics.

8·053. ACOUSTICS. (Not offered Nov. 1944–June 1945.)

8·061. INTERMEDIATE PHYSICS (THERMODYNAMICS AND KINETIC THEORY.) Physics of intermediate grade, covering material somewhat more advanced than that in 8·01–8·04. Topics dealt with include first and second laws of thermodynamics with applications to properties of gases, change of state, and chemical equilibrium. Elementary kinetic theory, Maxwell distribution of velocities, and the Maxwell-Boltzmann formula.

8·062. INTERMEDIATE PHYSICS (ELECTRONICS) A continuation of 8·061. Topics covered include thermionic emission, photoelectric effect, and electron optics.

8·09. PHYSICAL MEASUREMENTS. Introduction to experimental physics with emphasis on laboratory manipulation. Includes glass blowing, microsoldering, vacuum technique, evaporation of metals and assembly of optical systems. Application of the techniques to physical measurements. Selected experiments on heat, electricity, light, X-rays, gas kinetics and properties of matter.

8·11. EXPERIMENTAL PHYSICS (B). Designed to train the student in methods of analyzing experimental problems to determine suitable methods of achieving a desired result, both in the design and use of experimental equipment. The case system is used and the entire field of experimental physics, both pure and applied, is drawn on. In the laboratory work the experiments are of a semi-research character, designed to develop initiative, resourcefulness, and familiarity with modern experimental technique.

OPTICS AND PHOTOGRAPHY

8·15. PHOTOGRAPHY. An elementary subject intended primarily as an elective for students not in Course VIII.

8·152. ADVANCED PHOTOGRAPHY. An advanced laboratory subject. The experiments are concerned chiefly with the determination of the various characteristics of photographic materials and are designed to give practice in photographic technique.

8·161. OPTICS. Fundamental principles of geometrical, physical and physiological optics. Includes refraction at spherical surfaces, thick lenses, the limitation of rays by apertures, lens aberrations, the resolving power of optical instruments, diffraction, interference, polarization, radiation, light sources, the eye, photometry, color, photoelectricity, the design and construction of optical instruments, stereoscopy, and a detailed description of the performance of well-known optical systems such as telescopes, microscopes, photographic objectives, and projection systems.

8·162. OPTICAL MEASUREMENTS. Laboratory exercises illustrating the principles, methods and manipulation of optical instruments.

8·173. COLOR MEASUREMENTS (B). The measurement and specification of color in both the objective and subjective sense and the application of such methods to industrial problems. The experiments are designed to illustrate the photometric and chromatic properties of the human eye and to give experience in the technique of spectrophotometry and colorimetry.

8·174. MOTION PICTURE PHOTOGRAPHY (B). (Not offered Nov. 1944–June 1945.)

8·181, 8·182. OPTICS SEMINAR (A). (Not offered Nov. 1944–June 1945.)

8·183. SPECIAL PROBLEMS IN OPTICS (A). Supervised experimental work in the optics laboratory, to be taken by students who desire to carry out special investigations not under the head of thesis work.

8·191. MICROSCOPY AND PHOTOMICROGRAPHY. (Not offered Nov. 1944–June 1945.)

8·194. ADVANCED PHYSICAL OPTICS (A). (Not offered Nov. 1944–June 1945.)

ELECTRONICS

8·202. ELECTRONICS LABORATORY. Intermediate electrical and electronic measurements.

8·21. ELECTRONIC PHENOMENA (A). An introduction to modern electron theory including an elementary treatment of Maxwell-Boltzmann and Fermi-Dirac statistics with applications of these theories to thermionic and photoelectric emission from metals and to gas discharge phenomena.

8·212. EXPERIMENTAL ELECTRONICS (A). The theory and use of modern experimental apparatus as applied to electronic investigations. This includes experiments with the Compton quadrant electrometer, the FP-54 vacuum tube "Electrometer," the cathode ray oscillograph and the thyratron, as well as experiments of a fundamental nature on thermionic emission, photoelectric effect, and gas discharge phenomena.

8·213. ADVANCED ELECTRONICS (A). (Not offered Nov. 1944–June 1945.)

8·214. ADVANCED ELECTRONICS (A). (Not offered Nov. 1944–June 1945.)

8·215. SPECIAL PROBLEMS IN ELECTRONICS (A). An advanced problem in electronics, with assigned reading and consultation.

X-RAYS AND THE STRUCTURE OF MATTER

8·26. MOLECULAR STRUCTURE (A). (Not offered Nov. 1944–June 1945.)

8·27. X-RAYS AND CRYSTAL PHYSICS (B). X-ray apparatus production of X-rays, absorption, scattering, refraction, X-ray spectra. Theory and application of the diffraction of X-rays in matter to the determination of the structure of crystals, and the atomic and molecular arrangement in liquids and amorphous solids. A general review of the structure of matter as determined by X-ray diffraction analysis.

8·271. ADVANCED PHYSICS OF X-RAYS (A). (Not offered Nov. 1944–June 1945.)

8·28. X-RAY DIFFRACTION (A). (Not offered Nov. 1944–June 1945.)

8·29. QUANTUM THEORY OF THE SOLID STATE (A). Motion of electrons in a periodic potential field. Methods of calculation of the elastic properties of solids. Discussion of electric conductivity, of the magnetic and optical properties of solids, and of the structure of alloys. (Alternate years.)

8·30. SPECIAL PROBLEMS IN CRYSTAL PHYSICS (A). An advanced problem in X-ray diffraction or crystal physics, with assigned reading and consultation.

ATOMIC STRUCTURE AND SPECTROSCOPY

8·311. ATOMIC STRUCTURE. The study of electron and ion beams, and of the scattering of alpha-particles, electrons, and light by atoms. The corpuscular nature of light and the wave nature of the electron. The Bohr theory of atomic structure and the vector model of the atom. Radioactivity and nuclear structure.

8·312. ATOMIC STRUCTURE LABORATORY. A continuation of 8·09 with application of the laboratory techniques to the study of selected topics in modern physics such as absorption and emission spectra, inelastic impacts of the first and second kind, resonance radiation, fluorescence, critical potentials, gamma ray absorption and artificial radioactivity.

8·32. LINE SPECTRA (A). Deals with the characteristics of atomic spectra and their description in terms of quantum numbers, their interpretation in terms of current theories of atomic structure, and their use in explaining the chemical properties of the elements.

8·341, 8·342. SPECTROSCOPY SEMINAR (A). (Not offered Nov. 1944–June 1945.)

8·343. SPECIAL PROBLEMS IN SPECTROSCOPY (A). Supervised experimental work in the Spectroscopy Laboratory, to be taken concurrently with the Spectroscopy Seminar by students who desire to carry out special investigations not under the head of thesis work.

Physics Continued

NUCLEAR PHYSICS

8·411. Nuclear Physics (B). Treats the principal fields in the study of atomic nuclei, building each up from its beginnings to the status of present knowledge. The treatment is primarily factual, the experimental results being correlated with those given by current theories. Lectures are supplemented by laboratory work in which the student deals directly with the latest types of apparatus. Includes the properties of stable nuclei; isotopes, nuclear moments, mass and charge; radioactive transformations; mathematical theory of statistics and fluctuations; properties of alpha rays, gamma rays, electrons and positrons.

8·412. Nuclear Physics (B). Continuation of 8·411 considering the nuclear spectra of alpha, beta, gamma rays and nuclear energy levels; nuclear force fields and scattering of alpha rays, protons, neutrons and electrons; excitation and transmutation of nuclei; artificial radioactivity; cosmic rays; applications of nuclear techniques to chemistry, biology, geology and other fields.

8·42. Seminar in Nuclear Physics (A). (Not offered Nov. 1944–June 1945.)

8·43. Theory of Nuclear Structures (A). (Not offered Nov. 1944–June 1945.)

8·44. Applied Radiochemistry (A). Applications of radioactive elements to studies in chemistry, biology, medicine, metallurgy, etc., are considered in principle and practice. An extensive survey of such applications is included to indicate the scope of field and to suggest new ways to apply radiochemical techniques. Laboratory work will demonstrate the special problems involved in applied radiochemistry and will furnish practice in the preparation, application, and detection of radioactive materials.

8·441, 8·442. Special Problems in Nuclear Research (A). Supervised experimental work on radioactivity, nuclear bombardment, and general nuclear research, for students who wish to carry out special investigations which do not come under the head of thesis work.

THEORETICAL PHYSICS

8·461. Introduction to Theoretical Physics I (B). Mechanics, vibrating particles, string, and membranes, with study of ordinary and partial differential equations, Fourier series, and vector analysis.

8·462. Introduction to Theoretical Physics II (B). Elasticity and hydrodynamics, heat conduction, electromagnetic theory, potential theory, and the electromagnetic theory of light.

8·463. Introduction to Theoretical Physics III (A). Wave mechanics and quantum theory, classical and quantum statistics, structure of atoms and molecules, and the properties of matter.

8·481. Advanced Mechanics I (A). (Not offered Nov. 1944–June 1945.)

8·482. Advanced Mechanics II (A). (Not offered Nov. 1944–June 1945.)

8·491. Methods of Theoretical Physics (A). An advanced subject coördinating and developing the methods used in the solving of problems in electrostatics, hydrodynamics, heat flow, diffusion, wave motion, wave mechanics, etc. The equations governing these phenomena are developed and the effects of boundary conditions on the solutions are studied. The uses of Green's functions, eigenfunctions, variational methods, and conformal transformations are discussed in detail. (Alternate years.)

8·511. Thermodynamics and Statistical Mechanics. (Not offered Nov. 1944–June 1945.)

8·512. Statistical Mechanics (A). The basic principles of statistical mechanics with applications to physical problems. (Alternate years.)

8·521. Quantum Mechanics (A). An advanced subject in modern atomic theory. The Dirac operator method is developed, and the theories of electron spin and of the interaction of radiation and matter are discussed. The theories are applied in the study of atomic and molecular spectra, collision processes and other topics. (Alternate years.)

8·54. Electromagnetic Theory (B). Formulation of field equations. Generalization to material media with discussion of theories of dielectric constant, permeability and polarization. Energy of the electromagnetic field — Poynting theorem. Wave propagation in unbounded media. Boundary conditions and propagation in bounded media: reflection and refraction of electromagnetic waves, with particular emphasis on the theory of propagation along conductors. Field due to an oscillating dipole and application to calculation of radiation from systems having known current distribution; antenna theory.

8·56. Electromagnetic Wave Theory (A). Radiation theory, electromagnetic boundary-value problems, propagation in dispersive media with application to the ionosphere. Application of Fourier and Laplace transform theory to field equations. (Alternate years.)

8·57. Cosmic Rays and High Energy Phenomena (A). (Not offered Nov. 1944–June 1945.)

8·58. Theory of Relativity (A). (Not offered Nov. 1944–June 1945.)

8·591, 8·592. Theoretical Seminar (A). (Not offered Nov. 1944–June 1945.)

8·60. Special Problems in Theoretical Physics (A). Reading, consultation, and original investigation on a problem in theoretical physics.

The following subject is offered as a General Study. For description see Division of General Studies.

G5. Introduction to Astronomy. (Not offered Nov. 1944–June 1945.)

CHEMICAL ENGINEERING

Subjects 10·00 to 10·99

10·15. Thesis Reports. Intended to give seniors training in the presentation of the results of technical investigations by oral and written reports. An attempt is made to reproduce the variety of situations which confront the practicing engineer in presenting oral reports to groups with varying degrees of engineering training and experience. Thesis reports consist of periodic oral and written reports on progress of thesis before fellow students and staff members in chemical engineering. Committee reports consist of oral reports on some technical problem before student groups from various branches of engineering. The Department of English coöperates in this work.

10·17. Industrial Chemistry. Deals chiefly with the industrial aspects of fuels, combustion and furnaces through the solution of numerous problems. Lewis and Radasch, *Industrial Stoichiometry.*

10·18. Industrial Chemistry. The more important industrial chemical processes are studied from the point of view of both the chemical reactions forming the basis of the process, and the plant necessary to carry on these reactions. In this way the interrelationships of the different industries as to raw materials, sources of energy, and standard types of apparatus are developed and a general survey of the field obtained. Extensive problem work is included.

10·203. Industrial Chemistry. Similar to 10·18 except that problems are of a less advanced character.

10·21. Industrial Chemistry (B). A continuation of 10·18. Devoted to those industries which deal with amorphous solids, including glass, ceramics, leather, paints, textiles, paper, rubber, etc.

10·25. Industrial Chemistry (A). Covers industrial stoichiometry and the industrial chemistry of the more important chemical industries. It includes a detailed discussion of the interrelationships of the important industries and

Chemical Engineering Continued

problem work on the various processes discussed. The subject is designed for graduate students primarily interested in industrial chemistry and particularly for new students from other schools who have had insufficient training in industrial stoichiometry.

10·26. Industrial Chemical Laboratory (B). A study of the evolution of a chemical process from the idea as originally formulated through the successive stages of laboratory development to the design and equipment of the necessary plant.

10·27. Industrial Chemical Laboratory (A). Provides experience in methods of attack upon typical industrial chemical problems, the solution of which necessitates brief laboratory investigation. The problems are of current industrial interest and emphasis is placed upon the interpretation of experimental results and their effective presentation in a series of group conferences. (Not offered Nov. 1944–June 1945.)

10·28. Chemical Engineering. A study of the thermal properties of matter and the energy relationships underlying mechanical and chemical processes, including a thorough discussion of the first law of thermodynamics as applied to both batch and flow processes, and such operations as combustion, compression and handling of fluids, thermal control of chemical reactions, and the like. The second law is developed and its more elementary applications discussed.

10·29. Chemical Engineering (B). Devoted primarily to the quantitative engineering applications of the second law. Includes heat engines, heat recovery, particularly in chemical operations, thermal level of heat in relation to industrial processes, chemical equilibria and thermodynamic efficiency of chemical processes. Because of its vital importance, attention is given to high pressure operations, particularly the influence of pressure on thermal effects and chemical equilibrium.

10·30. Engineering Equipment. (Not offered Nov. 1944–June 1945.)

10·31, 10·32. Chemical Engineering (B). These subjects cover the basic principles underlying the unit operations of chemical industry. Because most of the operations involve fundamental problems in flow of heat this topic is first discussed in detail. There follows an analysis of the operation of evaporation, distillation, drying, humidification, filtration, subdivision of solids, hydraulic classification and similar topics. Emphasis is laid on quantitative relationships and these are illustrated by the solution of numerous problems. Walker, Lewis, McAdams and Gilliland, *Principles of Chemical Engineering.*

10·311. Heat Transfer (B). A study of the fundamentals of conduction, convection, and radiation of heat, with applications to problems arising in practice. (For Naval Engineering Students only).

10·33. Analytical Treatment of Chemical Engineering Processes (A). The analysis of the unit operations of chemical engineering almost always involves three major principles: the conservation of matter and energy, the laws of equilibrium, and those of reaction rate. In a large majority of cases the latter reduce to problems of diffusion, requiring certain mathematical techniques, the presentation of which is the fundamental purpose of this subject. It involves the training in setting up ordinary and partial differential equations corresponding to specific physical situations, and presents methods available for their solution, including various graphical constructions. Sherwood and Reed, *Applied Mathematics in Chemical Engineering.*

ENGINEERING OPERATIONS

10·40. Chemical Engineering Thermodynamics (A). Properties of homogeneous and heterogeneous systems, physical and chemical equilibria and energy effects, and mechanical manipulation and control of industrial processes. Emphasis is laid on behavior of complex mixtures, correlation of data, and methods of approximation.

10·41. Distillation (A). A quantitative study of the basic principles of distillation, as applied to binary mixtures, both of complete and limited miscibility and to multicomponent systems. Problems include batch and continuous simple distillations, steam distillation, vacuum and pressure distillation, rectification, heat recovery and the like. Special attention is paid to graphical methods.

10·45. Distillation and Absorption (A). A quantitative study of distillation, including rectification of binary and complex mixtures. Also includes a study of diffusional processes, with particular attention given the design computations for gas absorption equipment. A combination and condensation of subjects 10·41 and 10·46.

10·46. Absorption and Extraction (A). The basic principles of equilibria, mechanism and rate of interaction are studied in detail. Quantitative applications include the absorption of single gases, such as sulfur dioxide, ammonia and hydrochloric acid, and complex mixtures, such as light oil, casing-head gasoline, refinery gases, and the like. Particular attention is paid to graphical methods.

Includes a study of the basic principles of extraction by liquids, solvent recovery by adsorption and the leaching of various solids. Sherwood, *Absorption and Extraction.*

10·50. Heat Transmission (A). A subject applying the fundamentals of conduction, radiation and convection of heat to the problems and situations most frequently encountered in chemical industry. Emphasis is laid upon the general relationships between fluid dynamics and diffusional processes. The approach to the problem is empirical, but dimensionally sound. Graphical methods are used in large degree. Every effort is made to orient the student as to the trends of present development. McAdams, *Heat Transmission.*

10·52. Chemical Engineering II (A). Offered for graduates of other schools whose training in chemical engineering has been along somewhat different lines from that given in 10·31 and 10·32. Emphasis is placed on basic theories in flow of fluids and flow of heat and application is made to problems of an advanced character. Attention is paid to recent developments in chemical engineering.

10·53. Chemical Engineering Design (A). Open only to students who have taken the fieldwork of Course X-A. The problems involve the design of a complete plant, from the viewpoint of both chemical engineering and economics. (Not offered Nov. 1944–June 1945.)

10·54. Economic Balance in Chemical Industry (A). Lectures and conferences planned to develop original power in the solution of problems in chemical industry. The problems cover a wide range of topics, but in each case the various factors under the control of the designer are analyzed quantitatively, to determine the optimum design from the viewpoint of cost and economic return.

10·55. Economic Balance (A). A shorter subject of the same character as 10·54.

APPLIED CHEMISTRY

10·61. Materials of Chemical Industry (Seminar). An analysis of chemical industry from the point of view of flexibility in use of raw materials and character of products. The contemporary situation makes it important to avoid or minimize consumption of critical basic raw materials with a minimum sacrifice in quality and quantity of products. Chemical industry offers unusual opportunity for constructive utilization of alternative materials and modified processes of manufacture. Choice and presentation of the subject matter is made in the light of fundamental needs, both military and civil.

10·62. Applied Chemical Thermodynamics (A). Energy relations of chemical processes. Equilibria and thermal effects in heterogeneous and homogeneous systems, and technique of utilization of data in interpretation and practical control of chemical reactions.

10·63. Industrial Chemistry II (A). A study of the chemical industries dealing primarily with amorphous materials, including thermoplastics, textile fibres, cellulose products, leather and rubber. A brief survey of the general principles of colloidal chemistry is followed by analyses of important problems encountered in these industries.

Chemical Engineering Continued

10·65. Catalysis and High Pressure Processes (A). A study of the principles involved in the use of high pressures and catalysts in certain chemical reactions, such as the synthesis of ammonia, synthesis of mixtures of aliphatic compounds, alcohols and hydrocarbons from water gas, hydrogenation of coal and oils, cracking of mineral oils, etc., together with a discussion of industrial applications, equipment requirements, and opportunities for research.

10·661. Introduction to Colloid Chemistry (A). A discussion of the colloidal state of matter and of the characteristics and behavior of colloids; a description of natural colloids and of the different methods of producing matter in the colloidal state, and a consideration of the methods applied in the study of substances in the colloidal state.

10·662. Colloid Chemistry (A). A continuation and extension of 10·661, with special attention to recent developments in surface reactions, gel formation, andtheir technical significance.

10·663. Introduction to Applied Colloid Chemistry (A). This subject constitutes a prerequisite to 10·63 Industrial Chemistry II, and is given for the purpose of acquainting those who have had no course in colloid chemistry with the fundamentals of this science. It has been arranged primarily for X-A students, but may be táken by other graduate students unable to attend courses in colloid chemistry during the first term.

10·673. Colloid Chemistry Laboratory (A). Designed to train a limited number of men in the use of special instruments such as stalagmometers, bubble pressure pipettes, and surface and interfacial tensiometers. Also includes the laboratory technique of dialysis, electro-dialysis, cataphoresis, modern microscopic technique, and micro-dissection, as well as the theoretical background pertaining to these methods.

10·674. Colloid Chemistry Laboratory (A). Continuation of 10·673.

10·68. Corrosion (A). Designed to assist in the selection of equipment for use in chemical engineering processes. Major emphasis is placed on resistance to corrosion and considerable time is devoted to theories of corrosion and methods of prevention.

10·69. Plastics and Other High Polymeric Substances (A). A general survey of the chemical and physical properties and molecular structure of organic and inorganic high polymeric substances. Emphasis will be placed on specialized colloid chemical and physical methods of investigation necessitated by the unique properties of this class of materials. An attempt will be made to correlate theoretical considerations of structure with properties of practical industrial importance.

10·691, 10·692. Special Industrial Chemistry (B). Designed for officers of the Chemical Warfare Service and open only to Government technical personnel assigned to duty at the Massachusetts Institute of Technology.

FUEL ENGINEERING

10·70. Principles of Combustion (A). Open to graduate students who wish to specialize in the engineering rather than the chemical phase of fuel engineering. As emphasis will be placed on the application of fundamental principles in combustion reactions, the subject matter will include instruction in physical and organic chemistry of particular importance in fuel engineering. Numerous problems, illustrating the quantitative application of these principles in fuel processing and utilization, will be assigned.

10·71. Fuel Engineering (A). An advanced subject in fuel engineering for students with an adequate background of physical and organic chemistry and thermodynamics. The subject includes such material as the mechanism of the combustion reactions, and the application of combustion principles to problems of design or use of equipment for fuel processing and utilization.

10·74. Furnace Design (A). A study of principles and calculations of furnace design and construction dealing with rates of heat transfer and with flow of gases in furnaces. The quantitative design and layout of several furnaces, retorts or still-settings will be carried out.

10·76. Seminar in Radiant Heat Transmission (A). Will stress the theory and derivations incident to heat transfer in furnaces. Among the subjects considered will be the general law of total radiation in its differential form, its applications to radiation between finite solid surfaces with evaluation for special shapes of engineering importance, the law of spectral energy distribution of radiation, its application to radiation from luminous and non-luminous gases, powdered coal flame radiation, and optical pyrometry.

10·79. Automotive Fuels (A). A brief discussion of refinery technology, particularly cracking; the mechanism of combustion in Otto and Diesel cycle engines; the relation of "engine knock" to chemical structure of a fuel; thermodynamics of engine cycles, allowing for dissociation; the volatility of motor fuels; gum in gasoline; theory of bearing lubrication. Problems will be assigned and a comprehensive report required on some motor fuel subject.

SCHOOL OF CHEMICAL ENGINEERING PRACTICE

10·81–10·86. Subjects in School of Chemical Engineering Practice. (Not offered Nov. 1944–June 1945.) See catalogue issue July 1943 for descriptions.

GENERAL

10·90. Experimental Research Problem (A). Designed to meet the needs of special and graduate students who wish to carry out some minor investigation in a particular field. Subject and hours arranged to fit individual requirements.

10·911, 10·912. Research Conferences (A). Regular conferences are held with research students by the Staff of the Laboratories of Chemical Engineering in which the work is conducted.

10·991, 10·992. Seminar in Chemical Engineering (A). Offered primarily for post graduate students on thesis or preparing for the oral examination for the Doctor of Science degree.

GEOLOGY

Subjects 12·00 to 12·99

Only subjects marked with an asterisk (*) will be offered during the period of temporary curtailment.

*** 12·011.** Mineralogy. Lectures and laboratory work on the fundamentals of crystallography and mineralogy. The introductory study of crystal models is followed by instruction in blowpipe analysis. These preliminaries are then applied to the study of minerals by intensive work in determinative mineralogy. A close acquaintance is made with about eighty common minerals exclusive of silicates. The objective of the course is to enable the student to be able to identify these minerals in the field.

12·03. Theoretical Mineralogy (B). (Not offered Nov. 1944–June 1945.)

12·05. Mineralogical Seminar (A). (Not offered Nov. 1944–June 1945.)

12·06. Mineralogical Research (A). (Not offered Nov. 1944–June 1945.)

12·15. Petrography. (Not offered Nov. 1944–June 1945.)

12·161, 12·162. Compositional Petrology Seminar (A). (Not offered Nov. 1944–June 1945.)

12·17. Advanced Petrography (A). (Not offered Nov. 1944–June 1945.)

12·18. Structural Petrology Seminar (A). (Not offered Nov. 1944–June 1945.)

Geology Continued

12·211. OPTICAL CRYSTALLOGRAPHY. (Not offered Nov. 1944–June 1945.)

12·26. X-RAY CRYSTALLOGRAPHY (A). (Not offered Nov. 1944–June 1945.)

12·301, 12·302. GENERAL GEOLOGY. (Not offered Nov. 1944–June 1945.)

* **12·321.** ENGINEERING GEOLOGY. Geology adapted to the needs of engineers. Ries and Watson, *Elements of Engineering Geology*.

12·322. ENGINEERING GEOLOGY (B). The relations of geology to engineering problems, with reviews of actual cases.

12·38. GEOMORPHOLOGY (B). (Not offered Nov. 1944–June 1945.)

12·39. ADVANCED GEOMORPHOLOGY (A). (Not offered Nov. 1944–June 1945.)

12·40. ECONOMIC GEOLOGY. Lectures on the occurrence and origin of ore deposits. Lindgren, *Mineral Deposits, Fourth Edition*. (Not offered Nov. 1944–June 1945.)

12·41. ECONOMIC GEOLOGY LABORATORY (B). (Not offered Nov. 1944–June 1945.)

12·42. APPLIED ECONOMIC GEOLOGY (B). (Not offered Nov. 1944–June 1945.)

12·431, 12·432. ECONOMIC GEOLOGY LABORATORY· ADVANCED (A). (Not offered Nov. 1944–June 1945.)

12·433, 12·434. ADVANCED ECONOMIC GEOLOGY SEMINAR (A). (Not offered Nov. 1944–June 1945.)

12·44. ECONOMIC GEOLOGY OF FUELS (B). (Not offered Nov. 1944–June 1945.)

12·511, 12·512. PALEONTOLOGY. (Not offered Nov. 1944–June 1945.)

12·52. PALEONTOLOGY, ADVANCED (A). (Not offered Nov. 1944–June 1945.)

12·53. INDEX FOSSILS (A). (Not offered Nov. 1944–June 1945.)

12·54. MICROPALEONTOLOGY (A). (Not offered Nov. 1944–June 1945.)

12·55. ADVANCED ORGANIC EVOLUTION (A). (Not offered Nov. 1944–June 1945.)

12·581. SEDIMENTATION (B). (Not offered Nov. 1944–June 1945.)

12·582. SEDIMENTATION (A). (Not offered Nov. 1944–June 1945.)

12·60. GLACIAL GEOLOGY (B). (Not offered Nov. 1944–June 1945.)

12·63. PHYSICAL GEOLOGY SEMINAR (A). (Not offered Nov. 1944–June 1945.)

12·64. GEOLOGY OF NORTH AMERICA (A). (Not offered Nov. 1944–June 1945.)

* **12·66.** RESEARCH (B). For students desiring special library, laboratory or field work on geologic problems.

12·671, 12·672. PROBLEMS IN GEOLOGY SEMINAR (A). (Not offered Nov. 1944–June 1945.)

12·701, 12·702. STRUCTURAL GEOLOGY (B). (Not offered Nov. 1944–June 1945.)

12·71. ADVANCED STRUCTURAL GEOLOGY (A). (Not offered Nov. 1944–June 1945.)

12·80. GEOLOGY OF COAL AND PETROLEUM (B). (Not offered Nov. 1944–June 1945.)

12·81. ADVANCED GEOLOGY OF PETROLEUM (A). (Not offered Nov. 1944–June 1945.)

12·851, 12·852. ADVANCED THEORETICAL GEOPHYSICS (A). (Not offered Nov. 1944–June 1945.)

12·86. ELEMENTS OF SEISMOLOGY (B). (Not offered Nov. 1944–June 1945.)

12·87. INTRODUCTION TO GEOPHYSICAL PROSPECTING (B). (Not offered Nov. 1944–June 1945.)

12·91. ELEMENTS OF MINING (B). Lectures, discussions, assigned reading to familiarize the student with mining history, terminology, and fundamentals of practice. Subjects include prospecting, exploration, drilling, shaft sinking, drifting, explosives, blasting, timbering, haulage, hoisting, ventilation, drainage, mining law, health and safety. (Not offered Nov. 1944–June 1945.)

12·92. MINING METHODS AND PRACTICE (B). Not offered Nov. 1944–June 1945.)

12·94. MINERAL ECONOMICS (B). (Not offered Nov. 1944–June 1945.)

12·95. MINE VALUATION (A). (Not offered Nov. 1944–June 1945.)

12·96. MINERAL ECONOMICS SEMINAR (A). (Not offered Nov. 1944–June 1945.)

The following subjects are offered as General Studies. For description see Division of General Studies.

* **G9.** GEOLOGY.
* **G10.** ORGANIC EVOLUTION.
* **G28.** ECONOMIC GEOGRAPHY.
* **G29.** TOPOGRAPHY IN THE WORLD WAR.

NAVAL ARCHITECTURE AND MARINE ENGINEERING

SUBJECTS **13·00** TO **13·99**

13·01, 13·02. NAVAL ARCHITECTURE (B). Geometry of the ship, principle of flotation, load line, capacity, tonnage, stability, buoyancy and stability in damaged condition, trochoidal waves, strength calculations, rolling and other ship oscillations, resistance, propellers, propulsion, powering, steering and launching.

13·021. NAVAL ARCHITECTURE. The resistance and powering of ships, influence of form and coefficients on resistance; powering and propulsion, propeller design, influence of hull on action of propeller; steering and maneuvering; rolling, pitching and yawing. (Not offered Nov. 1944–June 1945.)

13·03, 13·04. NAVAL ARCHITECTURE AND SHIP DESIGN (A). (Not offered Nov. 1944–June 1945.)

13·12. THEORY OF WARSHIP DESIGN (B).†

13·13. THEORY OF WARSHIP DESIGN (A).†

13·15. THEORY OF WARSHIP DESIGN (A).†

13·16. THEORY OF WARSHIP DESIGN (A).†

13·21. WARSHIP DESIGN (B).†

13·22. WARSHIP DESIGN (B).†

13·24. WARSHIP DESIGN (A).†

† Open only to Naval Students in Course XIII-A.

13·25. WARSHIP DESIGN (A).†

13·26. WARSHIP DESIGN (A).†

13·34. SHIP DESIGN. Structural arrangements of ships; general arrangements of ships of various classes; hull systems, including fire, drainage, sanitary, oil and ventilation systems; hull fittings and equipment, including anchor handling, steering gear, cargo and boat handling equipment.

13·40. ELEMENTARY SHIP CONSTRUCTION. Types of ships, geometry of ship form, general and structural arrangements of ships, propelling machinery, systems, hull engineering, ship design and construction, yachts.

13·41. NAVAL ARCHITECTURE DRAWING. Work in the drawing room includes fairing a set of lines from given offsets, the preparation of a body plan for calculations, making calculations for curves of form and stability.

13·43. SHIP DESIGN. The classroom work consists of lectures on the structural design of ships including the nature of stresses in the ship girder, shipbuilding materials, strength of individual members of ship structure, design of riveted and welded joints, strength of shell and inner bottom plating and framing practices on ships of various classes. The drawing

Naval Architecture and Marine Engineering Continued

room work is a continuation of work started in 13·41 and includes completion of stability calculations, making calculations for a floodable length curve, preparation of general arrangement plans and diagrammatic plans of hull systems.

13·45. Ship Design (B). The classroom work is a continuation of the lectures on structural design followed by lectures on preliminary ship design. The structural design lectures include the structural design of decks and bulkheads. The lectures on preliminary ship design deal with the methods of design and the considerations affecting the choice of principal dimensions, coefficients of fineness, amount of stability and degree of subdivision. The drawing room work is a continuation of 13·43 and includes the preparation of launching calculations and launching curves, longitudinal strength calculation, structural plan of midship section and computation of maximum stresses, structural plans of a main bulkhead and section of strength deck and laying out of plating, etc. on a wooden model.

13·46. Ship Design. The preparation of the preliminary design of a ship which possesses characteristics selected by the student preparing the design. The work to be completed includes, determination of displacement and principal dimensions, preparation of lines and preliminary buoyancy and stability calculations, including estimate of vertical and longitudinal position of center of gravity, preparation of preliminary general arrangement plans.

13·52. Marine Engineering. An introductory subject in marine engineering covering both steam and Diesel machinery; fuels, combustion, boilers, reciprocating engines, turbines, auxiliary machinery and steam power plant layouts. Diesel and oil engines, motor ship auxiliaries; types of engines, fuel injection and combustion, valve gears, supercharging, oil engine fuels, and Diesel electric drive. Chapman, *The Marine Power Plant*.

13·54. Marine Engineering (B). Special topics in dynamics and stress analysis. The dynamics of the crank-connecting rod mechanism; stresses in connecting rods; the balance of rotating and reciprocating machines; elementary vibration theory; torsional vibration in internal combustion engines and marine reduction gears; vibration of ships; dynamics of governors and flywheels; mechanical similitude and other related topics.

13·55. Marine Engineering. Following a brief review of nozzle and blade design the important dimensions of several turbines are computed and their principal features compared with other modern turbines. The effects of superheat, increased pressure, vacuum; types of auxiliary drive and heat balance of the marine steam plant are studied. Critical speed blade strength, design of reduction gears and pump laws are discussed.

13·56. Marine Engineering. An advanced subject covering the economic aspects of marine engineering; comparison of fuels, and the various types of steam and Diesel propelling machinery for different types of ships and trade routes; the economical operation of propelling machinery and auxiliaries at sea and in port; boilers, main engines, auxiliaries and auxiliary systems. (Not offered Nov. 1944–June 1945.)

13·61, 13·62. Marine Engineering Design (B). Calculations and preliminary design of main propelling units for a steamship; determination of sizes of auxiliaries; machinery layout; diagrammatic arrangements of principal piping systems; application of modern heat transfer formulas; propeller design, and other marine engineering problems.

13·73. Mechanical Vibration (A). The free and forced vibration of systems of a single degree of freedom; complex variable and vector representation; Fourier Series; harmonic analysis by tabular and mechanical methods; systems of several degrees of freedom; torsional systems; the transverse vibration of uniform beams; the balance of rotating machinery and reciprocating engines; the elements of torsional vibration problems in reciprocating engines.

13·74. Mechanical Vibration (A). Advanced theory of the torsional vibration of reciprocating engines, including uniform distributions, forced vibration, calculation of amplitude, branched systems, etc. The transverse vibration of irregular beams and the application to the vibration of turbines and other rotating machinery; Rayleigh's, Stodola's and other methods; separation of normal modes of vibration; vibration isolation; La Grange's theorem; non-linear systems; self-sustained oscillation.

13·75, 13·76. Naval Engineering (A). These subjects consist of lectures, conferences, and drafting, and deal with the various types of steam and Diesel propelling machinery and auxiliaries. A machinery layout is made in the drafting room for a specified ship. This work involves the basic design of boilers, propelling machinery, gears, condensers, auxiliaries, shafting and propellers. Attention is also given to fuels, lubrication, feed heating systems, heat balances, estimates of performance, analyses of trials, etc. A comparison is made of the various types of propelling machinery and auxiliaries.

13·78. Propeller Theory and Experimental Research (A). A discussion of modern ideas of propeller action based on air-foil theory; cavitation; interactions of hull and propellers; various available methods of design.

13·79. Propeller Design (A). The momentum and blade element theories of propeller action. Propeller testing procedure. Methods of presenting propeller test data. The application of theories and test data to the design of ships' propellers. Strength of propeller blades.

13·81, 13·82. Ship Operation (B). The engineering and economic aspects of ship operation, a study of the various items making up the operating disbursements and incomes; calculations for operating expenses and profits on various trade routes, comparison of different types of fuels and machinery for different sizes of ships and various lengths of voyage; influence of size of ship and speed on operating expenses; turn-around and port expenses; cubic and dead-weight ships; the design of cargo and passenger vessels from the owner's point of view; tonnage measurements, fuel conservation, repairs and maintenance; study of present and future trade routes, cargo movements, and factors influencing ocean freight rates. Coastwise, inland water transportation and interrelation of land and marine transportation. Numerous problems in both cargo and passenger ship operation are assigned to the student. (Not offered Nov. 1944–June 1945.)

13·83. Port Facilities and Cargo Transfer. A study of the functions, layouts, and facilities of ports; piers, quays, transit sheds and shipside cranes; warehouses and warehouse locations; lighters, inland watercraft, belt line railroads, road vehicles and roadways; comparison of ports and port locations; port administration and port planning; marine passenger terminals, port hinterlands and the coordination of all forms of inland transportation with ocean shipping; cargo handling equipment, methods of cargo transfer through deck hatches and side ports; methods of securing port dispatch and reducing cargo handling costs; the design of the ship with reference to cargo transfer; longshore labor problems and decasualization of longshore labor. (Not offered Nov. 1944–June 1945.)

METEOROLOGY

SUBJECTS 14·00 TO 14·99

14·11. DESCRIPTIVE METEOROLOGY I (B). A simplified treatment, as non-mathematical as possible, of the following topics: (1) composition and structure of the atmosphere; (2) elementary thermodynamics of the atmosphere; (3) heat balance of the atmosphere, radiation equilibrium and the stratosphere; (4) condensation phenomena, both the physical processes of formation and characteristic forms; (5) the circulation principle, geostrophic wind, gradient wind, the role of friction in the vertical wind structure. Humphreys: *Physics of the Air.*

14·12. DESCRIPTIVE METEOROLOGY II (B). Continuation of 14·11, with the following topics: (6) the general circulation of the earth's atmosphere, rôle of the secondary circulations; (7) the secondary circulations — monsoon or seasonal types (continental vs. maritime conditions), migratory types (extra-tropical vs. tropical), fronts and air masses; (8) tertiary (local) circulations — local convection, whirlwinds, showers, thunderstorms, tornadoes, land and sea breeze, drainage winds, föhn winds, local turbulence eddies; (9) diurnal and seasonal variations of the meteorological elements; (10) factors controlling long-period climatic changes. Humphreys: *Physics of the Air.*

14·14. LONG RANGE WEATHER FORECASTING (A). (Not offered Nov. 1944–June 1945.)

14·15. ELEMENTS OF LONG RANGE FORECASTING (A). A simplified discussion of the basic principles of long range weather forecasting covering the statistical indices pertaining to the general circulation of the atmosphere, mean charts, anomaly charts, formation of forecasts, forecast verification, etc. (Not offered Nov. 1944–June 1945.)

14·32. CLIMATOLOGY (B). A discussion of the climatological elements and factors, the classification, distribution and characteristics of the principal climatic zones. Regional climatology.

14·41. SYNOPTIC METEOROLOGY I (A). The fundamental principles of weather analysis: the meteorological elements and their conservatism, air mass characteristics, stability and instability and their relation to the weather phenomena; the use of thermodynamical diagrams in analysis for forecasting; international classification of cloud and hydrometeors; the formation and transformation of air masses; the analysis of the field of motion; and the relations between wind and atmospheric pressure. Petterssen: *Weather Analysis and Forecasting.*

14·42. SYNOPTIC METEOROLOGY II (A). The principles of weather forecasting: frontogenesis, frontal characteristics classification of fronts, structure and development of extratropical cyclones, isentropic analysis, practical rules and formulae for extrapolating the movement and development of pressure systems. Petterssen: *Weather Analysis and Forecasting.*

14·50. INTRODUCTORY METEOROLOGICAL LABORATORY. Explanation of international weather symbols and airways teletype code; decoding and plotting of daily weather reports; basic meteorological observations; elementary principles of surface weather map analysis.

14·51. SYNOPTIC LABORATORY I (B). Decoding and plotting of the daily weather reports as transmitted by the Department of Commerce teletype. Analysis of weather maps and practice forecasting for selected stations.

14·52. SYNOPTIC LABORATORY II (B). Analysis of weather maps and practice weather forecasting for selected stations, together with practice in special airways forecasting, utilizing the teletype line sequences.

14·53. SYNOPTIC LABORATORY III (A). Continuation of 14·52. Advanced methods of analysis and forecasting with special emphasis on the use of aerological diagrams, cross sections, isentropic charts, etc.

14·611. THERMODYNAMICS OF THE ATMOSPHERE (A). A review of classical thermodynamics. Thermodynamics of the atmosphere with special emphasis on the role of water vapor. Atmospheric statics. The theory and construction of the common thermodynamic diagrams used in meteorology.

14·613. DYNAMIC METEOROLOGY I (A). Simple atmospheric motions; geostrophic and gradient wind. Elementary hydrodynamical concepts. Circulation. Relations between fields of motion and of pressure in simple cases. Surfaces of discontinuity between different air masses. Haurwitz, *Dynamic Meteorology.*

14·62. DYNAMIC METEOROLOGY II (A). Theory of atmospheric turbulence, wind distribution in the frictional layer, vertical and lateral mixing. Energy transformations in the atmosphere. Theoretical discussion of the general circulation of the atmosphere. Survey of the wave theory of extratropical cyclones. Haurwitz, *Dynamic Meteorology.*

14·64. DYNAMIC METEOROLOGY III (A). A more advanced treatment of the dynamics and mechanics of viscous and non-viscous fluids, as applied to the atmosphere. Dynamic stability and the fundamentals of atmospheric wave motion.

14·71. ELEMENTARY PHYSICS OF THE ATMOSPHERE (B). An elementary treatment of atmospheric radiation, the ozone layer and the upper atmosphere, atmospheric electricity, atmospheric optics, propagation of sound in the atmosphere, and icing of aircraft.

14·72. PHYSICAL METEOROLOGY (A). A more detailed study of radiation theory as applied to the atmospheric heat balance; the structure and composition of the stratosphere with special reference to the ozone layer. The theory of the visual range; the physical theory of atmospheric condensation and precipitation processes. (Not offered Nov. 1944–June 1945.)

14·81. OCEANOGRAPHY (A). An introductory subject covering the principles and methods of physical and dynamical oceanography, and the current systems of the oceans with special emphasis on their meteorological significance. Sverdrup, *Oceanography for Meteorologists.*

14·91, 14·92. METEOROLOGICAL SEMINAR (A). Weekly reviews and discussions by staff members and students, of recent meteorological contributions published in current periodicals, and of original research.

14·911, 14·912. METEOROLOGICAL SEMINAR I (A). Same as 14·91.

14·95. SPECIAL PROBLEMS IN METEOROLOGY (A). Reading, consultation and original investigation on meteorological problems.

BUSINESS AND ENGINEERING ADMINISTRATION

SUBJECTS 15·00 TO 15·99

15·11, 15·12. INTRODUCTION TO BUSINESS MANAGEMENT (B). Introduces the student to the functions and methods of business. The principal topics are: corporate organization, finance, accounting, production, marketing, with emphasis on the interrelations between these functions. Considers business problems in the order that they would be encountered were a new business to be launched: survey for a new venture; promotion, organization; personnel; operation; control; expansion or liquidation. (Not open to Course XV; may be taken as an elective in other Courses.) (15·12 not offered Nov. 1944–June 1945.)

15·20. OCEAN SHIPPING ADMINISTRATION. (Not offered Nov. 1944–June 1945.)

15·25. INDUSTRIAL TRAFFIC MANAGEMENT (A). (Not offered Nov. 1944–June 1945.)

15·30. PERSONNEL MANAGEMENT. A study of personnel management as a staff function to assist line executives. On

Business and Engineering Administration Continued

the basis of case material, fundamental requirements for personnel work are discussed both as to the principles that build and the problems that test constructive personnel policies. Lectures and discussion topics include: selection, placement and follow-up of employees; basic problem of worker's attitude toward authority; the plant as a social system; manpower problems; recruitment, training and upgrading; management-union relationships; establishment and maintenance of satisfactory working conditions; job analysis and grading; employee evaluation; interviewing as a tool of management; wage administration; employee counseling.

15·41. Finance. Deals with the principles of financial organization and management. Following an introductory study of the modern business corporation, the student examines the instruments and agencies used in finance — corporate securities, investment banking and the exchanges, proceeding thereafter to the problems of internal financial control. Among the topics considered are: promotion, valuation, the financial plan, the sale of securities and the administration of income. Problems of expansion and the procedure during failure and reorganization conclude the subject. Specific cases illustrate the principles and afford an opportunity for individual analysis. Throughout the course emphasis is placed on the changing character of financial management, the growing demand for consideration of interests other than those of the control group, and the development of new relationships between business and government.

15·42. Financial Problems (B). Selected topics in the fields of corporate and personal finance. Case studies in internal financial administration of industry provide opportunity for applying to concrete situations the principles developed in 15·41. Problems in personal finance constitute the major part of the subject and include consideration of investment, insurance and taxation.

15·46. Financial Administration of Industry (A). (Not offered Nov. 1944–June 1945.)

15·50. Accounting. Familiarity with the use and interpretation of financial reports is an essential business tool. Since analysis depends upon a knowledge of constituent elements and their derivation, the subject begins with a brief consideration of double-entry bookkeeping. The major part of the term is devoted to a consideration of the problems inherent in the typical financial statements. The form and content of balance sheets and of profit and loss statements are considered; the problems of surplus, depreciation and valuation are studied. The subject concludes with an introduction to methods of statement analysis. So far as is possible, reports and accounting policies of actual companies form the basis for discussion. Throughout the course emphasis is placed upon interpretation of results. (Not open to students below the third year.)

15·51. Industrial Accounting (B). The application of accounting control to industry. Includes the principles of cost analysis as applied to problems of manufacturing, distribution and administration. Teaching material is drawn from a wide variety of business situations.

15·52. Accounting. This shorter subject has as its objective the introduction of the student to the elements of accounting. The preparation and structure of representative financial reports to stockholders and creditors are examined in order that the student may understand their use and significance. (Not offered Nov. 1944–June 1945.)

15·55. Problems in Accounting Policy (A). (Not offered Nov. 1944–June 1945.)

15·58. Problems in Accounting Control (A). (Not offered Nov. 1944–June 1945.)

15·61. The Law of Contracts (B). Covers the entire field of the law of contracts generally. Deals comprehensively with the rules applicable to the formation of contracts, their performance and discharge and also the rights of third parties in contracts. The rules applicable to special kinds of contracts such as agency, sales and negotiable instruments are treated incidentally but not comprehensively.

15·62. The Law of the Market (B). Deals with the rights and liabilities of buyers and sellers of goods and also the rules of law applicable to customary methods by which purchases and sales are financed. Covers fully the uniform law of sales and uniform law of negotiable instruments.

15·63. Industrial Law (B). Deals with the legal aspects of the social control of industry through governmental agencies. The constitutional powers and limitations of Federal and State authorities are discussed, and the trends of administrative law, past, present, and probable, are examined. In general, the relationship between government and business as evidenced by the rules and regulations which are currently developing, is considered in detail with especial emphasis upon the financial, production, and marketing problems arising therefrom. The law relative to inventions and their management, commonly called patent law, will be considered in detail.

15·64. The Law of Business Organization (B). (Not offered Nov. 1944–June 1945.)

15·70. Production. A basic treatment of the manufacturing process. Among the important topics covered are: factory organization and personnel; fabricating and assembling sequences; productive facilities, their selection, arrangement and coordination; product design; purchasing; internal and external transport of materials; inspection; stores; and salvage. Classroom work is supplemented by plant visits and reports.

15·71. Production (B). The application of the principles of scientific management in production. Topics covered include: production and expense budgets; production control methods; standardization and simplification policies and practices; the design and administration of wage systems, new product control, and management engineering techniques.

15·72. Technique of Executive Control (B). A survey of the means by which the line executive deals with the working group. The student considers the nature of executive responsibilities and methods of control; devices for stimulating the desire of the employee to improve the quantity and quality of his work; ways of collaborating with other executives and functional specialists. Considerable time is given to a study of common executive difficulties with subordinates, associates and superiors.

15·73. Management Laboratory (B). Work Simplification and Time Study. Instruction in the technique of motion study, an essential tool of modern management extensively used for the simplification and standardization of manual work. Includes such topics as process charts, micro-motion and principles of motion economy, proper work-place layout, labor-saving tools and equipment, assembly jigs, etc. Motion picture films of industrial operations are used as case material; instruction is given in labor relations involved in the introduction of work simplification; problems of employee training are considered; and the bearing of motion economy upon morale is discussed. Instruction in the use of the stop watch for rate setting includes such topics as selected times, leveling factors, fatigue study, allowances, base-rate evaluation.

15·75. Manufacturing Analysis (A). (Not offered Nov. 1944–June 1945.)

15·76. Mass Production Methods (B). (Not offered Nov. 1944–June 1945.)

15·81. Marketing. For most commodities the cost of distribution exceeds the cost of production. Therefore this general subject deals with the broader social and economic aspects as well as the managerial problems involved in marketing operation. Includes such topics as product policy, selection of channels of distribution, brand policy, advertising and sales promotion, customer relationships and problems of price structure. Major emphasis is laid on the marketing of manufactured consumer goods, although some attention is given to the marketing of industrial goods and agricultural products. Instruction is based primarily on the problem method, supplemented by reading assignments and conferences with marketing executives.

15·82. Sales Management (B). Familiarizes the student with the operation of sales departments of manufacturing and service organizations. Among the problems considered are: product planning, market research, pricing, credits, sales promotion and advertising, organization of the sales department, selection, training, supervision and control of

Business and Engineering Administration Continued

the sales force, and administrative control of sales operations, including budgets and selling costs. Class meetings are devoted largely to discussions of actual business situations. Several discussion sessions with marketing executives are scheduled throughout the term. Written reports of both detailed and memorandum character are assigned as are also laboratory problems requiring use of original sales records.

15·83. Marketing Research (B). (Not offered Nov. 1944–June 1945.)

15·85. Industrial Marketing (A). (Not offered Nov. 1944–June 1945.)

15·86. New Product Development and Reduction to Marketing Practice (A). In the study of new product development, attention is given to sources of ideas for new or improved products and to methods for screening such ideas in the light of potential market demand, costs, prices, and suitability to the company's production and marketing facilities. Attention is also paid to collaboration between the technical development staff and the marketing staff, and to problems of package design and the testing of market acceptability. Reduction to marketing practice includes the consideration of such topics as market analysis, sales forcasting, and the development of a complete marketing plan for the new or improved product. Treatment includes trade channels to be used, prices and discount schedules, selection and coördination of various sales promotion devices, and provisions for periodic appraisals of effectiveness. Major emphasis is given to consumer products.

15·88. Advertising (B). (Not offered Nov. 1944–June 1945.)

15·92. Industrial Problems (B). Coördinates the previous subjects which the student has taken. With the collaboration of operating executives, government representatives and military officials, students have surveyed the field of managerial activities and problems currently shouldered by industrialists. Field interviews, conferences, classroom presentations, case problems and discussions serve to reflect the interdependence of marketing and contract-procurement, finance, accounting, production and labor, and the interrelations of the going business as a whole with government and the public.

15·94. Contemporary Problems Seminar (A). (Not offered Nov. 1944–June 1945.)

15·95. Special Problems in Management (A). For graduate students who desire to do advanced work or to carry out some special investigation of a management problem not specifically covered elsewhere and not qualifying as a thesis. Hours and credit to be arranged. May include readings, conferences, laboratory and fieldwork, and reports.

15·96. Administrative Theory and Practice (A). (Not offered Nov. 1944–June 1945.)

15·97. Seminar in Business Administration (A). (Not offered Nov. 1944–June 1945.)

Thesis. To complete the requirements for graduation every student enrolled in the Department conducts an original investigation of a problem, preferably one of practical value to industry, in the field of management or engineering. The purpose of the thesis is threefold. It gives the student experience in applying the scientific method and specific research techniques to a typical business problem; it aids him in developing the ability to achieve constructive results on his own responsibility; it teaches him how to present his conclusions in convincing manner.

Graduate Thesis (A). Original research in the field of business administration. The purpose of such work is to ascertain the student's ability to make a contribution to existing knowledge.

AERONAUTICAL ENGINEERING

Subjects 16·00 to 16·99

16·01, 16·02. Introduction to Aeronautical Mechanics (B). Elementary dynamics of particles, fluids, and solid bodies, with applications to aeronautics.

16·03. Hydrodynamics and Its Application to Aeronautics (A). Selected advanced topics in continuation of 16·02, including the theory of flow potentials, the flow equations of Euler, the energy equations of Bernouilli and Kelvin, ideal two-dimensional flow, theory of finite wings and wing combinations, instability of discontinuous layers, and boundary layer.

16·04. Hydrodynamics and Its Application to Aeronautics (A). Continuation of 16·03 with practical application of its theory and methods.

16·07, 16·08. Advanced Topics in Aeromechanics (A). A detailed study of several aeromechanic problems of practical importance which are too long and too difficult to be included in 16·03 and 16·04. Particular attention given to the mechanics of airplane spin and of wing and tail flutter, and of air flow at compression speeds to advanced phases of boundary layer phenomena as they affect burbling, also to the problem of sound reduction and vibration damping directed toward greater passenger comfort, and to similar problems as time allows.

16·10. Applied Aerodynamics (B). Application of aerodynamic theory to airplane design and aircraft propellers. Warner, *Airplane Design, Vol. I;* Weick, *Aircraft Propeller Design.*

16·11. Airplane Performance (B). Discussion of the combinations of characteristics of airplane, propeller, and engine as they affect the performance of the airplane. Warner, *Airplane Design, Vol. I;* Weick, *Aircraft Propeller Design.*

16·13. Airplane Stability and Control (B). General theory of longitudinal and lateral stability, controllability and maneuverability of airplanes.

16·14. Airplane Design Problems (B). Lectures, discussions and drafting-room exercises devoted largely to the choice of type of airplane to be used for a given service. Several problems are assigned, and each student makes a selection of type, executes a preliminary design and estimates the airplane weight and performance. Warner and Johnson, *Aviation Handbook.*

16·17. Airplane Design Practice (B). Actual practice in design. Each student carries through the "layout" and calculations for a simple airplane. Niles and Newell, *Airplane Structures.*

16·20. Structures. A subject covering outer forces, reactions, shears and bending moments, the use of influence lines, the three moment equation, torsion and bending on simple sections, the design of members subjected to flexure only, the analysis of trusses by algebraic and graphical methods and the design of simple columns. Niles and Newell, *Airplane Structures.*

16·21. Structures (B). Covers the analysis of fittings and allied details, the use of the generalized three moment equation, the fundamental concepts of various methods for determining deflection of beams and trusses and the fundamentals of the method of least work. Niles and Newell, *Airplane Structures.*

16·22. Aircraft Structures (B). Covers applications of the methods of least work and deflections to the analysis of indeterminate structures, the elements of the analysis of space framework, the use of methods of analysis currently employed in the design of all-metal aircraft and a consideration of the assumptions used in the determination of design load factors and load distributions specified for use on commercial airplanes. Niles and Newell, *Airplane Structures.*

16·25. Advanced Aircraft Structures (A). The exact content of this subject varies somewhat from year to year as new methods of analysis become available for examina-

Aeronautical Engineering Continued

tion. Particular attention is paid to the investigation and development of methods for the analysis of all-metal airplanes and considerable time is spent on applications of the theory of elasticity to problems involving stiffened sheet in compression, plates under normal load and similar problems. Niles and Newell, *Airplane Structures*.

16·34. AIRCRAFT INSTRUMENTS (B). Lectures and problems comprising a survey of aircraft power-plant, flight and navigation instruments and meteorological instruments. This subject is intended as an elective for students not specializing in instruments and as a background for the more advanced problems treated in 16·42.

16·37. INSTRUMENTATION (A). An adaptation of subject 16·41 to meet the needs of U. S. Naval Officers.

16·38. INSTRUMENTS (A). An adaptation of portions of subject 16·42 to meet the needs of U. S. Naval Officers.

16·41. INSTRUMENTATION (A). Principles of instrument analysis with particular emphasis on dynamic performance. Generalized methods applicable to instrument problems are developed from the theory of one-dimensional systems.

16·42. AIRCRAFT INSTRUMENTS (A). Detailed dynamic analysis of various aircraft flight instruments using the methods developed in 16·41.

16·43. INSTRUMENTS LABORATORY (A). To be taken simultaneously with 16·41. Principles developed in 16·41 are applied to typical instrument problems.

16·44. METEOROLOGICAL INSTRUMENTS (B). Methods and instruments used to obtain and evaluate meteorological data. Lectures on the fundamental principles involved are accompanied by laboratory and field exercises. The student carries out calibrations of typical barographs, thermographs, meteorographs, and radiometeorographs. Wind velocity measurements are made with the theodolite and sounding balloons. Actual observations made with these instruments are plotted on various meteorological charts in a form suitable for synoptic or dynamic studies.

16·45. SPECIAL PROBLEMS IN AERONAUTICAL AND METEOROLOGICAL INSTRUMENTS (A). Problems of interest to properly qualified individual students are studied in consultation with the instructor.

16·46. VIBRATION MEASUREMENTS (A). Methods and instruments used to obtain and interpret data on mechanical vibrations are studied. Lectures and laboratory exercises are devoted to consideration of the possibilities and limitations of mechanical, optical and electrical instruments for measuring vibrations. Electromagnetic, piezoelectric, carbon and wire resistance pickup units are studied. Cathode ray and electromagnetic oscillographs are used for making visual observations and photographic records from internal combustion engines and other sources of vibration. The analysis of complex vibratory motions into harmonic components is illustrated by laboratory exercises.

16·47. INSTRUMENT DESIGN PRACTICE (A). Familiarizes the student with instrument design practice. Designs of typical instrument components are carried out emphasizing the methods of fabrication used in the instrument field.

16·48. INSTRUMENT DESIGN PRACTICE (A). A continuation of 16·47 in which the student carries out the design and constructs a working model of a complete instrument.

16·52. AIRCRAFT PROPELLER DESIGN (A). Theory and practice of propeller design including the study of propeller stresses. Classroom work is supplemented by actual design practice. Weick, *Aircraft Propeller Design*.

16·53. ADVANCED AIRPLANE ENGINE DESIGN (A). Advanced problems in the design of airplane engines, including drafting room layouts.

16·54. ADVANCED AIRPLANE ENGINE DESIGN (A). Continuation of 16·53, including the design of superchargers, reduction gears, etc.

16·60. ADVANCED AERONAUTICAL PROBLEMS (A). Covers individual advanced work by properly qualified graduate students. Problems are selected in consultation with the instructor, and the hours are arranged to suit the individual case.

16·62. AERONAUTICAL LABORATORY (B). Lectures on the methods and equipment used in aeronautical research, and experience in the making of tests in the Institute wind tunnels.

16·63. AERONAUTICAL LABORATORY AND RESEARCH METHODS (B). A continuation of 16·62, with lectures on more advanced laboratory methods, and on free-flight testing, together with training in the application of these methods.

16·75. CONSTRUCTION DETAILS OF AIRCRAFT (B). Drafting board problems and lectures dealing with the detail design of the airplane structure, and power plant installation.

16·81. AERONAUTICS (B). Aircraft and the general principles of flight.

16·82. AERONAUTICS. Introduction to aircraft and the general principles of flight.

BUILDING ENGINEERING AND CONSTRUCTION

SUBJECTS 17·00 TO 17·99

17·22. BUILDING CONSTRUCTION. A study of the construction of Third Class Buildings, with particular reference to the residence. The fundamentals of the assembly of various materials commonly used in such construction are discussed together with their proper relationship and the sequence in which they are ordinarily combined in the field. Improved details of construction and the use of new materials are introduced. The work is carried on by class discussions and by supervised basic problem analysis in the drafting room. *Departmental Notes.*

17·31. BUILDING CONSTRUCTION. A study of Second Class Buildings. This type of construction involves the combination of wood and masonry, or exposed steel, wood and masonry, in semi-fireproof or heavy timber construction. Introduction to foundation problems, exterior walls, interior frames and floor systems, and an integration of all factors into the finished building, are studied in the same manner as in 17·22. *Departmental Notes.*

17·32. BUILDING CONSTRUCTION. A study of the construction of First Class Buildings with special reference to those with reinforced concrete and structural steel frames. Heavy foundations, shoring, the relation of the frame to the exterior walls, the floor arches, the interior partitions, the mechanical equipment, the electrical services and the architectural balance are studied in the same way and in proper sequence, as in the previous courses in Building Construction. *Departmental Notes.*

17·33. BUILDING CONSTRUCTION. A continuation of the study of Third Class Buildings, and the study of the application of Second Class construction to light construction. Building and zoning codes and their restrictions upon Housing are studied and more rational approaches to flexible public controls for low-cost construction are discussed and analyzed. Modern systems, materials and services for home construction are coördinated with a study of their economic effects. Costs as affected by labor policies and field procedures are analyzed. The work is carried on by class discussions and supervised problem analyses. *Departmental Notes and Collateral Reading.*

17·34. BUILDING CONSTRUCTION. A study of the application of the principles of mass production to Housing. The various proposals for low-cost housing are analyzed and the possibilities for the development of mass production procedures using structural and wall and floor panels are explored. The development of plans on a modular basis with the maximum of interchangeability and demountability is studied. The effects of materials on details and methods are considered. The work is conducted by class discussions, collateral reading, and supervised drafting room studies.

Building Engineering and Construction Continued

17·40. ESTIMATING AND JOB MANAGEMENT (B). A study of two of the important functions exercised by the builder, designed to give a knowledge of the basic units into which each estimate is divided, together with a breakdown of such units into man-hours and materials required. Includes lectures and discussions on job planning, contract relations, labor relations, safety in construction and the business aspects of contracting. Pulver, *Construction Estimates and Costs*.

17·41, 17·42. CONSTRUCTION PROBLEMS (B). A continuation of previous courses in Building Construction. A critical study of the factors involved in specifications, details and construction procedure for an actual job in progress, or for an approved project in the field. The student is required to devise and discuss original and alternate specifications and methods from those used or proposed in the actual project.

17·52. STRUCTURAL PROBLEMS. The first part of this subject is intended to establish a connection by graphical and analytical methods between the study of applied mechanics and structural theory. The student is enabled by graphical analysis actually to see stress distribution and is thereby afforded a more visual concept of stress analysis. This procedure is applied to forces, homogeneous and nonhomogeneous beams of wood and steel and reinforced concrete, trusses and masonry piers and arches. The latter part of the subject is an application of these studies to structural design in timber, including the analysis of compound beams, trussed girders, floor frames of wood, roof trusses and details, timber and concrete-filled columns, and other details common to heavy timber construction. Wolfe, *Graphical Analysis;* Fuller and Johnston, *Applied Mechanics, Vol. II;* Voss and Varney, *Wood Construction*.

17·53. STRUCTURAL DESIGN (B). A study of the structural design of reinforced concrete building frames, including the development of the theory of design, consideration of specifications, design of solid and ribbed slabs, beam and girder frames, flat slab systems, columns and footings. Special consideration is given to economy in design. Peabody, *Design of Reinforced Concrete Structures*.

17·54. STRUCTURAL DESIGN (B). A study of the design of structural steel building frames, including the design of typical floor-arch systems, rolled and built-up beams and girders, design of details, truss analysis, columns and foundation problems. Special attention is given to general steel framing in its relation to architectural details and the application of structural design to shoring and underpinning. Voss and Varney, *Steel Construction*.

17·56. STRUCTURAL DESIGN. A study of the structural design of simplified frames in steel and reinforced concrete. The theory of the design of slabs, beams, columns and footings for light occupancy buildings is developed. The usual engineering procedures for the design and preparation of the working drawings for such buildings is followed. The subject is an abbreviation of the work given in 17·53 and 17·54. Peabody, *Design of Reinforced Concrete Structures;* Voss and Varney, *Steel Construction*.

17·70. MATERIALS. The application and amplification of fundamental physical and chemical phenomena to the field of building materials. The work consists of lectures and discussions with assigned reading.

17·71. MATERIALS — WOOD, PLASTICS AND ORGANIC PRODUCTS. Mechanical and physical properties of wood are studied in relation to growth, major and minor-structure and other characteristics which influence its use in the construction and engineering fields. Volume changes, moisture content, preservative treatment, wood products, identification, and selection of species for various uses. The fundamental properties and uses of plastics, and the basic characteristics of paints and fabrics used in construction are included. Class discussions are augmented by reports on assigned collateral reading. *Wood Handbook;* Leighou, *Chemistry of Engineering Materials; Departmental Notes*.

17·72. MATERIALS — MASONRY. Begins with a study of the geological origin, sources and composition of masonry materials together with their conversion into usable building forms. Clays and clay products, cements and lime, concrete aggregates, composition and qualities of mortars, natural and cast stone, gypsum products and various masonry specialties are taken up from the standpoint of construction and engineering design. Class discussions are augmented by reports on assigned collateral reading. *Departmental Notes*.

17·73. MATERIALS — METALS. The work in metals begins with alloy diagrams and their interpretation, followed by consideration of the more important non-ferrous alloys and a more detailed discussion of the ferrous metals, their properties and heat treatment. Supplementing this work is the chemistry of corrosion and welding theory and practice. Class discussions are augmented by reports on assigned collateral reading. Williams and Homerberg, *Principles of Metallography; Departmental Notes*.

17·74. MATERIALS. Lectures and laboratory work for students in Architecture and City Planning. The work covers the same field as 17·72. Laboratory exercises on the methods of making physical tests for the properties of the more common engineering materials, and a study of their behavior under stress are included.

17·77. SPECIAL PROBLEMS IN BUILDING MATERIALS (A). Offered for graduate students whose previous training fits them to undertake research in connection with the physical behavior of building materials, and the effect of the physical and chemical properties of the constituents of the materials on this behavior.

17·80. THESIS SEMINAR. For discussion of subjects for thesis studies, and the preparation of plans and schedules for such studies; conferences to discuss selected subjects. Methods and techniques of reporting are studied and emphasis is placed upon concepts and presentation, both written and oral.

GRAPHICS

SUBJECTS D1 TO D99

D11. ENGINEERING DRAWING. Instruction in the correct use of drafting instruments and materials. Practice in lettering. The theory of projection drawing. Drawing in orthographic, isometric, oblique and perspective projection. Practice in dimensioning, the making of dimensioned freehand sketches of machine parts and the accurate detail and assembly drawings from the sketches. Tracing in ink and pencil on cloth or paper of the finished drawings. A part of each exercise is devoted to a lecture. Svensen, *Essentials of Drafting*.

D12. DESCRIPTIVE GEOMETRY. A study of the fundamental concepts of descriptive geometry, including reference systems, representation of the point, line and plane; fundamental problems of position, of perpendicularity and of measurement. The solutions of the fundamental problems are checked by the methods of analytic geometry. A study of the various surfaces and solids, their sections, developments and intersections. Finally, the application of descriptive geometry to certain problems arising in engineering practice. Especial emphasis is placed on the ability to visualize the problems, and the processes involved in their solution. A part of each exercise is devoted to a lecture. *Notes on Descriptive Geometry*.

D31. NOMOGRAPHY. The nomographic method of solving equations in three or more variables and its application to scientific and engineering data. The subject matter includes a study of functional scales, network charts, simple nomographic relationships derived from plane geometry.

SUBJECTS Ec1 TO Ec99

Ec11T. ECONOMIC PRINCIPLES. Ranges over a wide field of economic analysis concentrating on: forms of business organization, the determination and behavior of costs and prices, distribution and exchange, the theory of money, international trade, and the influence of technological and other changes on the volume of production and employment. Business cases will be used especially in the study of costs, and practical problems will be integrated with the analysis.

Ec12T. INDUSTRIAL ECONOMICS. An examination of particular American industries with special attention to (1) the degree of monopoly and competition, (2) means of restoring competition, (3) the patent question, (4) regulation of public utilities, (5) public policy in relation to private enterprise, (6) the impact of the business cycle. Tools of analysis learned in the preceding subject in Economic Principles will be applied in case studies.

Ec15. ECONOMIC PRINCIPLES. Covers the same ground as Ec11T. Restricted to graduate students for whom it is especially designed.

Ec17, Ec18. ECONOMIC ANALYSIS (A). A review of the interdependent growth of theory and fact, followed by a study of the general theory of equilibirum under competition and monopoly. Findings will be revalued under conditions which more closely approach reality. (Not offered Nov. 1944–June 1945.)

Ec19. MATHEMATICAL APPROACH TO ECONOMICS (A). Lectures and discussions in the use of mathematical methods in all fields of economics. The topics included will vary from year to year. (Not offered Nov. 1944–June 1945.)

Ec24. SCHOOLS OF ECONOMIC THOUGHT (A). A comparative analysis of the economic ideas developed by different groups of economists in recent times. (Not offered Nov. 1944–June 1945.)

Ec26. BUSINESS CYCLES (A). A statistical historical, and theoretical examination of the determinants of income, production and employment. Modern methods are brought to bear on problems of analyses, forecasting, and control. (Not offered Nov. 1944–June 1945.)

Ec28, Ec29. ECONOMICS OF TECHNOLOGICAL CHANGE (B). A general survey of the factors influencing the development of industrial research and technology and the economic effects of technological change on investment and the business cycle. Attention is given also to the role of the government in promoting technological progress in this country and abroad. (Not offered Nov. 1944–June 1945.)

Ec32. ELEMENTARY ECONOMIC STATISTICS. Frequency distributions, averages, index numbers, time series, simple correlation, and elementary analysis of variance.

Ec37. ADVANCED ECONOMIC STATISTICS (A). Special topics in economic statistics. The topics will vary from year to year. (Not offered Nov. 1944–June 1945.)

Ec38. INDUSTRIAL STATISTICS (A). Application of statistical principles to (1) design and analysis of laboratory and factory experiments, (2) process and final inspection and (3) control of the quality of industrial output.

Ec39. STATISTICAL INFERENCE (B). Probability distributions, their origins and properties; sampling theory; statistical estimation; the testing of simple hypotheses. The exposition is mathematical. Some familiarity with statistical methods is assumed.

Ec40. MONEY AND BANKING. Forms of money and credit, credit instruments and institutions, commercial banking, price levels, monetary and banking policies.

Ec47. INVESTMENT FINANCE (A). Investment securities, corporate promotion, business expansion, working capital requirements, business failure and corporate reorganization are examined from the points of view of the business executive and of the investor. (Not open to Course XV students.) (Not offered Nov. 1944–June 1945.)

Ec48. INVESTMENT ANALYSIS (A). The investment characteristics of enterprises and methods of analyzing their securities. Corporate reports and their interpretation. Investment canons and their limitations. (Not offered Nov. 1944–June 1945.)

Ec49. PUBLIC FINANCE (B). An examination of the expenditures and revenue systems of federal and local governments in the United States, and a study of the effects of various fiscal policies and methods upon the social and economic development of the community. (Not offered Nov. 1944–June 1945.)

Ec50. BANKING AND FINANCE. (Not offered Nov. 1944–June 1945.)

Ec54. CORPORATIONS (B). Intended to meet the needs of those students whose professional interest may be in scientific or engineering fields, but who desire some knowledge of corporate organization and finance and the social and political problems of business. (Not open to Course XV students.) (Not offered Nov. 1944–June 1945.)

Ec56. PROBLEMS IN INDUSTRIAL ECONOMICS (B). A survey of the economic problems faced by small and large enterprises, and the public policies developed to meet these problems under conditions of competition and monopoly. (Not offered Nov. 1944–June 1945.)

Ec59. INTERNATIONAL ECONOMICS (A). A study of the conditions of international economic equilibrium and the operation of adjusting mechanisms as they are affected by recent national policies with respect to trade, finance, money, and exchange. (Not offered Nov. 1944–June 1945.)

Ec63. LABOR RELATIONS (B). Attention will be given to the development of the labor movement, to the growth and present status of labor legislation, and to the broad economic questions raised by these trends. The latter part of the course will deal with the major concrete questions of labor relations as they are encountered in industry today — wage determination, seniority and layoff methods, grievance procedure, technological changes, union-management coöperation, etc.

Ec64. INDUSTRIAL RELATIONS (B). With the tools acquired in Ec63, students will analyze and discuss case situations in current industrial relations.

Ec66. SEMINAR IN INDUSTRIAL RELATIONS (A). A small group of qualified students is invited for constructive participation in developing "situational thinking" as a distinctive approach to industrial relations. (Not offered Nov. 1944–June 1945.)

Ec67, Ec68. SEMINAR IN LABOR PROBLEMS (A). A study of the background and present nature of labor problems in the United States. The topics will vary somewhat from year to year. (Not offered Nov. 1944–June 1945.)

Ec72. AMERICAN GOVERNMENT. The governmental process in the United States viewed historically and functionally. The development of the American system will be studied in relation to the changes that have taken place in political ideas both in this country and abroad. (Not offered Nov. 1944–June 1945.)

Ec78. GOVERNMENT CONTROL OF INDUSTRY (A). A study of the relationship of the state to economic activity. Attention will be centered on the United States, but comparison will be made with medieval guild control, the policies of mercantilism and with contemporary foreign systems. (Not offered Nov. 1944–June 1945.)

Ec83. URBAN SOCIOLOGY. Social characteristics of urban and rural communities and the problems which arise in cities in connection with the provision of facilities for housing, industry, government, education, recreation, and transportation. (Not offered Nov. 1944–June 1945.)

Ec85, Ec86. LAND ECONOMICS (B). Principles of the classification and utilization of urban and rural land. Policies of the conservation and control of land and their effects on social development.

Ec88. BUILDING ECONOMICS. (Not offered Nov. 1944–June 1945.)

Economics and Social Science Continued

Ec91, Ec92. Economic Seminar (A). Consideration of special social problems or economic problems of particular industries. (Open to graduate students only.)

Ec93, Ec94. Industrial Economics Seminar (A). Readings, discussions, reports on such topics as industrial price policies, government regulation of industry, competitive practices and other phases of industrial economics.

Ec95, Ec96. Social Science Seminar (A). Reading, discussion, and case work relating to the non-economic aspects of human behavior and human relations in the perspective of modern social and industrial conditions.

The following subjects are offered as General Studies. For description of subjects see Division of General Studies.

G71. Introductory Psychology.

G74. Psychology in Industrial Relations.

G75. Human Relations.

G76. Human Relations.

G79. Comparative Political Institutions.

ENGLISH AND HISTORY

Subjects E1 to E99

E11. English Composition. A study of the principles of effective written and oral communication. Particular attention is given to the logical organization of papers and talks and to the precise and coherent expression of facts and opinions. Numerous papers and speeches are required. Conferences with the instructor are held at frequent intervals.

E12. English Composition. A continuation of E11.

E21T. The United States in World History. Presents the position of the United States in world civilization. Covers not merely the evolution of American political and social institutions as such, but also the ways in which the growth of the United States has influenced and been influenced by developments and forces in the rest of the world. The arrangement of material is topical, rather than strictly chronological or national. Economic, social, and governmental institutions and trends will be dealt with much more fully than will the narrative details of history. The first term covers the period 1600–1870.

E211. History of Thought. Traces the historical connection between present day ideas, and the theories of the great thinkers in science, philosophy, government, and economics from 1200 to 1789. (Not offered Nov. 1944–June 1945.)

E212. Literature. Provides a comprehensive view of some of the writings of outstanding western world authors. Only men in the first rank are dealt with, and their works are studied with the object of showing their place in world literature. Begins with classical Greek literature and ends with the age of enlightenment. (Not offered Nov. 1944–June 1945.)

E22T. The United States in World History. A continuation of E21T from 1870 to the present time.

E221. History of Thought. A continuation of E211 from 1789 to the present time. (Not offered Nov. 1944–June 1945.)

E222. Literature. A continuation of E212 from the age of enlightenment to the present time. (Not offered Nov. 1944–June 1945.)

E25. English Composition. Students who in the collective judgment of members of the Department of English and History have failed in E22T to meet certain standards of expression and therefore have received a Composition D will be required to take this subject. It may be prescribed at any time for juniors and seniors whose use of English in their professional courses is unsatisfactory. Instruction will be carried on in frequent group meetings and in individual conferences, at hours to be determined by the instructor. No credit will be given for this subject.

E33. Report Writing. Practice in writing simple memoranda, business letters, and comprehensive scientific reports. The search of the literature of subjects pertaining to the thesis in Chemistry, the arrangement of the material, and its presentation in oral and written report form. (Open to Course V students only.)

E35. Reports. The preparation and presentation of business and engineering reports. Practice in the investigation of subjects, the arrangement of material and its presentation in report form. Subjects covered range from simple memoranda and business letters to longer, more comprehensive reports. Emphasis is placed both on written reports and on oral presentation before committees.

E43, E44. Seminar in Economic and Industrial History (A). An historical study of the economic concepts and institutions which have governed the production and distribution of goods since the Middle Ages. Particular attention will be given to the evolutionary character of economic institutions and to the development of modern industrial organizations. Two full year subjects in Social Science will be required as preparation for admission to the subject.

The following subjects are offered as general studies. For description see Division of General Studies.

G1. History of Science.

G2. History of Science.

G7. Problems of Modern Philosophy.

G12. Seminar in Biography.

G17. Problems of the Far East. (Not offered Nov. 1944–June 1945.

G19. Introduction to Latin American Problems and Institutions.

G25. Social and Industrial History of Modern Europe. (Not offered Nov. 1944–June 1945.)

G26. Social and Industrial History of the United States. (Not offered Nov. 1944–June 1945.)

G27. Military History and Policy of the United States.

G31. Advanced Composition.

G32. Advanced Composition.

G34. American Literature. (Not offered Nov. 1944–June 1945.)

G35. Contemporary English Literature. (Not offered Nov. 1944–June 1945.)

G38. Public Speaking. (Not offered Nov. 1944–June 1945.)

G39. Reading Seminar.

G40. The Bible as Literature. (Not offered Nov. 1944–June 1945.)

G42. Shakespeare.

G61. Contemporary Fine Arts.

G62. History of Music.

G63. Introduction to Music.

G67. Principles of Debating. (Not offered Nov. 1944–June 1945.)

G68. Principles of Debating. (Not offered Nov. 1944–June 1945.)

G82. Introduction to International Relations.

HUMANITIES AND SOCIAL SCIENCES

DURING each regular academic year, in addition to required courses in mathematics, science, engineering, and modern languages, undergraduate students will be expected to carry one course in the general field of the humanities and social sciences. In the second half of the third year and in the fourth year a limited number of options will be permitted. The list of options may be modified or extended from year to year.

The coördinated program in the humanities and social sciences is expected to become fully operative in the near future. During the transition period students may select General Studies from a list which will be announced each term.

FIRST YEAR

First Term	English Composition	3–5
Second Term	English Composition	3–5

SECOND YEAR

First Term	The U. S. in World History	3–5
Second Term	The U. S. in World History	3–5

THIRD YEAR

First Term	Economic Principles	3–5
Second Term *Student's Choice of*	Psychology or Labor Relations or Industrial Economics	3–5

FOURTH YEAR

Student's Choice of	History of Thought or Music and the Fine Arts or Western World Literature or International Relations	3–5 each term

It is expected that a student will desire to follow the same field through both terms.

English Composition. Study of the principles of effective written and oral communication. Particular attention is given to the logical organization of papers and talks and to the precise and coherent expression of facts and opinions. Numerous papers and speeches are required. Conferences with the instructor are held at frequent intervals.

The United States in World History. Presents the position of the United States in world civilization. Covers not merely the evolution of American political and social institutions as such, but also the ways in which the growth of the United States has influenced and been influenced by developments and forces in the rest of the world. The arrangement of material is topical, rather than strictly chronological or national. Economic, social, and governmental institutions and trends will be dealt with much more fully than will the narrative details of history. The first term covers the period 1600–1870, the second term, the period from 1870 to the present time.

Economic Principles. Ranges over a wide field of economic analysis concentrating on: forms of business organization, the determination and behavior of costs and prices, distribution and exchange, the theory of money, international trade, and the influence of technological and other changes on the volume of production and employment. Business cases will be used especially in the study of costs, and practical problems will be integrated with the analysis. The main purpose will be to develop in the student a capacity to apply the tools of analysis to the economic problems he will meet as a business man and a citizen in a changing world. Fundamental revisions are being planned in the organization of material and in techniques of teaching.

Introductory Psychology. In recent years a fusion of the experimental-academic approach with the clinical-medical background and experience has given rise to a new way of thinking about human behavior. Out of the practice of therapists who solve daily the problems of real life, backed by an increasing amount of experimental evidence comes the rough shape of a new systematic approach involving a dynamic concept of the whole human being. This subject will be an attempt through the use of this dynamic approach to answer at the level of practical everyday living the commonest questions of normal youth, "Why do we behave as we do? How can we understand ourselves and those with whom we associate?"

Labor Relations. Attention will be given to the development of the labor movement, to the growth and present status of labor legislation, and to the broad economic questions raised by these trends. The latter part of the subject will deal with the major concrete questions of labor relations as they are encountered in industry today — wage determination, seniority and layoff methods, grievance procedure, technological changes, union-management coöperation, etc.

Industrial Economics. An examination of particular American industries with special attention to (1) the degree of monopoly and competition, (2) means of restoring competition, (3) the patent question, (4) regulation of public utilities, (5) public policy in relation to private enterprise, (6) the impact of the business cycle. Tools of analysis learned in the preceding subject in Economics will be applied to case studies.

History of Thought. The option in History of Thought will consider the theories of the leading philosophers, scientists, and social scientists, and the general trends of intellectual history from the ancient Greeks to the present. The purpose of the course is to give the students the background and perspective necessary for an understanding of the modern world.

Music and the Fine Arts. A course in the Fine Arts, one term to be devoted to the history and interpretation of music, and the other to such arts as painting and sculpture. This course will include an opportunity for some training in the methods of the graphic arts.

Western World Literature. The course will present to the student works of literature of the first rank for appreciation and enjoyment. As much emphasis will be placed on the intellectual and historical background as is necessary to insure intelligent understanding. From his contact with the course, the student should be able to recognize the outstanding figures of Western World literature and to gain first hand knowledge of some of their writings.

International Relations. This course will be divided into two parts: (1) Geography, both political and economic, with special attention to the problems of such regions as Latin America; and (2) Comparative Analysis of political institutions in various countries, especially the United States, and such topics in international relations as organization for world peace, modern diplomacy, and foreign trade policy.

GENERAL STUDIES

THIS section includes subjects of a general and essentially non-vocational character which are offered for the purpose of giving the student an opportunity of broadening his education. When the coördinated program in the humanities and social sciences goes into effect, these studies will be *optional electives without credit*. So far as possible, the subjects offered in any term, and the hours and methods of instruction will be planned to meet the needs of students who request subjects of this type. The list will accordingly be modified from time to time.

G1. History of Science. The history of science from its beginnings. The Babylonians and Egyptians, the development and decline of Greek Science; the transmission of science into Western Europe; the science of the Renaissance. The subject centers around the physical and biological sciences, but attention is paid to technical arts and sciences. Empha-

General Studies Continued

sis is placed on the development of scientific spirit and method. Illustrated by lantern slides.

G2. History of Science. A continuation of G1 covering in some detail the history of the various sciences to the end of the eighteenth century. Nineteenth century science is studied along the two lines of its most important development — geology, biology, and the theory of evolution; chemistry, physics, and the atomic nature of matter. Illustrated by lantern slides. (Either G1 or G2 may be taken independently.)

G5. Introduction to Astronomy. A survey of the facts and theories relative to the solar system and the sidereal universe. Illustrated by slides. Baker, *Astronomy*. (Not offered Nov. 1944–June 1945.)

G7. Problems of Modern Philosophy. The self and the will. Lectures and discussions, outside readings and reports.

G8. History of Philosophy. A general survey of modern philosophy from the time of Descartes.

G9. Geology. A consideration of the forces which are now modifying the earth and its inhabitants, and a history of the changes produced by these forces throughout the past, both upon the earth and its life. Shimer, *Introduction to Earth History*.

G10. Organic Evolution. A discussion of evolution, what it is and how it is shown in the organic world. There is especial reference to the evolution of man, his physical ancestry, his inherited impulses, and the development of his cultural environment. Shimer, *Evolution and Man*.

G12. Seminar in Biography. This seminar emphasizes training in the preparation and oral presentation of papers based upon the lives and works of some of the world's most important philosophers, scientists, and statesmen. It also gives opportunity for round table discussion of the questions to which each generation must seek its answers.

G13. Cartography. A survey of the historical, cultural and technical aspects of map-making and chart-making, with laboratory projects individually selected by the students. (Not offered Nov. 1944–June 1945.)

G20. French Civilization. A series of lectures and outside readings in English on the evolution of French civilization as regards cities, forms of government, industries, arts and sciences, literature, education, and social institutions. Illustrated. No knowledge of French required. (Not offered Nov. 1944–June 1945.)

G22. Development of Transportation. A series of thirty lectures on the history and development of transportation from the beginning down to the present day. It deals with land, water and air transportation, and includes, as transportation agencies, the railways, highways, ocean, coastwise and inland waters, and commercial airplanes. The influence of these means of transportation upon the industrial, economic and social development of the world forms the fundamental thesis of this subject.

G27. Military History and Policy of the United States. A course in American Military History. Some attention will be paid to the tactics of colonial and frontier warfare as well as those of the six important wars, but the emphasis will be placed on broad strategic considerations and on such problems as the development of mobilization, the influence of sea power, and the rise of such services as the Red Cross. Lectures, class discussions, papers.

G28. Economic Geography. Deals with the seas and the land masses of the world, with the geography of the human races, with the world's resources in mineral wealth and its resources of plant and animal origin; also with the distribution of commodities, with manufactured products, with the economic basis of world trade and with national control of raw materials.

G29. Topography in the World War. The influence of topography in directing military objectives is considered in every theatre of the world war, and the influence of topography in defense is considered for the areas which may reasonably become involved. The course is illustrated with abundant map studies and with lantern slides.

G31. Advanced Composition. Further practice for students interested in writing as an art. The composition of larger prose units including short stories, essays, articles, and verse. The subjects attempted and the forms employed in the required weekly papers are determined by the student's preference. Weekly conferences.

G32. Advanced Composition. Continuation of G31.

G38. Public Speaking. Designed, through practice and criticism, to afford knowledge of the principles of public speaking and, in the process of doing so, to extend the range of the student's intellectual interests. (Not offered Nov. 1944–June 1945.)

G39. Reading Seminar. Offers an opportunity to read good books under direction. The readings will be chosen from a selected list of the interesting and important works of the past and the present. Each student's selection, made with the advice of the instructor, will be given the unity of an interest in a period or a subject. There will be written critical reviews, oral presentations, and group discussions. The group will be limited to fifteen students.

G45. Historical Aspects of Architecture. Designed to introduce non-architects to the principles of the subject including the historical, aesthetic, and practical aspects, and the growth and development of communities and cities. Lectures, illustrated by slides, covering the historical periods of architecture and discussions conducted by members of the Institute staff and outside lecturers are supplemented by reference reading, preparation of papers, and group conferences. (Not offered Nov. 1944–June 1945.)

G48. Conversational German. The emphasis will be on the practical use of essential conversational vocabulary and forms, dealing largely with present day military life. Reading matter will consist of descriptions of Army and Navy activities, equipment, mobilization, accounts of battles, etc.

G50. Conversational French. The emphasis will be on the practical use of essential conversational vocabulary and forms, dealing largely with present day military life. Reading matter will consist of descriptions of Army and Navy activities, equipment, mobilization, accounts of battles, etc.

G57. Dante in English. A study of the Divine Comedy in English translation with readings and lectures on the life and times of Dante. (Not offered Nov. 1944–June 1945.)

G581, G582. Elementary Russian. Elementary grammar; practice in reading Russian. This subject should enable a good student by the end of the year to read scientific articles in Russian and at the same time lay the foundation for continued study of the language.

G66. The Arts of the Book. A study of paper, type, and printing plates, their history and their effective combination to produce appropriately designed printed material. Among the topics treated will be the history of fine printing, type nomenclature and specification, page and display layout, use and reproduction of illustration, modern typesetting and press work, estimation of printing costs, preparation of manuscript and seeing it through the press, bookbinding. Extensive use will be made of the Dard Hunter Paper Museum and of typographical exhibits. The student's assignment will be observation and written comment on fine printed production, or the actual design of such matter. (Not offered Nov. 1944–June 1945.)

G67. Principles of Debating. In addition to the discussion of the fundamentals of argumentation and debating, a public question with important economic and political significance will be selected for study and analysis. Students will be given individual instruction in the collection of material and in the oral presentation of their conclusions. The class will be open to a selected group of students, after consultation with the instructor, on the basis of capacity and interest in debating and public speaking. (Not offered Nov. 1944–June 1945.)

G68. Principles of Debating. Deals primarily with the psychology of persuasive speech, the separate assignments in argumentation, public speaking methods, and audience psychology being correlated to this end. About one-half the subject will be devoted to a study of the theory of persuasive

General Studies Continued

speech; the remainder will be devoted to the training of the individual student in the practical application of this theory. Each student will be asked to write and deliver (on a recording machine) two examples of "persuasive speech." Robert Oliver, *The Psychology of Persuasive Speech.* (Not offered Nov. 1944–June 1945.)

G75. Human Relations. The fundamental object is to give students a realization of the necessity for good method in dealing with human relations, as well as a grounding in what constitutes good method. Such basic influences as aptitudes, habits, attention, understanding, desires, and prejudices are analyzed and applied to typical situations which arise in the course of employment. Illustrative problems taken from actual cases are studied, but always with the emphasis on that structural analysis which characterizes good method. Except by special permission of the instructor, only juniors and seniors may elect the subject.

G76. Human Relations. A continuation of G75 which applies the fundamentals already learned to job interviews, hiring, discipline cases, problems in coöperation, industrial conflict, etc. Case demonstrations of actual situations in which selected students act as executives are presented in the classroom; the person taking the part of the employee is brought in from industry and the technique of the students handling the situation is subsequently discussed, often by actual business men familiar with the original situation. Except by special permission of the instructor, only juniors and seniors may elect the subject.

G86. Principles of Sanitary Science and Public Health. A consideration of the human body as a mechanism and the effect of the environment on its health, well-being, and proper functioning. The subject matter will include such items as infection and resistance, sources of infection, modes of disease transmission, air, water, milk, foods, sewage, refuse, housing, insects, and other factors in relation to disease, and the organized machinery for safeguarding the health of urban communities. The subject is designed for its cultural value and not for professional practice. Sedgwick's *Principles of Sanitary Science and Public Health,* Prescott and Horwood.

G88. From Molecule to Man. The nature and probable origin of life, its reproduction, the development of offspring, adaptations and mutations, effect of X-rays and other physical forces upon living matter, hormones, and other chemical regulators of birth, life, and death.

MATHEMATICS

Subjects M1 to M99

M11. Calculus. An elementary presentation of the fundamental ideas of the calculus. Differentiation and graphical representation of algebraic, trigonometric, logarithmics and exponential functions. Integration of simple algebraic and transcendental functions. Maxima and minima applications to problems in geometry and mechanics, such as determination of velocity, acceleration, area, volume and pressure. A brief discussion of the analytic geometry of the straight line, and the conic sections.

M112. Mathematics (College Transfer). Given for college transfer students who have taken calculus prior to their transfer but whose preparation is not sufficient to cover first year requirements.

M12. Calculus. Parametric representation of curves, polar coördinates. Methods of integration including approximate integration. Further applications of derivatives and integrals, including arc length, curvature, surface area, center of gravity and moment of inertia. Determinants. Elementary vector analysis in the plane, vector velocity and acceleration.

M21. Calculus. Partial differentiation. Infinite series. Complex numbers. Surfaces and vectors in three-dimensional space. Dot and cross products of vectors and their applications. Multiple integration and geometrical and physical applications.

M212. Mathematics (College Transfer). Given for college transfer students who have taken calculus prior to their transfer but whose preparation is not sufficient to cover second year requirements.

M22. Differential Equations. A treatment of ordinary differential equations including the principal types of first and second order equations, simultaneous equations, and linear equations with constant coefficients. The work is illustrated by numerous applications to geometry, chemistry, physics and mechanics. Phillips, *Differential Equations, Third Edition.*

M23. Algebra. Readings, problems, and discussions in advanced algebra. Hall and Knight, *Higher Algebra.*

M24. Interpolation. Accuracy of derived data, interpolation, calculation of determinants, numerical solution of algebraic and transcendental equations, numerical integration, numerical solution of differential equations, Fourier analysis, and smoothing of experimental curves. E. T. Whittaker and G. Robinson, *The Calculus of Observations.*

M31. Differential Equations. Complex numbers, Fourier series, partial differentiation, systems of ordinary differential equations and some simple partial differential equations with applications to the long line and the theory of heat flow. Franklin, *Differential Equations for Electrical Engineers.*

M331. Mathematical Theory of Statistics (B). A general treatment of mathematical methods of statistics and their application to scientific and engineering data. Includes systems of frequency curves and moments, theory of large and small sampling, simple partial and multiple correlations, contingency, statistical estimation, and analysis of variance.

M332. Mathematical Theory of Statistics (B) Statistical principles applied to design and analysis of complex experiments. Mathematical theory underlying modern experimental arrangements will be discussed. Practical problems involving Latin squares and their variations, factorial design, split plot experiments, confounding and partial confounding, etc. will be treated.

M341, M342. Modern Statistical Theory (B). Special topics will be taken up and varied from year to year. Papers taken from recent journals will be discussed. The solution of scientific and industrial statistical problems will be considered.

M351, M352. Advanced Calculus for Engineers (A). (Not offered Nov. 1944–June 1945.)

M36, M37. Advanced Calculus (A). Fundamental principles, power series, partial differentiation, implicit functions, Gamma and Beta functions, line, surface and space integrals, vectors, ordinary differential equations, Bessel functions, partial differential equations, calculus of variations, elliptic integrals.

M381, M382. Theory of Functions (A). Arranged for students who desire a general subject in analysis somewhat more advanced than M36, M37. Among the topics discussed are series, infinite products, the Riemann integral, functions of a complex variable, contour integration, asymptotic expansions, Fourier series, differential equations, integral equations, and various transcendental functions of importance in the applications of mathematics. Attention is given to the logical derivation of the processes of analysis used in connection with these topics. Whittaker and Watson, *Modern Analysis.*

M441. Projective Geometry (B). (Not offered Nov. 1944–June 1945.)

M442. Elementary Differential Geometry (B). Plane and space curves. First and second differential form of a surface. Theorems of Meusnier and Euler. Lines of curvature, asymptotic lines, conjugate lines, geodesics. Theorems of Gauss and Codazzi. Developable surfaces, surfaces of rotation, Liouville surfaces. Differential parameters. Problems on mapping. W. C. Graustein, *Differential Geometry* and L. P. Eisenhart, *Differential Geometry.*

Mathematics Continued

M451, M452. Fourier Series and Integrals (A). (Not offered Nov. 1944–June 1945.)

M461. Seminar in Applied Mathematics (A). (Not offered Nov. 1944–June 1945.)

M54. Mathematical Laboratory (B). Practical instruction in numerical, graphical and mechanical calculation and analysis as required in the engineering or applied mathematical sciences, numerical solution of equations; graphical methods; nomography and the construction of graphical charts; curve fitting to empirical data, approximate methods of integration, differentiation and interpolation; the use and principles of construction of instruments employed in calculation, and many kindred topics. Lipka, *Graphical and Mechanical Computation.*

M551, M552. Functions of a Real Variable (A). The first term is devoted to the theory of measure and Lebesgue Integration. The second term deals with extensions and applications including Fourier series and Fourier integrals.

M561, M562. Functions of a Complex Variable (A). (Not offered Nov. 1944–June 1945.)

M571, M572. Differential Equations (A). The physical problems which have given rise to the field of differential equations will be referred to constantly in motivating the various topics to be considered in this subject. Among these topics are various aspects of the linear differential equation including boundary value problems and the representation of an arbitrary function by Sturm Liouville functions, the solution of certain of the more common equations by series and integrals, and the classification of equations by singular points. The relationship between integral and differential equations will be considered. The linear partial differential equation of the second order will be treated in detail and problems from potential theory, vibrations, heat flow, and other fields will be studied by methods including the integral equation and Fourier transform. *Ordinary Differential Equations* by Ince and a text on partial differential equations will be used.

M581, M582. Continuous Groups (A). (Not offered Nov. 1944–June 1945.)

M62. Modern Algebra (B). Polynomials, determinants linear equations, linear transformation, matrices, linear independence, introduction to groups.

M631, M632. Modern Algebraic Theories (A). (Not offered Nov. 1944–June 1945.)

M641, M642. Tensor Calculus (A). The elements of tensor algebra, followed by the analysis of tensor fields, especially of those in which a metric is defined with the aid of a quadratic differential form. Applications to differential geometry, mechanics and physics. (M642 not offered Nov. 1944–June 1945.)

M651, M652. Analytical Mechanics (A). (Not offered Nov. 1944–June 1945.)

M661, M662. Algebra of Quantum Theory (A). (Not offered Nov. 1944–June 1945.)

M671, M672. Partial Differential and Integral Equations (A). This subject has two objectives: first, to show how various types of physical problems lead to partial differential equations and to integral equations; second, to show the existing technique for solving such equations. Partial differential equations are considered first and the Fourier technique is treated at some length, together with the various types of harmonics and special orthogonal functions which arise, and the Fourier integral. Among the equations treated are those which arise in potential theory, heat flow, wave propagation, etc. Next, integral equations are considered, the first step being to show how such equations arise in different types of physical problems. The available methods for solving such equations are then taken up, together with the various series, solutions, characteristic functions, etc. The Laplace transformation is also considered. Integral equation methods are contrasted with differential equation methods wherever possible.

M682. Calculus of Variations (A). (Not offered Nov. 1944–June 1945.)

M691, M692. Characteristic Value Problems (A). (Not offered Nov. 1944–June 1945.)

M73. Review of Mathematics. Review of algebra, plane and solid geometry, trigonometry, elementary calculus, differential equations.

M731, M732. Mechanics (B). (Not offered Nov. 1944–June 1945.)

M76. Theory of Probability (A). Permutations and combinations. Elementary principles of the theory of probabilities. Bernoulli's Theorem. Bayes' Theorem. Distributive functions and continuous variables. Averages. Curve fitting. H. Levy and L. Roth, *Elements of Probability.*

M77. Vector Analysis (B). A treatment of the vector functions and operations required in theoretical work on electricity. Phillips, *Vector Analysis.*

M78. Mathematical Logic and Its Applications. (Not offered Nov. 1944–June 1945.)

M791, M792. Theoretical and Applied Elasticity (A). Analysis of stress and strain in three dimensions. Stress-strain relations. Minimum principles in elasticity, their theory and application to the approximate solution of boundary value problems. Theory of bending and torsion of bars. Theory of plane stress and strain, Airy's stress function, use of elements of complex variable theory. Bending of flat plates. Bending and stretching of thin shells. Elastic stability theory. Elements of the finite deformation theory of elasticity.

M831, M832. Analysis (B). (Not offered Nov. 1944–June 1945.)

M90. Mathematical Reading (A). Designed to give the student an opportunity to read advanced mathematical treatises under the supervision of some member of the department. The treatise chosen and the time allowed will be determined by the needs in each particular case. This subject is for graduate students who may find it desirable to do advanced work not provided for in the regular courses. May be taken by undergraduates only under exceptional circumstances.

The following subjects are offered as General Studies. For description see Division of General Studies.

G3. History of Mathematics. (Not offered Nov. 1944–June 1945.)

G4. History of Mathematics. (Not offered Nov. 1944–June 1945.)

G8. History of Philosophy.

MILITARY SCIENCE AND TACTICS

Subjects MS1 to MS99

MS11. Military Science. (Required in all Courses.) Consists of eight weeks of infantry drill, ceremonies and physical drill and seven weeks of lectures on basic military training subjects.

MS12. Military Science. (Required in all Courses.) Consists of nine weeks of dimounted drill, extended order drill, formations, ceremonies, and physical drill and six weeks of marksmanship and map reading.

MS21. Military Science. (Required in all Courses.) Consists of eight weeks of infantry drill, formations, ceremonies and physical drill and seven weeks of lectures on interior guard duty, mechanical training with rifle, map and photograph reading.

MS22. Military Science. (Required in all Courses.) Consists of six weeks of formations, ceremonies and physical drill and nine weeks of classroom instruction covering combat branches of the army, tactical training and administrative procedures.

SEVERAL courses are offered in both French and German; two in Spanish, one in Italian, one in Russian. Those in French and German are of Elementary, Intermediate and Advanced grade. In the Elementary and Intermediate subjects a careful foundation is laid for reading, writing and speaking the foreign language. Great care is taken to secure a good pronunciation, a mastery of the working essentials of grammar, a reasonable vocabulary for the expression of common ideas, training of the ear, and a broad reading vocabulary. The reading texts include scientific matter, fiction, drama, historical or descriptive works of a nature to open up to the student the genius, institutions and social organization of the country studied. Part of the work consists of assignments for written translation of articles from recent foreign journals selected by each student according to his individual interests and needs. Occasional illustrated lectures are given to supplement the class exercises and stimulate interest. The General Study subjects offer the student an opportunity to carry his study beyond the Intermediate grade.

The elective courses in Spanish and Italian are parallel to the courses in French and German. They give a training in pronunciation, essentials of grammar, and reading of varied matter. On completion a student should be able to make intelligent contact with the foreign country, be able to read correspondence and translate reading matter of moderate difficulty. In all subjects the foreign language is used as far as practicable in the classroom.

L11, L12. German, Elementary. The necessary foundation for the study of the German language for scientific and literary purposes. It will also enable students to fulfill the entrance requirements in Elementary German. It consists of training in pronunciation, elementary grammar, acquisition of useful vocabulary, reading of varied matter, some of which deals with science, and individual written translations from recent scientific works. Texts (subject to modification): Cowden and Van Eerden, *Introduction to College German;* Sepmeier, *Hans und Liese;* Gerstacker, *Irrfahrten;* Wizinger, *German Science Readings.*

L21, L22. German, Intermediate. Includes a systematic review of grammar, miscellaneous prose and individual written translations from recent scientific works. At the end of the course students should be able to read understandingly any ordinary newspaper or magazine article of a literary or popular scientific nature, to understand simple spoken German, and to express simple thoughts in German. As far as practicable the exercises are conducted in German. Texts (subject to modification): Curts, *Readings in Scientific and Technical German;* Zeydel, *First Course in Written and Spoken German;* Kästner, *Drei Männer im Schnee.*

L31. German, Intermediate. Special subject required in Course V. Reading of selected texts and individual assignments of articles in recent chemical journals.

L51, L52. French, Elementary. The necessary foundation for the study of the French language and literature, or for scientific studies; it also enables students to fulfill the entrance requirement in Elementary French. Consists of training in pronunciation, elementary grammar, acquisition of useful vocabulary and reading of varied matter, part of which deals with French institutions and the history of France, practice in spoken French; also individual written translations from recent scientific works. The last term will include the reading of some technical French. Texts (subject to modification:) Fraser and Squair and Carnahan, *Standard French Grammar;* Hills and Dondo, *La France;* Maupassant, *Six Contes Choisis;* Eve Curie, *Madame Curie;* one short play.

L61, L62. French, Intermediate. A continuation of the study of grammar, pronunciation, and useful conversational forms; reading of matter dealing with French geography, history, and industrial activity; some standard modern authors; reading of scientific French; individual written translations from recent scientific works.

L81, L82. Spanish, Elementary. Pronunciation, elementary grammar (first term), graded reading matter. Practice in conversation, composition (second term). Texts (subject to modification): Hills, Ford, Rivera, *Brief Spanish Grammar for Colleges;* Castillo and Sparkman, *Graded Spanish Readers;* Valdes, *Los Puritanos;* Galdós, *Doña Perfecta;* the New York newspaper *La Prensa.*

L83, L84. Spanish, Intermediate. (Not offered Nov. 1944–June 1945.)

L91. L92. Italian, Elementary. (Not offered Nov. 1944–June 1945.)

The following subjects are offered as General Studies. For description see Division of General Studies.

G20. French Civilization. (Not offered Nov. 1944–June 1945.)

G48. Conversational German.

G50. Conversational French.

G51, G52. French Literature. (Not offered Nov. 1944–June 1945.)

G53, G54. French Literature. (Not offered Nov. 1944–June 1945.)

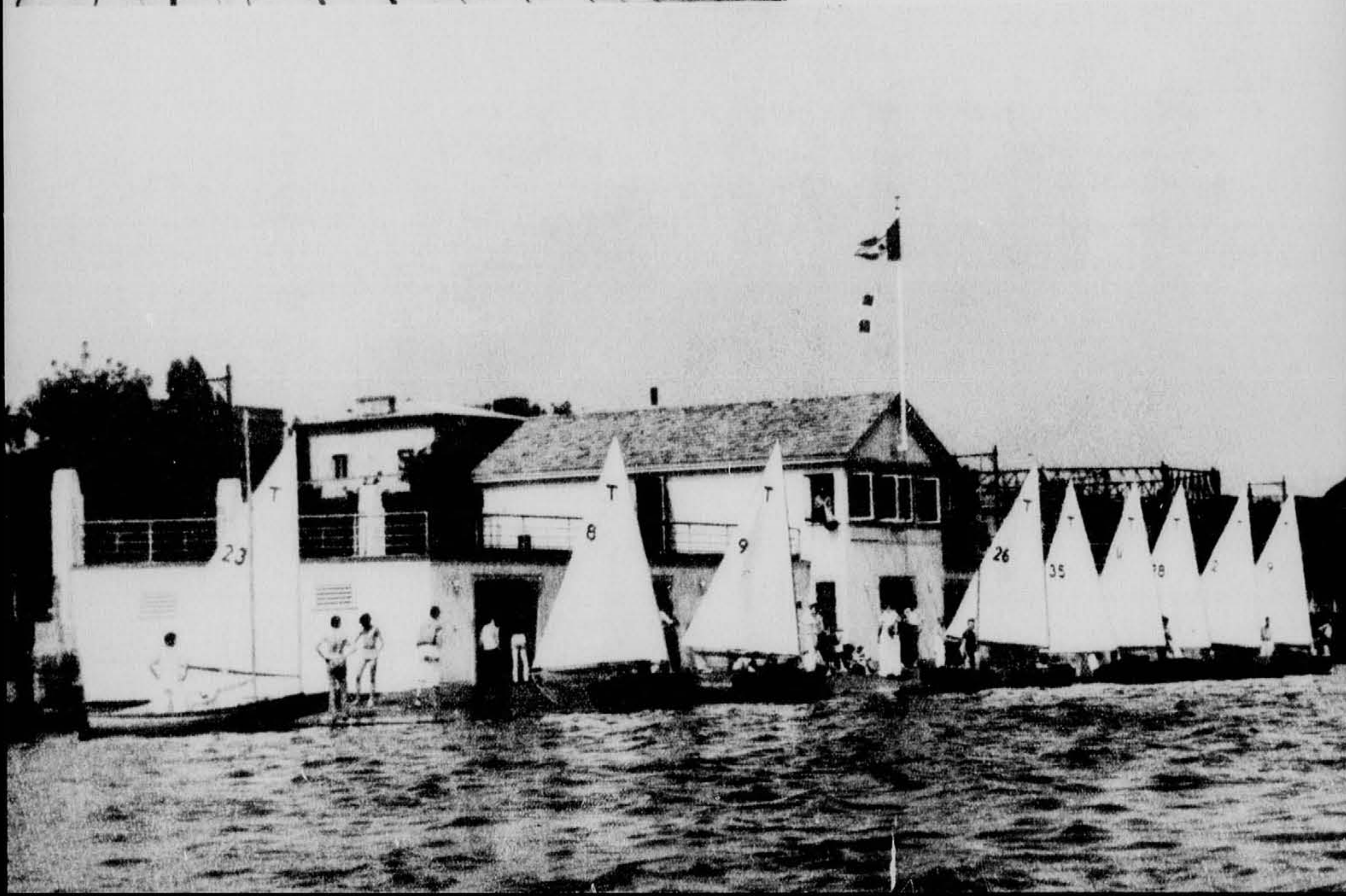
G57. Dante in English. (Not offered Nov. 1944–June 1945.)

G581, G582. Elementary Russian.

When Entrance or Course requirements for foreign language have already been met, any additional foreign language such as L11–12, L21–22, L51–52, L81–82, L91–92 may count as a General Study for a maximum credit of eight units.

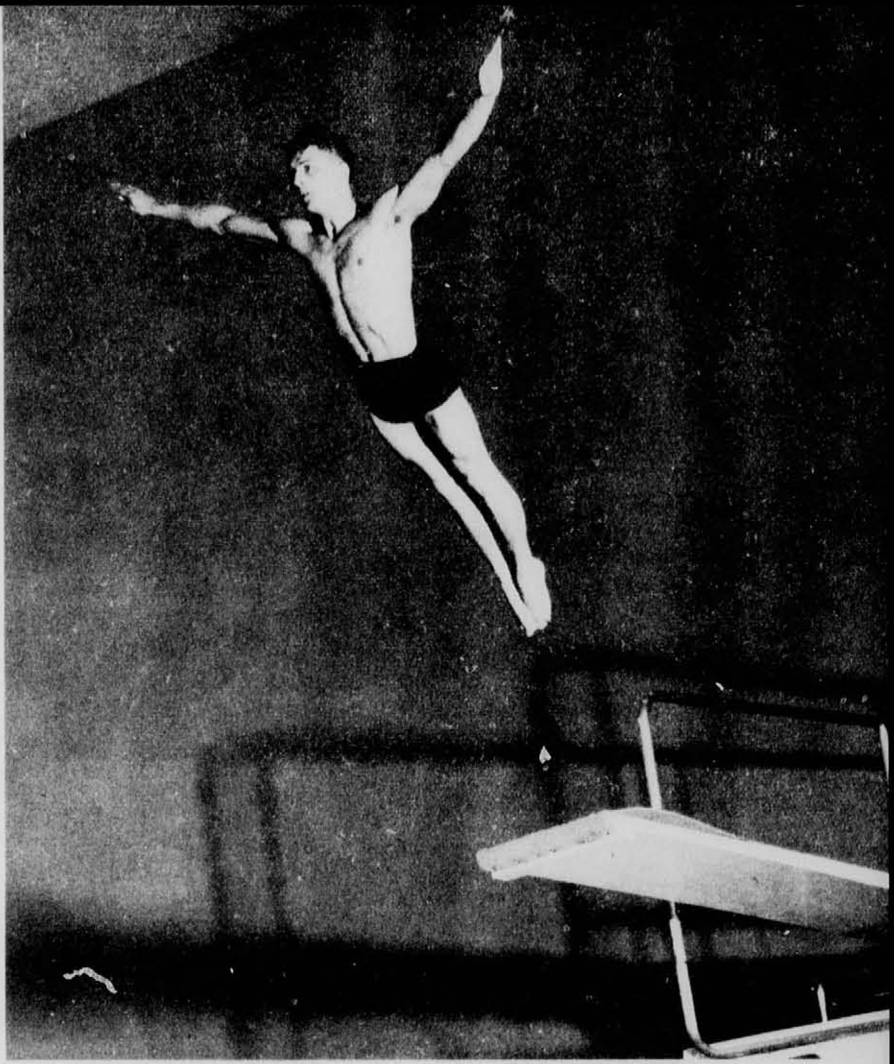
SAILING

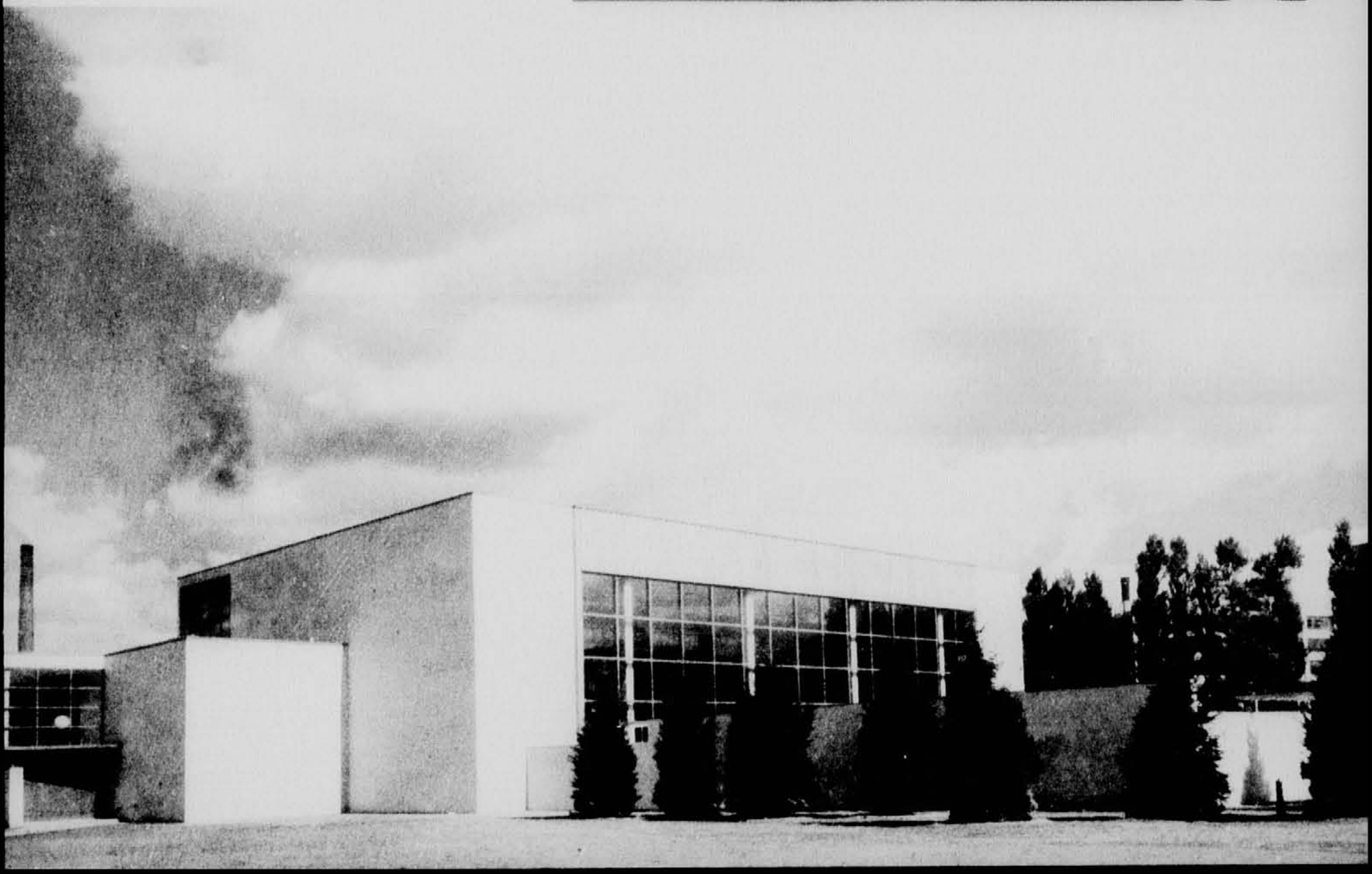
ONE OF THE MOST POPULAR RECREATIONS AT TECHNOLOGY IS SAILING ON THE CHARLES RIVER. THE SAILING PAVILION, LOCATED ON THE RIVER DIRECTLY IN FRONT OF WALKER MEMORIAL, HOUSES A LARGE FLEET OF TECHNOLOGY-DESIGNED DINGHIES AS WELL AS A NUMBER OF THE LARGER AND FASTER "110'S." THE NAUTICAL ASSOCIATION DIRECTS ALL SAILING ACTIVITIES, AND EVERY STUDENT IS ELIGIBLE TO PARTICIPATE.



SWIMMING

THE SPLENDID ALUMNI POOL, COMPLETED IN 1940, IS ONE OF THE BEST APPOINTED IN THE EAST. THE BUILDING HOUSES A STANDARD INTERCOLLEGIATE SIX-LANE SWIMMING POOL AS WELL AS A SMALLER PRACTICE POOL. A HUGE WINDOW EXTENDING ACROSS THE ENTIRE SOUTH WALL GIVES UPON A WALLED GARDEN AND SWIMMING AREA.





SUBJECTS OF INSTRUCTION TABULATED

The list below is necessarily subject to change. Subjects indicated as "Term 1" will be given during the Fall Term 1944-45; those indicated as "Term 2" will be given during the Spring Term 1945. First year, second term subjects will be repeated in the Fall Term 1944-45, and second year, first term subjects in the Spring Term 1945.

The number at the left is the subject number.

The numbers following the names of subjects indicate the prerequisite subjects (those in italics may be taken simultaneously).

To the right of the prerequisites are noted the year and term and the Professional Courses in which the subjects are required.

(A) following the year indicates that the subject is primarily for Graduate students. (B) indicates subjects for Graduate as well as Undergraduate students.

Some "B" subjects will not be credited toward a graduate degree in Courses in which they are required subjects of the undergraduate schedule.

Then follows the time distribution of the subject in units (a unit representing fifteen hours work). The total credit for a subject is the sum of the units allotted to Exercise (Recitation, Lecture, Laboratory, Drawing or Fieldwork), and Preparation. At the extreme right is given the name of the Instructor in charge of the subject.

CIVIL AND SANITARY ENGINEERING — 1·00-1·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
1·00	Surveying	D12	2	1	I	2	—	2	Shea
1·01	Topographical Drawing	D12	2	1	I	0	4	0	Shea
1·02	Surveying	D12	2	2	IV-B, IX-B	1	2	1	Shea
1·052	Surveying	1·00, 1·01	2	2	I	0	2	0	Shea
‡1·053	Surveying	1·052	3	1	(Elective)	0	6	0	Shea
1·12	Astron. & Spherical Trig.	1·00	2	2	I	2	—	4	Shea
			3	1	I				
1·13	Geodesy	M22, 1·12	3	1	I	2	—	3	Shea
1·135	Int. Vibration Theory	M22	4(B)	1	(Elective)	3	—	2	Ruge
‡1·136	Vibration Problems	1·135	G(A)	2	(Elective)	3	—	6	Ruge
‡1·138	Seismological Lab.	——	4(B)	1 or 2	(Elective)		★		Ruge
‡1·141	Geodesy, Adv.	1·13	G(A)	1	(Elective)	2	—	4	Shea
‡1·142	Geodesy, Adv.	1·141	G(A)	2	(Elective)	3	—	6	Shea
1·16	Aerial Surveying	1·00 or 1·02	4(B)	2	(Elective)	2	—	2	Shea
1·21	Rail. & High. Curves	M21, 1·00	2	2	I	2	—	2	Babcock
‡1·25	Eng. Construction	——	4(B)	1	(Elective)	3	—	1	Breed
‡1·26	Railway Signaling	——	4(B)	2	(Elective)	2	—	3	Babcock
1·271	Transportation Eng.	1·21, 1·35	4(B)	1	I(b)	4	2	5	Babcock, Bone
1·272	Transportation Eng.	1·271	4(B)	2	I(b)	3	2	4	Babcock, Bone
‡1·301	Railway Transport. Adv.	1·272	G(A)	1	(Elective)	2	—	4	Babcock
‡1·302	Railway Transport. Adv.	1·301	G(A)	2	(Elective)	2	—	4	Babcock
‡1·32	Des. of Harbor Works	1·48	G(A)	1	(Elective)	1	3	3	
1·34	Municipal Eng.	——	3(B)	1	IV-B	3	—	4	Bone
1·35	Roads & Pavements	1·21	3	2	I	2	—	1	Bone
1·371	High. Transport. Adv.	1·35	G(A)	1	(Elective)	2	—	4	Breed, Bone
1·372	High. Transport. Adv.	1·371	G(A)	2	(Elective)	2	—	4	Breed, Bone
1·38	Highway Design	*1·272*	4(B)	2	(Elective)	0	5	0	Bone
1·39	Graphic Statics	8·02	2	1	I	1	2	1	Mitsch
1·40	Structures, Theory	2·04	3	2	I	3	2	4	Fife
1·401	Structures, Theory	2·04	3	2	IX-B, $XVII_1$	3	—	5	Fife
1·41	Structures, Theory	1·40 or 1·401	4(B)	1	I, $XVII_1$	3	—	6	Mirabelli
1·42	Structures, Theory	1·41	4(B)	2	I, $XVII_1$	3	—	6	Mitsch
1·45	Materials of Const.	——	3	2	I	2	—	4	Norris
			4	1	I				
1·481	Soil Mechanics	——	4(B)	1	I, $XVII_1$	2	2	2	D. W. Taylor
1·482	Found. & Embankments	——	4(B)	2	I, $XVII_1$	3	—	4	D. W. Taylor
1·491	Soil Mechanics	2·04	G(A)	1	(Elective)	3	—	6	D. W. Taylor
1·492	Soil Mechanics	1·491	G(A)	2	(Elective)	3	—	6	D. W. Taylor
1·493	Soil Mech. Lab.	*1·491* or *1·495*	G(A)	1	(Elective)	0	3	3	D. W. Taylor
‡1·495	Soil Mechanics	2·04	G(A)	1	(Elective)	5	—	10	D. W. Taylor
‡1·496	Soil Mechanics	1·491 or 1·495	G(A)	2	(Elective)	5	—	10	D. W. Taylor
1·501	Bridge Design	*1·41*	4(B)	1	I	2	6	0	Mirabelli
1·502	Structural Design	1·501	4(B)	2	I	2	6	0	Mirabelli
1·521	Structural Lab.	*1·42*	G(A)	1	(Elective)		★		Norris
1·522	Structural Lab.	*1·42*	G(A)	2	(Elective)		★		Wilbur, Norris

★ Time specially arranged. ‡ Not offered November 1944–June 1945.

Civil and Sanitary Engineering Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
1·541	Reinf. Conc. Des. Adv.	1·42	G(A)	1	(Elective)	2	4	2	Mitsch
1·542	Reinf. Conc. Des. Adv.	1·541	G(A)	2	(Elective)	2	4	0	Peabody
1·551	Structural Design Adv.	1·41	G(A)	1	(Elective)	2	4	0	Wilbur
1·552	Structural Design Adv.	1·551	G(A)	2	(Elective)	2	4	0	Wilbur
1·561	Structural Theory Adv.	1·41	G(A)	1	(Elective)	4	—	8	Fife
1·562	Structural Theory Adv.	1·561	G(A)	2	(Elective)	2	—	6	Fife
1·571	Stat. Indet. Structures	1·42	G(A)	1	(Elective)	3	—	6	Wilbur
1·572	Stat. Indet. Structures	1·571	G(A)	2	(Elective)	3	—	6	Wilbur
1·58	Des. Reinf. Conc. Struct.	*1·40*	3(B)	2	I	2	4	0	Mitsch
‡1.59	Concrete Research	——	G(A)	1 or 2	(Elective)		★		——
1·62	Hydraulics	2·01	3	2	I, IX-B	4	—	6	Russell
1·63	Hydraulics	2·01	4	1	XIII-C, XV_1, $XVII_1$	2	—	3	Russell
1·64	Hydraulics	2·01	4	1	VI_1	3	—	6	Russell
1·66	Hydraulics, Adv.	1·62	G(A)	1	(Elective)	2	—	6	Russell
‡1·681	Theory of Models	1·62	G(A)	1	(Elective)	2	—	4	——
‡1·682	River Hydraulic Lab.	1·62, 1·681	G(A)	2	(Elective)	0	9	0	——
‡1·69	River Engineering	1·62	G(A)	2	(Elective)	2	—	4	——
1·70	Hydrology	1·62	4(B)	1	I(c)	3	4	4	Gifford
1·701	Hydrology	——	4(B)	1	(Elective)	3	—	4	Gifford
1·71	Water Power Eng. & Flood Control	1·70, 1·41	4(B)	2	I(c)	3	4	3	Gifford
1·711	Water Power Eng. & Flood Control	1·62 or 1·64; 1·70 or 1·701	4(B)	2	(Elective)	3	—	3	Gifford
‡1·731	Water Power Eng. Adv.	1·42, 1·71, *1·851*	G(A)	1	(Elective)	3	—	6	Gifford
‡1·732	Water Power Eng. Adv.	1·731, *1·852*	G(A)	2	(Elective)	3	—	6	Gifford
1·75	Hydraulic & San. Eng.	1·62	4(B)	1	I(a)	3	—	5	Stanley
1·76	Sanitary Engineering	1·75	4(B)	2	I(a)	3	—	4	Stanley
1·77	Sanitation	——	4	2	IV	2	—	4	Stanley
1·781	Sanitary Chemistry	5·02	3	1	I(d)	2	2	4	Stanley
1·79	Sanitary Design	1·75	4(B)	2	I(a)	0	2	0	Stanley
1·801	Hydraulic & San. Des.	*1·75*	4(B)	1	I(a)	0	3	0	Stanley
1·811	Sanitary Eng. Adv.	1·75	G(A)	1	(Elective)	3	—	6	Stanley
1·812	Sanitary Eng. Adv.	1·811, 1·76	G(A)	2	(Elective)	3	—	6	Stanley
1·821	Sanitary Eng. Lab.	1·75 or 1·76	G(A)	1	(Elective)		★		Stanley
1·822	Sanitary Eng. Lab.	1·75 or 1·76	G(A)	2	(Elective)		★		Stanley
‡1·851	Water Power Des. Adv.	*1·731*	G(A)	1	(Elective)	0	8	0	Gifford
‡1·852	Water Power Des. Adv.	1·851, *1·732*	G(A)	2	(Elective)	0	8	0	Gifford
1·881	Sanitary Design Adv.	*1·811*	G(A)	1	(Elective)	0	6	0	Stanley
1·882	Sanitary Design Adv.	*1·812*	G(A)	2	(Elective)	0	6	0	Stanley

MECHANICAL ENGINEERING — 2·00–2·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
2·00	Applied Mechanics	M12, 8·02	2	1	I, II, VI, IX-B, XIII, XIII-C, XIV, XV_1, XVI, XVII	3	—	5	L. S. Smith
2·01	Applied Mechanics	2·00	2	2	I, II, VI, IX-B, XIII, XIII-C, XIV, XV_1, XVI, XVII	3	—	5	L. S. Smith
2·011	Applied Mechanics	M12, *8·02*	2 3 3	1 1 2	IV III X	3	—	5	L. S. Smith
2·04	Applied Mechanics	2·01	3	1	I, II, $VI_{1,3,4}$, IX-B, XIII, XIII-C, XV_1, XVI, $XVII_1$	3	—	5	MacGregor
2·041	Applied Mechanics	——	3	1	XIII-A	3	1	5	MacGregor
2·042	Applied Mechanics	2·011	2 3 4	2 2 1	IV III X	3	—	5	MacGregor

★ Time specially arranged. ‡ Not offered November 1944–June 1945.

Mechanical Engineering Continued

	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
2·06	Applied Mechanics	2·04	3	2	II, XIII	3	—	5	Adkins
2·061	Applied Mechanics	2·041	3	2	XIII-A	3	—	6	Adkins
2·07	Applied Mechanics	2·04	3	2	VI$_{1, 4}$	3	—	5	Adkins
2·081	Applied Mechanics	2·04 or 2·041	4(B)	1	II	3	—	5	Soderberg
			4	2	XIII-A				
			G	1	II (T.E.)				
2·082	Applied Mechanics	2·06 or 2·061	4(B)	2	II	3	—	5	Soderberg
			G	2	II (T.E.)				
2·10	Ordnance Engineering	2·04	4(B)	1, 2	(Elective)	3	—	3	Holmes
‡2·11	Industrial Plant Eng.	2·06	4(B)	2	(Elective)	4	—	4	Holmes
2·121	Photoelasticity, App.	2·04	4(B)	1 or 2	(Elective)	1	2	3	Murray
2·125	Photoelasticity, Res.	2·121	G(A)	1 or 2	(Elective)		★		Murray
‡2·141	Dynamics in Mech. Eng., Adv.	2·082	G(A)	1	(Elective)	3	—	6	Soderberg
‡2·142	Dynamics in Mech. Eng., Adv.	2·141	G(A)	2	(Elective)	3	—	6	Soderberg
2·211	Mech. Eng. Prob., Adv.	2·082	G(A)	1	(Elective)	3	—	9	Soderberg
			G	1	II (T.E.), XIII-A				
2·212	Mech. Eng. Prob., Adv.	2·211	G(A)	2	(Elective)	3	—	9	Soderberg
			G	2	XIII-A				
2·221	Plasticity	2·082	G(A)	1	(Elective)	3	—	6	MacGregor
2·222	Plasticity Prob., Adv.	2·221	G(A)	2	(Elective)	3	—	6	MacGregor
2·223	Plasticity Res.	*2·221*	G(A)	1 or 2	(Elective)		★		MacGregor
2·251	Fluid Mechanics	M22, 2·01	3	1	II, XIII	3	2	3	Hunsaker
			4	1	VI$_4$				
2·252	Fluid Mechanics	2·251, 2·40	3	2	II	3	2	3	Hunsaker
2·256	Fluid Mechanics	2·061, 2·402	4(B)	1	XIII-A	3	—	6	Rightmire
2·258	Hyd. Trans. & Control.	M22, 2·07	4(B)	2	(Elective)	2	—	4	Rightmire
			G	2	II (T.E.)				
‡2·271	Hydromechanics	2·252	G(A)	1	(Elective)	3	—	6	Rightmire
2·30	Engineering Metals	——	2	2	II	1	1	2	Kyle
			3	1	(Elective)				
2·31	Engineering Materials	*2·30*	3	1	II	3	2	4	Kyle
2·311	Engineering Materials	——	2	1	XVI	3	2	4	Kyle
			3	2	XV$_1$				
			4	2	XIII				
2·312	Metal Processing	——	3	2	III	1	2	0	Kyle
2·32	Engineering Metals	2·31 or 2·351	4	1	(Elective)	1	1	3	Kyle
2·34	Metals & Testing, Adv.	2·31, 2·37	4(B)	2	(Elective)	2	1	2	Lessells
2·37	Test. Materials Lab.	2·04, 2·31	3	2	II, XVI	2	2	2	Cowdrey
2·371	Test. Materials Lab.	2·04 or 2·042	3	2	I(d)	0	2	1	Cowdrey
			4	1	III$_1$, XIII				
			4	2	X				
2·372	Test. Materials Lab.	2·04	4	1	(Elective)	0	3	2	Cowdrey
2·373	Test. Materials Lab.	2·04	3	1	XVII$_1$	0	5	2	Cowdrey
2·40	Heat Engineering	M21, 8·02	3	1	II, VI$_1$, IX-B, XIII, XIII-C, XVI	4	—	5	Svenson
2·402	Heat Engineering	——	3	1	XIII-A	4	2	7	Svenson
2·402T	Heat Engineering	——	G	1	II (T.E.)	4	—	5	Svenson
2·41	Heat Engineering	M21, 8·02	3	1	I	4	—	6	Taft
			3	2	XV$_1$				
			4	1	XVII$_1$				
2·42	Heat Engineering	2·40	3	2	II, VI$_1$, IX-B, XIII, XIII-C, XVI	4	—	5	Svenson
2·422	Heat Engineering	2·402	3	2	XIII-A	2	—	3	Svenson
2·43	Heat Engineering	2·40, 2·252	4(B)	1	II	3	—	5	Keenan
‡2·44	Heat Engineering	2·43	4(B)	2	(Elective)	3	—	5	Keenan
2·45	Eng. Thermodyn, Adv.	2·43, M36	G(A)	2	(Elective)	3	—	9	Keenan
			G	2	II (T.E.)				
‡2·451	Eng. Thermodynamics, Adv. Prob.	2·42, 2·252	G(A)	1 or 2	(Elective)		★		Keenan

★ Time specially arranged. ‡ Not offered November 1944–June 1945.

Mechanical Engineering Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
‡2·461	Refrigeration, Adv.	2·43	G(A)	1	(Elective)	3	—	9	Svenson
2·50	Heat Measurements	8·04	3	2	III	1	2	1	Wilkes
2·501	Heat Measurements	8·04	3	1	IX-A	0	2	1	Wilkes
2·53	Heat Measurements	2·50 or 2·501	G(A)	1 or 2	(Elective)		★		Wilkes
2·551	Power Plant Eng.	2·42	4(B)	2	II	3	—	5	Holt
‡2·57	Power Plants, Adv.	2·56	G(A)	1	(Elective)	3	—	6	Holt
‡2·58	Heat Eng. in Ind. Plants	2·42 or 2·41	4(B)	2	(Elective)	3	—	5	Taft
2·59	Torpedoes	——	G(B)	1	II (T.E.)	2	—	4	Keenan
‡2·60	Food Engineering	8·02	4	1	VII$_2$	2	—	2	Jones
‡2·601	Food Engineering	2·60	4	2	VII$_2$	3	—	3	Jones
‡2·621	Refrigeration Eng.	2·42 or 2·41	4(B)	1	(Elective)	2	—	4	Jones
2·622	Refrigeration Eng.	2·43 or 2·41	4(B)	2	(Elective)	3	—	5	Svenson
‡2·64	Refrigeration Eng.	2·43 or 2·41	G(A)	2	(Elective)	3	—	6	Svenson
2·66	Heat., Vent. & Air Cond.	2·40 or 2·41	4(B)	2	XVII$_1$	3	—	5	Holt
2·661	Heating and Ventilation	——	3	1	IV	2	—	4	Holt
2·662	Heating and Ventilation	2·661	3	2	IV	2	—	4	Holt
2·671	Air Conditioning, Adv.	2·66 or 2·661	G(A)	1	(Elective)	3	—	6	Holt
‡2·672	Heat. & Vent. Design	2·671	G(A)	2	(Elective)	4	—	4	Holt
2·680	Engineering Lab.	2·40	3	2	II	0	4	4	Eames
2·682	Engineering Lab.	2·680	4(B)	1	(Elective)	0	3	3	Eames
2·683	Engineering Lab.	2·40	3	2	XIII	0	2	2	Eames
2·684	Engineering Lab.	2·683	4	1	XIII	0	2	2	Eames
2·685	Engineering Lab.	2·40	3	2	XIII-C	0	4	4	Eames
2·686	Engineering Lab.	2·40 or 2·41	4	1	VI$_1$, IX-B, XVI	0	3	3	Eames
2·687	Hydraulic Lab.	1·62	4	2	I	0	2	2	Eames
2·688	Engineering Lab.	10·29	4	2	X	0	3	3	Eames
‡2·691	Refrigeration Lab.	2·42 or 2·41	4(B)	2	(Elective)	0	3	3	Jones
‡2·692	Air Conditioning Lab.	2·66	4(B)	2	(Elective)	0	3	3	Holt
‡2·693	Refrig. & Air Con. Lab., Adv.	2·691, 2·692	G(A)	2	(Elective)	0	6	6	Jones, Holt
2·701	Machine Drawing	D12	2	1	II, IX-B	0	6	0	Sloane
			3	1	XVI				
2·72	Machine Design	——	G	1	XIII-A	3	—	6	Townsend
2·730	Machine Design	*2·01*, D12	2	2	II, XVI	1	3	2	Sloane
2·731	Machine Design	2·04, 2·31 or 2·351, 2·730	3	2	II	2	2	1	Townsend
2·732	Machine Design	2·731	4(B)	1	(Elective)	2	2	2	Swett
‡2·751	Machine Design, Adv.	2·732	G(A)	1	(Elective)	3	5	2	Swett
‡2·752	Machine Design, Adv.	2·751	G(A)	2	(Elective)	3	5	2	Swett
2·761	Machine Design	——	G	1	II (T.E.)	2	4	2	Swett
2·762	Machine Design	——	G	2	II (T.E.)	1	2	2	Swett
2·78	Hydraulic Power Trans. & Controls, Des.	2·252	4(B)	2	(Elective)	2	2	2	Grosser
2·782	Design of Mechanical Sys.	2·732, *6·19*	4(B)	2	(Elective)	2	2	4	Hrones
‡2·79	Automotive Dynamics	2·791, *2·082*	4(B)	2	(Elective)	2	—	2	E. S. Taylor
2·791	Automotive Engines	2·42, 2·06	4(B)	1	(Elective)	3	2	3	C. F. Taylor
2·792	Automotive Engines	2·791	4(B)	2	(Elective)	3	2	3	C. F. Taylor
‡2·793	Automotive Eng. Des.	*2·791* or *2·797*	4(B)	1	(Elective)	1	3	0	C. F. Taylor
‡2·794	Automotive Eng. Des.	2·793	4(B)	2	(Elective)	1	3	0	C. F. Taylor
2·797	Automotive Engines	2·42, 2·06	4(B)	1	(Elective)	3	—	3	C. F. Taylor
2·798	Automotive Engines	2·791, or 2·797	4(B)	2	(Elective)	3	—	3	C. F. Taylor
2·801	Auto. Eng. Prob., Adv.	2·792	G(A)	1	(Elective)		★		E. S. Taylor
2·802	Auto. Eng. Prob., Adv.	2·792	G(A)	2	(Elective)		★		E. S. Taylor
2·805	Diesel Engines	2·42, 2·06	4(A)	2	XIII-A	3	—	6	C. F. Taylor
2·83	Steam Turbine Eng.	2·42	4(B)	1	(Elective)	2	—	4	Keenan
2·84	Gas Turbine Eng.	2·42	4(B)	2	(Elective)	2	—	4	Keenan
2·851	Machine Tool Lab.	——	2	1	II, XIII, XIV, XV$_1$	1	3	0	English
			3	1	XIII-A				
2·852	Machine Tool Practice	2·851	2	2	II, XIII	1	3	0	English
			3	2	XIII-A				
2·853	Machine Tool Lab.	——	2	1	VI	1	3	0	English
			2	2	XVI				

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Mechanical Engineering Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
2·854	Machine Tool Lab.	——	2 2	1 2	III, XIII-C IX-B	1	2	0	English
2·855	Machine Tool Lab.	——	2	2	VIII	0	2	0	English
‡2·871	Manufacturing Eng.	2·731 or *2·74*	4(B)	1 or 2	(Elective)	2	—	4	Buckingham
‡2·872	Prep. for Manufacturing	——	4(B)	2	(Elective)	2	—	4	Buckingham
‡2·88	Metrology & Dimens. Eng. Stand.	——	G(A)	1	(Elective)	3	—	6	Buckingham
2·901	Fabric Struct., Prin.	8·02	4(B)	1	(Elective)	3	—	6	Schwarz
2·902	Fabric Struct., Prin.	2·901	4(B)	2	(Elective)	3	—	6	Schwarz
2·903	Textile Manufact., Elem.	——	4(B)	1	(Elective)	3	—	6	Fox
2·904	Textile Manufact., Prin.	2·903	4(B)	2	(Elective)	3	—	6	Fox
2·905	Textile Tech. Anal.	8·04	G(A)	1	(Elective)	3	—	5	Schwarz
2·906	Textile Tech. Anal.	2·905	G(A)	2	(Elective)	3	—	5	Schwarz
2·907	Textile Microscopy	8·04	G(A)	1	(Elective)	2	3	2	Schwarz
2·908	Textile Microscopy	2·907	G(A)	2	(Elective)	2	3	2	Schwarz
2·911	Textile Testing Lab.	*2·905*	G(A)	1	(Elective)	0	6	2	Fox
2·912	Textile Research Lab.	*2·906*	G(A)	2	(Elective)	0	6	2	Schwarz
2·913	Textile Tech. Seminar	*2·905, 2·907*	G(A)	1	(Elective)	2	—	2	Schwarz
2·914	Textile Tech. Seminar	*2·906, 2·908*	G(A)	2	(Elective)	2	—	2	Schwarz
‡2·991	Mechanical Eng. Seminar	——	G(A)	1	(Elective)	2	—	2	Soderberg
‡2·992	Mechanical Eng. Seminar	——	G(A)	2	(Elective)	2	—	2	Soderberg

METALLURGY — 3·00–3·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
3·00	Metallurgy, Int.	——	2	2	III	0	3	1	R. S. Williams
3·01	Non-Ferrous Met. I	3·00	3	1	III	4	—	4	Hayward
3·02	Non-Ferrous Met. II	3·01	4	1	III_2	3	—	3	Hayward
3·03	Non-Ferrous Met. III	3·02	4(B)	1	(Elective)		★		Hayward
3·04	Metallurgical Lab.	——	3	1	III	0	5	0	Hayward
3·041	Electric Furnaces	8·04, 5·02	4(B)	1	(Elective)	1	2	2	Hayward
3·05	Metallurgy, General	3·02, 3·12	4(B)	1	(Elective)	3	—	3	Hayward
3·06	Non-Fer. Metal., Adv.	3·031, 3·05	G(A)	1	(Elective)	2	—	6	Hayward
‡3·07	Metal. Com. Metals	5·02	4	2	(Elective)	3	—	3	Hayward
3·08	Gen. Metal., Adv.	3·05	G(A)	1	(Elective)	2	—	6	Hayward
‡3·09	Metal. Calc., Adv.	3·05	G(A)	2	(Elective)	2	—	6	Hayward
‡3·10	Metal. Plant Visits	——	3	—	(Elective)	0	3	1	Floe
3·12	Met.: Iron & Steel	5·02	3	2	III	3	—	4	Bever
‡3·15	Met.: Iron & Steel, Adv.	3·12	G(A)	1	(Elective)		★		Waterhouse
‡3·16	Met.: Iron & Steel, Adv.	3·12	G(A)	2	(Elective)		★		Waterhouse
‡3·17	Metal. Plant Design	3·02, 3·12	G(A)	1	(Elective)	0	13	0	Waterhouse
‡3·18	Metal. Plant Design	3·01, 3·12	G(A)	2	(Elective)	0	13	0	Waterhouse
‡3·19	Metallurgical Plants	3·01, 3·12	4(B)	1 or 2	(Elective)	3	—	3	Waterhouse
3·20	Metal. Thermodynamics	5·62	4(B)	1	III	4	—	5	Chipman
3·21	Steel Making, Prin.	3·20	4(B)	2	(Elective)	2	—	4	Chipman
3·22	Fire Assaying	5·12, 12·011	3	1	(Elective)	1	4	1	Reed
‡3·23	Fire Assaying, Adv.	3·22	G(A)	1	(Elective)		★		Reed
‡3·30	Metallography	8·04	3	1	(Elective)	2	2	1	Floe
3·31	Metallography	5·12, 8·04	3	1	III	2	3	2	Cohen
3·32	Metallography and Heat Treatment	3·31	3	2	III	2	4	4	Floe
3·33	Metallography, App.	3·30 or 3·32	4(B)	1	III_1	1	2	2	Homerberg
‡3·34	Physical Metal., Adv.	3·33, 3·50	G(A)	2	(Elective)		★		Cohen
‡3·35	Physical Metal., Adv.	3·33, 3·50	G(A)	1	(Elective)		★		Cohen
3·38	Physical Metal., Adv.	——	G	1	II (T.E.)	4	—	4	R. S. Williams
3·39	Physical Metal., Adv.	3·38	G	2	II (T.E.)	1	3	2	Floe
3·391	Properties of Metals	——	3	1	XIII-A	3	—	3	R. S. Williams, Homerberg
3·392	Properties of Metals	3·391	3	2	XIII-A	3	—	3	R. S. Williams, Homerberg, Kyle
3·40	Cor. & Heat Res. Alloys	3·30 or 3·32	4(B)	1	III_1	2	—	4	Wulff
3·41	Light Alloys	3·30 or 3·32	4(B)	2	III_1	2	—	4	R. S. Williams

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Metallurgy Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
3·42	Powder Metallurgy	3·30 or 3·32	4(B)	1	(Elective)	2	—	4	Wulff
3·422	Powder Metal. Lab.	3·30 or 3·32	4(B)	1	(Elective)	1	3	2	Wulff
3·50	X-ray Metallography	M22, 3·30 or 3·31	4(B)	2	III_1	2	1	3	J. T. Norton
3·51	Physics of Metals	M22, 3·30 or 3·31 3·50	4(B)	2	(Elective)	2	—	4	J. T. Norton
3·52	Physics of Metals, Adv.	3·50, 3·51	G(A)	1 or 2	(Elective)		★		J. T. Norton
3·55	Welding Metallurgy	3·30 or 3·31, 3·32	4(B)	2	(Elective)	1	—	2	Rosenthal
‡3·60	Ferromagnetism	——	G(A)	1	(Elective)	2	—	4	Bitter
‡3·61	Atomic Arrangements in Alloys	——	G(A)	1	(Elective)	2	—	4	Bitter
3·62	Sp. Prob. in Metallurgy	——	G(A)	1	(Elective)		★		R. S. Williams
3·63	Sp. Prob. in Metallurgy	——	G(A)	2	(Elective)		★		R. S. Williams
‡3·65	Theory of the Solid State	M22, 8·04	4(B)	1	(Elective)	3	—	6	Bitter
‡3·70	Ceramics	5·02, 8·04	3	1	(Elective)	2	3	3	F. H. Norton
‡3·71	Optical Ceramics	8·04	4(B)	1	(Elective)	0	6	2	F. H. Norton
‡3·73	Ceramic Process, Fund.	2·50, 3·70, 5·61	G(A)	1	(Elective)	3	4	4	F. H. Norton
‡3·74	Phys. Prop. Cer. Prod.	3·73	G(A)	2	(Elective)	2	3	4	F. H. Norton
‡3·75	Spec. Prob. Ceramics	3·70, 3·71	G(A)	1	(Elective)		★		F. H. Norton
‡3·76	Spec. Prob. Ceramics	3·70, 3·71	G(A)	2	(Elective)		★		F. H. Norton
3·81	Mineral Dressing I	12·011	3	1	III	2	2	2	Gaudin
3·82	Mineral Dressing II	3·81	3	2	III	2	2	2	Gaudin
3·83	Mineral Dressing Plant	3·82	4(B)	1	III_2	3	—	2	Locke
3·84	Mineral Dressing Prac.	3·83	4(B)	2	III_2	2	—	2	Locke
3·85	Flotation	3·82	4(B)	2	III_2	3	—	3	Schuhmann
3·86	Comminution	3·82	4(B)	1	III_2	2	—	3	Schuhmann
3·87	Quant. Mineragraphy	3·82	4(B)	1	III_2	0	4	0	Schuhmann
3·88	Ore Testing	3·83	4(B)	2	(Elective)	0	6	2	Schuhmann
3·89	Mineral Dressing Des.	3·84	G(A)	1 or 2	(Elective)		★		Locke
3·90	Mineral Dressing, Adv.	3·84	G(A)	1 or 2	(Elective)	2	—	4	Gaudin
3·901	Mineral Dressing Lab. Adv.	3·83 or 3·85	G(A)	1 or 2	(Elective)		★		Gaudin
3·902	Mineral Dressing Lab. Adv.	3·901	G(A)	1 or 2	(Elective)		★		Gaudin
3·91	Mineral Dressing Sem.	3·84	G(A)	1 or 2	(Elective)	1	—	2	Gaudin

ARCHITECTURE — 4·00–4·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
4·031	Freehand Drawing	——	3	1	IV	0	4	0	Selmer-Larsen
4·032	Freehand Drawing	4·031	3	2	IV	0	4	0	Selmer-Larsen
4·041T	Freehand and Color	4·032	4	1	IV	0	6	0	Selmer-Larsen
4·042T	Freehand and Color	4·041T	4	2	IV	0	6	0	Selmer-Larsen
4·051	Freehand Drawing	4·042	5(B)	1	IV	0	6	0	Selmer-Larsen
‡4·051T	Freehand and Color	4·042T	5(B)	1	IV	0	6	0	Selmer-Larsen
4·052	Freehand Drawing	4·051	5(B)	2	IV	0	6	0	Selmer-Larsen
‡4·052T	Freehand and Color	4·051T	5(B)	2	IV	0	6	0	Selmer-Larsen
4·053	Freehand Drawing	4·052	G(A)	1	IV	0	6	0	Selmer-Larsen
4·054	Freehand Drawing	4·053	G(A)	2	IV	0	6	0	Selmer-Larsen
4·07	Shop	——	2	2	IV	0	4	0	Selmer-Larsen
4·091	Color, Comp. Th. & App.	4·082	5(B)	1	IV	1	—	4	Anderson
4·092	Color, Comp. Th. & App.	4·091	5(B)	2	IV	1	—	4	Anderson
4·10	Arch. Illumination	——	4	2	(Elective)	0	10	0	Anderson
‡4·451	History of Architecture	——	5	1	IV	3	—	5	
‡4·452	History of Architecture	4·451	5	2	IV	3	—	5	
4·481	Europ. Civilization & Art	4·472	5(B)	1	IV	2	—	3	Seaver
4·482	Europ. Civilization & Art	4·481	5(B)	2	IV	2	—	3	Seaver
4·491	Europ. Civilization & Art	4·482	G(A)	1	IV	2	—	4	Seaver
4·492	Europ. Civilization & Art	4·491	G(A)	2	IV	2	—	4	Seaver
4·52	Office Practice	——	G(A)	1	(Elective)	0	30	0	F. J. Adams
4·53	Professional Relations	——	5(B)	1	IV	1	—	2	Wurster
‡4·541	Housing Seminar	——	G(A)	1	(Elective)	2	—	4	Burchard
‡4·542	Housing Seminar	——	G(A)	2	(Elective)	2	—	4	Burchard
‡4·59	Gov. & Pub. Admin.	——	3(B)	1	IV-B	2	—	4	Shurtleff, Schaefer

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Architecture Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
4·60	Plan. Legis. & Admin.	——	4(B)	2	IV-B	2	—	5	Shurtleff
4·62	Site Plan. & Const.	——	3(B)	2	IV-B	0	12	0	Bender
4·641	City Planning, Principles	——	2	1	IV-B	2	—	2	Shurtleff
			4	1	IV				
4·651	City Plan., Th. & Prac.	4·641	3(B)	1	IV-B	3	—	3	F. J. Adams
4·652	City Plan., Th. & Prac.	4·651	3(B)	2	IV-B	3	—	3	F. J. Adams
4·661	City Planning Research	4·652	G(A)	1	(Elective)	2	—	4	F. J. Adams
4·662	City Planning Research	4·661	G(A)	2	(Elective)	2	—	4	F. J. Adams
4·672	City Planning Design	——	2	2	IV-B	0	10	5	Bender
4·681	City & Regional Planning	4·672	3(B)	1	IV-B	0	18	0	Bender
4·682	City & Regional Planning	4·681	3(B)	2	IV-B	0	12	0	F. J. Adams
4·683	City & Regional Planning	4·682	4(B)	1	IV-B	0	12	0	F. J. Adams
4·691	City & Reg. Plan., Adv.	4·682	G(A)	1	IV-B	0	30	0	F. J. Adams
4·692	City & Reg. Plan., Adv.	4·691	G(A)	2	IV-B	0	30	0	F. J. Adams
4·711	Architectural Drawing	——	1	1	IV	0	6	0	Bridge
4·712	Architectural Drawing	——	1	2	IV	0	6	0	Bridge
4·721	Architectural Design II	——	2	1	IV	0	13	2	Anderson, Bridge
4·722	Architectural Design II	4·721	2	2	IV	0	13	2	Anderson, Bridge
4·731	Architectural Design III	4·722	3	1	IV	0	15	3	Anderson, Bridge
4·732	Architectural Design III	4·731	3	2	IV	0	15	3	Anderson, Bridge
4·741T	Architectural Design IV	4·732, 4·811 4·812	4	1	IV	0	20	4	Anderson
4·742T	Architectural Design IV	4·741T	4	2	IV	0	20	4	Anderson
4·751	Architectural Design V	4·742	5(B)	1	IV	0	29	0	Anderson
‡4·751T	Architectural Design V	4·742T	5(B)	1	IV	0	20	4	Anderson
4·752	Architectural Design V	4·751	5(B)	2	IV	0	14	0	Anderson
4·761	Architectural Design VI	4·752	G(A)	1	IV	0	36	0	Anderson
4·762	Architectural Design VI	4·761	G(A)	2	IV	0	30	0	Anderson
‡4·78	Planning Principles	——	2	2	XVII	1	2	1	Anderson
4·811	Structural Analysis	2·042, 4·722	3	1	IV	2	6	0	Gelotte
4·812	Structural Analysis	4·811, 4·731	3	2	IV	2	6	0	Gelotte
‡4·91	Industrial Design	——	G	1	(Elective)	2	—	4	Müller
‡4·92	Industrial Design	——	G	2	(Elective)	2	—	4	Müller
4·98	Thesis Research	——	G(A)	1, 2	IV, IV-B	0	6	0	Anderson, F. J. Adams

CHEMISTRY — 5·00–5·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
5·01	Chemistry, General	——	1	1	All Courses	4	2	4	Wareham
5·02	Chemistry, General	5·01	1	2	All Courses	4	2	4	Wareham
5·061	Inorganic Chemistry, Adv.	5·13	4(B)	1	V	2	—	3	Schumb
5·062	Inorganic Chemistry, Adv.	5·061	4(B)	2	V	2	—	3	Schumb
5·071	Sem. Inorganic Chem.	5·062	G(A)	1	(Elective)	2	—	3	Schumb
5·072	Sem. Inorganic Chem.	5·071	G(A)	2	(Elective)	2	—	3	Schumb
5·08	Inorganic Lab., Adv.	5·13	G(A)	1 or 2	(Elective)	0	6	0	Young
5·10	Qualitative Analysis	5·02	2	1	V, X	3	11	4	Marvin
5·11	Qualitative Analysis	5·02	2	1	III, VII, VII-A, VIII IX-A, XV_2	3	4	2	Simpson
5·12	Quantitative Analysis	5·10 or 5·11	2	2	III, V, VII, VII-A IX-A, X, XV_2	3	4	2	Marvin
5·13	Quantitative Analysis	5·12	2	2	V	2	3	2	Marvin
5·141	Anal. Chemistry	5·12, 8·04	3	1	V	0	4	1	Gibb
			3	2	VII_2				
5·35	Applied Chemistry	5·02	3, 4	2	(Elective)	2	—	2	Marvin
5·41	Organic Chemistry I	5·12, 8·04	3	1	I(d), V, VII, VII-A IX-A, X, XV_2	4	—	3	Ashdown
			4	1	III_2				
5·414	Organic Preparations	5·12, *5·41*	3	1	V	0	9	0	Fletcher
5·416	Organic Preparations	5·12, *5·41*	3	1	X	0	7	0	Ashdown
5·417	Quant. Org. Anal.	*5·41*	3	2	V	0	4	0	Fletcher
5·418	Organic Preparations	5·12, *5·41*	3	2	IX-A	0	6	0	Ashdown
5·42	Organic Chemistry II	5·41	3	2	V, VII-A, X	4	—	2	Huntress

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No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
Chemistry Continued									
5·424	Org. Compounds, Ident.	5·414	3	2	V	0	9	0	Ashdown
5·426	Org. Compounds, Ident.	5·416 or 5·428	3	2	X	0	5	0	Ashdown
			4	2	VII-A				
5·428	Organic Chemistry Lab.	*5·41*	3	1	VII, VII-A	0	9	0	Ashdown
5·43	Organic Chemistry III	5·42	4(B)	1	V	3	—	6	Huntress
5·44	Organic Chemistry IV	5·43	4(B)	2	V	3	—	6	Huntress
5·51	Functional Groups in Organic Chemistry	5·42	G(A)	1	(Elective)	3	—	6	Huntress
5·52	Mechanism, Structure & Reactivity in Org. Chem.	5·42	G(A)	2	(Elective)	3	—	6	Morton
‡5·53	Sp. Topics in Org. Chem.	5·42	G(A)	1	(Elective)	3	—	6	Morton
‡5·54	Sp. Topics in Org. Chem.	5·42	G(A)	2	(Elective)	3	—	6	Morton
5·55	Org. Compounds, Ident.	5·42, 5·414	G(A)	1	(Elective)	2	8	0	Huntress
5·581	Organic Lab., Adv.	5·42, 5·424	G(A)	1	(Elective)	1	5	1	Morton
5·582	Organic Lab., Adv.	5·581	G(A)	2	(Elective)	0	5	1	Morton
‡5·591	Recent Adv. in Org. Chem.	5·42	G	1	(Elective)	1	—	1	Huntress
‡5·592	Recent Adv. in Org. Chem.	5·42	G	2	(Elective)	1	—	1	Huntress
5·61	Physical Chem. I	M21, 8·03, 5·12	3	1	III, V, VII_1, VII-A X, XV_2	4	—	4	Millard
5·611	Physical Chem. Lab. I	*5·61*	3	1	V, VII_1, VII-A	0	4	0	Dietrichson
5·612	Physical Chem. Lab. I	*5·61*	3	1	III, X	0	2	0	Dietrichson
5·62	Physical Chem. II	5·61	3	2	III, V, VII_1, VII-A X, XV_2	4	—	4	Millard
5·621	Physical Chem. Lab. II	5·611, *5·62*	3	2	V, VII_1, VII-A	0	4	0	Dietrichson
5·622	Physical Chem. Lab. II	5·612, *5·62*	3	2	X	0	2	0	Dietrichson
5·63	Thermodynamics, Int.	5·62	4(B)	1	V	3	—	5	Sherrill
5·64	Rad. Chemistry, Int.	5·62 or 5·71	4(B)	2	V	2	—	3	L. Harris
5·642	Radiation Chemistry	5·62 or 5·71	G(A)	2	(Elective)	2	—	4	L. Harris
5·66	Surface & Colloid Chem.	5·62 or 5·71	4(B)	2	V	2	—	3	Millard
5·71	Physical Chem.	M21, 8·03, 5·13	G(A)	1	(Elective)	3	—	5	Sherrill
5·72	Physical Chem.	5·71	G(A)	2	(Elective)	3	—	5	Sherrill
‡5·741	Radiation Chem., Adv.	5·64	G(A)	1	(Elective)	2	—	4	L. Harris
‡5·742	Statistical Mechanics	5·741	G(A)	2	(Elective)	2	—	4	Stockmayer
‡5·75	Chem. Thermodynamics	5·62 or 5·71	G(A)	1	(Elective)	3	—	6	Beattie
‡5·76	Chem. Thermodynamics	5·75	G(A)	2	(Elective)	3	—	6	Scatchard
5·77	Kinetic Theory	5·62 or 5·71	G(A)	1	(Elective)	2	—	4	Amdur
5·82	Chem. Literature	5·41, 5·61, L31	3	2	V	1	—	1	Huntress
5·90	Spec. Prob. in Chemistry	——	G(A)	1, 2	(Elective)		★		Huntress
‡5·911	Journal Meeting in Inorganic Chem.	——	G(A)	1	(Elective)	1	—	1	Schumb
‡5·912	Journal Meeting in Inorganic Chem.	——	G(A)	2	(Elective)	1	—	1	Schumb
‡5·921	Journal Meeting in Organic Chem.	——	G	1	(Elective)	1	—	1	Morton
‡5·922	Journal Meeting in Organic Chem.	——	G	2	(Elective)	1	—	1	Morton
‡5·931	Seminar in Phys. Chem.	——	G	1	(Elective)	1	—	1	Scatchard
‡5·932	Seminar in Phys. Chem.	——	G	2	(Elective)	1	—	1	Scatchard
	Research	——	G(A)	1 or 2	(Elective)		★		Huntress
	Inorganic Chemistry								Schumb
	Organic Chemistry								Morton
	Physical Chemistry								Scatchard
	Thesis	——	4	1	V	0	15	0	Hamilton
	Thesis	——	4	2	V	0	16	0	Hamilton

ELECTRICAL ENGINEERING — 6·00–6·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
6·00	Elec. Eng. Prin.	*M22*, 8·03	2	2	VI, VIII	4	—	6	Frazier
6·01	Elec. Eng. Prin.	6·00	3	1	VI	5	—	7	Frazier
6·02	Elec. Eng. Prin.	6·01	3	2	VI	5	—	7	Gray
			G	1	II (T.E.)				
6·03	Elec. Eng. Prin.	6·02	4	1	VI_1	6	—	8	Lyon
6·031	Elec. Eng. Prin.	6·02	4	1	$VI_{3,4}$	3	—	4	Lyon

★ Time specially arranged. ‡ Not offered November 1944–June 1945.

Electrical Engineering Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
6.04	Elec. Eng. Prin.	6.03	4(B)	2	VI$_1$	4	—	6	Dwight
6.11	Elec. Eng. Prin.	6.00	3	1	VIII	4	—	6	Gray, Kingsley
6.16	Electricity	8.04	4	2	IV	2	—	4	Dawes
6.17	Illumination	8.04	4	2	IV	2	—	4	Moon
6.18	Elec. Eng., Fund.	8.04	3	1	II	3	1	6	Fitzgerald
6.19	Elec. Eng., Fund.	6.18, 6.40 or 6.41	3	2	XV$_1$	3	1	6	Fitzgerald
			4	1	II				
6.20	Electronic Cont. & Meas.	6.02	4(B)	1	VI$_4$	3	—	6	Gray
6.211	App. Elec. in Industry	6.02	4(B)	1	(Elective)	3	—	6	Dawes
6.212	App. Elec. in Industry	6.03	4(B)	2	(Elective)	3	—	6	Dawes
6.221	Elec. Power Generation	2.42	4(B)	1	(Elective)	3	—	6	Mulligan
6.222	Elec. Power Generation	6.03	4(B)	2	(Elective)	3	—	6	Mulligan
6.23	Electrical Implementation	6.02	4(B)	2	VI$_4$	3	—	6	Frazier
6.251	Elec. Mach. Design	*6.03*	4(B)	1	(Elective)	3	—	6	Dwight
6.252	Elec. Mach. Design	6.03	4(B)	2	(Elective)	3	—	6	Dwight
‡6.26	Elec. Insulation	8.04	4(B)	1	(Elective)	3	—	6	von Hippel
6.27	Illum. Eng. Prin.	8.04	4	2	(Elective)	2	3	4	Moon
6.281	Wire Com., Prin.	6.02	4(B)	1	(Elective)	3	—	6	C. E. Tucker
‡6.282	Radio Com., Prin.	6.02	4(B)	2	(Elective)	3	—	6	Barrow
6.294	Radio Engineering	——	G(B)	2	(Elective)	3	4	6	Radford
6.30	Elec. Com. Prin.	*6.02*	3	2	VI$_3$	4	—	6	Guillemin
6.311	Elec. Com. Prin.	6.02	4(B)	1	VI$_3$	3	—	5	Radford
6.312	Elec. Com. Prin.	6.311	4(B)	2	(Elective)	3	—	6	Arguimbau
6.32	Elec. Com. Prin.	6.30, 6.02	4(B)	2	VI$_3$	4	—	8	Guillemin
6.331	Elec. Com. Lab.	6.02, *6.311*	4	1	VI$_3$	0	3	3	Radford
6.332	Elec. Com. Lab.	6.331	4	2	VI$_3$	0	4	4	Radford
6.34	Elec. Com. Lab.	——	4(B)	1 or 2	(Elective)		★		Radford
6.40	Elec. Eng., Elem.	*8.04*	3	1	XV$_1$, XVI, XVII$_1$	4	—	6	Hudson
			3	2	IX-B				
			4	1	III$_1$, X, XIII, XIII-C, XV$_2$				
6.41	Elec. Eng., Fund.	8.04	3	1	I	3	—	5	Fitzgerald
6.43	Electrical Eng.	——	4	1	XIII-A	3	—	5	Kingsley
6.44	Electrical Eng.	6.43	4	2	XIII-A	3	1	4	Kingsley
6.45	Electrical Eng.	6.44	G	1	XIII-A	3	1	4	Kingsley
6.46	Electrical Eng.	6.45	G	2	XIII-A	3	1	4	Kingsley
6.47	App. Elec. in Industry	6.18, 6.40 or 6.41	3	2	I	2	2	4	Tucker, Dawes
‡6.48	Elec. Equip. Bldgs.	8.04	4	2	(Elective)	1	—	2	Hudson
‡6.49	Instrument Electricity	8.04, M22	4(B)	2	(Elective) (Not open to VI)	3	3	8	Gray
			G	1	II (T.E.)				
6.501	Elec. Eng. Seminar	6.04 or 6.32	G(A)	1	VI	2	—	10	M. F. Gardner
6.502	Elec. Eng. Seminar	6.501	G(A)	2	VI	2	—	2	M. F. Gardner
6.511	Elec. Power Circuits	6.04	G(A)	1	(Elective)	3	—	7	Wildes
‡6.512	Elec. Power Circuits	6.04	G(A)	2	(Elective)	3	—	7	Wildes
6.515	Power Systems Lab.	*6.511, 6.516, 6.651* or *6.652*	G(A)	1 or 2	(Elective)		★		Fitzgerald
6.516	Power System Analysis	6.04	G(A)	2	(Elective)	3	2	5	Fitzgerald
6.521	Alt. Cur. Machinery, Adv.	6.04, M31	G(A)	1	(Elective)	3	—	7	Lyon
6.522	Alt. Cur. Machinery, Adv.	6.04, M31	G(A)	2	(Elective)	3	—	7	Lyon
‡6.531	Power System Economics	6.04, Ec12	G(A)	1	(Elective)	3	—	7	Balsbaugh
‡6.532	Power System Economics	6.04, Ec12	G(A)	2	(Elective)	3	—	7	Balsbaugh
‡6.541	Electric Power Gen.	6.03, Ec12	G(A)	1	(Elective)	3	—	6	Mulligan
‡6.542	Electric Power Gen.	6.03, Ec12	G(A)	2	(Elective)	3	—	6	Mulligan
‡6.551	Railroad Elec. Trac.	6.03, Ec12	G(A)	1	(Elective)	3	—	6	Balsbaugh
‡6.552	Railroad Elec. Trac.	6.551	G(A)	2	(Elective)	3	—	6	Balsbaugh
6.561	Network Theory, Adv.	6.32	G(A)	1	(Elective)	3	—	7	Guillemin
6.562	Network Theory, Adv.	6.561	G(A)	2	(Elective)	3	—	7	Guillemin
‡6.571	Illum. Eng., Prin.	8.04, M22	G(A)	1	(Elective)	2	3	4	Moon
‡6.572	Illum. Eng., Prin.	6.571	G(A)	2	(Elective)	2	3	4	Moon
6.58	Trans. in Linear Systems	6.04 or 6.32, M31	G(A)	1 or 2	(Elective)	3	—	7	M. F. Gardner
6.585	App. of Int. Equa. in Elec. Eng.	M22, 6.03	G(A)	1	(Elective)	3	—	6	Moon

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Electrical Engineering Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
6·586	Eng. App. of Field Theory	M22	G(A)	2	(Elective)	3	—	6	Moon
6·59	Communications Lab.	6·332 or 6·333	G(A)	1 or 2	(Elective)		★		Radford
6·60	Math. Anal. by Mech. Meth.	M22	G(A)	1	(Elective)	2	—	4	S. H. Caldwell
6·601	Mechanized Math. Lab.	6·60	G(A)	1	(Elective)	0	2	2	S. H. Caldwell
6·605	Servomechanisms	M22, 5·04	G(A) G	1 1	(Elective) II (T.E.)	3	—	6	G. S. Brown
6·606	Servomechanisms	6·605	G(A)	2	(Elective)	3	3	6	G. S. Brown
6·607	Servomechanisms Lab.	6·605	G(A)	2	(Elective)	0	12	0	G. S. Brown
‡6·61	Gen. & Util. of Super Voltages	6·04	G(A)	2	(Elective)	3	—	6	Trump
‡6·62	Elec. Com., Prin.	6·32	G(A)	2	(Elective)	2	3	5	Bowles
‡6·621	Radio Lines, Ant. & Prop.	6·32	G(A)	1	(Elective)	3	—	6	Guillemin
‡6·622	Radio Lines, Ant. & Prop.	6·621	G(A)	2	(Elective)	3	—	6	Guillemin
‡6·627	Patents & Rel. to Sci. & Eng.	——	G(A)	1	(Elective)	2	—	4	Bowles
‡6·628	Patent Background of Elec. Com. in U. S.	6·627	G(A)	2	(Elective)	2	—	4	Bowles
6·631	Engineering Electronics	6·03	G(A)	1	(Elective)	3	—	7	Gray
6·632	Engineering Electronics	6·631	G(A)	2	(Elective)	2	3	5	Gray
‡6·64	App. of Atomic Phys. in Elec. Eng.	6·26	G(A)	2	(Elective)	3	—	6	von Hippel
6·651	Elec. Power Distribution	6·04	G(A)	1	(Elective)	3	—	6	Balsbaugh
6·652	Elec. Power Distribution	6·04	G(A)	2	(Elective)	3	—	6	Balsbaugh
6·661	Elec. Mach. Dev., Prin.	6·03	G(A)	1	(Elective)	3	1	6	Dwight
6·662	Elec. Mach. Dev., Prin.	6·03	G(A)	2	(Elective)	3	1	6	Dwight
‡6·671	Vibrations	M31; or M22 and 2·082	G(A)	1	(Elective)	3	1	6	Woodruff
‡6·672	Vibrations	6·671	G(A)	2	(Elective)	3	1	6	Woodruff
6·68	Sp. Prob. in Elec. Eng.	——	G(A)	1 or 2	(Elective)		★		Hazen, Gardner
6·681	Spec. Prob. in Fire Control	6·605, 6·606	G(A)	1	(Elective)	0	8	0	Hazen, Brown
‡6·69	Sound in Elec. Com.	M31, 6·04 or 6·32 or 8·05	G(A)	2	(Elective)	2	3	5	Fay
6·73	Elec. Meas. Lab., Adv.	6·76, 6·02	G(A)	1 or 2	(Elective)		★		Gray
6·74	Elec. Eng. Lab., Adv.	6·04, 6·79	G(A)	1 or 2	(Elective)		★		C. E. Tucker
6·75	Elec. Eng. Lab.	6·00	3	1	VI	1	3	5	Gray
6·76	Elec. Eng. Lab.	6·75, *6·02*	3 G	2 1	VI II (T.E.)	1	2	4	Gray
6·77	Elec. Eng. Lab.	6·01	3	2	VI	2	2	4	C. E. Tucker
6·78	Elec. Eng. Lab.	6·77, *6·03*	4	1	VI$_1$	1	2	4	C. E. Tucker
6·781	Elec. Eng. Lab.	6·77, *6·031*	4	1	VI$_{3, 4}$	1	2	3	C. E. Tucker
6·79	Elec. Eng. Lab.	6·78, *6·04*	4	2	VI$_1$	1	3	5	C. E. Tucker
6·80	Elec. Eng. Lab.	6·00 or 6·40	4(B)	1 or 2	(Elective)		★		Tucker, Gray
6·81	Elec. Eng. Lab.	*6·40*	4	2	III$_1$	1	1	2	Gray
6·82	Elec. Eng. Lab.	*6·11*	3	1	VIII	0	2	3	C. E. Tucker
6·83	Electronic Eng. Lab.	6·76	4	1	VI$_4$	1	2	4	Gray
6·84	Elec. Implement. Lab.	6·76	4	2	VI$_4$	1	2	6	Gray, Frazier
6·85	Elec. Eng. Lab.	*6·40*	4	1	IX-B, X	0	2	3	C E. Tucker
6·89	Elec. Eng. Lab.	*6·40*	3 3 4 4	1 2 1 2	XVII$_1$ XVI XIII-C XIII	0	2	2	C. E. Tucker
6·901 – 6·904	Manufac. Prac.	——	—	—	VI-A	40 h.p.w.			Timbie
6.911 – 6·914	Pub. Util. Prac.	——	—	—	VI-A	40 h.p.w.			Timbie
6·951 – 6·954	Electronic App. Mfg. Prac.	——	—	—	VI-A	40 h.p.w.			Timbie

BIOLOGY AND BIOLOGICAL ENGINEERING — 7·00–7·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
7·03	Genetics	7·06	4(B)	1	VII$_1$, VII-A	2	—	4	Blake
7·05	Biology I	——	2 3	1 1	VII$_{1, 2}$, VII-A IX-A	2	6	2	Jennison
7·06	Biology II	7·05	2	2	VII$_{1, 2}$, VII-A	2	6	2	Sizer
7·11	Embryology	7·06	3	1	VII$_1$, VII-A	3	6	3	Waugh

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Biology and Biological Engineering Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
7·12	Cytology, General	7·11, 7·14, 7·19	G(A)	2	(Elective)	2	4	2	Waugh
7·14	Comparative Anatomy	7·06	3	1	VII, VII-A	3	6	3	Blake
‡7·17	Biol. Food Supplies	7·06	2	2	VII$_2$	3	—	2	Blake, Proctor
‡7·18	Tech. Aspects of Entom.	7·06	G(A)	1	(Elective)	2	—	3	Blake
7·19	Physiology, General	7·11, 7·14	3	2	VII, VII-A	3	—	3	Schmitt
7·21	Physiology Lab., General	——	3	2	VII, VII-A	0	4	2	Sizer
‡7·22	Personal Hyg. & Nut.	7·19	4(B)	2	VII$_2$	2	—	2	R. S. Harris
7·23	Nutrition, Applied	7·22	G(A)	2	(Elective)	2	1	4	R. S. Harris
7·24	Nutrition, Adv.	7·19, 7·22, 7·80	G(A)	2	(Elective)	3	4	2	R. S. Harris
7·301	Bacteriology	7·05	3	1	VII$_2$	2	4	4	Horwood
7·302	Bacteriology	7·301	3(B) 4	2 2	VII$_2$ (Elective)	2	4	3	Horwood
7·31	Biology of Bacteria	7·05	3	2	VII$_1$, VII-A	3	4	3	Jennison
7·321	Bacteriology, Adv.	7·301 or 7·31, 7·80	G(A)	1	(Elective)	3	—	4	Jennison
7·322	Bacteriology, Adv.	7·321	G(A)	2	(Elective)	1	4	2	Jennison
‡7·361	Indust. Microbiology	7·302	4	1	VII$_2$	1	4	2	Sluder
‡7·362	Indust. Microbiology	7·361	4(B)	2	VII$_2$	1	3	4	Dunn, Proctor
‡7·371	Indust. Microbiology, Adv.	7·362	G(A)	1	(Elective)	1	4	4	Dunn, Proctor
‡7·372	Indust. Microbiology, Adv.	7·371	G(A)	2	(Elective)	1	3	4	Dunn, Proctor
‡7·39	Bacteriology of Foods	7·302, 7·80	G(A)	2	(Elective)	1	3	2	Proctor
7·41	Chemistry of Water	5·12	3	1	(Elective)	1	3	1	Jennison
7·44	Surface Chem. in Biol.	7·11, 7·19, 5·41, 5·61	G(A)	2	(Elective)	2	4	2	Waugh
‡7·52	Industrial Hygiene	——	4(B)	2	VII$_2$	3	2	3	Gould
7·56	Prin. of Sanitation	7·301	3, 4(B)	2	(Elective)	2	—	5	Horwood
7·591	Public Health Eng.	7·56	G(A)	1	(Elective)	4	7	7	Horwood
7·592	Public Health Eng.	7·591	G(A)	2	(Elective)	6	4	6	Horwood
‡7·701	Tech. & Chem. of Food Supplies	5·41, *7·301*	3	1	VII$_2$	3	4	4	Proctor
‡7·702	Tech. & Chem. of Food Supplies	*7·302*	3	2	VII$_2$	3	2	3	Proctor
‡7·711	Tech. of Food Products	7·702	4(B)	1	VII$_2$	3	3	4	Proctor
‡7·712	Tech. of Food Products	7·711	4(B)	2	VII$_2$	3	3	3	Proctor
‡7·721	Food Technology, Adv.	7·712	G(A)	1	(Elective)	1	3	2	Proctor
‡7·722	Food Technology, Adv.	7·721	G(A)	2	(Elective)	1	3	2	Proctor
7·80	Biochemistry	5·41, 7·19	4(B)	1	VII, VII-A	3	5	5	Gould
7·81	Enzymology	7·80	4(A) G	1 1	VII-A (Elective)	2	4	3	Sizer
7·82	Biochemistry, Adv.	7·80	G(A)	2	(Elective)	2	4	3	Gould
7·831	Chem. of Microörganisms	7·301, 7·361, 5·428	G(A)	1	(Elective)	0	5	1	Gould
7·832	Chem. of Microörganisms	7·831	G(A)	2	(Elective)	0	5	1	Gould
7·85	Biophysics I	7·19, 5·41, 8·04	G(A)	1	VII-A	2	—	2	Bear
7·86	Biophysics II	7·19, 5·41, 8·04	G(A)	2	VII-A	2	—	2	Bear
‡7·87	Spectroscopy of Biol. Materials	7·92	G(A)	1	(Elective)	2	—	2	Loofbourow
‡7·871	Spectroscopy of Biol. Mat. Lab.	7·19, 5·41, 8·04	G(A)	1	(Elective)	0	4	0	Loofbourow
7·881	Biophysics Lab. I	7·19, 5·41, 8·04	G(A)	1	VII-A	0	4	1	Bear
7·882	Biophysics Lab. II	7·19, 5·41, 8·04	G(A)	2	VII-A	0	4	1	Bear
7·91	Biological Engineering I	——	4(B)	1	VII-A	2	4	3	Lion
7·92	Biological Engineering II	——	4(B)	2	VII-A	2	4	3	Lion
7·93	Selected Topics in Biol.	——	G(A)	1, 2	(Elective)		★		Staff
7·941	Research Problems	——	G(A)	1	(Elective)		★		Schmitt
7·942	Research Problems	——	G(A)	2	(Elective)		★		Schmitt

PHYSICS — 8·00–8·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
8·01	Physics (Mechanics)	——	1	1	All Courses	4	1	5	Sears
8·012	Physics (College Transfer)	M11	1	1	——	5	—	6	Goodman
8·02	Physics (Mech. and Heat)	8·01	1	2	All Courses	4	1	5	Sears
8·03	Physics (Electricity)	8·01, M12	2	1	All Courses except IV-B	4	1	5	Page, R. D. Evans
8·034	Physics (College Transfer)	M11	2	2	——	5	—	6	Goodman

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Physics Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
8·04	Physics (Elec. Optics & Modern Physics)	8·03	2	2	All Courses except IV-B	4	2	4	Page, R. D. Evans
8·05	Vibrations and Sound	8·04, M22	4(B)	1	VI$_3$	3	—	6	C. M. Harris
8·051	Sp. Problems in Acoustics	8·05	G(A)	1 or 2	(Elective)		★		P. M. Morse
8·052	Experimental Acoustics	8·05	4(B)	1	(Elective)	0	3	4	C. M. Harris
‡8·053	Acoustics	8·02	4	1	IV	3	2	3	
8·061	Intermediate Physics (Thermodynamics & Kinetic Theory)	8·04	3	1	VI$_3$, $_4$, VIII	3	—	4	Sears
8·062	Intermediate Physics (Electronics)	8·04	3	2	VI$_3$, $_4$, VIII	3	—	4	Sears
8·09	Physical Measurements	8·04	3	1	VIII	0	3	2	Stockbarger
8·11	Experimental Physics	8·202, 8·312	4(B)	1	VIII	2	6	4	Mueller
8·15	Photography	8·04	3	2	(Elective)	2	—	1	Hardy
8·152	Photography, Adv.	*8·15* or 8·161	–	2	(Elective)	0	3	2	Hardy
8·161	Optics	8·04	3	1	VIII	3	—	6	Hardy
8·162	Optical Measurements	*8·161*	3	1	VIII	0	3	2	Hardy
8·173	Color Measurements	8·04	4(B)	2	(Elective)	0	3	2	Hardy
‡8·174	Motion Picture Photography	8·161	4(B)	1	(Elective)	1	—	3	Hardy
‡8·181	Optics Seminar	8·161	G(A)	1	(Elective)	2	—	2	Hardy
‡8·182	Optics Seminar	8·161	G(A)	2	(Elective)	2	—	2	Hardy
8·183	Sp. Problems in Optics	8·161	G(A)	1 or 2	(Elective)		★		Hardy
‡8·191	Microscopy and Photomicrography	——	4	2	(Elective)	2	—	0	Hardy
‡8·194	Physical Optics, Adv.	8·161	G(A)	2	(Elective)	1	2	2	Hardy
8·202	Electronics Lab.	8·061	3	2	VIII	0	3	2	Nottingham
8·21	Electronic Phen.	8·061, *8·212*, 8·511	G(A)	2	(Elective)	2	—	4	Nottingham
8·212	Experimental Electronics	8·061, *8·21* or *8·213*	G(A)	2	(Elective)	1	3	3	Nottingham
‡8·213	Electronics, Advanced	M22, 8·061, 8·511 or 8·21	G(A)	1	(Elective)	1	—	3	Nottingham
‡8·214	Electronics, Advanced	8·21	G(A)	2	(Elective)	1	—	3	Nottingham
8·215	Sp. Prob. in Electronics	8·061	G(A)	1 or 2	(Elective)		★		Nottingham
‡8·26	Molecular Structure	8·311	G(A)	1	(Elective)	3	—	6	Mueller
8·27	X-rays & Crys. Phys.	8·04, M22	4(B)	1	(Elective)	3	1	5	Warren
‡8·271	Physics of X-rays, Adv.	8·27	G(A)	2	(Elective)	2	—	4	Harvey
‡8·28	X-ray Diffraction	8·27	G(A)	2	(Elective)	2	—	4	Warren
8·29	Quantum Th. of the Solid State	8·11, 8·463	G(A)	2	(Elective)	3	—	6	Slater
8·30	Sp. Prob. in Crys. Phys.	8·27	G(A)	2	(Elective)		★		Warren
8·311	Atomic Structure	8·04	3 4	2 2	VIII VII-A	3	—	5	Livingston
8·312	Atomic Struct. Lab.	8·09, *8·311*	3 4	2 2	VIII VII-A	0	3	2	Stockbarger
8·32	Line Spectra	8·311	G(A)	2	(Elective)	3	—	6	McNally
‡8·341	Spectroscopy Sem.	8·32	G(A)	1	(Elective)	1	—	1	Harrison
‡8·342	Spectroscopy Sem.	8·32	G(A)	2	(Elective)	1	—	1	Harrison
8·343	Sp. Prob. in Spectros.	8·32	G(A)	1 or 2	(Elective)		★		Harrison
8·411	Nuclear Physics	8·311	4(B)	1	(Elective)	2	3	4	R. D. Evans
8·412	Nuclear Physics	8·411	4(B)	2	(Elective)	2	3	4	R. D. Evans
‡8·42	Sem. in Nuclear Phys.	8·411	G(A)	2	(Elective)	1	—	2	Van de Graaff
‡8·43	Th. of Nuclear Struct.	8·411, *8·521*	G(A)	2	(Elective)	2	—	6	Frank
8·44	Applied Radiochemistry	5·12, 8·411, *8·412*	G(A)	2	(Elective)	2	3	3	Irvine
8·441	Sp. Prob. in Nuclear Res.	8·311, 8·411	G(A)	1	(Elective)		★		R. D. Evans
8·442	Sp. Prob. in Nuclear Res.	8·441, 8·412	G(A)	2	(Elective)		★		R. D. Evans
8·461	Int. to Th. Physics I	8·04, M22	4(B) G	1 1	VIII (Elective)	4	—	8	Feshbach
8·462	Int. to Th. Physics II	8·461	4(B)	2	VIII	4	—	8	Feshbach
8·463	Int. to Th. Physics III	8·311, 8·461	G(A)	1	(Elective)	3	—	9	Tisza
‡8·481	Adv. Mechanics I	8·462 or 8·471	G(A)	1	(Elective)	3	—	9	Stratton
‡8·482	Adv. Mechanics II	8·481	G(A)	2	(Elective)	3	—	9	Stratton
8·491	Meth. of Theoret. Phys.	8·462	G(A)	1	(Elective)	3	—	9	Feshbach
‡8·511	Thermodynamics and Statistical Mech.	8·02, M22	3	1	(Elective)	3	—	4	Tisza

★ Time specially arranged. ‡ Not offered November 1944–June 1945.

Physics Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
8·512	Statistical Mechanics	8·511	G(A)	2	(Elective)	3	—	9	Tisza
8·521	Quantum Mechanics	8·463	G(A)	2	(Elective)	3	—	9	Feshbach
8·54	Electromag. Theory	M77	4(B)	1	(Elective)	3	—	6	Harvey
8·56	Electromag. Wave Theory	8·491	G(A)	2	(Elective)	3	—	9	Harvey
‡8·57	Cosmic Rays High Energy Phenomena	8·463	G(A)	1	(Elective)	2	—	6	Vallarta
‡8·58	Th. of Relativity	8·462	G(A)	2	(Elective)	3	—	9	Vallarta
‡8·591	Theoret. Seminar	——	G(A)	1	(Elective)	1	—	1	Morse
‡8·592	Theoret. Seminar	——	G(A)	2	(Elective)	1	—	1	Morse
8·60	Sp. Prob. Theoret. Phys.	——	G(A)	1 or 2	(Elective)		★		Slater

CHEMICAL ENGINEERING — 10·00–10·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
10·15	Thesis Reports	10·26	4	2	X	2	—	2	Meissner
10·17	Industrial Chemistry	5·41, 5·61	3	2	X, XV_2	3	—	2	Meissner
10·18	Industrial Chemistry	10·17, 5·62	4	1	X, XV_2	4	—	6	Meissner
10·203	Industrial Chemistry	*5·42, 5·62*	4	1	V	3	—	4	Meissner
10·21	Industrial Chemistry	10·201, or 10·203, or 10·18	4(B)	2	V, X, XV_2	2	—	2	W. K. Lewis
10·25	Industrial Chemistry	5·42, 5·62	G(A)	1	(Elective)	5	—	7	W. K. Lewis
10·26	Industrial Chem. Lab.	*10·18*	4(B)	1	X	2	3	1	W. K. Lewis
‡10·27	Industrial Chem. Lab.	10·18	G(A)	1	(Elective)	2	6	0	W. K. Lewis
10·28	Chemical Eng.	*5·61*	3	1	X, XV_2	4	—	6	Stokes
10·29	Chemical Eng.	10·28	3(B)	2	X, XV_2	4	—	5	Stokes
‡10·30	Eng. Equipment	*10·32*	4	2	(Elective)	4	—	1	Vivian
10·31	Chemical Eng.	10·17, 10·29	4(B)	1	VII_2, X, XV_2	4	—	5	McAdams
10·311	Heat Transfer	——	4(B)	1	XIII-A	3	—	3	McAdams
			G	1	II (T.E.)				
10·32	Chemical Eng.	*10·31*	4(B)	2	X, XV_2	4	—	5	McAdams
10·33	Anal. Treat. of Chem. Eng. Processes	M22, 5·62	G(A)	1	(Elective)	3	—	6	Sherwood
10·40	Chem. Eng. Thermodyn.	5·62, 10·29	G(A)	1	(Elective)	4	—	8	Meissner
10·41	Distillation	10·32	G(A)	2	(Elective)	3	—	5	G. C. Williams
10·45	Distil. & Absorption	10·32	G(A)	1	(Elective)	4	—	8	G. C. Williams
10·46	Absorption & Extraction	10·32	G(A)	2	(Elective)	3	—	6	Sherwood
10·50	Heat Transmission	10·31	G(A)	2	(Elective)	2	—	4	McAdams
10·52	Chemical Eng. II	10·32	G(A)	1	(Elective)	4	—	5	McAdams
‡10·53	Chem. Eng. Design	10·81, 10·82, 10·83	G(A)	1	X-A	3	—	9	Vivian
10·54	Econ. Balance in Chem. Ind.	10·32	G(A)	1	(Elective)	5	—	7	G. C. Williams
10·55	Economic Balance	10·32	G(A)	2	(Elective)	3	—	6	Sherwood
10·61	Materials of Chem. Ind.	——	G	1	(Elective)	2	—	2	W. K. Lewis
10·62	App. Chem. Thermodyn.	5·62, 10·29	G(A)	2	(Elective)	3	—	6	Meissner
10·63	Industrial Chemistry II	10·661 or 10·663	G(A)	2	(Elective)	3	—	6	W. K. Lewis
10·65	Catal. & High Pres. Proc.	5·62, 10·29	G(A)	2	(Elective)	3	—	6	Meissner
10·661	Colloid Chem., Int.	5·42, 5·62	G(A)	1	VII-A	2	—	4	Hauser
10·662	Colloid Chemistry	10·661	G(A)	2	VII-A	2	—	4	Hauser
10·663	Applied Colloid Chem., Int.	5·42, 5·62	G(A)	2	(Elective)	2	—	4	Hauser
			3	2	VII_2				
10·673	Colloid Chem. Lab.	10·63 or *10·661*	G(A)	1, 2	(Elective)	0	3	3	Hauser
10·674	Colloid Chem. Lab.	10·673	G(A)	1, 2	(Elective)	0	3	3	Hauser
10·68	Corrosion	5·62	G(A)	1	(Elective)	2	—	4	W. K. Lewis
10·69	Plastics and Other High Polymeric Substances	——	G(A)	1	(Elective)	2	—	4	Hauser
10·691	Sp. Industrial Chem.	5·41, 5·61	G(B)	1	(Elective)	3	—	4	Hauser
10·692	Sp. Industrial Chem.	10·691	G(B)	2	(Elective)	3	—	4	Hauser
10·70	Combustion, Prin.	Gen. Inorg. Chem.	G(A)	1	(Elective)	4	—	6	Hottel
10·71	Fuel Engineering	10·70	G(A)	2	(Elective)	3	—	6	Hottel
10·74	Furnace Design	10·31	G(A)	1 or 2	(Elective)	3	—	6	Hottel
10·76	Sem. Rad. Heat Trans.	10·31	G(A)	2	(Elective)	2	—	4	Hottel
10·79	Automotive Fuels	5·42, 5·62, 2·42 or 10·29	G(A)	1	(Elective)	2	—	4	Hottel
10·90	Exp. Research Problem	5·42, 5·62	G(A)	1, 2	(Elective)		★		Stokes
10·911	Research Conf.	5·42, 5·62	G(A)	1	(Elective)	1	—	2	McAdams

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Chemical Engineering Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
10·912	Research Conf.	10·911	G(A)	2	(Elective)	1	—	2	McAdams
10·991	Seminar Chem. Eng.	10·32	G(A)	1	(Elective)	2	—	4	G. C. Williams
10·992	Seminar Chem. Eng.	10·32	G(A)	2	(Elective)	2	—	4	G. C. Williams

GEOLOGY — 12·00–12·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
12·011	Mineralogy	5·02	2 3	1 1	III IX-A	1	5	1	Buerger
‡12·03	Theoretical Mineralogy	12·011	4(B)	2	(Elective)	2	—	2	Buerger
‡12·05	Mineral. Seminar	12·03, 12·15	G(A)	1	(Elective)	2	—	4	Buerger
‡12·06	Mineral. Research	——	G(A)	1	(Elective)		★		Buerger
‡12·15	Petrography	12·211	3	2	(Elective)	2	4	2	Fairbairn
‡12·161	Comp. Petrology Seminar	12·15	G(A)	1	(Elective)	2	—	4	Fairbairn
‡12·162	Comp. Petrology Seminar	12·15	G(A)	2	(Elective)	2	—	4	Fairbairn
‡12·17	Petrography, Adv.	12·15	G(A)	1	(Elective)	0	4	0	Fairbairn
‡12·18	Struct. Petrol. Seminar	12·15	G(A)	2	(Elective)	2	—	4	Fairbairn
‡12·211	Optical Crystallog.	8·02	3	1	(Elective)	2	3	2	Buerger
‡12·26	X-ray Crystallog.	12·03	G(A)	2	(Elective)	2	—	4	Buerger
‡12·301	General Geology	——	2	1	(Elective)	3	4	2	Shrock
‡12·302	General Geology	12·301	2	2	(Elective)	3	4	2	Shrock
12·321	Eng. Geology	——	2 3	1 1	IV-B I, IX-A	3	2	2	Mead
‡12·322	Eng. Geology	12·321	G(B)	2	(Elective)	3	—	3	Mead
‡12·38	Geomorphology	12·301	4(B)	2	(Elective)	3	—	6	Morris
‡12·39	Geomorphology, Adv.	——	G(A)	2	(Elective)	3	—	6	Morris
‡12·40	Economic Geology	12·011, 12·301 12·302	4	2	III_2	3	—	6	Newhouse
‡12·41	Econ. Geology Lab.	12·40	4(B)	1	(Elective)	0	6	0	Newhouse
‡12·42	App. Econ. Geology	12·40	4(B)	2	(Elective)	3	—	6	Newhouse, Mead
‡12·431	Econ. Geol. Lab., Adv.	12·41	G(A)	1	(Elective)	0	4	1	Newhouse
‡12·432	Econ. Geol. Lab., Adv.	12·41	G(A)	2	(Elective)	0	4	1	Newhouse
‡12·433	Econ. Geol. Sem., Adv.	12·40	G(A)	1	(Elective)	2	—	6	Newhouse
‡12·434	Econ. Geol. Sem., Adv.	12·40	G(A)	2	(Elective)	2	—	6	Newhouse
‡12·44	Econ. Geol. of Fuels	G9	4(B)	2	(Elective)	3	—	3	Whitehead
‡12·511	Paleontology	12·301 or G9	3	1	(Elective)	1	2	4	Shrock
‡12·512	Paleontology	12·511	3	2	(Elective)	1	3	5	Shrock
‡12·52	Paleontology, Adv.	12·512	G(A)	1 or 2	(Elective)	1	3	3	Shrock
‡12·53	Index Fossils	12·511	G(A)	2	(Elective)	2	4	2	
‡12·54	Micropaleontology	12·512	G(A)	1	(Elective)	1	3	2	
‡12·55	Org. Evolution, Adv.	G10	G(A)	1 or 2	(Elective)	2	1	3	
‡12·581	Sedimentation	12·301	4(B)	2	(Elective)	2	3	2	Shrock
‡12·582	Sedimentation	12·581	G(A)	2	(Elective)	2	3	2	Shrock
‡12·60	Glacial Geology	12·302	4(B)	2	(Elective)	2	3	6	Morris
‡12·63	Physical Geol. Sem.	——	G(A)	1	(Elective)	2	—	5	Mead
‡12·64	Geology of N. America	12·302	G(A)	1	(Elective)	2	—	5	
12·66	Research	——	4(B)	1 or 2	(Elective)		★		Staff
‡12·671	Prob. in Geol. Seminar	12·302	G(A)	1	(Elective)	1	—	3	Morris and
‡12·672	Prob. in Geol. Seminar	12·302	G(A)	2	(Elective)	1	—	3	Staff
‡12·701	Structural Geology	12·301, or 12·321	3(B)	1	(Elective)	3	—	2	Mead
‡12·702	Structural Geology	12·701	3(B)	2	(Elective)	3	—	2	Mead and Staff
‡12·71	Structural Geology, Adv.	12·70	G(A)	2	(Elective)	3	—	6	Mead
‡12·80	Geology Coal & Petrol.	12·302 or G9	3(B)	2	(Elective)	4	—	3	Whitehead
‡12·81	Geology of Petrol., Adv.	12·80	G(A)	2	(Elective)	3	—	6	Whitehead
‡12·851	Th. Geophysics, Adv.	8·461	G(A)	1	(Elective)	3	—	6	Slichter
‡12·852	Th. Geophysics, Adv.	8·461	G(A)	2	(Elective)	3	—	6	Slichter
‡12·86	Seismology, Elem.	——	4(B)	2	(Elective)	2	—	2	Slichter
‡12·87	Intro. Geophysical Prospecting	——	4(B)	1	(Elective)	2	—	2	Slichter
‡12·91	Elements of Mining	——	4(B)	1	III_2	3	—	5	Parks
‡12·92	Mining Meth. & Practice	12·91	4(B)	2	(Elective)	3	—	6	Parks
‡12·94	Mineral Economics	——	4(B)	1	(Elective)	2	—	4	Parks
‡12·95	Mine Valuation	12·92	G(A)	2	(Elective)	3	—	8	Parks
‡12·96	Mineral Economics Seminar	——	G(A)	2	(Elective)		★		Parks

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NAVAL ARCHITECTURE AND MARINE ENGINEERING — 13·00–13·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
13·01	Naval Architecture	M21, 8·01	3(B)	1	XIII, XIII-A, XIII-C	3	—	5	Manning
13·02	Naval Architecture	13·01	3(B)	2	XIII, XIII-A	3	—	5	Manning
‡13·021	Naval Architecture	13·01	3	2	XIII-C	2	—	3	Chapman
‡13·03	Naval Arch. & Ship Des.	13·02, 13·45	G(A)	1	(Elective)		★		Keith
‡13·04	Naval Arch. & Ship Des.	13·03	G(A)	2	(Elective)		★		Keith
13·12	Th. of Warship Des.	——	3(B)	2	XIII-A	2	—	5	Manning
13·13	Th. of Warship Des.	——	4(A)	1	XIII-A	4	—	8	Keith
13·15	Th. of Warship Des.	——	G(A)	1	XIII-A	3	—	5	Manning
13·16	Th. of Warship Des.	——	G(A)	2	XIII-A	3	—	6	Manning, Keith
13·21	Warship Design	——	3(B)	1	XIII-A	0	5	0	Keith
13·22	Warship Design	——	3(B)	2	XIII-A	0	5	0	Manning
13·24	Warship Design	——	4(A)	2	XIII-A	0	5	0	Manning
13·25	Warship Design	——	G(A)	1	XIII-A	0	7	0	Manning
13·26	Warship Design	——	G(A)	2	XIII-A	0	6	0	Manning
13·34	Ship Design	——	3	1	XIII, XIII-C	3	—	3	Manning
13·40	Elem. Ship Construction	——	2	2	XIII	2	3	2	Manning
13·41	Naval Arch. Drawing	——	3	1	XIII, XIII-C	0	4	0	Manning
13·43	Ship Design	13·34, 13·01	3	2	XIII	2	5	0	Manning
			4	2	XIII-C				
13·45	Ship Design	13·43	4(B)	1	XIII	2	8	1	Manning
13·46	Ship Design	13·45	4	2	(Elective)	0	6	0	Manning
13·52	Marine Engineering	2·40	3	2	XIII, XIII-C	4	—	4	Burtner, Chapman
13·54	Marine Engineering	2·06, 13·52	4(B)	1	XIII	2	—	3	F. M. Lewis
13·55	Marine Engineering	2·42, 13·52	4	2	XIII	2	—	3	Burtner
‡13·56	Marine Engineering	13·52	4	2	XIII-C	3	—	3	Chapman
13·61	Marine Eng. Design	2·04, 2·40, 13·52	4(B)	1	XIII	1	5	1	Burtner
13·62	Marine Eng. Design	13·61	4(B)	2	XIII	1	5	1	Burtner
13·73	Mechanical Vibration	2·06	G(A)	1	(Elective) XIII-A	3	—	6	F. M. Lewis
13·74	Mechanical Vibration	13·73	G(A)	2	(Elective)	3	—	6	F. M. Lewis
13·75	Naval Engineering	——	G(A)	1	(Elective)	3	2	8	Keith
			4	1	XIII-A				
13·76	Naval Engineering	——	G(A)	2	(Elective)	2	4	4	Keith
			4	2	XIII-A				
13·78	Propeller Th. & Exp. Research	——	G(A)	2	(Elective)	2	—	4	F. M. Lewis
13·79	Propeller Design	——	4(A)	1	XIII-A	1	1	2	F. M. Lewis
			G	1	II (T.E.)				
‡13·81	Ship Operation	13·021, 13·52, 13·83	4(B)	1	XIII-C	3	—	6	Chapman
‡13·82	Ship Operation	13·81	4(B)	2	XIII-C	3	—	6	Chapman
‡13·83	Port Facilities and Cargo Transfer	——	3	2	XIII-C	4	—	4	Chapman

METEOROLOGY — 14·00–14·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
14·11	Descriptive Meteorol. I	M12, 8·02	3,4(B)	1	(Elective)	3	—	6	Willett
14·12	Descriptive Meteorol. II	14·11, 14·51	3,4(B)	2	(Elective)	3	—	6	Willett
‡14·14	Long Range Weather Fore.	14·12, *14·42*, 14·52, 14·611, 14·613	G(A)	2	(Elective)	3	8	6	Willett
‡14·15	Long Range Forecasting, Elem.	14·12, *14·42*, *14·52*, 14·613	G(A)	1	(Elective)	4	—	2	Willett
14·32	Climatology	14·11	3, 4(B)	2	(Elective)	2	—	4	Haurwitz
14·41	Synoptic Meteorol. I	*14·11*	G(A)	1	(Elective)	3	—	6	Austin

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Meteorology Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
14.42	Synoptic Meteorol. II	14.41, 14.51, 14.611, 14.613	G(A)	2	(Elective)	4	—	8	Austin
14.50	Meteorol. Lab., Int.	*14.11*	3	1	(Elective)	0	6	0	Austin
14.51	Synoptic Lab. I	*14.11*	4(B)	1	(Elective)	0	15	0	Austin
14.52	Synoptic Lab. II	14.51	4(B)	2	(Elective)	0	20	0	Willett
14.53	Synoptic Lab. III	*14.41*, 14.51	G(A)	1	(Elective)	0	15	0	Austin
14.611	Thermodyn. of Atmos.	8.02, M22	G(A)	1	(Elective)	3	—	6	Houghton
14.613	Dynamic Meteorol. I	8.02, M22	G(A)	1	(Elective)	2	—	4	Haurwitz
14.62	Dynamic Meteorol. II	14.611, 14.613	G(A)	2	(Elective)	3	—	6	Haurwitz
14.64	Dynamic Meteorol. III	14.611, 14.613 *14.62*	G(A)	2	(Elective)	3	—	9	Haurwitz
14.71	Phys. of Atmos., Elem.	*14.11*	4(B)	1	(Elective)	2	—	4	Houghton
‡14.72	Physical Meteorology	8.04, 14.611, 14.613	G(A)	2	(Elective)	3	—	6	Houghton
14.81	Oceanography	*14.42, 14.62*	G(A)	2	(Elective)	2	—	4	Houghton
14.91	Meteorol. Seminar I	*14.611, 14.613*	G(A)	1	(Elective)	2	—	2	Houghton
14.911	Meteorol. Seminar I	*14.611, 14.613*	G(A)	1	(Elective)	1	—	1	Houghton
14.912	Meteorol. Seminar I	14.911	G(A)	2	(Elective)	1	—	1	Houghton
14.92	Meteorol. Seminar II	14.91, *14.62*	G(A)	2	(Elective)	2	—	2	Houghton
14.95	Sp. Prob. in Meteorol.	14.42, 14.62	G(A)	1 or 2	(Elective)		★		Staff

BUSINESS AND ENGINEERING ADMINISTRATION — 15.00-15.99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
15.11	Bus. Manage., Int.	Ec12T	3(B)	1	IV-B	3	—	3	Cunningham
			4	1, 2	(Elective)				
‡15.12	Bus. Manage., Int.	15.11	3(B)	2	IV-B	3	—	3	Cunningham
			4	2	(Elective)				
‡15.20	Ocean Ship. Admin.	——	4	2	(Elective)	2	—	4	Fernstrom
‡15.25	Indust. Traf. Manage.	15.70	G(A)	1	(Elective)	3	—	6	Fernstrom
15.30	Personnel Management	15.70	2	2	XV	3	—	6	Pigors
15.41	Finance	Ec12T, 15.50	4	1	XV	3	—	6	D. S. Tucker
15.42	Financial Problems	15.41	4(B)	2	(Elective)	3	—	6	D. S. Tucker
‡15.46	Fin. Adm. of Industry	15.41 or Ec47	G(A)	2	(Elective)	3	—	6	D. S. Tucker
15.50	Accounting	*Ec11T*	3	1	XV_1	5	—	4	Porter, Robnett
			3	2	XV_2				
15.51	Indust. Accounting	15.50	4(B)	2	(Elective)	5	—	4	Fiske
‡15.52	Accounting	——	2	2	XIII-C	4	—	2	Porter, Robnett
			3	2	$XVII_1$				
‡15.55	Prob. in Account. Policy	15.50	G(A)	1	(Elective)	3	—	6	Fiske
‡15.58	Problems in Accounting Control	15.51	G(A)	2	(Elective)	3	—	6	Robnett
15.61	Law of Contracts	*Ec12T*	3(B)	1	XV	3	—	6	Schaefer
			4	1	IV-B, XIII-C				
15.62	Law of the Market	Ec12T	4(B)	2	(Elective)	3	—	6	Schaefer
15.63	Industrial Law	15.61	4(B)	1	(Elective)	3	—	6	Schaefer
‡15.64	Law of Business Org.	Ec12T	4(B)	2	(Elective)	3	—	6	Schaefer
15.70	Production	——	2	1	XV	3	—	6	Schell
15.71	Production	15.70	4(B)	1	(Elective)	3	—	6	Schell
15.72	Technique of Executive Control	15.70	4(B)	2	(Elective)	3	—	6	Schell
15.73	Management Lab.	15.11 or 15.70 or 2.731	4(B)	1	(Elective)	3	3	3	Goodwin
‡15.75	Manufact. Analysis	15.70	G(A)	1	(Elective)	3	—	6	Schell
‡15.76	Mass Production Methods	2.851, 15.70	4(B)	1	(Elective)	3	—	3	
15.81	Marketing	*Ec11T*,	3	1	XV_2	3	—	6	Tallman
			3	2	XV_1				
15.82	Sales Management	15.81	4(B)	2	(Elective)	3	—	6	Cunningham
‡15.83	Marketing Research	15.81	4(B)	1	(Elective)	3	—	6	Cunningham
‡15.85	Indust. Marketing	15.81	G(A)	1	(Elective)	3	—	6	Cunningham
15.86	New Prod. Develop. & Reduction to Marketing Practice	15.81	G(A)	2	(Elective)	3	—	6	Cunningham, Tallman
‡15.88	Advertising	15.81	G(B)	2	(Elective)	2	—	6	Cunningham, Tallman

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Business and Engineering Administration Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
15·92	Industrial Problems	15·41, 15·61, 15·70, 15·81	4(B)	2	XV	2	—	6	Schell
‡15·94	Contemp. Prob. Seminar	15·41, 15·61, 15·70, 15·81	G(A)	2	(Elective)	3	—	6	Schell
15·95	Sp. Prob. in Management	——	G(A)	1 or 2	(Elective)		★		Schell
‡15·96	Adm. Th. and Practice	15·41, 15·61, 15·70, 15·81	G(A)	2	(Elective)	3	—	6	Schell
‡15·97	Seminar in Bus. Adm.	——	G(A)	2	(Elective)	3	—	6	Schell
	Thesis	——	4	2	XV	0	10	0	Cunningham
	Graduate Thesis	——	G(A)	-	XV		★		Cunningham

AERONAUTICAL ENGINEERING — 16·00–16·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
16·01	Aero. Mech., Int.	M22	3(B)	1	XVI	4	2	6	Rauscher
16·02	Aero. Mech., Int.	16·01	3(B)	2	XVI	4	2	4	Rauscher
16·03	Hydrodyn. and its Appl. to Aero.	16·02	G(A)	1	(Elective)	3	—	6	R. H. Smith
16·04	Hydrodyn. and its Appl. to Aero.	16·03	G(A)	2	(Elective)	3	—	6	R. H. Smith
16·07	Adv. Topics in Aeromechanics	16·02	G(A)	1	(Elective)	3	—	6	R. H. Smith
16·08	Adv. Topics in Aeromechanics	16·02	G(A)	2	(Elective)	3	—	6	R. H. Smith
16·10	Aerodyn., Applied	2·04, 8·04, 16·01, 16·71	3(B)	2	XVI	3	—	3	Ober
16·11	Airplane Performance	16·02, 16·10	4(B)	1	XVI	3	—	3	Ober
16·13	Airpl. Stab. & Control	16·10	4(B)	1	XVI	4	—	6	Koppen
16·14	Airpl. Design Prob.	16·11, 16·17	4(B)	2	(Elective)	2	4	6	Koppen
16·17	Airpl. Des. Practice	16·10, *16·11*	4(B)	1	XVI	0	8	0	Koppen
16·20	Structures	2·04	3	2	XVI	3	—	5	Newell
16·21	Structures	16·20	4(B)	1	XVI	3	—	5	Newell
16·22	Aircraft Structures	16·21	4(B)	2	XVI	3	—	5	Newell
16·25	Aircraft Struct., Adv.	16·17, *16·21*	G(A)	1	(Elective)	3	—	6	Newell
16·34	Aircraft Instruments	M22, 8·04	4(B)	1	(Elective)	3	—	3	McKay
16·37	Instrumentation	2·081	G(A)	1 or 2	II (T.E.)	3	—	6	Draper
16·38	Instruments	16·37	G(A)	1 or 2	II (T.E.)	4	—	8	Draper
16·41	Instrumentation	16·02 or 2·082	G(A)	1	(Elective)	3	—	9	Draper
16·42	Aircraft Instruments	16·41	G(A)	2	(Elective)	3	—	9	McKay
16·43	Instruments Lab.	*16·41*	G(A)	1	(Elective)	0	3	6	McKay
16·44	Meteorological Inst.	*14·11*, M12, 8·02	4(B)	1	(Elective)	2	2	6	Keily
16·45	Sp. Prob. in Aero. & Met. Inst.	16·44 or 16·42	G(A)	1	(Elective)		★		Draper
16·46	Vibration Measurements	16·41, 13·73 or 6·671 or 8·05	G(A)	2	(Elective)	2	3	6	McKay
16·47	Instrument Des. Practice	2·701	G(A)	1	(Elective)	2	6	2	McKay
16·48	Instrument Des. Practice	16·47	G(A)	2	(Elective)	2	6	2	McKay
16·52	Aircraft Prop. Design	16·11	G(A)	2	(Elective)	2	2	4	Ober
16·53	Airplane Eng. Des., Adv.	2·792	G(A)	1	(Elective)	1	4	3	E. S. Taylor
16·54	Airplane Eng. Des. Adv.	16·53	G(A)	2	(Elective)	1	4	3	E. S. Taylor
16·60	Aeron. Prob., Adv.	16·11 or 16·25 or 16·63	G(A)	1 or 2	(Elective)		★		Staff
16·62	Aeronautical Lab.	*16·11*	4(B)	1	XVI	2	2	3	Ober
16·63	Aero. Lab. & Res. Meth.	16·62	4(B)	2	(Elective)	2	2	2	Ober
16·75	Constr. Details of Aircraft	16·11	4(B)	2	XVI	3	4	2	Koppen
16·81	Aeronautics	M21, 2·04	4(B)	1 or 2	(Elective)	3	—	1	Markham
16·82	Aeronautics	M21	2	2	XVI	3	—	1	Markham

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BUILDING ENGINEERING AND CONSTRUCTION—17·00–17·99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
17·22	Building Construction	D12	2	2	XVII	3	3	2	Voss
17·31	Building Construction	17·22	3	1	XVII$_1$	3	3	2	Staley
17·32	Building Construction	17·31	3	2	XVII$_1$	3	3	2	Staley
17·33	Building Construction	17·22	3	1	(Elective)	2	3	2	Voss
17·34	Building Construction	17·33	3	2	(Elective)	2	3	2	Voss
17·40	Estimating & Job Manage.	17·32	4(B)	2	XVII$_1$	2	3	1	Voss
17·41	Construction Problems	17·32	4(B)	1	(Elective)		★		Voss
17·42	Construction Problems	17·41	4(B)	2	(Elective)		★		Voss
17·52	Structural Problems	2·04	3	2	XVII$_1$	3	4	3	Peabody
17·53	Structural Design	17·52	4(B)	1	XVII$_1$	3	4	3	Peabody
17·54	Structural Design	17·53	4(B)	2	XVII$_1$	3	4	3	Peabody
17·56	Structural Design	17·52	4	2	(Elective)	2	3	2	Peabody
17·70	Materials	5·02, 8·02	2	1	XVII	3	—	3	Voss
17·71	Materials	17·70 or 5·02 and 8·02	2	1	IV	3	—	2	Staley
			3	1	XVII$_1$				
17·72	Materials	17·71	3	2	XVII$_1$	3	—	2	Staley
17·73	Materials	17·72	4	1	XVII$_1$	3	—	2	Voss
			3	1	IV				
17·74	Materials	17·73	3	2	IV	3	2	2	Staley
17·77	Sp. Prob. in Build. Mat.	——	G(A)	1 or 2	(Elective)		★		Staley
17·80	Thesis Seminar	——	4	1	(Elective)	2	—	0	Voss

GRAPHICS—D1–D99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
D11	Engineering Drawing	——	1	1	All courses except IV	0	4	0	Rule
D12	Descriptive Geometry	D11	1	2	All courses except IV	0	4	0	Rule
D31	Nomography	D12, M12	2, 3	2	(Elective)	2	4	0	Adams

ECONOMICS AND SOCIAL SCIENCE—EC1–EC99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
Ec11T	Economic Principles	E12	2	1	IV-B	3	—	3	D. S. Tucker
			3	1	I, II, III, IV, V, VI, VIII, IX-A, IX-B, X, XIII, XIII-C, XV, XVII$_1$, XVIII				
			3	2	VII, XVI				
			4	1	VII-A				
Ec12T	Industrial Economics	Ec11T	2	2	IV-B	3	—	3	Myers
			3	2	I, II, IV, V, VI, VIII, IX-A, IX-B, X, XIII, XIII-C, XV, XVII$_1$, XVIII				
			4	1	VII				
			4	2	III, VII-A, XVI				
Ec15	Economic Principles	E12	4	2	XIII-A	3	—	5	R. E. Freeman
‡Ec17	Economic Analysis	Ec12T	G(A)	1	(Elective)	3	—	6	Samuelson
‡Ec18	Economic Analysis	Ec17	G(A)	2	(Elective)	3	—	6	Samuelson
‡Ec19	Math. Approach to Economics	Ec18	G(A)	1	(Elective)	3	—	6	Samuelson, H. A. Freeman
‡Ec24	Schools of Econ. Thought	Ec63	G(A)	2	(Elective)	3	—	6	Bissell
‡Ec26	Business Cycles	Ec40	G(A)	2	(Elective)	3	—	6	Samuelson
‡Ec28	Econ. of Technol. Change	Ec12T	4(B)	2	(Elective)	3	—	6	Maclaurin
‡Ec29	Econ. of Technol. Change	Ec28	4(B)	1	(Elective)	3	—	6	Maclaurin
Ec32	Econ. Statistics, Elem.	M21	2	2	IV-B	3	—	3	H. A. Freeman
‡Ec37	Econ. Statistics, Adv.	Ec32	G(A)	1	(Elective)	3	—	6	H. A. Freeman, Samuelson
Ec38	Industrial Statistics	M21	G(A)	2	(Elective)	3	—	6	H. A. Freeman
Ec39	Statistical Inference	M21	G(B)	1	(Elective)	2	—	6	H. A. Freeman

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Economics and Social Science Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
Ec40	Money & Banking	Ec12T	3	2	IV-B	3		3	R. E. Freeman
‡Ec47	Investment Finance	Ec12T	G(A)	1	(Elective)	3	—	6	D. S. Tucker
‡Ec48	Investment Analysis	Ec47 or 15·42	G(A)	2	(Elective)	3	—	6	D. S. Tucker
‡Ec49	Public Finance	Ec40	4(B)	1	IV-B	2	—	5	Samuelson
‡Ec50	Banking and Finance	Ec12T	4	2	(Elective)	3	—	3	D. S. Tucker
‡Ec54	Corporations	Ec12T	4(B)	2	XIII-C	3	—	3	D. S. Tucker
‡Ec56	Industrial Econ., Prob.	Ec12T	4(B)	2	(Elective)	3	—	6	D. V. Brown
‡Ec59	Internat. Economics	Ec12T	G(A)	1	(Elective)	3	—	6	R. E. Freeman
Ec63	Labor Relations	Ec12T	4(B)	1	XIII-C, XV	3	—	5	Pigors
Ec64	Industrial Relations	Ec63	4(B)	2	(Elective)	3	—	5	Myers
‡Ec66	Seminar in Indust. Rel.	Ec63	G(A)	2	(Elective)	2	—	7	Pigors
‡Ec67	Seminar in Labor Prob.	Ec63	G(A)	1	(Elective)	3	—	6	D. V. Brown
‡Ec68	Seminar in Labor Prob.	Ec67	G(A)	2	(Elective)	3	—	6	D. V. Brown
‡Ec72	American Government	Ec12T	3	2	(Elective)	3	—	6	Schaefer
‡Ec78	Govt. Control of Industry	Ec12T	G(A)	2	(Elective)	3	—	6	Thresher
‡Ec83	Urban Sociology	Ec12T	2	1	IV-B	2	—	4	
			4	1	IV				
Ec85	Land Economics	Ec12T, 4·651	4(B)	1	IV-B	2	—	5	F. J. Adams
			5	1	IV (Not November 1944–June 1945)				
Ec86	Land Economics	Ec85	4(B)	2	IV-B	4	—	6	F. J. Adams
‡Ec88	Building Economics	Ec12T	5	2	IV	2	—	4	
Ec91	Economics Seminar	——	G(A)	1	(Elective)	3	—	6	R. E. Freeman
Ec92	Economics Seminar	——	G(A)	2	(Elective)	3	—	6	R. E. Freeman
Ec93	Ind. Econ. Seminar	Ec56	G(A)	1	(Elective)	3	—	6	D. V. Brown
Ec94	Ind. Econ. Seminar	Ec93	G(A)	2	(Elective)	3	—	6	D. V. Brown
Ec95	Social Science Seminar	Ec63	G(A)	1	(Elective)	3	—	6	McGregor,
Ec96	Social Science Seminar	Ec95	G(A)	2	(Elective)	3	—	6	Knickerbocker

ENGLISH AND HISTORY — E1–E99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
E11	English Composition	——	1	1	All courses	3	—	5	Greene
E12	English Composition	E11	1	2	All courses	3	—	5	Greene
E21T	U. S. in World History	——	2	1	All courses	3	—	5	Roberts, Rae
‡E211	History of Thought	——	2	1	(Elective)	3	—	5	Roberts
‡E212	Literature	——	2	1	(Elective)	3	—	5	Fuller
E22T	U. S. in World History	——	2	2	All courses	3	—	5	Roberts, Rae
‡E221	History of Thought	——	2	2	(Elective)	3	—	5	Roberts
‡E222	Literature	——	2	2	(Elective)	3	—	5	Fuller
E25	English Composition	——	3, 4	1 or 2	(Elective)		★		Urbach, Bryant
E33	Report Writing	E22	4	1	V	2	—	4	Bartlett
E35	Reports	E22	2	1	IV-B	2	—	4	Chalmers
			3	2	XV				
E43	Seminar Ec. & Ind. Hist.	——	G(A)	1	(Elective)	3	—	6	Bartlett
E44	Seminar Ec.& Ind. Hist.	——	G(A)	2	(Elective)	3	—	6	Bartlett

GENERAL STUDIES — G1–G99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
*G1	History of Science	——	–	1	——	2	—	4	de Santillana
G2	History of Science	——	–	2	——	2	—	4	de Santillana
‡G5	Astronomy, Int.	——	–	1	——	2	—	4	Boyce
G7	Prob. of Modern Philos.	——	–	1	——	2	—	2	de Santillana
G8	History of Philosophy	——	–	2	——	2	—	2	de Santillana
G9	Geology	——	–	1	——	2	—	2	Wiener
G10	Organic Evolution		–	2	——	2	—	4	Morris
G12	Seminar in Biography	——	4	2	$VI_{1,3,4}$	3	—	3	Bartlett
‡G13	Cartography	——	–	1	——	2	—	2	Watson
‡G20	French Civilization	——	–	2	——	2	—	4	Langley
G22	Dev. of Transportation	——	–	2	——	2	—	2	C. B. Breed

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General Studies Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
G27	Mil. Hist. & Policy of U.S.	——	–	1 or 2	——	2	—	4	Rae
G28	Economic Geography	——	2	2	XIII-C	2	—	4	Morris
G29	Topog. in the World War	——	–	1	——	2	—	4	Morris
G31	Composition, Adv.	——	–	1	——	2	—	2	Fassett
G32	Composition, Adv.	——	–	2	——	3	—	3	Fassett
‡G38	Public Speaking	——	4	2	IV-B	3	—	3	Copithorne
G39	Reading Seminar	——	–	1 or 2	——	2	—	4	Chalmers
‡G45	Hist. Aspects of Arch.	——	2	1	XVII	3	—	3	E. T. Putnam
G48	Conver. German	L12 or Elem. Entrance German	–	2	——	2	—	4	Koch
G50	Conver. French	L52 or Elem. Entrance French	–	2	——	2	—	4	Langley
‡G57	Dante in English	——	–	1	——	2	—	2	Langley
G581	Russian, Elementary	——	–	1	——	3	—	5	Znamensky
G582	Russian, Elementary	G581	–	2	——	3	—	5	Znamensky
‡G66	The Arts of the Book	——	–	2	——	2	—	2	H. L. Seaver
‡G67	Debating, Prin.	——	–	1	——	2	—	2	Leggett
‡G68	Debating, Prin.	——	–	2	——	2	—	2	Leggett
G75	Human Relations	——	–	1	——	3	—	3	Magoun
G76	Human Relations	——	–	2	——	3	—	3	Magoun
G86	San. Sci. & P. H., Prin.	——	2	2	IV-B	2	—	2	Horwood
G88	From Molecule to Man	——	–	2	——	2	—	2	Bunker

MODERN LANGUAGES — L1–L99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
L11	German, Elem.	——	–	1, 2	(Elective)	3	—	5	Currier
			2	1	XIV				
L12	German, Elem.	L11	–	1, 2	(Elective)	3	—	5	Currier
			2	2	XIV				
L21	German, Int.	L12, or Elem. Entrance German	–	1, 2	(Elective)	3	—	5	Kurrelmeyer
L22	German, Int.	L21	–	1, 2	(Elective)	3	—	5	Kurrelmeyer
L31	German, Int.	L12, or Elem. Entrance German	3	1	V	2	—	3	Kurrelmeyer
L51	French, Elem.	——	–	1, 2	(Elective)	3	—	5	Langley
L52	French, Elem.	L51	–	1, 2	(Elective)	3	—	5	Langley
L61	French, Int.	L52 or Elem. Entrance French	–	1, 2	(Elective)	3	—	5	Koch
L62	French, Int.	L61	–	2	(Elective)	3	—	5	Koch
L81	Spanish, Elem.	——	–	1	(Elective)	3	—	5	Langley
L82	Spanish, Elem.	L81	–	2	(Elective)	3	—	5	Langley
‡L83	Spanish, Int.	L82	–	1	(Elective)	3	—	5	Koch
‡L84	Spanish, Int.	L83	–	2	(Elective)	3	—	5	Koch
‡L91	Italian, Elem.	——	–	1	(Elective)	3	—	5	Langley
‡L92	Italian, Elem.	L91	–	2	(Elective)	3	—	5	Langley

MATHEMATICS — M1–M99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
M11	Calculus	Entrance Algebra, Solid Geometry, Trigonometry	1	1	All courses	3	—	6	Douglass
M112	Mathematics (College Transfer)	——	1	1	——	3	—	6	Douglass
M12	Calculus	M11	1	2	All courses	3	—	6	Douglass
M21	Calculus	M12	2	1	All courses except IV	3	—	6	Hitchcock
M212	Mathematics (College Transfer)	——	2	2	——	3	—	6	Douglass
M22	Diff. Equations	M21	2	2	All except IV, IV-B, VII_2, XIII-C	3	—	6	Zeldin
			G	1	II (T.E.)				

‡ Not offered November 1944–June 1945.

Mathematics Continued

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
M23	Algebra	M12	2	1	XVIII	3	—	6	Wadsworth
M24	Interpolation	M23	2	2	(Elective)	3	—	6	Wadsworth
M31	Diff. Equations	M22	3	1	VI	2	—	4	Franklin
M331	Math. Th. of Statistics	M22	3(B)	1	(Elective)	3	—	6	Wadsworth
M332	Math. Th. of Statistics	M331	3(B)	2	(Elective)	3	—	6	Wadsworth
M341	Modern Statistical Th.	M332	4(B)	1	(Elective)	3	—	6	Wadsworth
M342	Modern Statistical Th.	M341	4(B)	2	(Elective)	3	—	6	Wadsworth
‡M351	Calculus for Engineers, Adv.	M22	G(A)	1	(Elective)	3	—	6	Franklin
‡M352	Calculus for Engineers, Adv.	M351	G(A)	2	(Elective)	3	—	6	Franklin
M36	Calculus, Adv.	M22	G(A)	1	(Elective)	3	—	6	Douglass
			3	1	XIII-A				
M37	Calculus, Adv.	M36	G(A)	2	(Elective)	3	—	6	Douglass
			3	2	XIII-A				
M381	Theory of Functions	M22	G(A)	1	(Elective)	3	—	9	Cameron
M382	Theory of Functions	M381	G(A)	2	(Elective)	3	—	9	Cameron
‡M441	Projective Geometry	M22	3(B)	1	(Elective)	3	—	6	Struik
M442	Elem. Diff. Geometry	M22	4(B)	2	(Elective)	3	—	6	Struik
‡M451	Fourier Series & Integrals	M22	G(A)	1	(Elective)	3	—	9	Wiener
‡M452	Fourier Series & Integrals	M451	G(A)	2	(Elective)	3	—	9	Wiener
‡M461	Seminar in App. Math.	M22	G(A)	1	(Elective)	3	—	9	Reissner
M54	Mathematical Lab.	M22	3(B)	2	(Elective)	3	—	6	Douglass
M551	Funct. of Real Variable	M22	G(A)	1	(Elective)	3	—	9	Salem
M552	Funct. of Real Variable	M551	G(A)	2	(Elective)	3	—	9	Salem
‡M561	Functions of a Complex Variable	M22	G(A)	1	(Elective)	3	—	9	Levinson
‡M562	Functions of a Complex Variable	M561	G(A)	2	(Elective)	3	—	9	Levinson
M571	Diff. Equations	M22	G(A)	1	(Elective)	3	—	9	Levinson
M572	Diff. Equations	M571	G(A)	2	(Elective)	3	—	9	Levinson
‡M581	Continuous Groups	M22	G(A)	1	(Elective)	3	—	9	Zeldin
‡M582	Continuous Groups	M581	G(A)	2	(Elective)	3	—	9	Zeldin
M62	Modern Algebra	M22	3(B)	2	(Elective)	3	—	6	Hitchcock
‡M631	Modern Algebraic Th.	M22	G(A)	1	(Elective)	3	—	9	Clifford
‡M632	Modern Algebraic Th.	M631	G(A)	2	(Elective)	3	—	9	Clifford
M641	Tensor Calculus	M22	G(A)	1	(Elective)	3	—	9	Struik
‡M642	Tensor Calculus	M641	G(A)	2	(Elective)	3	—	9	Struik
‡M651	Analytical Mechanics	M22	G(A)	1	(Elective)	3	—	9	Crout
‡M652	Analytical Mechanics	M651	G(A)	2	(Elective)	3	—	9	Crout
‡M661	Algebra of Quantum Th.	M62	G(A)	1	(Elective)	3	—	9	Hitchcock
‡M662	Algebra of Quantum Th.	M661	G(A)	2	(Elective)	3	—	9	Hitchcock
M671	Partial Differential & Integral Equations	M22	G(A)	1	(Elective)	3	—	9	Crout
M672	Partial Differential & Integral Equations	M671	G(A)	2	(Elective)	3	—	9	Crout
‡M682	Calculus of Variations	M22	G(A)	2	(Elective)	3	—	9	Cameron
‡M691	Char. Value Prob.	M22	G(A)	1	(Elective)	3	—	9	Franklin
‡M692	Char. Value Prob.	M691	G(A)	2	(Elective)	3	—	9	Franklin
M73	Review of Mathematics	——	3	–	XIII-A	20	—	0	Douglass
‡M731	Mechanics	M22	3(B)	1	(Elective)	3	—	6	Crout
‡M732	Mechanics	M731	3(B)	2	(Elective)	3	—	6	Crout
M76	Th. of Probability	M21	G(A)	2	(Elective)	3	—	9	Struik
M77	Vector Analysis	M22	3(B)	2	VIII	3	—	6	Hitchcock
‡M78	Math. Logic & Its App.	M22	G	1	(Elective)	3	—	9	Pitts
M791	Th. & App. Elasticity	M22	G(A)	1	(Elective)	3	—	9	Reissner
M792	Th. & App Elasticity	M791	G(A)	2	(Elective)	3	—	9	Reissner
‡M831	Analysis	M22	3(B)	1	(Elective)	3	—	6	Franklin
‡M832	Analysis	M831	3(B)	2	(Elective)	3	—	6	Franklin
M90	Math. Reading	——	G(A)	1 or 2	(Elective)		★		Phillips

★ Time specially arranged. ‡ Not offered November 1944 June 1945

MILITARY SCIENCE — MS1-MS99

No.	Subject	Prerequisite	Year	Term	Taken by	Rec. Lec.	Lab. Draw.	Prep.	Instructor in Charge
MS11	Military Science	—	1	1	All courses	0	3	0	Cuddire
MS12	Military Science	—	1	2	All courses	0	3	0	Cuddire
MS21	Military Science	—	2	1	All courses	3	—	0	Cuddire
MS22	Military Science	—	2	2	All courses	3	—	0	Cuddire

APPENDIX A

STUDENT AID AND PRIZES

RESOURCES for financial aid to students include: The Technology Loan Fund, available for undergraduate and graduate students; Freshman Competitive and other scholarships open to students entering from secondary schools; undergraduate scholarship aid to upper classmen; fellowships and graduate scholarships, Teaching Fellowships, and full- and part-time Assistantships to aid students pursuing work leading to the Master's or Doctor's degree; and prizes.

The extent of these resources is indicated by the facts that, since its establishment in 1930, over 2,500 men have borrowed more than $1,830,000 from the Technology Loan Fund; and approximately $90,000 and $102,000 are annually available for undergraduate and graduate scholarship aid, respectively.

TECHNOLOGY LOAN FUND

It is the general policy to make a loan only to men who have completed at least one year of residence at the Institute with a good academic record. In *exceptional* cases, applications will be considered after one term of residence and in *very special and unusual* cases from entering students who have met, with high standing, all entrance requirements.

The maximum amount loaned to an individual in a single year may not exceed the tuition fee, with the additional stipulation that the maximum total loans granted to an applicant may not exceed $1,800 during his undergraduate period, or $2,400 during his undergraduate and graduate periods.

To receive favorable consideration an applicant must:

1. Be endorsed as to character and personality by: (*a*) an alumnus of the Institute from the community in which he has resided, or by some other citizen of standing in that community; (*b*) the Principal or Head Master of the high school or preparatory school, or the President or Dean of the college or university he has previously attended, (*c*) his Registration Officer or the Head of his Course.

2. Have passed, with a standing satisfactory to the Board, the physical examination required annually of all Institute students.

3. Submit a statement of his financial needs and such other information as the Board may deem necessary, on the application form supplied by the Board, such application to have the approval of his parent or guardian.

4. Be prepared to furnish such life insurance as collateral as may be required by the Board.

A recipient of a loan will be required to sign promissory notes in $50 units up to the amount of his loan, each note carrying interest at two per cent per annum from the date of its issue to a date not exceeding two years after he leaves the Institute, and at five per cent per annum thereafter. Interest is to be paid semi-annually. Each note shall have a definite maturity, such maturities to be spaced at intervals of six months, beginning on or before the December thirty-first following the recipient's expected date of graduation, but payments may be anticipated.

Upon signing notes, the student will be supplied with copies thereof. After leaving the Institute he will be required to advise the Board annually, or at more frequent intervals, as to his whereabouts, the character of the work in which he is engaged, the remuneration he is receiving and his plans for the repayment of his obligations to this Fund.

FRESHMAN SCHOLARSHIPS

These are confined to students who make application at least 60 days *in advance of matriculation* to the Office of the Dean of Students.

Approximately 200 Freshman Competitive awards covering part tuition for the first year are made annually to students entering from secondary schools. Selection is based, to a large degree, upon the candidate's entrance record, College Boards, Regents, and preparatory or high school records; in other words, upon the evidence that he has the academic aptitude and training to enable him to pursue Institute studies with profit to himself and, in due time, to graduate creditably. However, and this is *considered of utmost importance*, the candidate is expected to give evidence through recommendations from former teachers, prominent citizens of his local community, and Institute graduates that he possesses excellent qualities of character and personal bearing, as well as willingness and ability to coöperate with the demands of an engineering, scientific, or architectural curriculum.

Except where distance from Cambridge precludes, a personal interview between an officer of the Institute and the applicant is required and, to facilitate these arrangements, early application is desired. Interviews with some nearby representative of the Institute will be arranged for candidates who live at a distance from Cambridge.

Besides the Freshman Competitive awards, other freshman scholarships are open to qualified applicants under terms set forth below. Most of these grants depend in part upon a candidate having some special qualification in addition to presenting evidence that he has high scholastic ability, i.e., that he be from a particular locality, a graduate of a particular school, etc. The figures in parentheses are the dates of establishment:

ALUMNI REGIONAL (1926). As a means of coöperating with Alumni in various Technology centers in attracting to the Institute students of exceptional ability and promise from all parts of the United States, several Regional Scholarships, carrying an award of full tuition for the freshman year, are offered in Chicago, Denver, Detroit, District of Columbia, Kansas City, Los Angeles, New York, New Jersey, Northern Ohio, Philadelphia, Pittsburgh, Portland, Ore., San Francisco, St. Louis, Seattle, Schenectady, Southern Ohio, and Westchester County, New York. These are open to American citizens of good character and health whose standing in their preparatory school studies has been high and who have satisfied with high standing all entrance requirements.

ARMY AND NAVY (1930). Sons of regular Army, Navy, Marine Corps and Coast Guard Officers, who are admitted as undergraduate students to the Institute, will pay half the regular tuition upon the recommendation of the Faculty Committee on Undergraduate Scholarships, the total number not to exceed ten each year. Preference will be given to qualified applicants admitted to the first-year class. Applications should be addressed to the Office of the Dean of Students and should be accompanied by documentary evidence that the applicant's father is a commissioned officer in the regular Army, Navy, Marine Corps or Coast Guard. It is the policy of the Committee not to recommend a man for one of these awards unless he has satisfied with high standing all entrance requirements of the Institute. Holders of these scholarships, if recommended by the Committee, may continue at the half-tuition rate during their second and succeeding undergraduate years.

BRIDGEPORT (1932). Established by the Institute through a bequest from Horace T. Smith of the Class of 1898, to be known as the Horace T. Smith Scholarship Fund. A scholarship, carrying a stipend of full tuition for the freshman year, is annually offered to a graduate of the High Schools of Bridgeport, Connecticut. Application should be made to the Office of the Dean of Students.

CAMBRIDGE (1916). A limited number of scholarships is granted to students entering the first year class at the Institute, who are graduates of schools in Cambridge and children of legal residents of that city. These Cambridge Scholarships, which carry a stipend of full tuition, are confined to students who make application furnishing evidence of need. An award may be continued in the second, third, and fourth years upon annual reapplication, providing the holder maintains a satisfactory scholastic record and continues to furnish evidence of need. Original application for a Cambridge Scholarship should be made through the Headmaster, or Principal, of the applicant's school, and such application must be filed with the Headmaster, or Principal. Awards will be by competition, based upon special examinations given by the Institute, with the stipulation that no successful candidate will be entitled to benefit from an award unless he or she satisfies prior to admission, all entrance requirements of the Institute.

CLASS OF '96 FUND (1923). Received from the Class of 1896 to found a scholarship to be awarded subject to the approval of the Secretaries of the Class. Preference in making awards will be given to descendants of members of the Class of 1896, including freshmen, and grants from this fund are to be considered as loans to be repaid by the recipients when and if able.

CLASS OF '09 FUND (1937). Established as the "Class of 1909 Scholarship Fund," the net income to "be used to assist such deserving students as may be selected from time to time . . . , preference being given to direct descendants of members of the Class of 1909."

CLASS OF '22 FUND (1942). Established at the twentieth reunion of the Class of 1922, the "income and principal . . . to be used to assist students entering the Institute as freshmen from secondary schools, with preference being given to sons (or daughters) of members of the Class." Beneficiaries "are expected to issue notes agreeing to repay the face value, with interest, of amounts received."

EAST BRIDGEWATER (1932). Established by the Institute through a bequest from Horace T. Smith of the Class of 1898, to be known as the Horace T. Smith Scholarship Fund. A scholarship, carrying a stipend of full tuition for the freshman year, is annually offered to a graduate of the High School of East Bridgewater, Massachusetts, recommended by the Principal, to whom application must be made.

FALL RIVER AND SWANSEA (1932). Established by the Institute through a bequest of Elizabeth R. Stevens, known as the Albert G. Boyden Fund. A limited number of scholarships for the freshman year, carrying stipends of part tuition, are annually offered to qualified applicants residing in Fall River or Swansea, Massachusetts. Applications must be filed at the Office of the Dean of Students. Selection will be based on qualifying examinations given by the Institute, and with the stipulation that no individual will be eligible to receive an award until he has fulfilled all entrance requirements of the Institute.

CHARLES HAYDEN MEMORIAL (1939). Established through a grant from the Charles Hayden Foundation, the Institute offers a number of scholarship awards in memory of the late Charles Hayden, a graduate of the English High School Class of 1886 and of the M. I. T. Class of 1890: "To aid deserving 'Boston and New York boys'— high school graduates whose parents are unable to finance the entire cost of their education — to enroll as members of the first-year class at Technology." Full particulars concerning these awards, which are suspended for the duration of the war, may be obtained from the Office of the Dean of Students.

LLORA CULVER KRUEGER FUND (1936). Established from the residuary estate of the late Emma Robinson Culver "for needy and worthy Massachusetts Institute of Technology students who come from Schenectady or its immediate vicinity, preferably those recommended by the local Regional Scholarship Committee."

GEORGE H. MAY (1914). Gift of $5,000 from George H. May of the Class of 1892 to provide a scholarship "to assist graduates of the Newton High Schools who are students at M. I. T. and who have been recommended as eligible by the Superintendent and Head Master of the Newton High Schools." Beneficiaries under this fund are expected to issue notes agreeing to repay the face value, without interest, of amounts received.

MILTON HIGH SCHOOL FUND (1885). Founded by the Institute in recognition of contributions from residents of Milton. This scholarships is conferred upon such former pupils of the Milton High School in good standing at the Institute as the Master of that school and the School Committee of the town may select.

VERMONT (1924). Gift of $25,000 from Redfield Proctor of the Class of 1902 to found a scholarship "in memory of Vermonters who, having received their education at the Institute, served as engineers in the Armies of the Allies in the World War." The income is awarded annually "to worthy students . . . preference to any bona fide residents of Vermont doing undergraduate work at the Institute of Technology, and also Vermont students doing graduate work, or students who are graduates of or transfers from Middlebury College or Norwich University . . . who shall meet regular scholastic and other requirements."

UNDERGRADUATE SCHOLARSHIP AID FOR UPPER CLASSMEN

In addition to the Freshman Scholarships, the Institute holds funds from the income of which awards are made to students in the upper undergraduate years. It is the policy of the Faculty Committee on Undergraduate Scholarships to assist as many well qualified students as possible by assigning, in general, amounts less than full tuition. Awards are made only to students who have completed at least a year of satisfactory work at the Institute.

In making selections, the ability of the student, as indicated by the scholastic record, is the primary consideration. However, account is also taken of the applicant's evidences of need for financial assistance, of his good character, and of his general worthiness and professional promise. Applications should, except as noted below, be made on blanks to be obtained at Room 3-108.

The scholarships or funds described are arranged in the alphabetical order of their names, the figures in parentheses being the dates of establishment:

ELISHA ATKINS (1894). Founded by Mrs. Mary E. Atkins of Boston with a gift of $5,000.

THOMAS WENDALL BAILEY (1914). Bequest of Thomas Wendall Bailey, the income to assist "needy students in the Department of Architecture."

CHARLES TIDD BAKER (1922). Bequest of $20,000 from Charles Tidd Baker, one half of the net income "applied each year to the assistance of poor and worthy students."

BILLINGS STUDENT (1900). Bequest of $50,000 from Robert C. Billings "to found the Billings Student Fund. Any student receiving benefit from this fund is expected to abstain from the use of alcohol or tobacco in any of their varied forms."

LEVI BOLES (1915). Bequest of $10,000 from Frank W. Boles in memory of his father, Levi Boles, the "net income thereof to be applied annually to the assistance of needy and deserving students."

JONATHAN BOURNE (1915). Bequest of $10,000 from Hannah B. Abbe to constitute a fund "known as the Jonathan Bourne Scholarship Fund, the income only to be used in aid of deserving students."

ALBERT G. BOYDEN (1931). Bequest of $40,000 from Elizabeth R. Stevens as a permanent fund, to be known as the Albert G. Boyden Fund, "income only to be awarded as scholarships to assist worthy and needy students, preference to be given to young men or women residents of the town of Swansea or the city of Fall River."

HARRIET L. BROWN FUND (1932). Bequest of Harriet L. Brown "to be held in trust as a scholarship . . . the income to be given to such needy and deserving young women desiring to become students at M. I. T., as would otherwise be unable to attend; and in case of two or more applicants of equal merit, preference shall be given to a native of either Massachusetts or New Hampshire."

MABEL BLAKE CASE (1920). Gift from Lucius Clapp to form a fund "to aid worthy students who may not be able to complete their studies without help."

NINO TESHER CATLIN (1926). Gift from Maria T. Catlin to establish a fund in memory of her son, Nino T. Catlin of the Class of 1918, the income "to be awarded to needy and deserving students."

LUCIUS CLAPP (1905). Gift from Lucius Clapp to form a fund "to aid worthy students who may not be able to complete their studies without help."

CLASS OF '96 FUND (1923). Received from the Class of 1896 to found a scholarship to be awarded subject to the approval of the Secretaries of the Class. Preference in making awards will be given to descendants of members of the Class of 1896, including freshmen, and grants from this fund are to be considered as loans to be repaid by the recipients when and if able.

CLASS OF '09 FUND (1937). Established as the "Class of 1909 Scholarship Fund," the net income to "be used to assist such deserving students as may be selected from time to time . . . , preference being given to direct descendants of members of the Class of 1909."

CLASS OF 1917 SCHOLARSHIP FUND (1942). Established on the twenty-fifth anniversay of the Class, the "income and principal . . . to be used to assist such deserving students as may be selected from time to time, preference being given to direct descendants of members of the Class of 1917. Beneficiaries are expected to issue notes agreeing to repay the face value, without interest, of amounts received."

FRED L. AND FLORENCE L. COBURN (1932). Bequest of $5,000 from Fred L. Coburn, the income of which "shall be expended by said Trustees in giving aid and assistance to students of M. I. T. . . . preference being given by said Trustees to students residing in Somerville, Massachusetts."

COFFIN MEMORIAL (1929). This gift from the executors of the estate of Charles A. Coffin — a bequest — carried out the wishes of Mr. Coffin. The fund is to be used for loans or other aid to students as determined by the Executive Committee.

ALBERT CONRO SCHOLARSHIP FUND (1943). Bequest of Mary T. Conro, sister of Emma O. Conro, of the Class of 1884, in memory of their uncle, "for the purpose of establishing and maintaining a scholarship in . . . mining engineering . . . to be known as the Albert Conro Scholarship."

CONSOLIDATED VULTEE AIRCRAFT CORPORATION SCHOLARSHIPS (1944). Two scholarships carrying stipends of full tuition for the senior year, established by this Corporation and "open to highly recommended engineering students in Civil Engineering, Electrical Engineering, Mechanical Engineering, or Aeronautical Engineering, and pursuing courses related to aeronautical engineering, who will have completed their junior year."

THE GEORGE R. COOKE FUND (1939). Established by gift of $3,000, "the income to be awarded to a student, preferably in the Course in Civil Engineering, or in some related field of study giving preparation for Public Service and Government. Prior to matriculation, the recipient, who need not necessarily be a candidate for a degree, must have acquired practical experience and earned his living by working in some field, preferably for one year or more. Candidates are to be judged upon their evidences of character, sincerity of purpose and need for assistance."

LUCRETIA CROCKER (1916). By the will of Matilda H. Crocker, the Institute was made the residuary legatee of her estate "for the establishment of one or more scholarships for women in memory of my sister, Lucretia Crocker . . . the income to aid one or more young women in need of pecuniary assistance in obtaining instruction at said Institute."

ISAAC W. DANFORTH (1903). Bequest of $5,000 from James H. Danforth for scholarship purposes as a memorial to his brother, Isaac Warren Danforth.

ANN WHITE DICKINSON (1898). Bequest of $40,000 from Ann White Dickinson "to establish free scholarships in M. I. T. . . . such persons enjoying benefit . . . shall be worthy young men of American origin."

DORMITORY (1903). Raised by miscellaneous subscriptions and formerly known as Students' Aid Fund.

THOMAS MESSINGER DROWN (1928). Bequest of $50,000 from Mary Frances Drown, "to be used to establish scholarships for deserving undergraduate students, to be known as the Thomas Messinger Drown Scholarships."

FRANCES AND WILLIAM EMERSON FUND (1930). Awards not exceeding $600 to students in the School of Architecture. Applications should be made directly to the Dean of the School of Architecture.

FARNSWORTH (1889). Founded by Mrs. Mary E. Atkins of Boston with a gift of $5,000.

CHARLES LEWIS FLINT (1889). Bequest of $5,000 from Charles L. Flint, for the "support of some worthy student, preference to be given to some graduate of the English High School, Boston."

SARAH S. FORBES (1913). Originally a fund of $2,800 given in trust in 1868 by Sarah S. Forbes to William Barton Rogers and Henry S. Russell, trustees, and transferred in 1913 to the Institute, "for the maintenance and education of a scholar in M. I. T."

NATHAN R. GEORGE LOAN FUND (1943). Bequest of $29,000 from Professor Nathan R. George of the Department of Mathematics, the "income to be loaned to undergraduates of M. I. T. who are either citizens or who intend to become citizens" and who are members of the third or fourth year classes.

NORMAN H. GEORGE (1919). Bequest of Norman H. George "to be used for the assistance of needy and worthy students in obtaining an education in M. I. T."

ARTHUR B. GILMORE (1941). Bequest of $10,000 from Arthur B. Gilmore ". . . for the purpose of assisting needy students who shall be members of the Beta Theta Pi Fraternity . . . said net income to be divided among not more than two students in any one year."

BARNETT D. GORDON FUND (1942). Gift of $5,000 from Barnett D. Gordon of the Class of 1916, "the income as scholarships for deserving students at M. I. T."

JOHN A. GRIMMONS (1930). In memory of John A. Grimmons of the Class of 1921 through a deed of trust executed by the late C. Lillian Moore, the Institute received a sum of money to be "used in making loans to undergraduates who are preparing to make Electrical Engineering their life work; such loans to be known as given from the John A. Grimmons Perpetual Loan Scholarship; such loans are not to exceed six hundred (600) dollars to any one student in any one year and are to be made on condition that the loans shall bear interest at five per cent, and shall be repaid within ten years, and that repaid loans shall be treated as income to revert into the Perpetual Loan Fund and to be reloaned from time to time; such loans are to be protected by life insurance. . . . Loans are to be awarded to male, white, native born citizens of the United States, who are loyal to the State and Nation, are of sound physical body and show steadiness of purpose and zeal in educational acquirements."

HALL-MERCER SCHOLARSHIP FUND (1940). Bequest of Alexander G. Mercer ". . . income only . . . for the benefit of such poor students as have passed through some of the Public Schools with the best reputation for character and ability."

JAMES H. HASTE (1930). Bequest of James H. Haste of the Class of 1896, "for the aid of deserving students . . . of insufficient means, said fund, together with any other sums which said institution may receive under this will, to be known as the James H. Haste Fund."

GEORGE HOLLINGSWORTH (1916). Bequest of $5,000 from Rose Hollingsworth to found the George Hollingsworth Scholarship.

T. STERRY HUNT (1894). Bequest of $3,000 from T. Sterry Hunt, for seven years Professor of Geology at Technology, to found a scholarship in his name. Restricted to students of Chemistry and preference is given to those in the higher years.

WILLIAM F. HUNTINGTON (1892). From Susan E. Covell, the Institute received a gift of $5,000 to constitute a fund in memory of William F. Huntington of the Class of 1875, the "income to apply to payments of tuition of needy and deserving students . . . preference to be given to students in Civil Engineering."

DAVID L. JEWELL (1928). Bequest of $25,000 from Colonel David L. Jewell "to be known as the David L. Jewell Fund, the income therefrom to be used to pay the tuition charges of five young men who may be selected by the President or Board of Trustees of the Institute as worthy of assistance, and who, were it not for such assistance, might be unable to pursue their studies at such Institute."

JOY (1886). Established by the gift of Nabby Joy and created pursuant to a decree of the Supreme Judicial Court of Massachusetts for the benefit of "one or more women studying Natural Science at M. I. T."

WILLIAM LITCHFIELD (1910). Bequest of $5,000 from William Litchfield to establish "a single scholarship . . . known as William Litchfield Scholarship, income to be awarded and paid annually to such student in said Institute as may, upon a competitive examination, be determined by the President of said Institute to be entitled thereto for excellence in scholarship and conduct."

ELISHA T. LORING (1890). Bequest of $5,000 from Elisha Thacker Loring, for "the assistance of needy and deserving pupils."

LOWELL INSTITUTE (1923). Gift from the alumni of the Lowell Institute School to found a Fund, the income of which is annually awarded to assist some graduate of that School who desires to enter upon undergraduate studies at M. I. T. Applications must be filed at the Office of the Dean of Students.

RUPERT ANDERSON MARDEN (1933). Established by an anonymous gift "toward a memorial to be known as the Rupert Anderson Marden Scholarship Fund, income available annually to aid a worthy student at M. I. T. — Protestant and of American origin — preference to a student taking the Coöperative Course in Electrical Engineering."

ROBERT W. MILNE FUND (1943). Bequest of $70,000 as "an endowment fund under the title of 'The Robert W. Milne Fund' the income thereof to be used and applied for the assistance of worthy and needy students in obtaining an education in said Institute."

JAMES H. MIRRLEES (1886). Gift of $2,500 from James Buchanan Mirrlees of Glasgow, Scotland, to constitute a scholarship in memory of his son, James Henry Mirrlees, who died in 1886 while attending the Institute. The income is awarded to the "student in the third or fourth year of the Mechanical Engineering Course most deserving pecuniary assistance."

FRED W. MORRILL SCHOLARSHIP FUND (1941). Bequest of Hattie B. Morrill the "income from which is to be used for the purpose of providing financial assistance to some student or students at the discretion of the Trustees of said Institute. . . ."

NICHOLS (1895). Bequest of $5,000 from Mrs. Betsy F. W. Nichols to constitute The Nichols Scholarship in memory of her son William Ripley Nichols of the Class of 1869, for sixteen years Professor of General Chemistry at the Institute. Preference is given to students in the Course in Chemistry.

CHARLES C. NICHOLS (1904). Bequest of $5,000 from Charles C. Nichols to constitute a scholarship.

JOHN FELT OSGOOD (1909). Bequest of $5,000 from Eliza B. Osgood "to establish and maintain a scholarship in Electricity in memory of my husband, John Felt Osgood."

GEORGE L. PARMELEE (1921). Bequest from George L. Parmelee of "one third of my property and estate, interest thereof to be used for tuition of worthy students, either special or regular, according to the direction of the Faculty."

RICHARD PERKINS (1887). Bequest of $100,000 from Richard Perkins, the income from half of which is available for the "support of free scholarships in said Institute."

FLORENCE E. PRINCE FUND (1943). Bequest of Florence E. Prince "for the aid of worthy students who may need assistance in the matter of maintenance and living expenses while pursuing their studies."

SONS AND DAUGHTERS OF NEW ENGLAND PURITAN COLONY (1931). Gift of $600 from the Sons and Daughters of New England Puritan Colony. Holders of this scholarship must be of New England ancestry.

THOMAS ADELBERT READ (1934). Bequest of $10,000 from Julia A. Read "to establish the Thomas Adelbert Read Scholarship, in memory of my late brother of that name; the income of said fund to be awarded to some worthy and needy student of that institution, preferably to a resident of Fall River. . . ."

CHARLES A. RICHARD'S FUND (1939). Bequest of approximately $30,000 "to be known as the Charles A. Richard's Fund . . . the income only for assistance of poor Protestant students in the Institute."

JOHN ROACH (1937). Bequest of $2,400 from Emeline Roach to constitute a fund "to be known as the John Roach Scholarship Fund, the income to be used to provide an annual scholarship to a needy and deserving student pursuing the Course in Naval Architecture and Marine Engineering."

WILLIAM BARTON ROGERS (1904). Established by the Institute in commemoration of the early association of President William Barton Rogers with the College of William and Mary. Stipend $400 per year; granted to a student nominated by the faculty of the College of William and Mary.

WILLIAM P. RYAN MEMORIAL (1935). Established by friends of the late Professor William P. Ryan of the Class of 1918, the income to be used for scholarship aid (graduate or undergraduate) in Chemical Engineering, the award to be made by the Scholarship Committee on recommendation of the Head of the Department of Chemical Engineering.

JOHN P. SCHENKL (1922). Bequest of $20,000 from Johanna Pauline Schenkl "to be held in trust to establish one or more scholarships in the Department of Mechanical Engineering" in memory of her father, John P. Schenkl.

THOMAS SHERWIN (1871). Founded with a gift of $5,000 from the English High School Association in memory of Thomas Sherwin. Holders must be graduates of the English High School of Boston and must be pursuing a regular course at the Institute.

HORACE T. SMITH (1931). Bequest from Horace T. Smith of the Class of 1898, to provide scholarships to worthy students, preference to be given to graduates of the East Bridgewater (Massachusetts) and Bridgeport (Connecticut) High Schools.

ANNA SPOONER FUND (1939). Bequest of approximately $7,500 "the income therefrom . . . to be used . . . in assisting meritorious students."

STEVENSON TAYLOR (1928). Established by the American Bureau of Shipping in memory of Stevenson Taylor, its late President. Tenable for two years; carries an annual stipend of $500; awarded in alternate years to a deserving third year student (who must be an American citizen) in the Course in Marine Transportation of the Department of Naval Architecture and Marine Engineering. Applications should be made directly to the Head of the Department of Naval Architecture and Marine Engineering.

TECHNOLOGY CLUB OF CHICAGO SCHOLARSHIP FUND (1944). Gift of $5,000 from Harold B. Harvey of the Class of 1905 "to establish scholarships to be known as the Technology Club of Chicago Scholarship Fund," the awards to be made by a committee composed of the Honorary Secretaries of the Chicago area and the Dean of Students, and restricted "to boys who reside in the area of the club membership."

SAMUEL E. TINKHAM (1924). Established by the Boston Society of Civil Engineers to aid a worthy student in Civil Engineering.

F. B. TOUGH (1924). Established "for the purpose of extending financial assistance to worthy students." Preference is given to students in Mining or Oil Production. Applications should be made directly to the Head of the Department of Geology.

SUSAN UPHAM (1892). Gift of $1,000 from Susan Upham, "to assist students deserving financial aid."

SAMSON R. URBINO (1927). Bequest of $1,000 from Samson R. Urbino, "to be used to aid students who need assistance, Germans preferred."

VERMONT (1924). Gift of $25,000 from Redfield Proctor of the Class of 1902 to found a scholarship "in memory of Vermonters who, having received their education at the Institute, served as engineers in the Armies of the Allies in the World War." The income is awarded anually "to worthy students . . . preference to any bona fide residents of Vermont doing undergraduate work at the Institute of Technology, and also Vermont students doing graduate work, or students who are graduates of or transfer from Middlebury College or Norwich University . . . who shall meet regular scholastic and other requirements."

ANN WHITE VOSE (1896). Bequest from Ann White Vose of $25,000 "plus one half of the remainder of my estate . . . to establish free scholarships in M. I. T. . . . such persons enjoying benefit . . . shall be worthy young men of American origin."

ARTHUR M. WAITT (1925). Bequest of $10,000 from Arthur M. Waitt, for "assisting needy and deserving students in the second-, third-, and fourth-year classes of the Mechanical Engineering Course of said Institute."

GRANT WALKER FUND (1943). Bequest of $50,000 "the income to be used for scholarships for deserving students in said Institute."

JAMES WATT (1942). Bequest of Jennie A. Douglas, to establish "a scholarship in Mechanical Engineering to be known as the James Watt Scholarship."

HERMAN E. WEIHMILLER FUND (1942). Gift of H. E. Weihmiller of the Class of '25 in memory of his late father "for aiding students or prospective students of M. I. T., who are deserving of financial aid in furtherance of, or as assistance towards an aeronautical career at M. I. T. . . . without restriction as to sex, creed, color or nationality."

LOUIS WEISSBEIN (1915). Bequest of $4,000 from Louis Weissbein "to found a scholarship to be awarded each year to a promising student, preference to be given a Jewish boy in making the award." Since the donor was an architect, this scholarship, in accordance with the wish of the Executor of the donor's estate, is given, if possible, to a Jewish student in the Department of Architecture.

FRANCES ERVING WESTON (1912). Bequest of Frances Erving Weston, "to aid a native-born American Protestant girl of Massachusetts."

SAMUEL MARTIN WESTON (1912). Bequest of Frances Erving Weston, to found a scholarship in memory of her husband, Samuel Martin Weston, "to aid a native-born American Protestant boy, preference to be given one from Roxbury."

AMASA J. WHITING (1927). Bequest of $2,000 from Mary W. C. Whiting "to constitute a fund to be known as Amasa J. Whiting Fund . . . the income . . . to pay or help to pay tuition of deserving students whose means are limited. . . . Preference shall be given to students coming from the town of Hingham, Massachusetts."

ELIZABETH BABCOCK WILLMANN (1935). Bequest from Elizabeth Babcock Willmann, "to help in paying the tuition of girl students taking the Chemistry Course."

MORRILL WYMAN (1915). Bequest of Morrill Wyman, the income of which is "applied in aid of deserving and promising students, but without exclusion in regard to rank, upon the understanding that if in after life the person receiving aid shall find it possible, he shall reimburse the said fund for moneys so applied, but there shall be no legal obligation to make such reimbursement."

GRADUATE FELLOWSHIPS AND SCHOLARSHIPS

GRADUATE scholarships are awarded only to students pursuing programs leading to higher degrees. Applications from new students must be accompanied by an application for admission to the Graduate School, indicating the Department in which the student desires to major. Except for Institute students, an official transcript of the applicant's college record and at least three letters addressed to the Dean by persons personally acquainted with his academic work are required. Both applications must be made on forms which may be obtained from the Secretary of the Committee on the Graduate School.

Awards to students who have not been in residence at least one term will usually be limited to the amount of full tuition. Fellowships carrying stipends in excess of tuition are, in general, awarded only to students who have demonstrated their ability to carry on graduate study and research in residence.

In the award of graduate scholarships the Committee on the Graduate School considers primarily the ability of the applicant to pursue advanced study and research. Grants are not made unreservedly and their continuance from term to term is dependent on the recipient maintaining a satisfactory standard of scholarship. The recipient of a scholarship grant is expected to complete the period of study for which the grant is made. In case he discontinues his work before the end of such period, he will be expected to refund the amount received from the grant, unless released therefrom for satisfactory reasons by the Committee on the Graduate School.

Correspondence concerning scholarship aid may be addressed to the Dean of the Graduate School or to the Chairman of the appropriate Departmental Committee on Graduate Students.

ASSISTANTSHIPS AND TEACHING FELLOWSHIPS

Assistantships and Teaching Fellowships are staff appointments made upon recommendations of heads of departments to whom applications shall be addressed, at the same time that application for admission to the Graduate School and Application for Scholarship Aid are filed with the Secretary of the Committee on the Graduate School.

A "full time" assistant, if also a graduate student, may register for approximately 17 units per term of work toward an advanced degree; a "half time" assistant or teaching fellow for approximately 25 units per term.

Graduate students upon the staff may also apply for financial assistance to the Technology Loan Fund.

FELLOWSHIPS

ALLIED CHEMICAL AND DYE COMPANY FELLOWSHIPS. Two fellowships open to graduate students, one in Chemical Engineering and one in Physical Chemistry or Physics. Each stipend, $750.

AUSTIN RESEARCH FELLOWSHIP. Open to a graduate student in any department. Stipend, $1,000.

WILLIAM SUMNER BOLLES FELLOWSHIP. Open to a graduate student in any department for study in residence or abroad. The stipend may be divided in any year to provide one or more scholarships. Stipend, $900.

COMPANIA ARGENTINA DE ELECTRICIDAD FELLOWSHIPS. Open to three graduate electrical engineers of Argentina.

DUPERIAL FELLOWSHIP. Open to a graduate of a college or university of Argentina.

DU PONT FELLOWSHIP IN CHEMISTRY. Stipend, $750.

HARRY WENTWORTH GARDNER FELLOWSHIP. Open to a graduate student in the School of Architecture for advanced study in residence or elsewhere. Not available in 1944–45.

INSTITUTE OF INTERAMERICAN AFFAIRS FELLOWSHIP. Travel, maintenance, and tuition awarded by the sponsor to an applicant accepted for graduate work.

LEVER BROTHERS COMPANY FELLOWSHIP. Open to a graduate student in Nutritional Biochemistry. Stipend, $1,000.

ARTHUR D. LITTLE FELLOWSHIP. Open to a student enrolled for a doctorate in chemistry. Stipend, $1,000.

ARTHUR D. LITTLE FELLOWSHIP. Open to a student enrolled for a doctorate in chemical engineering. Stipend, $1,000.

MOORE FELLOWSHIP. Open to a graduate of this Institute for study in residence or elsewhere in chemistry, preference being given to the field of organic chemistry. Stipend, $1,000.

PAINT AND VARNISH PRODUCTION CLUB RESEARCH FELLOWSHIP. For research on the technology of paint and varnish. Stipend, $750.

ELLEN H. RICHARDS MEMORIAL FELLOWSHIP. Open to a graduate student, preferably a woman, in the department of chemistry for advanced research in sanitary or allied branches of chemistry. Stipend, $800.

RICHARD LEE RUSSELL FELLOWSHIP. Open to a graduate student in civil engineering. Not available in 1944–45.

STANDARD OIL COMPANY OF CALIFORNIA FELLOWSHIP. Awarded to an employee of the donor company on leave of absence who is able to qualify for admittance into the Graduate School, whose demonstrated technical ability and other qualifications are such that it is judged that he will benefit by graduate study. Stipend, $1,500.

TEXTILE SCHOOL GRADUATE FELLOWSHIPS. Open to American born graduates of the Lowell Textile School for mechanical engineering or chemical work in textile research. Stipend, $750.

GRADUATE SCHOLARSHIPS

AUSTIN FUND. Open to graduate students in all departments, as tuition scholarships not to exceed $600. Available, $14,000.

CAUCA UNIVERSITY SCHOLARSHIP. Open to an advanced student from Cauca University, Colombia.

F. W. CHANDLER TRAVELING SCHOLARSHIP IN CITY PLANNING. Open to a regular or special student in City Planning who has passed at least two years in the course, of which one must have been either a senior or graduate year, for study and travel in any country. Available, $400.

COLLAMORE SCHOLARSHIP. Open to women graduate students in all departments. May be subdivided. Available, $450.

CHARLES H. DALTON SCHOLARSHIP. Open to an American male graduate of this Institute for advanced chemical study and research — especially if applicable to textile industries. Available, $225.

FRANCES AND WILLIAM EMERSON FUND. Open to graduate students in the School of Architecture, tuition scholarships not to exceed $600 each, upon recommendation of the Dean of Architecture.

WILFRED LEWIS SCHOLARSHIP IN MECHANICAL ENGINEERING. Not available in 1944–45.

NATIONAL SCHOOL OF ENGINEERS SCHOLARSHIP. Open to a graduate of the National School of Engineers, Lima, Peru.

WILLARD B. PERKINS TRAVELING SCHOLARSHIP IN ARCHITECTURE. Stipend, $1,200. Not available 1944–45.

HENRY BROMFIELD ROGERS SCHOLARSHIPS. Open to women graduate students in all departments. Tuition scholarships not to exceed $600 each. Available, $850.

HENRY SALTONSTALL SCHOLARSHIP. Open to a graduate student in any department. For exceptional merit, may be increased to not over $750. Stipend, $350.

JAMES SAVAGE SCHOLARSHIP. Open to a graduate student in any department. For exceptional merit, may be increased to not over $750. Stipend, $450.

STAFF GRADUATE SCHOLARSHIPS. Open to graduate students holding staff appointments in all departments. Tuition scholarships.

SUSAN H. SWETT SCHOLARSHIP. Open to a graduate student in any department. Stipend, $350.

FRANK HALL THORP SCHOLARSHIP. Open to a graduate student in industrial chemistry, approved by the department of Chemical Engineering. For exceptional merit, may be increased to not over $750. Stipend, $350.

LOUIS FRANCISCO VERGES SCHOLARSHIP. Open to a graduate student conducting research in the sugar industry. For exceptional merit may be increased to not over $750. Stipend, $350.

WESTERN HEMISPHERE SCHOLARSHIPS. Open to graduates of colleges in the Western Hemisphere, exclusive of the United States. Available $3,000 in 1944–45.

WHITNEY FUND. Open to graduate students in all departments, as tuition scholarships not to exceed $600. Available, $18,000.

THE TECHNOLOGY LOAN FUND

Graduate students on scholarship or without scholarship aid may apply for financial assistance not to exceed $600 per academic year to the Technology Loan Fund. For further information regarding this Fund address the Chairman of the Technology Loan Fund Board, 3-108, Massachusetts Institute of Technology.

PRIZES

ROBERT A. BOIT (1921). Bequest of $5,000 from Robert A. Boit, to provide annual prizes "to stimulate the interest in the best use of the English language." Awards are made to first- and second-year men on the basis of essays written on topics announced by the Department of English and History.

CABOT MEDALS (1901). Gift of Samuel Cabot of the Class of 1870, awarded to five members of each first-year class who have shown the greatest physical improvement during the year.

JAMES MEANS MEMORIAL (1925). A medal and monetary prize of $100 offered annually for the best thesis on an aeronautical subject. Joint theses may be entered and, if successful, duplicate medals will be awarded and the prize divided. Open only to candidates for the Bachelor's degree. (Not offered during the war.)

WILLIAM BARTON ROGERS AWARDS (1937). Monetary prizes to members of the Senior Class who, in the opinion of the Faculty Committee on Undergraduate Scholarships, have demonstrated "outstanding qualities, weight to be given to non-academic or extra-curricular as well as academic accomplishment, and consideration of financial need to be disregarded."

STRATTON (1930). Established by the late President Samuel W. Stratton. Prizes of $50, $30, and $20 awarded for the best presentation of scientific papers by undergraduates, the final competition being held at a public meeting.

The following annual prize is offered to students in the Department of Aeronautical Engineering:

HENRY WEBB SALISBURY MEMORIAL AWARD (1941). Established by the family and friends of Henry Webb Salisbury '33 to provide the award of useful reference books, preferably annually, to a student who has done outstanding work in the Department of Aeronautical Engineering.

The following annual prizes are awarded to students of the School of Architecture:

ALPHA RHO CHI MEDAL (1932). To the graduating senior of the School of Architecture who has shown an ability for leadership, performed willing service for his school and department, and given promise of real professional merit through his attitude and personality.

CHAMBERLIN (1913). Gift of Boston Society of Architects. Prize of $25 to a student in the graduate class in Architecture. Awarded in alternate years.

F. W. CHANDLER (1914). Gift of Boston Society of Architects in memory of Professor Chandler. Five prizes of $5 each awarded for sketch problems in the fourth, fifth, and graduate years.

CLASS OF 1904 (1925). Gift of the Class of 1904. Three prizes of $5 each awarded to students in the third-year class in Architecture for sketch problems.

WILLIAM EMERSON (1940). Gift of the Alumni and Staff. Five prizes of $10 each awarded in the first, second, third, fourth and fifth years of Course IV and one prize of $10 awarded in either Course IV-B or IV-C.

FREEHAND DRAWING (1920). Prizes of a book to each of the students whose work is judged to be the best in composition and in life class drawing.

LIBRARY (1931). Awarded to the second-year student receiving the highest award on a designated project.

ROTCH (1895). Gift of Arthur Rotch. Two prizes of $200 awarded at the end of the fifth year to the regular and the special student having the best general records. The special student must have spent at least two years in residence to be eligible.

SCHOOL OF ARCHITECTURE MEDALS (1922). A bronze medal of the School awarded at the end of the academic year to the winner of each prize, and also to students in the fifth and graduate years with the highest number of "medal" values.

STUDENT MEDAL OF THE AMERICAN INSTITUTE OF ARCHITECTS (1914). Awarded on the recommendation of the School to the member of the fifth-year class whose record for the Course is the best.

SUMMER SKETCHING (1921). For the best set of outdoor summer sketches in pencil or pen and ink or measured drawings, and for the best set of outdoor summer sketches in water colors or wash; prizes of a book to each.

BOSTON SOCIETY OF ARCHITECTS (1923). Gift of the Society. Prizes totalling $50 for week-end conjunctive problems with Harvard and the Boston Architectural Club.

WILLIAM R. WARE (1923). In memory of the founder of the School, prizes totalling $50 for week-end conjunctive problems with Harvard and the Boston Architectural Club.

H. LANGFORD WARREN (1923). In memory of Professor Warren, prizes totalling $50 for week-end conjunctive problems with Harvard and the Boston Architectural Club.

The following annual prize is offered to students in the Department of Naval Architecture and Marine Engineering:

AMERICAN BUREAU OF SHIPPING (1924). Award of $100 by the Bureau to the American citizen in the graduating class who attains the highest average in scholarship for the last two years in the Course.

The following annual prize is offered to students in the Department of Chemical Engineering:

HUNNEMAN (1927). Established by William Cooper Hunneman in memory of his son, Roger DeFriez Hunneman, A.B. Harvard 1917, S.M. M. I. T. 1923. Award of $50 to the most meritorious senior who has shown outstanding originality in his work in the regular Course in Chemical Engineering.

APPENDIX B

DIRECTORY OF HONORARY SECRETARIES

THE Honorary Secretaries listed below are alumni "Ambassadors of Technology" in communities throughout the United States and in selected foreign centers. Prospective applicants for admission to the First-Year Class, living more than 100 miles from Cambridge, are referred to the nearest Honorary Secretary for a conference as a part of the required entrance procedure.

The Honorary Secretary is not expected to be a source of detailed information on entrance requirements, credits and the like, nor does he make, on behalf of the Institute, commitments regarding admission or the award of scholarships. All such matters should be taken up directly with the proper officers of the Institute. The function of the Honorary Secretary is to advise the student regarding his educational program and objectives, and to assist the Admissions Office in the selection of the limited number of applicants accepted each year in the entering class.

Students wishing to enter with advanced standing, or as members of the graduate school, are likewise encouraged to confer with the nearest Honorary Secretary, but are not required to do so.

ALABAMA:
Birmingham. Douglas F. Elliott, '24, Alabama Power Co., 600 N. 18th St.
Montgomery. Charles M. Smith, Jr., '25, Troy Laundry.

ARIZONA:
Phoenix. Charles F. Willis, '06, *The Mining Journal*, 520 Title and Trust Bldg.

CALIFORNIA:
Los Angeles. Kenneth C. Kingsley, '23, Norris Stamping and Mfg. Co., 5215 S. Boyle Ave.
Charles H. Toll, Jr., '23, U. S. Steel Products Co., 5100 Santa Fe Ave.
San Francisco. Richard L. Cheney, '27, Glass Container Association of America, 525 Market St.

COLORADO:
Denver. Alfred E. Perlman, '23, Chief Engineer, Denver & Rio Grande Western R. R., 628 Equitable Bldg.

CONNECTICUT:
Bridgeport. Edward L. Wemple, '34, 939 Barnum Ave.
Hartford. James A. Burbank, '16, The Travelers Insurance Co., 700 Main St.
Thomas D. Green, '26, 38 Montclair Dr., W. Hartford.
New Haven. Albert S. Redway, '23, The Geometric Tool Co., Blake and Valley Sts.
Waterbury. Harold G. Manning, '12, The Post College Bldg., 24 Central Ave.

DELAWARE:
Wilmington. Willis F. Harrington, '05, E. I. du Pont de Nemours & Co., du Pont Bldg.

DISTRICT OF COLUMBIA:
Washington.
J. Y. Houghton, '26, Department of Justice.
William K. MacMahon, '22, Rosslyn Gas Co., 3240 Wilson Blvd., Arlington, Va.
Edward D. Merrill, '09, Capital Transit Co., 36th and M Sts., N.W.
George D. Mock, '28, Washington Gas Light Co., 1100 29th St., N.W.
Robert K. Thulman, '22, Federal Housing Administration, 1001 Vermont Ave., N.W.

FLORIDA:
Jacksonville. George W. Simons, Jr., '15, Hildebrandt Bldg.
Miami. B. Howard Brown, '30, 70 S. W. 27th Rd.
Tampa. Franklin O. Adams, '07, 305 Morgan St.

GEORGIA:
Atlanta. William E. Huger, '22, Courts & Co., 11 Marietta St., N.W.

ILLINOIS:
Chicago. L. H. G. Bouscaren, '04, Stone & Webster, 33 S. Clark St.
Edmund G. Farrand, '21, United Conveyor Corp., 1200 Old Colony Bldg.
Lonsdale Green, '87, 5639 Kenwood Ave.
J. Sherry O'Brien, '17, Harvey Metal Corp., 74th St. and Ashland Ave.
Ralph Sargent, '18, Sargent & Lundy, 140 S. Dearborn St.
Dixon. William C. Steinwedell, '25, Green River Ordnance Plant, Stewart-Warner Corp.
Rockford. Arthur B. Brand, '26, Cummings, Brand & McPherson Advertising, 716 Gas-Electric Bldg.

INDIANA:
Fort Wayne. Frederick P. Feustel, '33, City Light and Water Utilities, 308 E. Berry St.
Indianapolis. Howard S. Morse, '03, Indianapolis Water Co., 113 Monument Circle.

IOWA:
Des Moines. Harold C. Neumann, '17, Arthur H. Neumann & Bros., Inc., Hubbell Bldg.
Dubuque. Richard V. McKay, '06, Key City Gas Co., 669 Main St.

KENTUCKY:
Louisville. Frank D. Rash, '01, 55 Hill Rd., "Castlewood."

LOUISIANA:
New Orleans. Theo. O. Hotard, '12, Orleans Parish School Board, 703 Carondelet St.

MAINE:
Augusta. Willard B. Purinton, '22, Purinton Brothers Co., 333 Water St.
Bangor. Carl E. Danforth, '05, 164 Leighton St.
Portland. Stanley W. Hyde, '17, Prin., N. Yarmouth Academy, Yarmouth.

MARYLAND:
Baltimore. George W. Spaulding, '21, 1605 Lexington Bldg.

MICHIGAN:
Detroit. Charles T. Ellis, '17, 1377 Harvard Rd., Grosse Pointe Park.
Allyne C. Litchfield, '17, U. S. Rubber Products, Inc., 6600 E. Jefferson Ave.

MINNESOTA:
Duluth. William C. Lounsbury, '03, Minnesota Power and Light Co.
Minneapolis. Willis R. Salisbury, '12, Salisbury & Satterlee Co.
St. Paul. Winter Dean, '21, Nicols, Dean & Gregg.

MISSOURI:
Kansas City. James C. Irwin, Jr., '18, U. S. Cold Storage Corp., 500 E. Third St.
St. Louis. Herbert C. DeStaebler, '21, Lambert Pharmacal Co., 2117 Franklin Ave.
Delos G. Haynes, '09, 818 Olive St.

MONTANA:
Butte. William A. Kemper, '04, 118 W. Broadway.
Great Falls. Earl S. Bardwell, '06, 18 Smelter Hill.

NEBRASKA:
Omaha. Louis A. Metz, '23, Ceco Steel Products Corp., 1141 N. 11th St.

NEW HAMPSHIRE:
Concord. Leigh Spaulding Hall, '14, Hall Brothers Co., 31 S. Main St.

New Jersey:
Atlantic City. Harold I. Eaton, '09, Eastern Engineering Co., 4 N. North Carolina Ave.
Bloomfield. Carole A. Clarke, '21, 215 Linden Ave., Glen Ridge.
Camden. Robert E. Worden, '36, Campbell Soup Co., Second and Market Sts.
Dover. Howard B. Allen, '18, New Jersey Power and Light Co., 9 W. Blackwell St.
East Orange. Harold McCready, '09, 130 S. Munn Ave.
Elizabeth. Donald D. Way, '19, 226 Wychwood Rd., Westfield.
Glen Ridge. Stewart C. Coey, '06, 39 Wildwood Ter.
Hackensack. Harold H. Brackett, '12, 515 Summit Ave., Oradell.
Irvington. William J. Grady, '22, 26 N. Crescent, Maplewood.
Jersey City. Edwin S. Lockwood, '21, Public Service Electric and Gas Co., 325 Palisade Ave.
Kearny. Dr. Robert V. Townend, '14, 101 Seeley Ave., Arlington.
Manasquan. Munroe C. Hawes, '21, 111 Union Ave.
Maplewood. Gordon G. Holbrook, '10, 9 Beach St.
Millburn. A. Raymond Brooks, '17, Wayside, Brantwood, Short Hills.
Montclair. Livingston P. Ferris, '11, 11 Bellevue Ave., Upper Montclair.
Morristown. Everett W. Vilett, '22, 91 Whitney Rd., Short Hills.
Newark. Henry C. Colson, Jr., '09, Carnrick Co., 20 Mt. Pleasant Ave.
Orange. Frank Maguire, '17, 201 Vose Ave., S. Orange.
Passaic. Frank L. Bradley, '20, Forstmann Woolen Co.
Paterson. Edmund J. Thimme,'23, Valley View Ter., Packanack Lake.
Plainfield. Geoffrey M. Rollason, '13, Aluminum Co. of America, Garwood.
Ridgewood. Herman A. Affel, '14, 827 Morningside Rd.
Rutherford. Newton S. Foster, '28, 15 E. Pierrepont Ave.
South Orange. Alfred I. Phillips, Jr., '10, 211 Lenox Ave.
Summit. Winfield I. McNeill, '17, 14 Hillcrest Ave.
Trenton. Thomas H. Gill, '22, 9 Stuart Ave., Hillwood Lakes.
Westfield. Lyman L. Tremaine, '23, 422 Baker Ave.

New York:
Albany. Burt R. Rickards, '99, State Department of Health.
Binghamton. Irving K. Peck, '21, Binghamton Gas Works, 267 Court St.
Buffalo. Whitworth Ferguson, '22, Ferguson Electric Construction Co., 204 Oak St.
Marvine Gorham, '93, 420 Jackson Bldg.
Hudson. Robert A. Schmucker, '15, 545 Union St.
Newburgh. Thomas C. Desmond, '09, 94 Broadway.
New York City. William J. Barrett, '16, Metropolitan Life Insurance Co.
C. George Dandrow, '22, Johns-Manville Co., 22 E. 40th St.
Laurence B. Davis, '22, Socony-Vacuum Oil Co., Inc., 26 Broadway.
Charles P. Fiske, '14, General Motors Acceptance Corp., 1775 Broadway.
Saxton W. Fletcher, '18, J. O. Ross Eng. Corp., 350 Madison Ave.
Alfred T. Glassett, '20, W. J. Barney Corp., 101 Park Ave.
Laurence C. Hart, '13, Johns-Manville Co., 22 E. 40th St.
Irving D. Jakobson, '21, Jakobson Shipyard, Inc., West End Ave., Oyster Bay, L. I.
William T. Kniesner, '16, Room 2800, Commerce Bldg., 155 E. 44th St.
William H. Latham, '26, Director of Maintenance and Operation, Arsenal Bldg., 5th Ave. and 64th St.
Duncan R. Linsley, '22, First Boston Corp., 100 Broadway.
James A. Lyles, '27, Vice-President, First Boston Corp., 100 Broadway.
William H. Mueser, '22, Moran, Proctor, Freeman, and Mueser, 420 Lexington Ave.
John J. Murphy, '23, Linde Air Products Co., 30 E. 42d St.
Kenneth Reid, '18, Editor, *Pencil Points*, 330 W. 42d St.
Raymond C. Rundlett, '22, Curtis Publishing Co., 60 E. 42d St.
Robert P. Shaw, '23, N. Y. Museum of Science and Industry, R. C. A. Bldg., 30 Rockefeller Plaza.
Poughkeepsie. George T. Welch, '21, Comptroller, Vassar College.
Rochester. John F. Ancona, '03, 311 Hiram Sibley Bldg., 316 Alexander St.
Rome. Richard A. Wilkins, '18, Revere Copper and Brass, Inc.
Schenectady. Ralph C. Robinson, '01, Vacuum Tube Dept., Bldg. 37, General Electric Co.
Syracuse. Edwin A. Gruppe, '22, Central N.Y. Power Corp., 300 Erie Blvd., West.
Utica. Carl H. Anderson, '27, 280 Genesee St.

North Carolina:
Charlotte. Beaumert Whitton, '33, Southeastern Construction Co., 218 W. Second St.

Ohio:
Akron. Earl W. Glen, '29, Goodyear Tire and Rubber Co.
Cincinnati. Stuart R. Miller, '07, William S. Merrell Co., Lockland Station.
Cleveland. Howard P. Ferguson, '27, Standard Oil Co., Room 1754, Midland Bldg.
William C. Sessions, '26, Bosworth & Sessions, 1337 Guardian Bldg.
Henry G. Steinbrenner, '27, Kinsman Transit Co., 706 Rockefeller Bldg.
Columbus. Clarence E. Richards, '18, American Education Press, Inc., 400 S. Front St.
Dayton. Michael J. Gibbons, '06, 116 Thruston Blvd.
Toledo. Herbert A. Barnby, '23, Owens-Illinois Glass Co.
Youngstown. James L. Wick, '06, Falcon Bronze Co., 218 S. Phelps St.

Oklahoma:
Oklahoma City. Charles B. Stuart, '34, 812 N. W. 39th St.
Tulsa. William J. Sherry, '21, 804 Kennedy Bldg.

Oregon:
Portland. Ernest B. MacNaughton, '02, First National Bank.
A. Glenn Stanton, '21, Railway Exchange Bldg.

Pennsylvania:
Bethlehem. Charles H. Herty, Jr., '21, Bethlehem Steel Co.
Erie. John L. Parsons, '17, Hammermill Paper Co.
Harrisburg. Percy E. Tillson, '06, Bell Telephone Co. of Pennsylvania, 210 Pine St.
Lancaster. Charles K. Miller, '23, Armstrong Cork Co.
Philadelphia. Philip M. Alden, '22, Philadelphia Electric Co., 1000 Chestnut St.
H. W. Anderson, '15, Fidelity Machine Co., 3908 Frankford Ave.
Greville Haslam, '15, Episcopal Academy, Overbrook.
Pittsburgh. Elbridge J. Casselman, '15, Mellon Institute of Industrial Research, 4400 Fifth Ave.
Thomas Spooner, '09, Manager, Central Eng. Labs. and Stds. Dept., Westinghouse Elec. and Mfg. Co., E. Pittsburgh.
Reading. Allyn C. Taylor, '06, Consumers Gas Co., 441 Penn St.
Scranton. Robert K. Moore, Jr., '34, 1703 Madison Ave.

South Carolina:
Charleston. James F. Crist, '21, South Carolina Power Co.

Tennessee:
Chattanooga. Richard S. Bicknell, '10, 1516 Sunset Rd., N. Chattanooga.
Knoxville. Erwin Harsch, '20, Tenn. Valley Authority, 316 Union Bldg.
Memphis. C. W. Loomis, '16, Bemis Bro. Bag Co., P. O Box 2566, De Soto Station.
Nashville. Donald W. Southgate, '11, Nashville Trust Bldg.

Texas:

Dallas. Jonathan A. Noyes, '12, Sullivan Machinery Co., 1914 Commerce St.
El Paso. Charles I. Auer, '01, 1012 Park Rd.
Fort Worth. Count B. Capps, '20, W. B. Fishburn Cleaners, Inc., 1212 Main St.
Houston: George B. Forristall, '11, 10002 S. Main St., P. O. Box 112.
San Antonio. Terrell Bartlett, '06, The Terrell Bartlett Engineers, 912 Smith-Young Tower.

Utah:

Salt Lake City. Bayard W. Mendenhall, '02, Mendenhall Auto Parts Co., 28 S. W. Temple St.

Vermont:

Rutland. Birney C. Batcheller, '86, Wallingford.

Virginia:

Lynchburg. Edward R. Harris, '25, The Mead Corp.
Norfolk. Chas. W. Johnston, '05, 214 Broad St., Portsmouth.
Richmond. Donald N. Frazier, '11, American Mutual Liability Insurance Co., 1223 Mutual Bldg.

Washington:

Seattle. H. W. McCurdy, '22, Puget Sound Bridge and Dredging Co., 2929 16th Ave., S.W.
Spokane. Edward E. Scofield, '19, Washington Water Power Co.

West Virginia:

Charleston. William S. Brackett, '23, Carbide and Carbon Chemicals Corp., S. Charleston.

Wisconsin:

Milwaukee. Philip N. Cristal, '17, Northwestern Mutual Life Insurance Co.
Mitchell Mackie, '05, Central Office Bldgs., Inc., 207 E. Michigan St.

U. S. TERRITORIES AND DEPENDENCIES

Canal Zone:
Balboa Heights. Meade Bolton, '16, Box 23.

Hawaii:
Honolulu. William C. Furer, '06, 1909 Alco Pl.

FOREIGN COUNTRIES

Argentina:
Buenos Aires. Jose Carlos Bertino, '23, Central Naval, Florida 801.

Brazil:
Rio de Janeiro. Alexandre H. Leal, '35, Cia Carris, Luz e Forca, Avenida Marechal Floriano 168.

Canada:
Montreal, Que. Augustin Frigon, '11, Manager, Canadian Broadcasting Corp., 1440 St. Catherine St.
A. D. Ross, '22, Canadian Comstock Co., Ltd., Room 835, Dominion Square Bldg.
St. John, N. B. H. Usher Miller, '09, P. O. Box 796.
Toronto, Ont. John S. Keenan, '23, 29 Rosedale Heights Drive.
Winnipeg, Man. Richard C. Huggard, '30, Huggard & Moncrieff, Ltd., 1 Somerset Bldg.

Cuba:
Havana. Frank Sheldon, '40, Ruston Academy.

England:
London. David A. Shepard, '26, 36 Queen Anne's Gate, Westminster, London, S.W.1.

India:
Bombay. William F. Rivers, '26, c/o Standard-Vacuum Oil Co., P. O. Box 355.

Mexico:
Mexico City. George D. Camp, '16, Apartado 1005.

Peru:
Lima. Commander Charles Hibbard, '09, Mission Naval Americana, Ministerio de Marina.

Salvador, C. A.
San Salvador. Ernesto de Sola, '33.

Switzerland:
Zurich. Werner Schoop, '22, c/o Oelheizungs Ag. Flexflam, Splügenstr. 11.

APPENDIX C

STUDENT HOUSING

EFFECTIVE JULY 1, 1944. (*Subject to change*)

THE Massachusetts Institute of Technology reopened the Houses of the Undergraduate Dormitories for student occupancy on July 1, 1944. Rooms are available upon application in accordance with the following memorandum which gives a summary of prewar dormitory policy as previously published in the General Catalogue of the Institute but amended to conform to present circumstances. It is expected dormitory accommodations will now be available without interruption. The following information is effective, however, as of July 1, 1944, and subject to change.

THE GRADUATE HOUSE

The Graduate House, located at Memorial Drive and Massachusetts Avenue, Cambridge, directly across the Avenue from the main educational group, is being used exclusively by students of the United States Armed Services and is not available to civilian graduate students.

GOODALE, BEMIS, AND WALCOTT
(*Temporary Graduate House*)

Goodale, Bemis, and Walcott Halls of the dormitory unit on Ames Street, Cambridge (rear of Walker Memorial), are available for occupancy as a temporary Graduate House for registered male students. The term "registered student" includes part-time or full-time graduate students, junior staff members and research workers taking substantial academic work for credit toward a degree, and Army and Navy officers whose assignment to M. I. T. is primarily for study.

Accommodations consist of two hundred and eleven single rooms, fully equipped for occupancy. Equipment includes bed, mattress, pillow, blankets, chiffonier, desk and chair, study chair, bookcase, rug, draperies, desk lamp, and interconnecting telephone. Bed linen and towels are furnished and replaced regularly. The rental also includes heat, light, continuous hot and cold water, soap, towel and linen supply, and laundry service for bed linen and towels. The Dormitories have modern toilet and shower facilities.

Rentals will be at the rate of $6 per week, payable at the Dormitory Office in Munroe Hall, rear of Walker Memorial, with choice of available rooms. Payment of rent is due on a weekly basis on Monday of each week and must be paid in advance. A resident may, however, pay up to four weeks in advance. Rent week begins on Monday and adjustments in rental for a portion of a week will be at a rate of $1 per day.

Applicants for reservations in Goodale, Bemis, and Walcott should also refer to "INFORMATION FOR RESIDENTS" (last page of Appendix C) and should consult Mr. Henry K. Dow, Manager of Dormitories, Munroe Hall (telephone Kirkland 5300 or Kirkland 6900, Extension 437), address Massachusetts Institute of Technology Dormitories, 3 Ames Street, Cambridge 39, Mass., for further details.

THE SENIOR HOUSE

The Senior House, located on Memorial Drive, east of the Walker Memorial and the President's House, will be available in the near future.

MUNROE, HAYDEN, AND WOOD UNDERGRADUATE HOUSES

FOR CIVILIAN UNDERGRADUATE STUDENTS

GENERAL INFORMATION

The student housing facilities provided at the Massachusetts Institute of Technology have been carefully planned and organized to afford an economical, comfortable place in which to live, an environment conducive to study and an opportunity to participate in those social and extra-curricular activities which properly supplement scholastic work.

In addition to the Institute dormitories, the Institute recognizes twenty-three national fraternity chapters and one local fraternity, whose houses are situated on private property in Cambridge, Boston, and Brookline. Local apartment and rooming houses are also available, but lack the advantages of residence in the dormitories and fraternity houses, which provide more intimate contact with Technology life and activities.

Parents who anticipate fraternity affiliation for their sons should, if possible, grant them permission to act on their own initiative as approximately ninety per cent of the new fraternity men are pledged during or prior to the first week of the academic year, and may assume residence at the fraternity house of their choice immediately. Privileges in the cancellation of dormitory reservations are extended to those who make a prompt decision in order that accommodations may be immediately available to those on the waiting list who prefer residence in the dormitories.

Munroe, Hayden, and Wood have a capacity of two hundred and ten men. Most of the rooms are for single occupancy — some interconnecting — with a limited number of double and triple suites. There are lavatory installations in all these rooms, supplemented by adequate toilets and showers on each floor of every hall.

The government of the undergraduate house is administered as a part of the general plan of student self-government at the Massachusetts Institute of Technology, with the coöperation of the Dormitory Board, appointed by the President and acting in an advisory capacity.

EQUIPMENT

All rooms are *fully equipped for occupancy*, and additions by the students to the standard equipment are not permitted.

Single Rooms. Special bed or couch, all hair innerspring mattress with cover, pillow, couch cover, blankets, chiffonier, desk and chair, study chair, bookcase, rug, draperies, desk lamp, wastebasket and interconnecting telephone. Bed linen and towels are furnished, and regularly replaced, by porters who make up and clean the rooms each weekday.

Double and Triple Rooms. These rooms are furnished in a manner similar to the single rooms, but in addition have study tables.

SERVICE

In addition to space, the rental includes heat, light, continuous hot and cold water, intercommunicating telephone service, porter service, soap, towel and linen supply, and laundry service for bed linen and towels. The dormitory buildings are of first-class construction and are fireproof. Rooms are vacuum cleaned, mazda lamps are furnished and each room provided with extra electrical outlets. Steam heat is available throughout the year, day and night. The house service is directly in charge of the manager and is maintained by experienced porters. A representative of the Institute is on the premises day and night.

APPLICATION FOR ROOMS

Applications for rooms in the undergraduate houses should be made to Mr. Henry K. Dow, Manager of the Undergraduate Dormitories, Massachusetts Institute of Technology, 3 Ames Street, Cambridge 39, Mass. No application fees are required.

ALLOTMENT OF ROOMS

Students in Residence. The assignment of rooms by the Dormitory Board will be in order of application, but the Board reserves the right to reject any applicant for sufficient reason. Priority in the assignment of rooms is granted to undergraduates already living in the dormitories. Assignments will be made to these applicants immediately and a definite reservation made by the Manager of the Undergraduate Dormitories, provided a deposit covering rental for four weeks in advance is made. The Dormitory Board reserves the right to assign a registered student from the waiting list to a vacancy in a double or triple suite.

First-Year Students. Applications for rooms will be filed in order by date as received. Preference in the assignment of rooms will be granted, however, in order from this list to applicants whose admission as first-year students is approved by the Director of Admissions. Notification of an assignment will be forwarded to successful applicants, and a definite reservation made. Payment of rental four weeks in advance or for term if desired (see Rentals, Payments and Refunds) must be forwarded to Mr. Henry K. Dow, Manager of the Undergraduate Dormitories, Massachusetts Institute of Technology, 3 Ames Street, Cambridge 39, Mass., two weeks prior to the opening of any term; otherwise the rooms will be reassigned. Checks should be made payable to D. L. Rhind, Bursar.

Due to the privileges in the cancellation of dormitory reservations extended to those who affiliate with recognized fraternities, a number of rooms may become available for occupancy at the beginning of any term. Applicants on the waiting list should, therefore, report in person to the Office of the Manager, Undergraduate Dormitories (rear of Walker Memorial), on arrival, to apply for immediate assignment to rooms released by cancellation or withdrawal, or to withdraw their names from the waiting list, if accommodations have been secured elsewhere.

RENTALS, PAYMENTS, AND REFUNDS

A standard rental for the rooms in Munroe, Hayden and Wood of $6 a week, payable in units of $24 or four weeks in advance, regardless of location, has been established. The majority of the rooms in these units are similar in every respect.

Parents or guardians who so desire may make larger payments in advance, subject to adjustment. Under present circumstances academic terms vary in length. The academic year beginning in July 1944 covers a 35-week period; therefore advance payment of $105 for each term is recommended.

Reservations may be cancelled and payment refunded ten days before the opening of any term upon written notice to the Manager of the Dormitories. Within 15 days after the opening of any term, students who desire to move to recognized fraternity houses will be refunded any payment which has been made less a $6 charge for each week or fraction thereof of reservation or occupancy, provided authorized representatives of the fraternities request such transfer.

Other students who desire to move from the dormitories and who do not contemplate leaving the Institute will be refunded any payment which has been made less a $6 charge for each week or fraction thereof of reservation or occupancy, less $10, unless another student is available on the waiting list to assume occupancy immediately.

Reservations are automatically cancelled upon the withdrawal of a student from the Institute or transfer to a coöperative course and a proportionate refund on a weekly basis allowed. The student is not allowed, however, to sublet or transfer his room, or his share in a room, without the consent of the Dormitory Board.

INFORMATION FOR RESIDENTS
M. I. T. DORMITORIES

TEMPORARY GRADUATE HOUSE
(Walcott, Bemis, Goodale)

UNDERGRADUATE HOUSE (Munroe, Hayden, Wood)

Information and Regulations

KEY DEPOSITS AND REFUND. A deposit of $1 is required for room and mail-box keys, subject to refund in full when returned.

LAUNDRY AND VALET SERVICE. Laundry service is on a cash basis. Laundry bags, slips and tags are available at the office desk. Notification of return of laundry will be through the mail boxes. Laundry service one week, valet service four days. Prices reasonable.

TELEPHONE AND WESTERN UNION SERVICE. Long-distance and local calls received through the dormitory switchboard will be relayed through telephones located on each floor. Intercommunicating and Institute service is available through the room telephones. Western Union messages may be sent from the office. *Telephone number is Kirkland 5300.*

PORTER SERVICE. Available Monday through Saturday only. Sunday porter service is limited under present conditions to cases of emergency only. Residents are required to care for their rooms on Sundays.

VISITORS. The dormitories are for men only, and persons of the opposite sex are not permitted in the rooms or buildings, except the dormitory office, and the Burton Room, Munroe Hall. The use of liquor and the preparation of meals or cooking of any kind on the premises are prohibited. Violation of these regulations will result in the cancellation of room assignments.

DINING SERVICE. Dining facilities are in the Walker Memorial, headquarters of student activities, adjacent to the dormitories, on a cafeteria basis. No board by the day or week is furnished, and no student is required to use this service. Because of the low cost and the excellent facilities, however, about 2000 meals a day are served. Under wartime conditions, the dining service operates six days a week. A sandwich and soda bar is, however, available seven days a week and there are suitable dining facilities in the vicinity which are open on Sundays.

STORAGE. Space is available in the basement for trunks and baggage at the owner's risk. The Institute assumes no liability, and articles must be removed when occupancy is cancelled. No boxes or trunks will be permitted in the rooms.

EQUIPMENT. The dormitory rooms are equipped for occupancy and additions to the standard equipment are not permitted.

MAIL AND EXPRESS. Packages and mail should be addressed to Massachusetts Institute of Technology Dormitories, 3 Ames Street, Cambridge 39, Mass.

INDEX TO SUBJECTS OF INSTRUCTION

(With reference to pages containing description)

ALPHABETICAL INDEX