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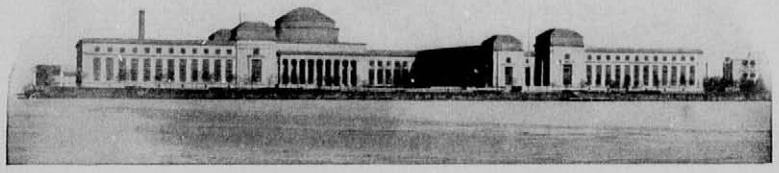
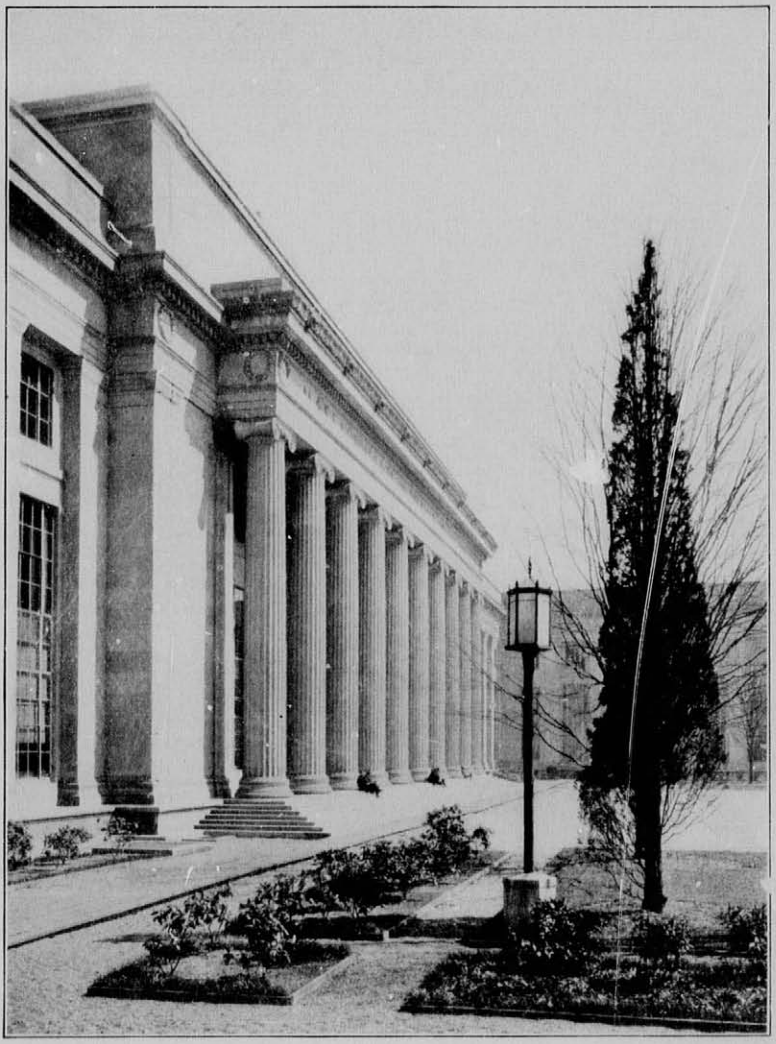


# Massachusetts Institute of Technology

## The Courses of Study
AND
## Subjects of Instruction

Cambridge, Massachusetts
APRIL 1922



MAIN ENTRANCE FROM EASTMAN COURT

VOLUME 57 NUMBER 6

Massachusetts
Institute of Technology

# THE COURSES OF STUDY

AND

# SUBJECTS OF INSTRUCTION

INCLUDING SPECIAL COURSES ARRANGED FOR OFFICERS OF THE UNITED STATES ARMY AND FOR OFFICERS OF THE UNITED STATES NAVY

APRIL 1922
THE TECHNOLOGY PRESS
CAMBRIDGE

## CALENDAR

| For Academic Year | 1921–22 | 1922–23 | 1923–24 |
|---|---|---|---|
| Entrance Examinations at Technology Begin | Sept. 24 | Sept. 20 | Sept. 19 |
| College Year Begins | Oct. 3 | Oct. 2 | Oct. 1 |
| December Examinations | Dec. 16–22 | Dec. 15–21 | Dec. 15–21 |
| Christmas Vacation | Dec. 23–Jan. 2 | Dec. 22–Jan. 1 | Dec. 22–Jan. 1 |
| Second Term Begins | 1922 Jan. 3 | 1923 Jan. 2 | 1924 Jan. 2 |
| Final and Condition Examinations | Mar. 13–18 | Mar. 12–17 | Mar. 10–15 |
| Third Term Begins | Mar. 20 | Mar. 21 | Mar. 19 |
| Spring Recess | April 17–19 | April 19–21 | April 21–23 |
| Last Exercise, Third Term | June 1 | June 1 | May 29 |
| Final and Condition Examinations | June 2–13 | June 2–13 | June 1–11 |
| Last Examination, Fourth Year | June 5 | June 5 | June 3 |
| Commencement Day | June 12 | June 12 | June 10 |
| Examinations, College Entrance Examination Board | June 19–24 | June 18–23 | June 16–21 |
| Summer Camp Begins | Aug. 1 | July 31 | Aug. 5 |

Exercises are omitted on legal holidays of Massachusetts.

# TABLE OF CONTENTS

## A NOTE CONCERNING THE INSTITUTE PUBLICATIONS

The regular publications of the Massachusetts Institute of Technology are as follows:

GENERAL INFORMATION, a pamphlet sent to candidates for admission.

SCHOLARSHIPS, FELLOWSHIPS AND PRIZES.

DIRECTORY OF OFFICERS AND STUDENTS, the personnel of the staff and the students.

PRESIDENT'S REPORT TO THE CORPORATION, including the Treasurer's Report.

THE SUMMER SESSION AND THE SUMMER CAMP.

COURSES OF STUDY AND SUBJECTS OF INSTRUCTION, a detailed account of the curriculum.

GRADUATE STUDY AND RESEARCH.

This pamphlet, COURSES OF STUDY AND SUBJECTS OF INSTRUCTION, gives the curriculum in detail, with descriptions of the subjects of study given by the various departments of the Institute. This pamphlet includes:

Schedules of the Professional Courses.
Description of the subjects of instruction.
Tabulation of the subjects with
  Hours of exercise.
  Year and Term.
  Instructor in charge.
  Required preparation.
Laboratory Fees.
Alphabetical list of subjects.
Required preparation for subjects of instruction.

For a general description of the Professional Courses, with a statement of their purposes, the intending student is referred to the pamphlet of GENERAL INFORMATION which should be consulted in connection with this publication.

## FIRST YEAR. All Courses Except IV.

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Chemistry 5·01, 5·02, 5·03 | 80 — 50 | 80 — 50 | 80 — 50 |
| Descriptive Geometry D171, 172, 173 | 30 — 0 | 30 — 0 | 30 — 0 |
| English and History, EH11, 12, 13 | 30 — 50 | 30 — 50 | 30 — 50 |
| Machine Drawing, Elem. D122, 123 | .. .. | 30 — 0 | 30 — 0 |
| Mathematics M11, 12, 13 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Drawing D101 | 30 — 0 | | |
| Military Science MS21, 22, 23 | 30 — 0 | .. .. | .. .. |
| Physical Training PT15 | 10 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·011, 8·012, 8·013 | 40 — 50 | 20 — 0 | 10 — 0 |
| | | 40 — 50 | 40 — 50 |
| Hours of exercises and preparation: | 490 = 280 + 210 | 500 = 290 + 210 | 490 = 280 + 210 |

## FIRST YEAR. COURSE IV. OPTION 1

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Architectural Drawing, Elem. D132, 133 | .. .. | 30 — 0 | 30 — 0 |
| Architectural History 4·41 | 20 — 40 | 20 — 40 | 20 — 40 |
| Descriptive Geom. D171, 172, 173 | 30 — 0 | 30 — 0 | 30 — 0 |
| English and History EH11, 12, 13 | 30 — 50 | 30 — 50 | 30 — 50 |
| Freehand Drawing D151, 152, 153 | 70 — 0 | 30 — 0 | 40 — 0 |
| French L63 | 20 — 40 | 20 — 40 | 20 — 40 |
| Mathematics M11, 12, 13 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Drawing D101 | 30 — 0 | | |
| Military Science MS21, 22, 23 | 30 — 0 | .. .. | .. .. |
| Perspective 4·12 | .. .. | 30 — 0 | 30 — 0 |
| Physical Training PT15 | 10 — 0 | 10 — 30 | 10 — 20 |
| Theory of Design 4·30 | 10 — 20 | 20 — 0 | 10 — 0 |
| | | 10 — 20 | 10 — 20 |
| Hours of exercises and preparation | 490 = 280 + 210 | 500 = 260 + 240 | 490 = 260 + 230 |

## FIRST YEAR. COURSE IV. OPTION 2

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Architectural Drawing, Elem. D132, 133 | .. .. | 30 — 0 | 30 — 0 |
| Chemistry 5·01, 5·02, 5·03 | 80 — 50 | 80 — 50 | 80 — 50 |
| Descriptive Geometry D171, 172, 173 | 30 — 0 | 30 — 0 | 30 — 0 |
| English and History EH11, 12, 13 | 30 — 50 | 30 — 50 | 30 — 50 |
| Mathematics M11, 12, 13 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Drawing D101 | 30 — 0 | | |
| Military Science MS21, 22, 23 | 30 — 0 | .. .. | .. .. |
| Physical Training PT15 | 10 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·011, 8·012, 8·013 | 40 — 50 | 20 — 0 | 10 — 0 |
| | | 40 — 50 | 40 — 50 |
| Hours of exercises and preparation: | 490 = 280 + 210 | 500 = 290 + 210 | 490 = 280 + 210 |

## FIRST YEAR (JUNIOR GRADE). All Courses Except IV.

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| | Jan. 2–Mar. 17 | Mar. 20–June 12 | Summer |
| Chemistry 5·01, 5·02, 5·03 | 80 — 50 | 80 — 50 | 80 — 50 |
| Descriptive Geometry D171, 172, 173 | 30 — 0 | 30 — 0 | 30 — 0 |
| English and History EH11, 12, 13 | 30 — 50 | 30 — 50 | 30 — 50 |
| Machine Drawing, Elementary D122, 123 | .. .. | 30 — 0 | 30 — 0 |
| Mathematics M11, 12, 13 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Drawing D101 | 30 — 0 | | |
| Military Science MS11, 12, 13 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physical Training PT15 | 10 — 0 | 20 — 0 | |
| Physics 8·011, 8·012, 8·013 | 40 — 50 | 40 — 50 | 40 — 50 |
| Hours of exercises and preparation: | 490 = 280 + 210 | 500 = 290 + 210 | 480 = 280 + 200 |

# Civil Engineering — COURSE I

**First year, Page 4. Description of Subjects of Instruction, Pages 49-130**

## SECOND YEAR ALL OPTIONS

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| Astronomy 1·12 | .. .. | 30 — 30 | .. .. |
| Descriptive Geometry D211 | 60 — 45 | .. .. | .. .. |
| English and History EH21, EH22, EH23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Geodesy 1·13 | .. .. | .. .. | 30 — 30 |
| Graphic Statics 1·39 | .. .. | 40 — 20 | .. .. |
| Map Reading and Topographical Draw. 1·19 | .. .. | .. .. | 30 — 0 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanism 2·02 | 30 — 45 | .. .. | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Spherical Trigonometry 1·11 | 10 — 20 | .. .. | .. .. |
| Surveying and Plotting 1·00 | .. .. | 30 — 60 | 30 — 0 |
| Hours of exercises and preparation: | 500 = 230 + 270 | 500 = 230 + 270 | 500 = 250 + 250 |

## REQUIRED SUMMER COURSES AT CAMP TECHNOLOGY

| | |
|---|---|
| Geodetic and Topographic Surveying 1·08 | 100 hours |
| Hydrographic Surveying 1·60 | 75 hours |
| Plane Surveying 1·07 | 100 hours |
| Railway Fieldwork 1·20 | 80 hours |

## THIRD YEAR

### OPTION 1. Hydraulic Engineering

### OPTION 2. Transportation Engineering

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·21, 2·221, 2·221 | 30 — 60 | 20 — 30 | 20 — 30 |
| Electrical Engineering, Elem. of 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·86 | .. .. | 20 — 30 | .. .. |
| Geology 12·301, 12·311, 12·321 | 30 — 20 | 40 — 25 | 30 — 30 |
| Materials 1·43 | .. .. | .. .. | 20 — 40 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Railway Drafting 1·23 | 60 — 0 | 60 — 0 | .. .. |
| Railway and Highway Engineering 1·21 | 30 — 55 | 30 — 30 | .. .. |
| Roads and Pavements 1·30 | .. .. | .. .. | 20 — 20 |
| Structures 1·40 | .. .. | .. .. | 40 — 80 |
| Testing Materials Laboratory 2·36 | .. .. | .. .. | 20 — 10 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 240 + 240 | 480 = 260 + 220 | 480 = 210 + 270 |

## THIRD YEAR

### OPTION 3. Hydro-electric Engineering

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Accounting Ec50 | 40 — 50 | .. .. | .. .. |
| Applied Mechanics 2·21, 2·221, 2·221 | 30 — 60 | 20 — 30 | 20 — 30 |
| Electrical Engineering, Elem. of 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | 30 — 30 | .. .. |
| Geology 12·301, 12·311, 12·321 | 30 — 15 | 40 — 25 | 30 — 30 |
| Hydraulics 1·62 | .. .. | .. .. | 40 — 60 |
| Materials 1·43 | .. .. | .. .. | 20 — 40 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Railway and Highway Engineering 1·21 | 20 — 40 | 20 — 30 | .. .. |
| Structures 1.41 | .. .. | 20 — 40 | 20 — 40 |
| Testing Materials Laboratory 2·36 | .. .. | .. .. | 20 — 10 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 210 + 270 | 480 = 220 + 260 | 480 = 210 + 270 |

## Civil Engineering — COURSE I — *Continued*

### FOURTH YEAR

### OPTION 1. Hydraulic Engineering

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Bridge Design 1·53 | 50 — 0 | 60 — 0 | 70 — 0 |
| Engineering and Hydraulic Lab. 2·64 | .. .. | .. .. | 30 — 30 |
| Foundations 1·48 | 10 — 15 | .. .. | .. .. |
| Heat Engineering 2·46, 2·47, 2·48 | 30 — 60 | 30 — 60 | 30 — 30 |
| Hydraulic and Sanitary Design 1·79 | .. .. | .. .. | 30 — 0 |
| Hydraulic and Sanitary Eng. 1·75 | 30 — 45 | 30 — 50 | 30 — 60 |
| Hydraulics 1·62 | 40 — 80 | .. .. | .. .. |
| Sanitary Science and Public Health 7·56 | .. .. | .. .. | 20 — 0 |
| Structures 1·49 | 40 — 80 | 50 — 100 | 30 — 60 |
| Thesis | .. .. | 40 — 0 | 60 — 0 |
| General Study | .. .. | 30 — 30 | .. .. |
| Hours of exercises and preparation: | 480 = 200 + 280 | 480 = 240 + 240 | 480 = 300 + 180 |

### FOURTH YEAR

### OPTION 2. (a and b) Transportation Engineering

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Bridge Design 1·53 | 50 — 0 | 60 — 0 | 70 — 0 |
| (b) Chemistry of Road Materials 5·37 | .. .. | 60 — 10 | .. .. |
| Engineering and Hydraulic Lab. 2·64 | .. .. | .. .. | 30 — 30 |
| Foundations 1·48 | 10 — 15 | .. .. | .. .. |
| Heat Engineering 2·46, 2·47, 2·48 | 30 — 60 | 30 — 60 | 30 — 30 |
| (b) Highway Design 1·33 | .. .. | .. .. | 40 — 0 |
| (b) Highway Transportation 1·32 | .. .. | .. .. | 30 — 50 |
| Hydraulics 1·62 | 40 — 80 | .. .. | .. .. |
| (a) Railway Design 1·26 | .. .. | 40 — 0 | 40 — 0 |
| (a) Railway Engineering 1·25 | .. .. | 20 — 40 | 30 — 50 |
| Railway and Highway Engineering 1·24 | 30 — 45 | .. .. | .. .. |
| Structures 1·49 | 40 — 80 | 50 — 100 | 30 — 60 |
| (b) Testing Highway Materials 1·31 | .. .. | 15 — 15 | .. .. |
| Thesis | .. .. | 20 — 0 | 80 — 0 |
| General Study | .. .. | 30 — 30 | .. .. |
| Hours of exercises and preparation: | | | |
| (2a) | 480 = 200 + 280 | 480 = 250 + 230 | 480 = 310 + 170 |
| (2b) | 480 = 200 + 280 | 480 = 265 + 215 | 480 = 310 + 170 |

### FOURTH YEAR

### OPTION 3. Hydro-electric Engineering

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Central Stations 6·231 | .. .. | .. .. | 30 — 60 |
| Electric Transmission and Distribution of Energy 6·44 | 30 — 60 | .. .. | .. .. |
| Foundations 1·48 | 10 — 15 | .. .. | .. .. |
| Heat Engineering 2·46, 2·47, 2·48 | 30 — 60 | 30 — 60 | 30 — 30 |
| Report Writing E33 | .. .. | 30 — 30 | .. .. |
| Steam and Hydraulic Lab. 2·65 | .. .. | .. .. | 40 — 40 |
| Structural Design 1·531 | 50 — 0 | 60 — 0 | 30 — 0 |
| Structures 1·50 | 40 — 80 | 50 — 100 | .. .. |
| Water Power Engineering 1·69, 1·70, 1·71 | 30 — 60 | 30 — 60 | 80 — 20 |
| General Study | .. .. | .. .. | 30 — 30 |
| Thesis | 15 — 0 | 30 — 0 | 60 — 0 |
| Hours of exercises and preparation: | 480 = 205 + 275 | 480 = 230 + 250 | 480 = 300 + 180 |

# Mechanical Engineering — COURSE II

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·202 | .. .. | .. .. | 40 — 60 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Forging 2·801, 2·802 | 30 — 0 | 30 — 0 | .. .. |
| Foundry 2·82 | .. .. | 60 — 0 | .. .. |
| Machine Drawing 2·12 | .. .. | .. .. | 60 — 0 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Engineering Drawing 2·10, 2·11 | 60 — 0 | 30 — 0 | .. .. |
| Mechanism 2·00, 2·01 | 30 — 60 | 30 — 60 | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Pattern Making 2·84 | .. .. | .. .. | 50 — 0 |
| Physics 8·021, 8.022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Surveying 1·02 | 30 — 0 | .. .. | .. .. |
| Hours of exercises and preparation: | 500 = 280 + 220 | 500 = 280 + 220 | 500 = 280 + 220 |

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·212, 2·222, 2·232 | 40 — 60 | 40 — 60 | 30 — 50 |
| Engineering Laboratory 2.602, 2·603 | .. .. | 20 — 10 | 20 — 10 |
| Heat Engineering { 2·40, 2·42, 2·44 | 30 — 60 | 30 — 60 | 20 — 30 |
| Heat Engineering { 2·41, 2·43, 2·432 | 20 — 10 | 20 — 10 | 20 — 10 |
| Hydraulics 1·65 | .. .. | .. .. | 20 — 40 |
| Machine Design 2·702, 2·703 | .. .. | 30 — 0 | 30 — 0 |
| Machine Drawing 2·13 | 30 — 0 | .. .. | .. .. |
| Machine Tool Work 2·88, 2·90 | .. .. | 40 — 0 | 40 — 0 |
| Materials of Engineering 2·302, 2·303 | .. .. | 20 — 20 | 20 — 20 |
| Mechanism of Machines 2·05 | 30 — 40 | .. .. | .. .. |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Vise and Bench Work 2·86 | 40 — 0 | .. .. | .. .. |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 250 + 230 | 480 = 260 + 220 | 480 = 260 + 220 |

## Mechanical Engineering — COURSE II — *Continued*

### FOURTH YEAR. General Course

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Dynamics of Machines 2·25 | 30 — 40 | .. .. | .. .. |
| Electrical Engineering, Elem. of 6.41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Engineering Laboratory 2.61, 2·62 | 40 — 40 | 40 — 40 | .. .. |
| General Engineering Lectures 2·76 | .. .. | 10 — 0 | .. .. |
| Heat Engineering 2·451, 2·452 | 20 — 30 | 20 — 20 | .. .. |
| Hydraulic Engineering 1·68 | 30 — 45 | .. .. | .. .. |
| Industrial Plants 2·77, 2·78 | .. .. | 50 — 35 | 60 — 10 |
| Machine Design 2·71, 2·72 | 60 — 0 | 60 — 0 | .. .. |
| Machine Tool Work 2·92 | 40 — 0 | .. .. | .. .. |
| Mechanics of Engineering 2·262, 2·263 | .. .. | 20 — 30 | 20 — 40 |
| Power Plant Design 2·58 | .. .. | .. .. | 60 — 0 |
| Testing Materials Laboratory 2·351, 2·352 | 20 — 10 | 20 — 20 | .. .. |
| General Study | .. .. | .. .. | 30 — 30 |
| Thesis | .. .. | .. .. | 120 — 0 |
| Electives *2·75 | .. .. | 40 — 0 | 40 — 0 |
| Hours of exercises and prepartion: | 480 = 270 + 210 | 485 = 290 + 195 | 480 = 360 + 120 |

*In the second and third terms of the fourth year an elective, or electives, must be taken by each student, these electives totalling at least 70 hours. The electives may be chosen from the list offered by the Department of Mechanical Engineering, or other subjects for which the student has the adequate preparation may be taken if approved by the Department.

### ELECTIVES OFFERED BY MECHANICAL ENGINEERING DEPARTMENT

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| 1. Automatic Machinery 2·751 | .. .. | 20 — 20 | 20 — 20 |
| 2. Fire Protection Engineering 2·754 | .. .. | 20 — 20 | .. .. |
| 3. Heat Transmission 2·755 | .. .. | 20 — 20 | .. .. |
| 4. Heat Treatment 2·756 | .. .. | 40 — 0 | 40 — 0 |
| 5. Internal Combustion Engines 2·757 | .. .. | 20 — 20 | 20 — 20 |
| 6. Locomotive Engineering 2·758 | .. .. | 40 — 0 | 40 — 0 |
| 7. Mechanical Equipment of Buildings 2·752 | .. .. | .. .. | 20 — 20 |
| 8. Refrigeration 2·759 | .. .. | .. .. | 20 — 20 |
| 9. Steam Turbine Engineering 2·753 | .. .. | 20 — 20 | .. .. |
| 10. Theory of Elaticity 2·7510 | .. .. | 20 — 20 | .. .. |

### ELECTIVES OFFERED BY DEPARTMENT OF MINING, METALLURGY AND GEOLOGY

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Metallurgy of the Common Metals 3·49 | .. .. | 20 — 20 | 20 — 20 |

### ELECTIVES OFFERED BY DEPARTMENT OF CHEMISTRY

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Chemistry 5·342 | .. .. | 20 — 20 or | 20 — 20 |
| Engineering Chemistry 5·343 | .. .. | 20 — 20 or | 20 — 20 |
| Industrial Water Analysis 5·21 | .. .. | 30 — 0 | .. .. |
| Testing of Oils 5·361 | .. .. | 35 — 5 or | 35 — 5 |

### ELECTIVE OFFERED IN AERONAUTICAL ENGINEERING

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Aeronautics 8·591 | .. .. | 30 — 30 | 30 — 30 |

## Mechanical Engineering — COURSE II — *Continued*

### FOURTH YEAR

### OPTION 1. Automotive Engineering

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Automotive Engineering 2·792, 2·793 | .. .. | 20 — 20 | 60 — 20 |
| Dynamics of Machines 2·25 | 30 — 45 | .. .. | .. .. |
| Elements of Electrical Engineering, 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Engineering Laboratory 2·61, 2·62 | 40 — 40 | 40 — 40 | .. .. |
| General Engineering Lectures, 2·76 | .. .. | 10 — 0 | .. .. |
| Heat Engineering 2·451, 2·452 | 20 — 30 | 20 — 20 | .. .. |
| Hydraulic Engineering 1·68 | 30 — 40 | .. .. | .. .. |
| Industrial Plants 2·77 | .. .. | 50 — 35 | .. .. |
| Machine Design 2·71, 2·72 | 60 — 0 | 60 — 0 | .. .. |
| Machine Tool Work 2·92 | 40 — 0 | .. .. | .. .. |
| Materials and Heat Treatment 2·33 | .. .. | .. .. | 20 — 10 |
| Mechanics of Engineering 2·262, 2·263 | .. .. | 20 — 30 | 20 — 40 |
| Power Plant Design 2·58 | .. .. | .. .. | 60 — 0 |
| Testing Materials Laboratory 2·351, 2·352 | 20 — 10 | 20 — 20 | .. .. |
| General Study | .. .. | .. .. | 30 — 30 |
| Thesis | .. .. | .. .. | 120 — 0 |
| | 270+210 480 | 270+210 480 | 340+140 480 |

### FOURTH YEAR

### OPTION 2. Engine Design

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Dynamics of Machines 2·25 | 30 — 45 | .. .. | .. .. |
| Elements of Electrical Engineering 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Engineering Laboratory 2·61, 2·62 | 40 — 40 | 40 — 40 | .. .. |
| Engine Design 2·732, 2·733 | .. .. | 40 — 0 | 60 — 20 |
| General Engineering Lectures 2·76 | .. .. | 10 — 0 | .. .. |
| Heat Engineering 2·451, 2·452 | 20 — 30 | 20 — 20 | .. .. |
| Hydraulic Engineering 1·68 | 30 — 40 | .. .. | .. .. |
| Industrial Plants 2·77 | .. .. | 50 — 35 | .. .. |
| Machine Design 2·71, 2·72 | 60 — 0 | 60 — 0 | .. .. |
| Machine Tool Work 2·92 | 40 — 0 | .. .. | .. .. |
| Materials and Heat Treatment 2·33 | .. .. | .. .. | 20 — 10 |
| Mechanics of Engineering 2·262, 2·263 | .. .. | 20 — 30 | 20 — 40 |
| Power Plant Design 2·58 | .. .. | .. .. | 60 — 0 |
| Testing Materials Laboratory 2·351, 2·352 | 20 — 10 | 20 — 20 | .. .. |
| General Study | .. .. | .. .. | 30 — 30 |
| Thesis | .. .. | .. .. | 120 — 0 |
| | 270+210 480 | 290+190 480 | 340+140 480 |

## Mechanical Engineering — COURSE II — *Continued*

### FOURTH YEAR

### OPTION 3. Textile Engineering

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Dynamics of Machines 2.25 | 30 — 45 | .. .. | .. .. |
| Elements of Electrical Engineering, 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Engineering Laboratory 2·61, 2·62 | 40 — 40 | 40 — 40 | .. .. |
| Fire Protection Engineering 2·754 | .. .. | 20 — 20 | .. .. |
| General Engineering Lectures 2·76 | .. .. | 10 — 0 | .. .. |
| Heat Engineering 2·451, 2·452 | 20 — 30 | 20 — 20 | .. .. |
| Hydraulic Engineering 1·68 | 30 — 40 | .. .. | .. .. |
| Industrial Plants 2·77 | .. .. | 50 — 35 | .. .. |
| Machine Design 2·71, 2·72 | 60 — 0 | 60 — 0 | .. .. |
| Machine Tool Work 2·92 | 40 — 0 | .. .. | .. .. |
| Mechanics of Engineering 2·262, 2·263 | .. .. | 20 — 30 | 20 — 40 |
| Power Plant Design 2·58 | .. .. | .. .. | 60 — 0 |
| Testing Materials Laboratory 2·351, 2·352 | 20 — 10 | 20 — 20 | .. .. |
| Textile Engineering 2·69 | .. .. | .. .. | 80 — 30 |
| General Study | .. .. | .. .. | 30 — 30 |
| Thesis | .. .. | .. .. | 120 — 0 |
| Hours of exercises and preparation: | 270+210 480 | 270+210 480 | 340+140 480 |

### FOURTH YEAR

### OPTION 4. Ordnance R. O. T. C.

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Dynamics of Machines 2·25 | 30 — 45 | .. .. | .. .. |
| Elements of Electrical Engineering 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Engineering Laboratory 2·61, 2·62 | 40 — 40 | 40 — 40 | .. .. |
| General Engineering Lectures 2·76 | .. .. | 10 — 0 | .. .. |
| Heat Engineering 2·451, 2·452 | 20 — 30 | 20 — 20 | .. .. |
| Heat Treatment 2·756 | .. .. | .. .. | 40 — 0 |
| Hydraulic Engineering 1·68 | 30 — 40 | .. .. | .. .. |
| Industrial Plants 2·77 | .. .. | 50 — 35 | .. .. |
| Machine Design 2·71, 2·72 | 60 — 0 | 60 — 0 | .. .. |
| Machine Tool Work 2·92 | 40 — 0 | .. .. | .. .. |
| Mechanics of Engineering 2·262, 2·263 | .. .. | 20 — 30 | 20 — 40 |
| Ordnance Engineering 2·292, 2·293 | .. .. | 30 — 10 | 50 — 20 |
| Power Plant Design 2·58 | .. .. | .. .. | 60 — 0 |
| Testing Materials Laboratory 2·351, 2·352 | 20 — 10 | 20 — 20 | .. .. |
| General Study | .. .. | .. .. | 30 — 30 |
| Thesis | .. .. | .. .. | 120 — 0 |
| Hours of exercises and preparation: | 270+210 480 | 280+200 480 | 350+130 480 |

Students enrolled in the Ordnance unit of the Reserve Officers Training Corps will in general register for Option. Exceptions may be made in cases approved by both the Military Science Department and the Mechanical Engineering Department.

## Mechanical Engineering — COURSE II — *Continued*

### ARMY ORDNANCE

This work begins with a summer session extending from July 5 to September 23, inclusive. Subjects covered: Differential Equations, M72, a course of two hundred and twenty-nine hours; Ordnance Engineering 2·67, this course extending through a period of two hundred and eighteen hours.

**Schedule for the academic year**

| | First Term | Second Term | Third Term |
|---|---|---|---|
| Chemical Laboratory 5·80d, 5·80e | 60 — 0 | .. .. | 100 — 0 |
| Chemistry Lect. (Explosives) 5·80a, 5·80b, 5·80c. | 20 — 30 | 30 — 30 | 10 — 10 |
| Heat Engineering 2·46, 2·47, 2·48 | 30 — 60 | 30 — 60 | 30 — 60 |
| Ordnance Engineering 2·681, 2·682, 2·683 | 40 — 80 | 30 — 50 | 20 — 20 |
| Theory of Elasticity 2·271, 2·272 | .. .. | 30 — 60 | 30 — 60 |
| Electrical Engineering Lectures 6·431, 6·432 | 40 — 40 | 30 — 30 | .. .. |
| Electrical Engineering Laboratory 6·91, 6·92 | .. .. | 100 — 40 | 80 — 20 |
| Machine Tool Work 2·881 | 120 — 0 | .. .. | .. .. |
| Power Laboratory 2·66 | .. .. | .. .. | 40 — 40 |
| | 310+210 | 250+270 | 310+210 |

Officers of the Ordnance Department, United States Army, taking Course II Ordnance School at Watertown Arsenal, will take a course marked: Gas Engine Laboratory, No. 2·631. This course being of one hundred and ninety-five hours' duration, from September 7 to October 11, inclusive.

## Mechanical Engineering — COURSE II — *Continued*

### ORDNANCE DESIGN, UNITED STATES NAVY

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Alternating Currents and Alternating Current Machinery 6·54 | 30 — 60 | .. .. | .. .. |
| Dynamics of Machines 2·25 | 30 — 40 | .. .. | .. .. |
| Dynamo Design (A. C.) 6·26 | .. .. | 30 — 60 | .. .. |
| Electrical Engineering Laboratory, Sp. | .. .. | .. .. | 100 |
| Interior Ballistics 2·685 | .. .. | .. .. | 30 — 30 |
| Machine Design 2·71 | 60 — 0 | .. .. | .. .. |
| Machine Design 2·72 | .. .. | 60 — 0 | .. .. |
| Machine Design Adv. 2·74 | .. .. | .. .. | 120 — 0 |
| Mathematical Laboratory M54 | .. .. | 20 — 40 | .. .. |
| Mechanism of Machines 2·05 | 30 — 40 | .. .. | .. .. |
| Mechanics of Engineering 2·262, 2·263 | .. .. | 20 — 30 | 20 — 40 |
| Metallography I 3·61 | 60 — 20 | .. .. | .. .. |
| Metallography I 3·62 | .. .. | 20 — 0 | .. .. |
| Metallurgy of Engineering Materials 3·43 | .. .. | .. .. | 40 — 80 |
| Structural Design 1·52 | .. .. | 60 — 0 | .. .. |
| Structures, Theory of 1·45 | 20 — 40 | 30 — 60 | .. .. |
| Theory of Elasticity 2·28 | 30 — 60 | 30 — 60 | .. .. |
| Theory of the Gyroscope M57 | .. .. | .. .. | 20 — 40 |
| Hours of exercises and preparation: | 520 = 260 + 260 | 520 = 270 + 250 | 520 = 330 + 190 |

### TORPEDO DESIGN, UNITED STATES NAVY

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Alternating Currents and Alternating Current Machinery 6·45 | 30 — 60 | .. .. | .. .. |
| Dynamics of Machines 2·25 | 30 — 40 | .. .. | .. .. |
| Dynamo Design (A. C.) 6·26 | .. .. | 30 — 60 | .. .. |
| Engineering Laboratory 2·61 | 20 — 20 | .. .. | .. .. |
| Engineering Laboratory 2·62 | .. .. | 40 — 40 | .. .. |
| Engineering Laboratory 2·63 | .. .. | .. .. | 40 — 40 |
| Heat Engineering 2·40 | 30 — 60 | .. .. | .. .. |
| Heat Engineering 2·42 | .. .. | 30 — 60 | .. .. |
| Heat Engineering 2·44 | .. .. | .. .. | 20 — 40 |
| Heat Treatment 2·756 | .. .. | 80 — 0 | 60 — 0 |
| Machine Design, Special | 60 — 0 | 60 — 0 | 60 — 0 |
| Materials of Engineering (Sp.) | 20 — 40 | .. .. | .. .. |
| Mathematical Laboratory M54 | .. .. | 20 — 40 | .. .. |
| Mechanism of Machines 2·05 | 30 — 40 | .. .. | .. .. |
| Metallography 5·41 | .. .. | .. .. | 40 — 20 |
| Physical Metallurgy 2·34 | 20 — 20 | 20 — 20 | 20 — 20 |
| Theory of the Gyroscope M57 | .. .. | .. .. | 20 — 40 |
| Turbines (Special) 2·55 | .. .. | .. .. | 30 — 60 |
| Hours of exercises and preparation: | 520 = 240 + 280 | 520 = 280 + 220 | 510 = 290 + 220 |

# Mining Engineering and Metallurgy — COURSE III

## OPTION 1. Mining Engineering

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanism 2.02 | .. .. | .. .. | 30 — 60 |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Mineralogy 12·01, 12·02 | 60 — 10 | 60 — 10 | .. .. |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Qualitative Analysis 5·10 | 120 — 20 | .. .. | .. .. |
| Quantitative Analysis 5·121, 5·122 | .. .. | 120 — 20 | 110 — 10 |
| Hours of exercises and preparation: | 500 = 310 + 190 | 500 = 310 + 190 | 500 = 270 + 230 |

### THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20, 2·21, 2·22 | 30 — 60 | 30 — 60 | 30 — 60 |
| Economic Geology 12·40 | .. .. | .. .. | 50 — 60 |
| Engineering Laboratory 2·606 | .. .. | .. .. | 20 — 20 |
| Fire Assaying 3·31 | 90 — 20 | .. .. | .. .. |
| Geology 12·30 | 50 — 40 | .. .. | .. .. |
| Geology 12·31 | .. .. | 30 — 30 | .. .. |
| Geology 12·32 | .. .. | .. .. | 40 — 30 |
| Heat Engineering 2·46, 2·47 | 30 — 60 | 30 — 60 | .. .. |
| Heat Engineering 2·41 | 20 — 10 | .. .. | .. .. |
| Ore Dressing 3·21 | .. .. | 40 — 40 | .. .. |
| Ore Dressing Laboratory 3·22 | .. .. | 80 — 20 | .. .. |
| Political Economy Ec31, Ec32, Ec33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Stationary Structures 1·44 | .. .. | .. .. | 30 — 50 |
| Testing Materials Laboratory 2·36 | .. .. | .. .. | 20 — 10 |
| Hours of exercises and preparation: | 470 = 250 + 220 | 480 = 240 + 240 | 480 = 220 + 260 |

### REQUIRED SUMMER COURSES

| | |
|---|---|
| Surveying 1·03 | 240 hours |
| Underground Surveying 1·04 | 120 hours |

### FOURTH YEAR (For 1922–1923 only)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Electrical Engineering, Elem. of 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Forging 2·81 | .. .. | .. .. | 40 — 0 |
| Geological Surveying 12·34 | .. .. | .. .. | 40 — 30 |
| Geology, Economic 12·40 | .. .. | 50 — 50 | .. .. |
| Geology, Field 12·33 | 40 — 20 | .. .. | .. .. |
| Metallurgical Calculations 3·59 | 20 — 20 | .. .. | .. .. |
| Metallography 3·63 | 20 — 10 | .. .. | .. .. |
| Mining Engineering 3·03, 3·04 | 60 — 75 | .. .. | .. .. |
| Ore Dressing 3·21 | .. .. | 40 — 30 | .. .. |
| Ore Dressing Laboratory 3·22 | .. .. | 80 — 10 | .. .. |
| Power in Mining 2·53 | 40 — 40 | .. .. | .. .. |
| Thermochemistry and Ch. Equil. 5·68 | .. .. | .. .. | 30 — 60 |
| Thesis | .. .. | 85 — 0 | 120 — 30 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 240 + 240 | 480 = 315 + 165 | 480 = 290 + 190 |

# Mining Engineering and Metallurgy — COURSE III

## OPTION 1. Mining Engineering

### FOURTH YEAR (Effective October 1923)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Elements of Electrical Engineering 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Forging 2·81 | .. .. | .. .. | 30 — 0 |
| Geology 12·33 | 40 — 20 | .. .. | .. .. |
| Hydraulics 1·64 | .. .. | 30 — 50 | .. .. |
| Metallurgical Laboratory 3·421 | 40 — 35 | .. .. | .. .. |
| Metallurgy 3·412, 3·43 | 60 — 30 | 60 — 25 | .. .. |
| Mining Engineering 3·01, 3·02, 3·03 | 70 — 50 | 90 — 90 | 80 — 70 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Thesis | .. .. | .. .. | 170 |
| Hours of exercises and preparation: | 270 + 210 = 480 | 240 + 240 = 480 | 340 + 140 = 480 |

# Mining Engineering and Metallurgy — COURSE III

## OPTION 2. Metallurgy

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

Same as for Option 1

## REQUIRED SUMMER COURSES

**Machine Drawing 2·14, 45 — 0**
**Surveying 1·001, 60 — 15**

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20, 2·21, 2·22 | 30 — 60 | 30 — 60 | 30 — 60 |
| Electrochemistry 8·90 | .. .. | .. .. | 50 — 40 |
| Engineering Laboratory 2·606 | .. .. | .. .. | 20 — 30 |
| Fire Assaying 3·31 | 90 — 20 | .. .. | .. .. |
| Gas Analysis 5·31 | .. .. | .. .. | 20 — 10 |
| Heat Engineering 2·46, 2·47 | 30 — 60 | 30 — 60 | .. .. |
| Heat Engineering 2·41 | 20 — 10 | .. .. | .. .. |
| Heat Measurements 8·12 | .. .. | 40 — 20 | .. .. |
| Metallography 3·61, 3·62 | .. .. | 80 — 20 | .. .. |
| Ore Dressing 3·23 | .. .. | 40 — 40 | .. .. |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Stationary Structures 1·44 | .. .. | .. .. | 30 — 50 |
| Testing Materials Laboratory 2·36 | .. .. | .. .. | 20 — 10 |
| Thermochemistry and Chemical Equilibrium 5·68 | 30 — 60 | .. .. | .. .. |
| *General Study | .. .. | .. .. | 30 — 30 |
| Hours of exercises and preparation: | 480 = 240 + 240 | 480 = 250 + 230 | 480 = 230 + 250 |

## FOURTH YEAR (For 1922–1923 Only)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Electrical Engineering, Elem. of 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Engineering Laboratory 2·606 | .. .. | .. .. | 20 — 10 |
| Foundry 2·831 | 40 — 0 | .. .. | .. .. |
| Heat Engineering 2·40, 2·42 | 30 — 60 | 30 — 60 | .. .. |
| Heat Engineering 2·41, 2·43 | 20 — 10 | 20 — 10 | .. .. |
| Metallurgical Calculations 3·59 | 20 — 20 | .. .. | .. .. |
| Metallography 3·61, 3·62 | 80 — 20 | .. .. | .. .. |
| Ore Dressing (Lecture and Laboratory) 3·23 | .. .. | 45 — 10 | .. .. |
| Stationary Structures 1·44 | .. .. | .. .. | 30 — 50 |
| Thermochemistry and Ch. Equil. 5·68 | .. .. | .. .. | 30 — 60 |
| Thesis | 25 — 10 | 80 — 0 | 90 — 30 |
| *General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| *Professional Option | .. .. | 40 — 40 | 15 — 15 |
| Hours of exercises and preparation: | 470 = 275 + 195 | 470 = 275 + 195 | 480 = 245 + 235 |

* For Professional Option the choice lies between Economic Geology 12·40 (40 — 40) or Machine Tool Work 2·88 (40 — 0) and Vise and Bench Work 2·86 (40 — 0) or Metallurgical Plants 3·56 (40 — 40).

Economic Geology is recommended but to be admitted to it, the student must have taken Geology as a General Study in first term of either third or fourth year. Ordnance R. O. T. C. students are expected to take 3·56.

## Mining Engineering and Metallurgy — COURSE III

### OPTION 2. Metallurgy

### FOURTH YEAR (Effective October 1923)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Elements of Electrical Engineering 6·41, 6·42. | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Forging 2·81 | .. .. | .. .. | 30 — 0 |
| Foundry 2·831 | 40 — 0 | .. .. | .. .. |
| Hydraulics 1·64 | .. .. | 30 — 50 | .. .. |
| Metallurgical Calculation 3·59 | .. .. | 20 — 20 | .. .. |
| Metallurgy { (Copper and Lead) 3·41 | 160 — 60 | .. .. | .. .. |
| Metallurgy { (Iron and Steel) 3·45 | 35 — 50 | .. .. | .. .. |
| or | | | |
| { (Copper and Lead) 3·41 | 90 — 50 | .. .. | .. .. |
| { (Iron and Steel) 3·45 | 105 — 60 | .. .. | .. .. |
| Metallurgy (Gold and Silver) 3·42 | .. .. | 110 — 25 | .. .. |
| or | | | |
| { (Gold and Silver) 3·42 | .. .. | 60 — 25 | .. .. |
| { (Iron and Steel) 3·46 | .. .. | 50 — 0 | .. .. |
| Metallurgy, General, Zinc and Minor Metals 3·44 | .. .. | .. .. | 50 — 50 |
| Mining Engineering 3·05 | .. .. | 30 — 30 | .. .. |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Professional Option | .. .. | .. .. | 60 |
| Thesis | .. .. | 30 | 160 |
| | 295+185 480 | 250+230 480 | 140+340 480 |

### OPTION 3. Geology

### FOURTH YEAR

Discontinued after 1923

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Electrical Engineering, Elem. of 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | 30 — 40 | .. .. |
| Geological Surveying 12·34 | .. .. | .. .. | 40 — 30 |
| Geology, Applied Economic 12.42 | .. .. | .. .. | 20 — 20 |
| Geology, Economic 12·40, 12·41 | .. .. | 50 — 50 | 40 — 10 |
| Geology, Field 12 33 | 40 — 20 | .. .. | .. .. |
| Geology, Historical 12·50 | 40 — 30 | .. .. | .. .. |
| Hydraulics 1·64 | .. .. | .. .. | 30 — 40 |
| Mining Engineering 3·03, 3·04 | 60 — 75 | .. .. | .. .. |
| Ore Dressing 3·21 | .. .. | 40 — 30 | .. .. |
| Ore Dressing, Laboratory 3·22 | .. .. | 80 — 10 | .. .. |
| Power in Mining 2·53 | 40 — 40 | .. .. | .. .. |
| Thermochemistry and Ch. Equil. 5·68 | .. .. | .. .. | 30 — 60 |
| Thesis | .. .. | 15 — 0 | 100 — 0 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 240 + 240 | 480 = 275 + 205 | 480 = 290 + 190 |

# Architecture — COURSE IV

## OPTION 1. Architecture

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·204, 2·214, 2·224 | 30 — 50 | 30 — 50 | 30 — 50 |
| Architectural History 4·41 | 20 — 40 | 20 — 40 | 20 — 40 |
| Design 4·71 | 100 — 0 | 100 — 0 | 140 — 0 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Freehand Drawing 4·02 | 40 — 0 | 40 — 0 | 40 — 0 |
| French L71 | 20 — 30 | 20 — 30 | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Office Practice 4·211 | .. .. | 40 — 0 | 40 — 0 |
| Shades and Shadows 4·11 | 30 — 10 | .. .. | .. .. |
| Water Color 4·06 | 20 — 0 | 20 — 0 | 20 — 0 |
| Hours of exercises and preparation: | 500 = 320 + 180 | 500 = 330 + 170 | 490 = 350 + 140 |

### REQUIRED SUMMER COURSE

**Office Practice 4·212, 100 — 0**

### THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·211, 2·226 | 30 — 60 | 30 — 60 | .. .. |
| Applied Perspective 4·14 | 20 — 0 | 20 — 0 | 20 — 0 |
| Architectural History 4·42 | 10 — 20 | 20 — 40 | 20 — 30 |
| Building Construction 4·80 | 20 — 10 | .. .. | .. .. |
| Constructive Design 4·81 | .. .. | .. .. | 80 — 0 |
| Design 4·72 | 140 — 0 | 140 — 0 | 160 — 0 |
| European Civilization and Art 4·46 | 30 — 40 | 30 — 40 | 30 — 40 |
| Freehand Drawing 4·03 | 40 — 0 | 40 — 0 | 40 — 0 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 320 + 160 | 480 = 310 + 170 | 480 = 380 + 100 |

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Constructive Design 4·82 | 60 — 0 | 40 — 0 | .. .. |
| Design 4.73 | 255 — 0 | 275 — 0 | 330 — 0 |
| European Civilization and Art 4·47 | 30 — 40 | 30 — 40 | 30 — 40 |
| Life Class 4·04 | 60 — 0 | 60 — 0 | 60 — 0 |
| Philosophy of Architecture 4·51 | 10 — 10 | 10 — 10 | .. .. |
| Professional Relations 4·22 | 10 — 5 | 10 — 5 | 10 — 10 |
| Hours of exercises and preparation: | 480 = 425 + 55 | 480 = 425 + 55 | 480 = 430 + 50 |

# Architecture — COURSE IV

## OPTION 2. Architectural Engineering*

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| Architectural History 4·41 | 20 — 40 | 20 — 40 | 20 — 40 |
| Design 4·71 | 100 — 0 | 100 — 0 | 140 — 0 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Perspective 4·12 | .. .. | 10 — 30 | .. .. |
| Physics 8·021, 8·022 | 40 — 50 | 40 — 50 | .. .. |
| Shades and Shadows 4·11 | 30 — 10 | .. .. | .. .. |
| Hours of exercises and preparation: | 490 = 280 + 210 | 490 = 260 + 230 | 490 = 280 + 210 |

### THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·215, 2·225, 2·235 | 30 — 60 | 30 — 60 | 30 — 60 |
| Architectural History 4·42 | 10 — 20 | 20 — 40 | 20 — 30 |
| Building Construction 4·80 | 20 — 10 | .. .. | .. .. |
| Color and Acoustics 8·06 | 10 — 10 | .. .. | .. .. |
| Electric Wiring of Buildings 6·38 | .. .. | 10 — 20 | .. .. |
| European Civilization and Art 4·46 | 30 — 40 | 30 — 40 | 30 — 40 |
| Materials 1·43 | .. .. | .. .. | 20 — 40 |
| Office Practice 4·211 | 80 — 0 | .. .. | .. .. |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Professional Relations 4·22 | 10 — 5 | 10 — 5 | 10 — 10 |
| Structural Design 4·91 | .. .. | 95 — 0 | 70 — 0 |
| Structural Drawing 4·90 | 40 — 15 | .. .. | .. .. |
| Structures 1·41 | .. .. | 20 — 40 | 20 — 40 |
| Surveying 1·02 | 30 — 0 | .. .. | .. .. |
| Hours of exercises and preparation: | 480 = 290 + 190 | 480 = 245 + 235 | 480 = 230 + 250 |

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Business and Patent Law GS4 | .. .. | .. .. | 30 — 30 |
| Engineering Laboratory 2·607 | .. .. | .. .. | 10 — 0 |
| European Civilization and Art 4·47 | 30 — 40 | 30 — 40 | 30 — 40 |
| Foundations 1·48 | 10 — 15 | .. .. | .. .. |
| Hydraulics 1·63 | .. .. | 20 — 40 | .. .. |
| Mechanical Equipment of Buildings, including Steam and Heat and Ventilation 2·57 | .. .. | .. .. | 40 — 40 |
| Philosophy of Architecture 4·51 | 10 — 10 | 10 — 10 | .. .. |
| Sanitary Science and Public Health 7·56 | .. .. | .. .. | 20 — 0 |
| Structural Design (including Concrete) 4·92 | 165 — 0 | 180 — 0 | 150 — 0 |
| Structures 1·51 | 40 — 80 | 50—100 | .. .. |
| Testing Materials Laboratory 2·37 | 30 — 10 | .. .. | .. .. |
| Testing Materials Laboratory (Concrete) 2·38 | 30 — 10 | .. .. | .. .. |
| Thesis | .. .. | .. .. | 90 — 0 |
| Hours of exercises and preparation: | 480 = 315 + 165 | 480 = 290 + 190 | 480 = 370 + 110 |

*Definition adopted by the Association of Collegiate Schools of Architecture, May 1921. Architectural Engineering: "Essentially an engineering course, giving fundamental and comprehensive training in engineering and including sufficient preparation in Architecture to put the student in full sympathy with the ideals of the Architect but with no attempt to give him facility in Architectural Design."

# Chemistry — COURSE V

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SUMMER SESSION (FOLLOWING FIRST YEAR)

**Qualitative Analysis 5·10, 210 — 30**

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Language | 40 — 40 | 40 — 40 | 40 — 40 |
| Mathematics M21, 22 | 30 — 60 | 30 — 60 | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8.021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Quantitative Analysis 5·121, 5·122, 5·13 | 110 — 20 | 110 — 20 | 110 — 25 |
| Options | | | |
| 1. Mineralogy 12·03 | .. .. | .. .. | 70 — 15 |
| 2. General Biology and Bacteriology 7·29 | .. .. | .. .. | 70 — 15 |
| Hours of exercises and preparation: | 500 = 280 + 220 | 500 = 280 + 220 | 500 = 320 + 180 |

### THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Chemical Literature 5·19 | 30 — 45 | .. .. | .. .. |
| Chemical Principles I 5·65, Lecture | 10 — 10 | 10 — 10 | 10 — 10 |
| Recitations | 30 — 30 | 30 — 30 | 30 — 30 |
| Laboratory | 12 — 18 | 12 — 18 | 12 — 18 |
| Gas Analysis 5·31 | 20 — 10 | .. .. | .. .. |
| Metallography I 5·41 | .. .. | 40 — 20 | .. .. |
| Organic Chemistry I 5·51 | 40 — 30 | 40 — 30 | 30 — 25 |
| Organic Chemistry Laboratory 5·561 | 75 — 0 | 120 — 0 | 145 — 0 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Special Methods and Instruments 5·40 | .. .. | .. .. | 30 — 20 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 277 + 203 | 480 = 312 + 168 | 480 = 317 + 163 |

## Chemistry — COURSE V — *Continued*

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Chemical Principles II 5·67, Recitations | 30 — 50 | .. .. | .. .. |
| Laboratory | 10 — 10 | .. .. | .. .. |
| Colloidal Chemistry 5·69 | .. .. | 20 — 20 | .. .. |
| History of Chemistry 5·93 | .. .. | .. .. | 30 — 30 |
| Industrial Chemistry 10·21, 10·22, 10·23 | 40 — 40 | 40 — 40 | 20 — 20 |
| Inorganic Chemistry II 5·06 | .. .. | 20 — 20 | 20 — 20 |
| Recent Developments in Science 5·94 | 10 — 0 | 10 — 0 | .. .. |
| Research Problem 5·90 | 160 — 20 | .. .. | .. .. |
| Thesis 5·95 | .. .. | 150 — 20 | 200 — 0 |
| Thesis Reports 5·96 | .. .. | .. .. | 20 — 10 |
| General Study | .. .. | 30 — 30 | .. .. |
| | 250 + 120 | 270 + 130 | 290 + 80 |

Optional Subjects ..... 300 hours for the year
Hours of exercises and preparation: 1440 hours for the year

Students offering Elementary and Advanced French upon entrance will take German as shown in the Course Scheme.

Students offering Elementary and Advanced German upon entrance will take Elementary French in the second year in place of the German appearing in the Course Schedule. This course will include Technical French in the third period.

Students offering Elementary French and Elementary German will, in the second year, take Technical French the first term, and the last two terms take Intermediate German.

Ordnance R. O. T. C. Students are expected to take as an elective 5·59b, Chemistry of Powder and Explosives in 1st term of the fourth year, unless they have already had the equivalent.

### OPTIONAL SUBJECTS

Chemistry of Foods 5·25 ..... any term 50 — 10
Food Analysis 5·26 ..... any term 70 — 0
Optical Methods 5·29 ..... any term 30 — 20
Testing of Oils 5·36 ..... any term 30 — 0

| First Term | | Second Term | | Third Term | |
|---|---|---|---|---|---|
| Chem. of Powder and Explos. 5·59b | 30—30 | | | | |
| Theoret. Phys. 8·23 | 30—60 | Theoret. Phys. 8·23 | 30—60 | Theoret. Phys. 8·23 | 30—60 |
| El. Elec. Eng. 6·40 | 30—40 | Heat Meas. 8·12 | 40—15 | Heat Meas. 8·11 | 50—40 |
| Mathematics M36 | 30—60 | Elec. Eng. Lab. 6·85 | 30—40 | Mathematics M39 | 30—60 |
| Metallurgy 3·41 | 40—40 | Mathematics M50 | 30—60 | Metallurgy 3·431 | 20—20 |
| Biochemistry 7·27 | 30—50 | Mathematics M38 | 30—60 | Metal. of Common Metals | |
| Prox. Anal. 5·30 | 90—30 | Metallurgy 3·42 | 30—30 | 3·49 | 20—20 |
| Ind. Chem. Lab. | | Metal of Common Metals | | | |
| 10·51 | 90—20 | 3·49 | 20—20 | | |
| Optical Crys. 12·21 | 50—30 | | | | |

Optional subjects other than those listed above may be taken with the approval of the Head of the Department of Chemistry.

Graduate courses in Chemistry may be elected with the consent of the instructors in charge of the several courses.

# Electrical Engineering — COURSE VI

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| Electrical Engineering, Principles of 6·00 | .. .. | .. .. | 50 — 70 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Foundry 2·83 | 30 — 0 | .. .. | .. .. |
| Machine Drawing 2·12 | .. .. | 60 — 0 | .. .. |
| Machine Tool Work 2·89 | .. .. | 60 — 0 | .. .. |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Engineering Drawing 2·10 | 60 — 0 | .. .. | .. .. |
| Mechanism 2·00, 2·01 | 30 — 60 | 30 — 60 | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8.021, 8.022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Vise and Bench Work 2·87 | 30 — 0 | .. .. | .. .. |
| Hours of exercises and preparation: | 500 = 280 + 220 | 500 = 280 + 220 | 500 = 210 + 290 |

## REQUIRED SUMMER COURSE

**Surveying 1·001, 60 — 15**

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanis 2·21, 2·22 | 30 — 60 | 30 — 50 | .. .. |
| Electrical Engineering, Principles of 6·01 | 40 — 60 | .. .. | .. .. |
| Electrical Engineering, Principles of 6·02 | .. .. | 40 — 60 | .. .. |
| Electrical Engineering, Principles of 6·03 | .. .. | .. .. | 40 — 60 |
| Electrical Engineering Laboratory 6·70 | 25 — 25 | .. .. | .. .. |
| Electrical Engineering Laboratory 6·71 | .. .. | 50 — 40 | .. .. |
| Electrical Engineering Laboratory 6·72 | .. .. | .. .. | 50 — 40 |
| Heat Engineering 2·50, 2·51, 2·52 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mathematics M35 | 30 — 60 | .. .. | .. .. |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| General Study | .. .. | 30 — 30 | 30 — 30 |
| **Options:** | | | |
| Applied Mechanics (Kinetics) 2·24 / Stationary Structures 1·44 | .. .. | .. .. | 30 — 50 |
| Hours of exercises and preparation: | 480 = 185 + 295 | 480 = 210 + 270 | 480 = 210 + 270 |

## Electrical Engineering — COURSE VI — *Continued*

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Electrical Engineering, Principles of 6·04 | 60 — 80 | .. .. | .. .. |
| Electrical Engineering, Principles of 6·05 | .. .. | 60 — 70 | .. .. |
| Electrical Engineering, Principles of 6·06 | .. .. | .. .. | 60 — 80 |
| Electrical Engineering Laboratory 6·73 | 70 — 50 | .. .. | .. .. |
| Electrical Engineering Laboratory 6·74 | .. .. | 70 — 50 | .. .. |
| Engineering Laboratory 2·605 | 40 — 30 | .. .. | .. .. |
| Hydraulics 1·65 | 20 — 40 | 20 — 40 | .. .. |
| Thesis | .. .. | 20 — 0 | 190 — 0 |
| General Study | .. .. | 30 — 30 | 30 — 30 |
| Professional Options | 30 — 60 | 30 — 60 | 30 — 60 |
| Hours of exercises and preparation: | 480 = 220 + 260 | 480 = 230 + 250 | 480 = 310 + 170 |

### OPTION IN ELECTRICAL COMMUNICATION

Students who wish to particularly follow the theory and practice underlying electrical communication may embrace the following option upon approval of the Head of the Department.

In third year substitute Electrical Communication I 6·30, 6·31, 6·32 for Heat Engineering 2·50, 2·51 and 2·53, but take Heat Engineering 2·50, optional in third term.

In fourth year substitute Electrical Communication II (Electron Theory 8·211 and Electron Apparatus 8·212) for Hydraulics 1·65, and substitute Electrical Communication Laboratory I 6·33 for Engine Laboratory 2·605, Electrical Communication III 6·28 to be taken as a professional option for three terms of fourth year.

The thesis, 190 hours in the third term of fourth year, is likewise to be devoted to an electrical communication problem.

## Electrical Engineering — COURSE VI-A (Co-operative Course)

**Description of Subjects of Instruction, Pages 49–130**

In preparation for this curriculum students must have successfully completed the first year of the undergraduate Electrical Engineering course (Course VI) at the Institute, or the equivalent.

### GROUP A

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term Mar. 19–June 23 14 Weeks |
|---|---|---|---|
| **AT M. I. T. – Both Options** | | | |
| Applied Mechanics 2·203 | .. .. | 40 — 80 | .. .. |
| English and History EH21, 22 | 30 — 50 | 30 — 50 | .. .. |
| Machine Drawing 2·12 | 60 — 0 | .. .. | .. .. |
| Mathematics M21, 22 | 30 — 60 | 30 — 60 | .. .. |
| Mechanical Engineering Drawing 2·10 | 60 — 0 | .. .. | .. .. |
| Mechanism 2·00, 2·01 | 30 — 60 | 30 — 60 | .. .. |
| Military Science MS31, 32 | 30 — 0 | 30 — 0 | .. .. |
| Physics 8·021, 8·022 | 40 — 50 | 40 — 50 | .. .. |
| **AT GENERAL ELECTRIC WORKS** | | | |
| **Option 1** | | | |
| Electrical Engineering, Principles of 6·101 | .. .. | .. .. | 20 — 40 |
| English: Effective Writing and Speaking E31a | .. .. | .. .. | 20 — 40 |
| Lectures on Manufacturing Methods | .. .. | .. .. | 10 — 0 |
| Machine Shop Training Room, Assembling and Inspecting | | | Daily |
| **AT EDISON PLANTS — Option 2** | | | |
| Electrical Engineering, Principles of 6·101 | .. .. | .. .. | 20 — 40 |
| Electrical Engineering Office or Maintenance of Line Department | | | 48 hours per week |

### GROUP B

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| **AT M. I. T.** | | | |
| Applied Mechanics 2·203 | .. .. | 40 — 80 | .. .. |
| Electrical Engineering Laboratory 6·69 | .. .. | .. .. | 50 — 40 |
| Electrical Engineering, Principles of 6·00 | .. .. | .. .. | 50 — 70 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Machine Drawing 2·12 | 60 — 0 | .. .. | .. .. |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Engineering Drawing 2·10 | 60 — 0 | .. .. | .. .. |
| Mechanism 2·00, 2·01 | 30 — 60 | 30 — 60 | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |

## COURSE VI-A — *Continued*

### GROUP A

### THIRD YEAR

| AT M. I. T. — Both Options | Summer Term June 26– Sept. 5 | First Term Oct. 2– Dec. 16 | Second Term Dec. 26– Mar. 17 | Third Term Mar. 19– June 2 |
|---|---|---|---|---|
| Electrical Engineering, Prin. of 6·11, 6·12, 6·03 | 50 — 70 | 40 — 60 | .. .. | 40 — 60 |
| Electrical Engineering Laboratory, 6·69, 6·75, 6·76 | 50 — 40 | 50 | .. .. | 90 |
| Applied Mechanics 2·213, 2·223 | .. .. | 30 — 60 | .. .. | 30 — 50 |
| English and History EH23 | 30 — 50 | .. .. | .. .. | .. .. |
| Mathematics M23, M35 | 30 — 60 | 30 — 60 | .. .. | .. .. |
| Military Science MS33 | 30 — 0 | .. .. | .. .. | .. .. |
| Physics 8·023 | 40 — 50 | .. .. | .. .. | .. .. |
| Heat Engineering 2·50, 2·51 | .. .. | 30 — 60 | .. .. | 30 — 60 |
| Political Economy Ec31, 32 | .. .. | 30 — 30 | .. .. | 30 — 30 |
| Electron Theory 8·211 (Option 1) | .. .. | .. .. | .. .. | 20 — 40 |
| General Study (Option 2) | .. .. | .. .. | .. .. | 30 — 30 |
| **AT GENERAL ELECTRIC WORKS — Option 1** | | | | |
| Electrical Engineering, Prin. of 6·121 | .. .. | .. .. | 20 — 40 | .. .. |
| English: Business English E31b | .. .. | .. .. | 20 — 40 | |
| Lectures on Manufacturing Methods | .. .. | .. .. | 10 — 0 | |
| Armature Winding, Drafting and Design | .. .. | .. .. | 44 hours per week | |
| **AT EDISON PLANTS — Option 2** | | | | |
| Electrical Engineering, Prin. of 6·121 | .. .. | .. .. | 20 — 40 | |
| Maintenance of Lines or Electrical Engineering Office | .. .. | .. .. | 48 hours per week | |

Vacation: September 10–October 1, inclusive; December 17–December 25, inclusive; June 3–June 24, inclusive; Recess April 19–21, inclusive

## COURSE VI-A — *Continued*

### GROUP B

### THIRD YEAR

| | Summer Term June 26–Sept. 30 | First Term Oct. 2–Dec. 23 | Second Term Jan. 2–Mar. 10 | Third Term Mar. 19–June 23 |
|---|---|---|---|---|
| **AT GENERAL ELECTRIC WORKS — Option 1** | | | | |
| Machine Shop Training Room, Assembling and Inspecting | 48 hours per week | .. .. | .. .. | .. .. |
| Armature Winding, Drafting and Design | .. .. | 48 hours per week | .. .. | .. .. |
| Foundries, Standardization, Laboratory and Meter Testing | .. .. | .. .. | .. .. | 48 hours per week |
| Lectures on Manufacturing Methods | 10 — 0 | 10 — 0 | .. .. | 10 — 0 |
| Electrical Engineering (Dir. Cur. Mach. and Alt. Cur.) 6·111, 6·112, 6·131 | 20 — 40 | 20 — 40 | .. .. | 20 — 40 |
| English: E31a, E31b | 20 — 40 | 20 — 40 | .. .. | .. .. |
| General Study | .. .. | .. .. | .. .. | 20 — 40 |
| **AT EDISON PLANTS— Option 2** | | | | |
| Electrical Engineering Offices or Maintenance of Lines Department | 48 hours per week | 48 hours per week | .. .. | .. .. |
| Steam Generation and Electrical Installations or Electrical Generation, Sales and Supply Departments | .. .. | .. .. | .. .. | 48 hours per week |
| Electrical Engineering, Prin. of 6·111, 6·112, 6·131 | 20 — 40 | 20 — 40 | .. .. | 20 — 40 |
| **AT M. I. T. — Both Options** | | | | |
| Electrical Engineering (Alt. Cur.) 6·02 | .. .. | .. .. | 40 — 60 | |
| Applied Mechanics 2·213 | .. .. | .. .. | 30 — 60 | |
| Political Economy Ec31 | .. .. | .. .. | 30 — 30 | |
| Heat Engineering 2·50 | .. .. | .. .. | 30 — 60 | |
| Mathematics M35 | .. .. | .. .. | 30 — 60 | |
| Electrical Engineering Laboratory 6·75 | .. .. | .. .. | 60 | |
| Vacation | June 14–June 25 inclusive<br>December 24–January 1 inclusive<br>March 11–March 18 inclusive | | | |

## COURSE VI-A — *Continued*

### GROUP A

### FOURTH YEAR

| | Summer Term June 26–Sept. 9 | First Term Oct. 2–Dec. 23 | Second Term Jan. 2–Mar 10 | Third Term Mar. 19–June 23 |
|---|---|---|---|---|
| **AT M. I. T.** | | | | |
| Electrical Engineering, Prin. of 6·14, 6·05 | 60 — 80 | .. .. | 60 — 80 | .. .. |
| Electrical Engineering Lab. 6·77, 6·78 | 50 | .. .. | 50 | .. .. |
| Heat Engineering 2·52 | 30 — 60 | .. .. | .. .. | .. .. |
| Stationary Structures 1·44 | 30 — 50 | .. .. | .. .. | .. .. |
| Applied Psychology | 30 — 30 | .. .. | .. .. | .. .. |
| Political Economy Ec33 | 30 — 30 | .. .. | .. .. | .. .. |
| Engineering Laboratory 2·605 | .. .. | .. .. | 40 — 30 | .. .. |
| Hydraulics 1·65 | .. .. | .. .. | 40 — 80 | .. .. |
| Testing Materials Lab. 2·36 | .. .. | .. .. | 20 — 20 | .. .. |
| Electron Theory 8·211 (Option 1) | .. .. | .. .. | 20 — 40 | .. .. |
| General Study (Option 2) | .. .. | .. .. | 30 — 30 | .. .. |
| **AT GENERAL ELECTRIC WORKS — Option 1** | | | | |
| Electrical Engineering, Prin. of 6·142, 6·161 | .. .. | 20 — 40 | .. .. | 20 — 40 |
| Designing, Meter Testing, Motor Transformer and Turbine Testing | .. .. | 48 hours per week | .. .. | 48 hours per week |
| Lectures in Manufacturing Methods | .. .. | 10 — 0 | .. .. | 10 — 0 |
| General Study | .. .. | 20 — 40 | .. .. | 20 — 40 |
| **AT EDISON PLANTS— Option 2** | | | | |
| Electrical Engineering, Prin. of 6·142, 6·161 | .. .. | 20 — 40 | .. .. | 20 — 40 |
| Steam Generation and Electrical Installations or Electrical Generation Sales and Supply Department | .. .. | 48 hours per week | .. .. | .. .. |
| Standardization, Testing and Research | .. .. | .. .. | .. .. | 48 hours per week |
| Vacation { September 10–October 1, inclusive; December 24–January 1, inclusive; March 11–March 18, inclusive | | | | |

## COURSE VI-A — *Continued*

### GROUP B

### FOURTH YEAR

| | Summer Term June 26–Sept. 30 | First Term Oct. 2–Dec. 16 | Second Term Dec. 26–Mar. 17 | Third Term Mar. 19–June 2 |
|---|---|---|---|---|
| **AT GENERAL ELECTRIC WORKS — Option 1** | | | | |
| Electrical Engineering, Prin. of 6·131, 6·142 | 20 — 40 | .. .. | 20 — 40 | .. .. |
| Accounting | 20 — 40 | .. .. | .. .. | .. .. |
| General Study | .. .. | .. .. | 20 — 40 | .. .. |
| Lectures on Manufacturing Methods | 10 — 0 | .. .. | 10 — 0 | .. .. |
| Drafting, Designing, Meter Testing, Motor, Transformer and Turbine Testing | 48 hours per week | .. .. | 48 hours per week | .. .. |
| **AT EDISON PLANTS — Option 2** | | | | |
| Electrical Engineering, Prin. of 6·142 | 20 — 40 | .. .. | 20 — 40 | .. .. |
| Steam Generation and Electrical Installations or Electrical Generation Sales and Supply Department | 48 hours per week | .. .. | 48 hours per week | .. .. |
| **AT M. I. T. — Both Options** | | | | |
| Electrical Eng., Prin. of (Alt. Current Mach. and Transmission) 6·14, 6·05 | .. .. | 60 — 80 | .. .. | 60 — 80 |
| Electrical Engineering Lab. 6·77, 6·78 | .. .. | 50 | .. .. | 50 |
| Heat Engineering 2·52 | .. .. | 30 — 60 | .. .. | .. .. |
| Political Economy Ec33 | .. .. | 30 — 30 | .. .. | .. .. |
| Stationary Structures 1·44 | .. .. | 30 — 50 | .. .. | .. .. |
| Engineering Lab. 2·605 | .. .. | .. .. | .. .. | 40 — 30 |
| Hydraulics 1·65 | .. .. | .. .. | .. .. | 40 — 80 |
| Testing Materials Lab. 2·36 | .. .. | .. .. | .. .. | 20 — 20 |
| Electron Apparatus 8·212 (Option 1) | .. .. | 40 — 20 | .. .. | .. .. |
| General Study (Option 1) | .. .. | .. .. | .. .. | 30 — 30 |
| General Study (Option 2) | .. .. | 30 — 30 | .. .. | 30 — 30 |

Vacation { December 17–December 25, inclusive; June 3–June 24, inclusive; Recess April 19–21, inclusive

## COURSE VI-A — *Continued*

### GROUP A

### FIFTH YEAR

| | Summer Term June 26–Sept. 9 | First Term Oct. 2–Dec. 23 | Second Term Jan. 2–Mar. 17 | Third Term Mar. 19–June 4 |
|---|---|---|---|---|
| **AT M. I. T.— Both Options** | | | | |
| Electrical Engineering, High Voltage Transmission 6·05 | 60 — 80 | .. .. | .. .. | .. .. |
| Electrical Engineering Lab. 6·78 | 50 | .. .. | .. .. | .. .. |
| Electron Apparatus 8·212 (Option 1) | 40 — 20 | .. .. | .. .. | .. .. |
| Testing Materials Lab. 2·36 | 20 — 20 | .. .. | .. .. | .. .. |
| Hydraulics 1·65 | 40 — 80 | .. .. | .. .. | .. .. |
| Engineering Lab. 2·605 | 40 — 30 | .. .. | .. .. | .. .. |
| General Study (Option 2) | 30 — 30 | .. .. | .. .. | .. .. |
| Electrical Engineering, Adv. Course | .. .. | .. .. | 60 — 80 | .. .. |
| Business Law and Org. | .. .. | .. .. | .. .. | 40 — 80 |
| Graduate Courses and Research | .. .. | .. .. | 360 | 360 |
| **AT GENERAL ELECTRIC WORKS — Option 1** | | | | |
| Engineering and Research Assignments at Lynn, Schenectady or Pittsfield | .. .. | 44 hours per week | .. .. | .. .. |
| Electrical Engineering, Adv. Course | .. .. | 30 — 60 | .. .. | .. .. |
| Lectures on Manufacturing Methods | .. .. | 10 — 0 | .. .. | .. .. |
| **AT EDISON PLANTS — Option 2** | | | | |
| Electrical Engineering, Adv. Course | .. .. | 30 — 60 | .. .. | .. .. |
| Standardization and Research Laboratories | .. .. | 44 hours per week | .. .. | .. .. |
| Vacation | September 10–October 1, inclusive<br>December 24–January 1, inclusive<br>Recess April 19–21, inclusive | | | |

The prescribed course is here completed with the conferring of the Master's Degree at Commencement Exercises of the Institute in June.

For those students of Option 1 who desire it, opportunity will be afforded to spend an additional (optional) summer term of Engineering and Research work with the General Electric Company.

## COURSE VI-A — *Continued*

### GROUP B

### FIFTH YEAR

| | Summer Term June 25–Sept. 30 | First Term Oct. 2–Dec. 16 | Second Term Dec. 26–Mar. 17 | Third Term Mar. 19–June 4 |
|---|---|---|---|---|
| **AT GENERAL ELECTRIC WORKS — Option 1** | | | | |
| Electrical Engineering, Prin. of 6·142 | 20 — 40 | .. .. | .. .. | .. .. |
| Electrical Engineering, Adv. 6·162 | .. .. | .. .. | 30 — 60 | .. .. |
| General Study | 20 — 40 | .. .. | .. .. | .. .. |
| Lectures on Manufacturing Methods | 10 — 0 | .. .. | 10 — 0 | .. .. |
| Motor, Transformer and Turbine Testing | 48 hours per week | .. .. | .. .. | .. .. |
| Engineering and Research Assignments at Lynn, Schenectady or Pittsfield | .. .. | .. .. | 44 hours per week | .. .. |
| **AT EDISON PLANTS — Option 2** | | | | |
| Electrical Engineering, Prin. of | 20 — 40 | .. .. | .. .. | .. .. |
| Electrical Engineering, Adv. Course | .. .. | .. .. | 30 — 60 | .. .. |
| Standardization and Research Laboratories | 44 hours per week | .. .. | 44 hours per week | .. .. |
| **AT M. I. T.— Both Options** | | | | |
| Electrical Engineering, Prin. of 6·05 | .. .. | 60 — 80 | .. .. | .. .. |
| Graduate Study and Research | .. .. | 360 | .. .. | 360 |
| Business Law and Org. | .. .. | .. .. | .. .. | 40 — 60 |

Vacation { June 3–June 26, inclusive; December 17–December 25, inclusive; Recess April 19–21, inclusive

The prescribed course is here completed with the conferring of the Master's Degree at Commencement Exercises of the Institute in June.

For those students of Option 1 who desire it, opportunity will be afforded to spend an additional (optional) summer term of Engineering and Research Work with the General Electric Company.

# Biology and Public Health — COURSE VII

## OPTION 1. Public Health

First Year, Page 4. Description of Subjects of Instruction, Pages 49–130

## SUMMER SESSION (FOLLOWING FIRST YEAR)

Qualitative Analysis 5·10, 110 — 20
Quantitative Analysis 5·121, 110 — 20

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Accounting Ec50 | 40 — 50 | .. .. | .. .. |
| Biology, General 7·01 | .. .. | 60 — 30 | .. .. |
| Botany 7·04 | .. .. | .. .. | 70 — 30 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Language | 30 — 30 | 30 — 30 | 30 — 30 |
| Mathematics M21, 22 | 30 — 60 | 30 — 60 | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Organic Chemistry 5·50 | 30 — 30 | .. .. | .. .. |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Political Economy Ec22, Ec23 | .. .. | 30 — 30 | 30 — 30 |
| Zoölogy 7·05 | .. .. | .. .. | 50 — 30 |
| Hours of exercises and preparation: | 500 = 230 + 270 | 500 = 250 + 250 | 500 = 280 + 220 |

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Anatomy and Histology 7·10 | 100 — 50 | 80 — 40 | 60 — 30 |
| Bacteriology 7·30 | 90 — 50 | 80 — 40 | .. .. |
| Biochemistry 7·27 | 80 — 60 | 80 — 60 | .. .. |
| Chemistry of Foods 5·25 | .. .. | .. .. | 100 — 30 |
| Physiology 7·20 | .. .. | 50 — 50 | 60 — 80 |
| Sanitary Science and Public Health 7·56 | .. .. | .. .. | 30 — 30 |
| Water Supplies 5·20 | 40 — 10 | .. .. | .. .. |
| General Study | .. .. | .. .. | 30 — 30 |
| Hours of exercises and preparation: | 480 = 310 + 170 | 480 = 290 + 190 | 480 = 280 + 200 |

## FOURTH YEAR (For 1922–1923)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Biochemistry 7·27 | 30 — 50 | .. .. | .. .. |
| Biological Colloquium 7·80 | 10 — 10 | 10 — 10 | 10 — 10 |
| Industrial Hygiene 7·53 | .. .. | 60 — 60 | .. .. |
| Industrial Microbiology 7·36 | 60 — 20 | .. .. | .. .. |
| Infection and Immunity 7·50 | 40 — 40 | .. .. | 20 — 20 |
| Microscopy of Waters 7·06 | .. .. | .. .. | .. .. |
| Municipal Sanitation 7·64 | .. .. | 60 — 50 | .. .. |
| Parasitology 7·07 | .. .. | 30 — 60 | .. .. |
| Personal Hygiene 7·22 | 30 — 30 | .. .. | .. .. |
| Problems and Practice in Public Health 7·54 | .. .. | .. .. | 40 — 70 |
| Public Health Laboratory Methods 7·38 | .. .. | 60 — 20 | 60 — 20 |
| Theoretical Biology 7·03 | 30 — 50 | .. .. | .. .. |
| Vital Statistics 7·58 | 30 — 50 | .. .. | .. .. |
| General Study | .. .. | .. .. | 30 — 30 |
| Thesis | | 60 | 170 |
| Hours of exercises and preparation: | 480 = 230 + 250 | 480 = 280 + 200 | 480 = 330 + 150 |

## Biology and Public Health — COURSE VII — *Continued*

### OPTION 2. Industrial Biology. (*Fisheries Engineering)

**First Year, Page 4.** **Description of Subjects of Instruction, Pages 49–130**

### SUMMER SESSION (FOLLOWING FIRST YEAR)

**Qualitative Analysis 5·10, 110 — 20**
**Quantitative Analysis 5·121, 110 — 20**

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Accounting Ec50 | .. .. | .. .. | 40 — 50 |
| Biology General 7·01 | .. .. | 60 — 30 | .. .. |
| Botany 7·04 | .. .. | .. .. | 70 — 30 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| †Introduction to Fisheries 7·16 | .. .. | .. .. | 10 — 20 |
| Mathematics M21, 22 | 30 — 60 | 30 — 60 | .. .. |
| Mechanism 2·02 | 30 — 60 | .. .. | .. .. |
| Military Science MS 31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| **Oceanography 7·40 | .. .. | 30 — 30 | .. .. |
| Organic Chemistry 5·50 | 30 — 30 | .. .. | .. .. |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Political Economy Ec22, Ec23 | 30 — 30 | 30 — 30 | .. .. |
| Zoology 7·05 | .. .. | .. .. | 50 — 30 |
| Hours of exercises and preparation: | 500 = 220 + 280 | 500 = 250 + 250 | 500 = 270 + 230 |

### THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| †Applied Ichthyology 7·18 | 70 — 30 | 90 — 50 | 60 — 25 |
| Bacteriology 7·3[illegible] | 100 — 50 | 70 — 40 | .. .. |
| Business Management Ec 70 | .. .. | .. .. | 30 — 45 |
| Chemistry of Foods 5·25 | .. .. | .. .. | 100 — 40 |
| †Fish Culture 7·17 | .. .. | .. .. | 20 — 40 |
| Heat Engineering 2·50, 2·51 | 30 — 60 | 30 — 60 | .. .. |
| Industrial Organization Ec56, Ec57 | 30 — 60 | 30 — 60 | .. .. |
| **Navigation 1·15 | .. .. | .. .. | 20 — 40 |
| Sanitary Science and Public Health 7·56 | .. .. | .. .. | 30 — 30 |
| Statistics Ec65 | .. .. | 30 — 20 | .. .. |
| Water Supplies 5·20 | 40 — 10 | .. .. | .. .. |
| Hours of exercises and preparation: | 480 = 270 + 210 | 480 = 250 + 230 | 480 = 260 + 220 |

### FOURTH YEAR (Beginning 1922–1923)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Biological Colloquium 7·80 | 10 — 10 | 10 — 10 | 10 — 10 |
| Business Management Ec71, 72, 73 | 30 — 60 | 30 — 60 | 20 — 25 |
| Business Law Ec60 | 20 — 40 | 20 — 40 | 20 — 40 |
| Cost Accounting Ec51 | .. .. | 40 — 70 | .. .. |
| Heat Engineering 2·451 | 20 — 30 | .. .. | .. .. |
| Microscopy of Waters 7·06 | .. .. | .. .. | 20 — 20 |
| Personal Hygiene 7·22 | 30 — 30 | .. .. | .. .. |
| Plant Sanitation 7·67 | .. .. | 10 — 10 | .. .. |
| Refrigeration 2·759 | .. .. | .. .. | 20 — 20 |
| †Technology of Fishery Products 7·37 | 80 — 40 | 80 — 40 | 60 — 45 |
| Theoretical Biology 7·03 | 30 — 50 | .. .. | .. .. |
| Thesis | .. .. | 60 | 170 |
| Hours of exercises and preparation: | 480 = 220 + 260 | 480 = 250 + 230 | 480 = 320 + 160 |

*This option as scheduled is a preparation for Industrial and Engineering work in the Fisheries Industry. By electing suitable substitutes for the courses marked ** and by varying somewhat the special courses which are marked † students may obtain a preparation for work in other lines of Industrial Biology as applied to food production and conservation.

# Physics — COURSE VIII

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanism 2·02 | 30 — 60 | .. .. | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physical Instruments 8·09 | .. .. | .. .. | 40 — 20 |
| Physics Literature 8·10 | .. .. | 20 — 40 | 20 — 40 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Qualitative Analysis 5·10 | 100 — 20 | .. .. | .. .. |
| Quantitative Analysis 5·121 | .. .. | 140 — 10 | .. .. |
| Hours of exercises and preparation: | 500 = 260 + 240 | 500 = 290 + 210 | 500 = 220 + 280 |

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·211 | 30 — 60 | .. .. | .. .. |
| Electrical Engineering, Elem. of 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Electrical Engineering Laboratory 6·88 | .. .. | 30 — 45 | .. .. |
| Electricity 8·20 | .. .. | 50 — 40 | 50 — 40 |
| Heat Measurements 8·11 | .. .. | .. .. | 50 — 40 |
| Optics and Laboratory 8·17, 8·18 | .. .. | 30 — 60 | 60 — 30 |
| Photography 8·16 | 60 — 30 | .. .. | .. .. |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Technical Electrical Measurements 6·90 | 30 — 45 | .. .. | .. .. |
| Theoretical Physics 8·231, 8·232, 8·233 | 30 — 60 | 30 — 60 | 30 — 60 |
| General Study | .. .. | .. .. | 30 — 30 |
| Hours of exercises and preparation: | 480 = 210 + 270 | 480 = 200 + 280 | 480 = 250 + 230 |

## FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Electrochemistry, Principle of 8·80 | 40 — 70 | 30 — 60 | 30 — 60 |
| Mathematics M36, 37, 38 | 30 — 60 | 30 — 60 | 30 — 60 |
| Metallography I 5·41 | .. .. | .. .. | 40 — 20 |
| Organic Chemistry 5·50 | 30 — 30 | .. .. | .. .. |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| | 130 + 190 | 90 + 150 | 130 + 170 |
| Thesis | 30 | 110 | 120 |
| Elective* | 130 | 130 | 60 |
| Hours of exercises and preparation: | 480 | 480 | 480 |

*German or French, Heat Engineering, Aeronautics, Chemical Engineering, Industrial Chemistry, Organic Chemistry Laboratory, Advanced Mathematics, Theoretical Physics, Experimental Physics, Optical Crystallography 12·21.

# General Science — COURSE IX-A

**First Year Page 4. Description of Subjects of Instruction, Pages 49-130**

## Summer Session (Optional)

FOLLOWING FIRST YEAR

**Qualitative Analysis 5·10, 110 — 20**

**(Students taking this course in the Summer Session will take Quantitative Analysis 5·121 in First Term of Second Year.)**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Biology, General, and Bacteriology 7·29 | .. .. | .. .. | 70 — 60 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Language | 40 — 40 | 40 — 40 | 40 — 40 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Qualitative Analysis 5·10 | 110 — 20 | .. .. | .. .. |
| Quantitative Analysis 5·121 | .. .. | 120 — 10 | .. .. |
| Hours of exercises and preparation: | 500 = 280 + 220 | 500 = 290 + 210 | 500 = 240 + 260 |

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Astronomy GS66 | .. .. | 30 — 30 | .. .. |
| Crystallography 12·19 | .. .. | .. .. | 20 — 20 |
| Geology 12·30 | 50 — 40 | .. .. | .. .. |
| Geology 12·31 | .. .. | 30 — 30 | .. .. |
| Geology 12·32 | .. .. | .. .. | 40 — 20 |
| Heat Measurements 8·14 | 40 — 20 | .. .. | .. .. |
| Organic Chemical Laboratory 5·562 | .. .. | 60 — 0 | .. .. |
| Organic Chemistry 5·50 | 30 — 30 | .. .. | .. .. |
| Organic Evolution GS64 | .. .. | .. .. | 30 — 30 |
| Physical Instruments 8·09 | .. .. | .. .. | 40 — 20 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Theoretical Physics 8·23 | 30 — 60 | 30 — 60 | 30 — 60 |
| *Professional Elective | 90 | 150 | 110 |
| Hours of exercises and preparation: | 450 | 480 | 480 |

## FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Major Professional Elective | 90 | 90 | 90 |
| Professional Elective and Thesis | 330 | 330 | 330 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 | 480 | 480 |

*The program of elective courses should be as far as practicable, laid out at the beginning of the junior year in consultation with the professor in charge of Course IX.

# General Engineering — COURSE IX-B

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| Astronomy 1·12 | .. .. | 30 — 30 | .. .. |
| English and History EH21, EH22, EH23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Foundry 2·831 | 40 — 0 | .. .. | .. .. |
| Machine Drawing 2·12 | .. .. | 30 — 0 | 30 — 0 |
| Map Reading and Topographical Draw. 1·19 | .. .. | .. .. | 30 — 0 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Engineering Drawing 2·10 | 60 — 0 | .. .. | .. .. |
| Mechanism 2·02 | 30 — 50 | .. .. | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Spherical Trigonometry 1.11 | 10 — 20 | .. .. | .. .. |
| Surveying and Plotting 1·00 | .. .. | 30 — 60 | 30 — 0 |
| Vise, Bench and Machine Tool Work 2·95 | .. .. | 30 — 0 | 30 — 0 |
| Hours of exercises and preparation: | 500 = 270 + 230 | 500 = 250 + 250 | 500 = 280 + 220 |

Optional Summer School in Surveying, Mechanical, Electrical or Chemical Subjects

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·21, 2·22 | 30 — 60 | 30 — 60 | .. .. |
| Electrical Engineering, Elements of 6·41, 6·42 | 30 — 60 | 30 — 60 | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Heat Engineering { 2·40, 2·42 | 30 — 60 | 30 — 60 | .. .. |
| Heat Engineering { 2·41, 2·43 | 20 — 10 | 20 — 10 | .. .. |
| Hydraulics 1·64 | .. .. | .. .. | 30 — 50 |
| Materials of Engineering 2·302, 2·303 | .. .. | 20 — 20 | 20 — 20 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Structures 1·40 | .. .. | .. .. | 40 — 80 |
| General Study | 30 — 30 | .. .. | .. .. |
| Options | 60 | 80 | 110 |
| Hours of exercises and preparation: | 480 = 230 + 250 | 480 = 240 + 240 | 480 = 260 + 220 |

## FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Engineering Laboratory 2·605 | 40 — 20 | .. .. | .. .. |
| Heat Measurements 8·11 | 40 — 20 | .. .. | .. .. |
| Mathematical Laboratory M54, M55 | .. .. | 20 — 40 | 20 — 40 |
| Testing Materials Laboratory 2·351, 2·352 | 20 — 10 | 20 — 10 | .. .. |
| Professional Option (Major) | 90 | 90 | 90 |
| Professional Options (Minor) and Thesis | 180 | 240 | 270 |
| General Study | 30 — 30 | 30 — 30 | 30 — 0 |
| Hours of exercises and preparation: | 480 | 480 | 450 |

*The program of elective courses should be as far as practicable laid out at the beginning of the junior year in consultation with the professor in charge of Course IX.

# Mathematics — COURSE IX-C

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Language | 40 — 40 | 40 — 40 | 40 — 40 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |

*Additional work in Mathematics and Electives in Science or Engineering subjects, approved by the Department of Mathematics, may be chosen to complete the required number of hours for the year.

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Calculus, Adv. M36, 37, 38 | 30 — 60 | 30 — 60 | 30 — 60 |
| *Mathematical Electives | 30 — 60 | 30 — 60 | 30 — 60 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Theoretical Physics 8·231, 8·232, 8·233 | 30 — 60 | 30 — 60 | 30 — 60 |
| *Electives in Science, Engineering and General Studies | 450 hours | | |

## FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Aeronautics, Theoretical M43 | 30 — 60 | 30 — 60 | 30 — 60 |
| Least Squares and Probability M26 | 20 — 20 | .. .. | .. .. |
| Mathematical Laboratory M54, M55 | .. .. | 20 — 40 | 20 — 40 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |

Electives (one course in each term may be hosen in Science or Engineering subjects) and the remaining time is to be devoted to mathematics and thesis, making a total of 1,440 hours for the year's work.

* The program of elective courses should be as far as practicable laid out at the beginning of the junior year in consultation with the professor in charge of Course IX.

## Chemical Engineering — COURSE X

First Year, Page 4. Description of Subjects of Instruction, Pages 49–130

### SUMMER SESSION (Following First Year)

Qualitative Analysis 5·10, 210 — 30

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Language | 40 — 60 | 40 — 60 | 40 — 60 |
| Mathematics M21, 22 | 30 — 60 | 30 — 60 | .. .. |
| Mechanism 2·02 | .. .. | .. .. | 30 — 60 |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Problems of the Chemical Engineer 10·11 | 10 — 0 | .. .. | .. .. |
| Quantitative Analysis 5·121, 5·122, 5·13 | 80 — 20 | 90 — 20 | 90 — 20 |
| Hours of exercises and preparation: | 500 = 260 + 240 | 500 = 260 + 240 | 500 = 260 + 240 |

### THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| Chemical Principles 1 5·651 Lecture | 10 — 10 | 10 — 10 | 10 — 10 |
| Laboratory | 12 — 18 | 12 — 18 | 12 — 18 |
| Recitation | 30 — 30 | 30 — 30 | 30 — 30 |
| Electrical Engineering, Elements of 6·41 | .. .. | .. .. | 30 — 40 |
| Heat Engineering 2·46, 2·47, 2·48 | 30 — 60 | 30 — 60 | 30 — 30 |
| Industrial Chemistry 10·21, 10·22, 10·23 | 40 — 40 | 40 — 40 | 20 — 20 |
| Organic Chemistry I 5·51 | 40 — 30 | 40 — 30 | 30 — 20 |
| Organic Chemical Laboratory 5·561 | 70 — 0 | 70 — 0 | .. .. |
| Political Economy Ec31, Ec32, Ec33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 262 + 218 | 480 = 262 + 218 | 480 = 222 + 258 |

## Chemical Engineering — COURSE X — *Continued*

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·21, 2·22 | 30 — 60 | 30 — 60 | .. .. |
| *Applied Mathematics M41 | 30 — 60 | .. .. | .. .. |
| Chemical Engineering 10·31, 10·32, 10·33 | 30 — 40 | 30 — 40 | 30 — 40 |
| Electrical Engineering, Elements of 6·42 | 30 — 40 | .. .. | .. .. |
| Electrical Engineering Laboratory 6·85 | 30 — 40 | .. .. | .. .. |
| Engineering Laboratory 2·605, 2·612 | 40 — 20 | 20 — 10 | .. .. |
| Foundry 2·83 | 30 — 0 | .. .. | .. .. |
| *Industrial Chemical Laboratory 10·51 | .. .. | 70 — 20 | .. .. |
| Inorganic Chemistry 5·05 | .. .. | 30 — 45 | 30 — 45 |
| Machine Tool Work 2·97 | .. .. | .. .. | 30 — 0 |
| Testing Materials Laboratory 2·36 | .. .. | .. .. | 20 — 10 |
| Thesis Report and Memoirs 10·15 | .. .. | .. .. | 50 — 30 |
| Thesis | .. .. | 35 — 0 | 135 — 0 |
| Vise, Bench and Machine Tool Work 2·95 | .. .. | 30 — 0 | .. .. |
| General Study | .. .. | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 220 + 260 | 480 = 275 + 205 | 480 = 325 + 155 |

Students who offer no German upon entrance will take German L12 as the language requirement shown in the course scheme. Those offering elementary German, but not intermediate, will take L22.

Students offering intermediate German upon entrance will take elementary French L67 and technical German L37 as the language requirement in the course scheme.

Students desiring to enter X-A must indicate their intention not later than the end of the first term of the fourth year.

*Forty per cent of class will take course as scheduled. Remainder will take Industrial Chemical Laboratory 10·51 in the first and Applied Mathematics M41 in the second term.

### FOURTH YEAR

### (For Students Admitted to School of Chemical Engineering Practice—X-A)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Analytical Chemistry 5·14 | .. .. | .. .. | 60 — 15 |
| Applied Mechanics 2·21, 2·22 | 30 — 60 | 30 — 60 | .. .. |
| *Applied Mathematics M41 | 30 — 60 | .. .. | .. .. |
| Chemical Engineering 10·31, 10·32, 10·33 | 30 — 40 | 30 — 40 | 30 — 40 |
| Electrical Engineering, Elements of 6·42 | 30 — 40 | .. .. | .. .. |
| Electrical Engineering Laboratory 6·85 | 30 — 40 | .. .. | .. .. |
| Engineering Laboratory 2·60, 2·612 | 40 — 20 | 20 — 10 | .. .. |
| Foundry 2·83 | 30 — 0 | .. .. | .. .. |
| *Industrial Chemical Laboratory 10·51 | .. .. | 70 — 20 | .. .. |
| Inorganic Chemistry 5·05 | .. .. | 30 — 45 | 30 — 45 |
| Testing Materials Laboratory 2·36 | .. .. | .. .. | 20 — 10 |
| Thesis Report and Memoirs 10·15 | .. .. | .. .. | 50 — 30 |
| Thesis | .. .. | 65 — 0 | 90 |
| General Study | .. .. | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 220 + 260 | 480 = 275 + 205 | 480 = 310 + 170 |

## Chemical Engineering — *Continued*

## Chemical Engineering Practice — COURSE X-B

Students desiring to take the work of the School of Chemical Engineering Practice as undergraduates may apply for permission at the end of the third year of the regular course X. If accepted, they will substitute for the fourth year work the program shown below:

### SUMMER SESSION (Following Third Year)

| | |
|---|---|
| Chemical Engineering 10·34 | 25 — 60 |
| Industrial Chemical Laboratory 10·51 | 65 — 30 |
| General Study | 30 — 30 |

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mathematics M41 | 30 — 60 | | |
| Applied Mechanics 2·211 | 30 — 60 | | |
| Chemical Engineering I 10·35 | 40 — 55 | | |
| Electrical Engineering, Elements of 6·42 | 30 — 40 | School of Chemical Engineering Practice | |
| Inorganic Chemistry 5·05 | 30 — 45 | | |
| General Studies | 30 — 30 | | |
| School of Chemical Engineering Practice and Thesis | | 528 | 528 |
| Hours of exercise and preparation: | 480 = 190 + 290 | 528 | 528 |

# Sanitary Engineering — COURSE XI

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| Astronomy 1·12 | .. .. | 30 — 30 | .. .. |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Map Reading and Topographical Draw. 1·19 | .. .. | .. .. | 30 — 0 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanism 2·02 | 30 — 45 | .. .. | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Qualitative Analysis 5·10 | 120 — 15 | .. .. | .. .. |
| Quantitative Analysis 5·121, 5·121 | .. .. | 50 — 10 | 50 — 10 |
| Surveying and Plotting 1·00 | .. .. | 30 — 60 | 30 — 0 |
| Hours of exercises and preparation: | 500 = 280 + 220 | 500 = 240 + 260 | 500 = 270 + 230 |

## REQUIRED SUMMER COURSES AT CAMP TECHNOLOGY

| | |
|---|---|
| Geodetic and Topographic Surveying 1·08 | 100 hours |
| Hydrographic Surveying 1·60 | 75 hours |
| Plane Surveying 1·07 | 100 hours |
| Railroad Fieldwork 1·20 | 80 hours |

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·21, 2·221, 2·221 | 30 — 60 | 20 — 30 | 20 — 30 |
| Bacteriology, Elements of 7·31 | .. .. | 50 — 10 | .. .. |
| Biology, Elements of 7.02 | 30 — 10 | .. .. | .. .. |
| Geology 12·301, 12·311, 12·321 | 30 — 20 | 40 — 25 | 30 — 30 |
| Industrial Water Analysis 5·21 | .. .. | 30 — 0 | .. .. |
| Materials 1·43 | .. .. | .. .. | 20 — 40 |
| Organic Chemical Laboratory 5·562 | .. .. | .. .. | 60 — 0 |
| Organic Chemistry 5·50 | 30 — 30 | .. .. | .. .. |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Railway Drafting 1·23 | 60 — 0 | 50 — 0 | .. .. |
| Railway and Highway Engineering 1·21 | 20 — 40 | 20 — 25 | .. .. |
| Roads and Pavements 1·30 | .. .. | .. .. | 20 — 20 |
| Structures 1·41 | .. .. | 20 — 40 | 20 — 40 |
| Testing Materials Laboratory 2·36 | .. .. | .. .. | 20 — 10 |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 260 + 220 | 480 = 290 + 190 | 480 = 250 + 230 |

## FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Bacteriology of Water and Sewage 7·32 | .. .. | 30 — 10 | .. .. |
| Engineering and Hydraulic Lab. 2·64 | .. .. | .. .. | 30 — 30 |
| Heat Engineering 2·46, 2·47, 2·48 | 30 — 60 | 30 — 60 | 30 — 30 |
| Hydraulics and Sanitary Design 1·80 | .. .. | 20 — 0 | 60 — 0 |
| Hydraulics 1·62 | 40 — 80 | .. .. | .. .. |
| Microscopy of Waters 7·06 | .. .. | .. .. | 20 — 20 |
| Sanitary Science and Public Health 7·56 | .. .. | .. .. | 20 — 0 |
| Sanitary Engineering 1·77 | 20 — 40 | 20 — 40 | 40 — 80 |
| Structural Design 1·54 | .. .. | 40 — 0 | 20 — 0 |
| Structures 1·50 | 40 — 80 | 50—100 | .. .. |
| Vital Statistics 7·58 | 20 — 20 | .. .. | .. .. |
| Water Supply and Wastes Disposal 5·22 | 30 — 20 | .. .. | .. .. |
| Thesis | .. .. | 20 — 0 | 100 — 0 |
| General Study | .. .. | 30 — 30 | .. .. |
| Hours of exercises and preparation: | 480 = 180 + 300 | 480 = 240 + 240 | 480 = 320 + 160 |

# Geology and Geological Engineering — COURSE XII

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Mineralogy 12·01, 12·02, 12·02 | 60 — 10 | 60 — 10 | 60 — 20 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Qualitative Analysis 5·10 | 120 — 20 | .. .. | .. .. |
| Quantitative Analysis 5·121, 5·122 | .. .. | 120 — 20 | 110 — 20 |
| Hours of exercises and preparation: | 500 = 310 + 190 | 500 = 310 + 190 | 500 + 300 = 200 |

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Geology 12·30, 12·31, 12·32 | 50 — 40 | 30 — 30 | 40 — 30 |
| Geology Economic 12·40 | .. .. | .. .. | 50 — 60 |
| Language | 40 — 40 | 40 — 40 | 40 — 40 |
| Ore Dressing 3·21 | .. .. | 40 — 30 | .. .. |
| Paleontology 12·51 | 30 — 40 | 30 — 40 | .. .. |
| Petrography 12·15 | 50 — 30 | 60 — 20 | 30 — 10 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Thermochemistry and Chemical Equilibrium 5·68 | .. .. | .. .. | 40 — 80 |
| *Professional Options | 90 — 10 | 30 — 30 | .. .. |
| Hours of exercises and preparation: | 480 = 290 + 190 | 480 = 260 + 220 | 480 = 230 + 250 |

## REQUIRED SUMMER COURSES

| | |
|---|---|
| Surveying 1·03 | 240 hour |
| Underground Surveying 1·04 | 120 hour |

## FOURTH YEAR (For 1922-1923 only)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Economic Geology 12·42 | .. .. | .. .. | 20 — 20 |
| Economic Geology 12·40, 12·41 | .. .. | 50 — 40 | 60 — 30 |
| Geological Seminar 12·62 | 30 — 60 | 30 — 60 | .. .. |
| Geological Surveying 12·341 | .. .. | .. .. | 80 — 30 |
| Geology, Field 12·33 | 40 — 20 | .. .. | .. .. |
| Geology, Historical 12·50 | 40 — 30 | .. 240 .. | .. 240 .. |
| Thesis and Professional Option | 260 | 30 — 30 | .. .. |
| General Study | .. .. | | |
| Hours of exercises and preparation: | 480 = 370 + 110 | 480 = 350 + 130 | 480 = 400 + 80 |

*Professional Options may be chosen in Metallurgy, Mining, Physiography, Paleontology, Advanced Mineralogy or Petrology, Geology of Coal and Petroleum, etc.

## Geology and Geological Engineering — COURSE XII

*Continued*

### FOURTH YEAR (Effective October 1923)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Economic Geology 12·42 | .. .. | 20 — 20 | .. .. |
| Economic Geology 12·41 | 60 — 30 | .. .. | .. .. |
| Engineering Geology 12·47 | 20 — 20 | .. .. | .. .. |
| Field Geology 12·33 | 40 — 20 | .. .. | .. .. |
| Geological Seminar 12·62 | 30 — 60 | 30 — 60 | .. .. |
| Geological Surveying 12·341 | .. .. | .. .. | 80 — 40 |
| Geology of Clay, Cement and Building Stones 12·45 | .. .. | .. .. | 20 — 20 |
| Geology of Coal and Petroleum 12·44 | 30 — 30 | .. .. | .. .. |
| Historical Geology 12·50 | 40 — 30 | .. .. | .. .. |
| Hydrology 12·61 | .. .. | .. .. | 20 — 20 |
| Metallurgy 3·41 | 40 — 30 | .. .. | .. .. |
| Physiography 12·60 | .. .. | 30 — 30 | .. .. |
| Valuation of Oil Lands 12·441 | .. .. | 20 — 20 | .. .. |
| General Study | .. .. | 30 — 30 | .. .. |
| Thesis | .. .. | 80 | 120 |
| Professional Option | .. .. | 110 | 160 |
| Hours of exercises and preparation: | 480 = 260 + 220 | 480 = 320 + 160 | 480 = 400 + 80 |

# Naval Architecture and Marine Engineering — COURSE XIII

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Forging 2·80 | .. .. | 60 — 0 | .. .. |
| Foundry 2·82 | 60 — 0 | .. .. | .. .. |
| Machine Drawing 2·12 | .. .. | 60 — 0 | .. .. |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Engineering Drawing 2·10 | 60 — 0 | .. .. | .. .. |
| Mechanism 2·00, 2·01 | 30 — 60 | 30 — 60 | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Ship Construction 13·31 | .. .. | .. .. | 20 — 20 |
| Ship Drawing 13·41 | .. .. | .. .. | 60 — 0 |
| Surveying Instruments 1·01 | .. .. | .. .. | 20 — 0 |
| Hours of exercises and preparation: | 500 = 280 + 220 | 500 = 280 + 220 | 500 = 260 + 240 |

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·21, 2·22, 2·231 | 30 — 60 | 30 — 60 | 30 — 60 |
| Engineering Laboratory 2·608 | .. .. | .. .. | 40 — 20 |
| Heat Engineering 2·40, 2·42 | 30 — 60 | 30 — 60 | .. .. |
| Heat Engineering 2·411 | 20 — 20 | .. .. | .. .. |
| Machine Tool Work 2·88, 2·90 | .. .. | 40 — 0 | 40 — 0 |
| Naval Architecture 13·01 | 20 — 30 | 20 — 40 | 20 — 40 |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Ship Construction 13·32 | .. .. | 10 — 10 | 20 — 20 |
| Ship Drawing 13·42 | 50 — 0 | 60 — 0 | 70 — 0 |
| Vise and Bench Work 2·86 | 40 — 0 | .. .. | .. .. |
| General Study | 30 — 30 | 30 — 30 | 30 — 30 |
| Hours of exercises and preparation: | 480 = 250 + 230 | 480 = 250 + 230 | 480 = 280 + 200 |

## FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Chemistry 5·341 | 20 — 20 | .. .. | .. .. |
| Electrical Engin., Elem. of 6·41, 6·42 | 30 — 45 | 30 — 45 | .. .. |
| Engineering Laboratory 2·613, 2·614 | 20 — 20 | 20 — 20 | .. .. |
| Hydraulics 1·63 | .. .. | 20 — 40 | .. .. |
| Machine Tool Work 2·92 | 30 — 0 | .. .. | .. .. |
| Marine Engineering 13·51 | .. .. | 20 — 40 | 20 — 30 |
| Marine Engine Design 13·52 | .. .. | 40 — 0 | 60 — 0 |
| Materials of Engineering 2·302, 2·303 | .. .. | 20 — 20 | 20 — 20 |
| Naval Architecture 13·02 | 20 — 30 | 30 — 45 | .. .. |
| Ship Construction 13·33 | 20 — 20 | 20 — 20 | 20 — 20 |
| Ship Drawing 13·43 | 70 — 0 | 50 — 0 | 80 — 0 |
| Shipyard Org. and Management 13·15 | .. .. | .. .. | 20 — 20 |
| Steam Turbines 13·60 | 30 — 60 | .. .. | .. .. |
| Testing Materials Laboratory 2·37 | 30 — 15 | .. .. | .. .. |
| Thesis | .. .. | .. .. | 110 — 0 |
| General Study | .. .. | .. .. | 30 — 30 |
| Hours of exercises and preparation: | 480 = 270 + 210 | 480 = 250 + 230 | 480 = 360 + 120 |

# Naval Architecture — COURSE XIII-A

## Course for Naval Constructors

### SENIOR YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Alternating Currents and Alternating Current Machinery 6·45 | 30 — 60 | .. .. | .. .. |
| Alternating Current Machinery and its Applications 6·46 | .. .. | 30 — 60 | .. .. |
| Business Law GS4 | .. .. | .. .. | 20 — 40 |
| Electrical Engineering Laboratory 6·87 | .. .. | .. .. | 50 — 40 |
| Internal Combustion Engines 2·757 | .. .. | .. .. | 20 — 20 |
| Marine Engine Design 13·55 | 50 — 0 | 60 — 30 | .. .. |
| Marine Engineering 13·53 | 30 — 30 | .. .. | .. .. |
| Model Making 13·45 | .. .. | .. .. | 30 — 0 |
| Naval Architecture 13·01 | 20 — 40 | 20 — 40 | 20 — 40 |
| Political Economy Ec31, Ec32, Ec33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Shipyard Practice 13·14 | .. .. | .. .. | 30 — 30 |
| Steam Turbines 13·60 | .. .. | 30 — 60 | .. .. |
| Theory of Warship Design 13·11 | 40 — 40 | 40 — 40 | 40 — 40 |
| Warship Design 13·21 | 80 — 0 | 80 — 0 | 80 — 0 |
| | 480 = 280 + 200 | 550 = 290 + 260 | 560 = 320 + 240 |

### GRADUATE YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Aeronautics 8·59, 8·60, 8·602 | 80 — 60 | 80 — 40 | 40 — 80 |
| Business Management Ec70 | .. .. | .. .. | 30 — 60 |
| Merchant Shipbuilding 13·35 | 30 — 30 | .. .. | .. .. |
| Naval Architecture 13·02 | 20 — 40 | 20 — 40 | .. .. |
| Rigid Dynamics M73 | .. .. | 20 — 40 | 30 — 60 |
| Structures (Lectures) 1·45 | 20 — 40 | 30 — 60 | .. .. |
| Structures (Design) 1·52 | .. .. | 30 — 0 | .. .. |
| Theory of Warship Design 13·12 | 40 — 40 | 40 — 40 | 40 — 40 |
| Warship Design 13·22 | 80 — 0 | 80 — 0 | 80 — 0 |
| Thesis | .. .. | .. .. | 130 — 0 |
| | 480 = 270 + 210 | 520 = — + 220 | 590 = 350 + 240 |

# Electrochemical Engineering — COURSE XIV

**First Year, Page 4. Description of Subjects of Instruction, Pages 49-130**

**Summer Session**

**FOLLOWING FIRST YEAR**

**Qualitative Analysis 5·10, 190 — 30.** **Mechanism 2·02, 35 — 55**

## SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Electrical Engineering, Principles of, 6·00 | .. .. | .. .. | 40 — 60 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Language† | 40 — 40 | 40 — 40 | 40 — 40 |
| Machine Tool Work 2·91, 2·911 | .. .. | 20 — 0 | 20 — 0 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Quantitative Analysis 5·121, 5·122 | 90 — 20 | 90 — 20 | .. .. |
| Vise and Bench Work 2·871 | 20 — 0 | .. .. | .. .. |
| Hours of exercises and preparation: | 500 = 280 + 220 | 500 = 280 + 220 | 490 = 230 + 260 |

† Students credited with Elementary and Intermediate French on entrance will take Elementary German L11, or, if they have had preparation, Intermediate German L21.

Students credited with Elementary and Intermediate German on entrance will take Elementary French L61, or, if they have had preparation, Intermediate French L62.

Students credited with Elementary French and Elementary German on entrance will take Intermediate German L21.

## THIRD YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20, 2·211 | 30 — 60 | 30 — 60 | .. .. |
| Electrochemistry, Principles of, 8·80 | 40 — 70 | 30 — 60 | 30 — 60 |
| Electrical Eng., Prin. of 6·01, 6·02, 6·031 | 40 — 60 | 40 — 60 | 40 — 60 |
| Electrical Eng. Lab. 6·81, 6·82, 6·83 | 30 — 30 | 20 — 20 | 35 — 25 |
| Heat Engineering 2·43, 2·48 | .. .. | 20 — 10 | 20 — 20 |
| Heat Measurements 8·12 | .. .. | .. .. | 30 — 10 |
| Organic Chemistry 5·50 | 30 — 30 | .. .. | .. .. |
| Organic Chemistry Laboratory 5·562 | .. .. | 70 — 0 | .. .. |
| Political Economy Ec31, 32, 33 | 30 — 30 | 30 — 30 | 30 — 30 |
| Testing Materials Laboratory 2·36 | .. .. | .. .. | 20 — 10 |
| General Study | .. .. | .. .. | 30 — 30 |
| Hours of exercises and preparation: | 480 = 200 + 280 | 480 = 240 + 240 | 480 = 235 + 245 |

## Electrochemical Engineering — COURSE XIV — *Continued*

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Electrochemical Laboratory 8·87 | .. .. | 70 — 0 | .. .. |
| Applied Electrochemistry 8·85 | .. .. | 30 — 60 | 10 — 50 |
| Colloquium 8·93 | .. .. | 10 — 10 | 10 — 10 |
| Electrical Engineering, Principles of 6·041 | 50 — 70 | .. .. | .. .. |
| Electrical Engineering Laboratory 6·84 | 35 — 25 | .. .. | .. .. |
| Electrochemical Laboratory 8·86 | 70 — 0 | .. .. | .. .. |
| Electrochemistry II 8·82 | 30 — 60 | .. .. | .. .. |
| Industrial Chemistry 10·21, 10·22 | 30 — 30 | 30 — 30 | .. .. |
| Metallography I 5·41 | .. .. | .. .. | 40 — 20 |
| Thesis* | .. .. | 60 — 0 | 180 — 0 |
| Optional Studies** | 80 | 180 | 160 |
| Hours of exercises and preparation: | 480 | 480 | 480 |

* Time subject to adjustment with optional studies with approval of Department.
** Time varies as to exercises and preparation.
Suggested Optional Studies:
Electrochemistry III 8·83. Physical Materials 8·41.
Electrical Engineering 6·04 (in place of 6·041), 6·05, 6·06 and Professional Options.
Chemical Engineering 10·31, 10·32, 10·33.
Assaying and Metallurgy 3·32, and other courses in metallurgy by arrangement with Department.
Industrial Chemical Laboratory 10·51 (may also be taken in summer).
Hydraulics 1·65, 1·69; Proximate Technical Analysis 5·30; Colloidal Chemistry 5·69; Heat Measurements 8·14.

| | | | |
|---|---|---|---|
| General Study (*must* be taken during one term and may be taken each term if desired) | 30 — 30 | 30 — 30 | 30 — 30 |

# Engineering Administration — COURSE XV

**First Year, Page 4. Description of Subjects of Instruction, Pages 49–130**

## OPTION 1. Civil Engineering

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Accounting Ec50 | 40 — 50 | .. .. | .. .. |
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| Astronomy 1·12 | .. .. | 30 — 30 | .. .. |
| Descriptive Geometry D201 | 45 — 0 | .. .. | .. .. |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanism 2·02 | 30 — 45 | .. .. | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Political Economy Ec22, Ec23 | .. .. | 30 — 30 | 30 — 30 |
| Spherical Trigonometry 1·11 | .. .. | 10 — 20 | .. .. |
| Surveying and Plotting 1·00 | .. .. | 20 — 40 | 40 — 20 |
| Hours of exercises and preparation: | 500 = 245 + 255 | 500 = 220 + 280 | 500 = 230 + 270 |

### REQUIRED SUMMER COURSES AT CAMP TECHNOLOGY

| | |
|---|---|
| Geodetic and Topographic Surveying 1·08 | 100 hours |
| Hydrographic Surveying 1·60 | 75 hours |
| Plane Surveying 1·07 | 100 hours |
| Railroad Field Work 1·20 | 80 hours |

### THIRD YEAR * (See page 48)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·21, 2·221, 2·221 | 30 — 60 | 20 — 30 | 20 — 30 |
| Banking Ec37 | 30 — 50 | .. .. | .. .. |
| Business Management Ec70 | .. .. | .. .. | 30 — 45 |
| Electrical Engineering, Elements of 6·40 | 30 — 40 | .. .. | .. .. |
| Electrical Engineering Laboratory 6·83 | .. .. | .. .. | 20 — 30 |
| English E32 | .. .. | 30 — 60 | .. .. |
| Heat Engineering 2·46, 2·47, 2·48 | 30 — 60 | 30 — 60 | 30 — 30 |
| Industrial Organization Ec56, Ec57 | 30 — 60 | 30 — 60 | .. .. |
| Materials 1·43 | .. .. | .. .. | 20 — 40 |
| Railway and Highway Engineering 1·21 | 20 — 40 | 20 — 30 | .. .. |
| Report Writing E33 | .. .. | 30 — 30 | .. .. |
| Securities and Investments Ec38 | .. .. | .. .. | 30 — 40 |
| Statistics Ec65 | .. .. | 30 — 20 | .. .. |
| Structures 1·40 | .. .. | .. .. | 40 — 75 |
| Hours of exercises and preparation: | 480 = 170 + 310 | 480 = 190 + 290 | 480 = 190 + 290 |

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Business Law Ec60 | 20 — 40 | 20 — 40 | 20 — 40 |
| Business Management Ec71, 72, 73 | 30 — 60 | 30 — 60 | 20 — 25 |
| Cost Accounting Ec51 | .. .. | 40 — 70 | .. .. |
| Engineering and Hydraulic Lab. 2·64 | .. .. | .. .. | 30 — 30 |
| Foundations 1·48 | 10 — 15 | .. .. | .. .. |
| Hydraulic Engineering 1·68 | .. .. | .. .. | 30 — 60 |
| Hydraulics 1·62 | 40 — 70 | .. .. | .. .. |
| Industrial Relations Ec46 | .. .. | .. .. | 30 — 45 |
| Railway and Highway Engineering 1·24 | 30 — 45 | .. .. | .. .. |
| Sanitary Science and Public Health 7·56 | .. .. | .. .. | 20 — 0 |
| Structural Design 1·54 | .. .. | 40 — 0 | 20 — 0 |
| Structures 1·50 | 40 — 80 | 50—100 | .. .. |
| Testing Materials Laboratory 2·36 | .. .. | 20 — 10 | .. .. |
| Thesis | .. .. | .. .. | 110 |
| Hours of exercises and preparation: | 480 = 170 + 310 | 480 = 200 + 280 | 480 = 280 + 200 |

# Engineering Administration — COURSE XV

## OPTION 2. Mechanical and Electrical Engineering

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Accounting Ec50 | .. .. | .. .. | 40 — 50 |
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Machine Drawing 2·12, 2·13 | .. .. | 60 — 0 | 30 — 0 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanical Engineering Drawing 2·10 | 60 — 0 | .. .. | .. .. |
| Mechanism 2·00, 2·01 | 30 — 60 | 30 — 60 | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8.023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Political Economy Ec22, 23 | 30 — 30 | 30 — 30 | .. .. |
| Hours of exercises and preparation: | 500 = 250 + 250 | 500 = 250 + 250 | 500 = 230 + 270 |

### REQUIRED SUMMER COURSES

| | |
|---|---|
| Mechanical Laboratory 2·96 | 75 — 0 |
| Surveying 1·001 | 60 — 15 |

### THIRD YEAR* (See page 48)

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·21, 2·22, 2·23 | 30 — 60 | 30 — 60 | 30 — 50 |
| Banking Ec37 | 30 — 50 | .. .. | .. .. |
| Business Management Ec70 | .. .. | .. .. | 30 — 45 |
| Electrical Engineering, Elements of 6·41 | .. .. | .. .. | 30 — 45 |
| Engineering Laboratory 2·602, 2·603 | .. .. | 20 — 10 | 20 — 10 |
| English E32 | .. .. | 30 — 60 | .. .. |
| Heat Engineering { 2·40, 2·42 | 30 — 60 | 30 — 60 | .. .. |
| Heat Engineering { 2·41, 2·43 | 20 — 20 | 20 — 20 | .. .. |
| Hydraulics 1·64 | .. .. | .. .. | 30 — 60 |
| Industrial Organization Ec56, Ec57 | 30 — 60 | 30 — 60 | .. .. |
| Machine Tool Work 2·97 | 30 — 0 | .. .. | .. .. |
| Materials of Engineering 2·32 | .. .. | .. .. | 20 — 40 |
| Report Writing E33 | 30 — 30 | .. .. | .. .. |
| Securities and Investments Ec38 | .. .. | .. .. | 30 — 40 |
| Statistics Ec65 | .. .. | 30 — 20 | .. .. |
| Hours of exercises and preparation: | 480 = 200 + 280 | 480 = 190 + 290 | 480 = 190 + 290 |

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Business Law Ec60 | 20 — 40 | 20 — 40 | 20 — 40 |
| Business Management Ec71, 72, 73 | 30 — 60 | 30 — 60 | 20 — 25 |
| Central Stations 6·231 | .. .. | .. .. | 30 — 60 |
| Cost Accounting Ec51 | .. .. | 40 — 70 | .. .. |
| Electrical Engineering, Elements of 6·42 | 30 — 45 | .. .. | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | .. .. | 30 — 40 |
| Electrical Transmission and Distribution of Energy 6·44 | .. .. | 30 — 45 | .. .. |
| Engineering Laboratory 2·611, 2·621 | 40 — 40 | 20 — 10 | .. .. |
| Engineering Electives | .. .. | 40 — 0 | .. .. |
| General Engineering Lectures 2·76 | .. .. | 10 — 5 | .. .. |
| Hydraulic Engineering 1·68 | 30 — 45 | .. .. | .. .. |
| Industrial Relations Ec46 | .. .. | .. .. | 30 — 45 |
| Machine Design 2·704, 2·711 | 60 — 10 | 60 — 0 | .. .. |
| Testing Materials Laboratory 2·36 | 20 — 10 | .. .. | .. .. |
| Thesis | .. .. | .. .. | 140 |
| Hours of exercises and preparation: | 480 = 230 + 250 | 480 = 250 + 230 | 480 = 270 + 210 |

# Engineering Administration — COURSE XV

## OPTION 3. Chemical Engineering

**Summer Session. Qualitative Analysis 5·10, 210 — 30**

FOLLOWING FIRST YEAR

### SECOND YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Accounting Ec50 | 40 — 50 | .. .. | .. .. |
| English and History EH21, 22, 23 | 30 — 50 | 30 — 50 | 30 — 50 |
| Language | 30 — 30 | 30 — 30 | 30 — 30 |
| Mathematics M21, 22, 23 | 30 — 60 | 30 — 60 | 30 — 60 |
| Mechanism 2·02 | 30 — 30 | .. .. | .. .. |
| Military Science MS31, 32, 33 | 30 — 0 | 30 — 0 | 30 — 0 |
| Physics 8·021, 8·022, 8·023 | 40 — 50 | 40 — 50 | 40 — 50 |
| Political Economy Ec22, Ec23 | .. .. | 30 — 30 | 30 — 30 |
| Quantitative Analysis 5·121, 5·122 | .. .. | 80 — 10 | 80 — 10 |
| Hours of exercises and preparation: | 500 = 230 + 270 | 500 = 270 + 230 | 500 = 270 + 230 |

### THIRD YEAR*

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·20 | .. .. | .. .. | 30 — 60 |
| Banking Ec37 | 30 — 50 | .. .. | .. .. |
| Business Management Ec70 | .. .. | .. .. | 30 — 45 |
| Electrical Engineering, Elements of 6·41 | .. .. | .. .. | 30 — 45 |
| English E32 | .. .. | 30 — 60 | .. .. |
| Heat Engineering 2·46, 2·47, 2·48 | 30 — 60 | 30 — 60 | 30 — 30 |
| Industrial Chemistry 10·21, 10·22, 10·23 | 30 — 30 | 30 — 30 | 30 — 35 |
| Industrial Organization Ec56, Ec57 | 30 — 60 | 30 — 60 | .. .. |
| Organic Chemical Laboratory 5·562 | 100 — 0 | 40 — 0 | .. .. |
| Organic Chemistry 5·50 | 30 — 30 | .. .. | .. .. |
| Report Writing E33 | .. .. | 30 — 30 | .. .. |
| Statistics Ec65 | .. .. | 30 — 20 | .. .. |
| Thermochemistry and Ch. Equil. 5·68 | .. .. | .. .. | 40 — 75 |
| Hours of exercises and preparation: | 480 = 250 + 230 | 480 = 220 + 260 | 480 = 190 + 290 |

### FOURTH YEAR

| | First Term 10 Weeks | Second Term 10 Weeks | Third Term 10 Weeks |
|---|---|---|---|
| Applied Mechanics 2·211 | 30 — 60 | .. .. | .. .. |
| Business Law Ec60 | 20 — 40 | 20 — 40 | 20 — 40 |
| Business Management Ec71, 72, 73 | 30 — 60 | 30 — 60 | 20 — 25 |
| Chemical Engineering 10·36, 10·36 | 30 — 30 | 30 — 30 | .. .. |
| Cost Accounting Ec51 | .. .. | 40 — 70 | .. .. |
| Electrical Engineering, Elements of 6·42 | 30 — 40 | .. .. | .. .. |
| Electrical Engineering Laboratory 6·85 | .. .. | 30 — 40 | .. .. |
| Engineering Laboratory 2·604 | .. .. | .. .. | 60 — 30 |
| Industrial Chemical Laboratory 10·51 | 90 — 20 | .. .. | .. .. |
| Industrial Relations Ec46 | .. .. | .. .. | 30 — 45 |
| Securities and Investments Ec38 | .. .. | .. .. | 30 — 40 |
| Testing Materials Laboratory 2·36 | .. .. | 20 — 10 | .. .. |
| Thesis | .. .. | 20 | 140 |
| Vise, Bench, Machine Tool Work 2·951 | .. .. | 40 — 0 | .. .. |
| Hours of exercises and preparation: | 480 = 230 + 250 | 480 = 230 + 250 | 480 = 300 + 180 |

Students enrolled for Ordnance Unit of the Reserve Officers Training Corps will be given 30 hours on Ordnance problems in the second term of the fourth year. These 30 hours are in addition to the regular schedule.

*The total number admitted to the Third Year of Course XV inclusive of the three Options shall not exceed 150 students, until the number of applicants for this course with perfectly clear records in the work of the first two years shall exceed 150.

# DESCRIPTION OF COURSES

## CIVIL AND SANITARY ENGINEERING

The instruction in Civil and Sanitary Engineering is given by means of lectures and recitations, and by practice in the field, the drafting-room and the laboratory. The strictly professional work begins in the second year and includes a thorough classroom course in surveying, followed by field practice in the use of surveying instruments and by drafting-room work consisting of computations and the preparation and interpretation of maps and profiles. This work is preliminary to an extensive summer course in which thorough training is given in surveying and in railroad field work. Students in civil engineering also take astronomy, geodesy and a brief course in graphic statics during this year, while the sanitary engineers have extended courses in qualitative and quantitative analysis; students in both courses also begin applied mechanics during this year.

In the third year the chief professional subjects for the civil engineers are railway and highway engineering and the theory of structures; students in both courses also complete during this year their formal instruction in applied mechanics and in materials. The sanitary engineers continue chemistry and begin subjects of biology and bacteriology, while the civil engineers are given a course of considerable length in electrical engineering. Students taking the hydro-electric option take a slightly different course in the third year from the other civil engineering students. In the fourth year the work is almost entirely professional and leads the student into various branches of engineering. The work of this year is divided into three distinct options: (1) hydraulic engineering, (2) transportation engineering, (3) hydro-electric engineering. Option 1 gives special attention to the application of the principles of hydraulics to branches of engineering which have to do with public water supplies, irrigation, sewage and its disposal, and the development of water power. Option 2 is divided into two parts, permitting the student to give special attention to either railway transportation or highway transportation. Option 3 deals in considerable detail with the problems that arise in hydro-electric developments.

In all this work the object is to enable the student to apply intelligently to practical problems the principles that he has studied; to give power, to avoid rule-of-thumb methods, and to train the students to have courage and self-reliance in solving the problems that the engineer has to meet.

**1·00. Surveying and Plotting.** This course consists of a thorough classroom drill in the principles of surveying given in the second term; this is followed in the third term by fieldwork, accompanied by computations and the making of scaled drawings, profiles and contour maps, and the study of their application to the solution of engineering problems. Textbook: *Breed and Hosmer's Principles and Practice of Surveying, Vol. I.*

**1·001. Surveying and Plotting.** This course, given in the summer between the second and third years, covers the same ground as course 1·00 somewhat more briefly. Textbook: *Breed and Hosmer's Principles and Practice of Surveying, Vol. I.*

**1·01. Surveying Instruments.** This brief course illustrates the use of the common forms of surveying instruments.

**1·02. Surveying.** The methods of using the compass and chain, the transit and tape, and the level, in making plane surveys, are explained by

lectures and by field exercises. In the drafting-room the computations and drawings necessary to interpret surveying field notes are made.

**1·03. Surveying.** This course is given in the summer between third and fourth years; it consists of 240 hours, lectures, recitations, drafting and fieldwork. The fieldwork consists of plane, topographic and elementary railroad surveying. Plans and maps will be made in the drafting-room from notes taken in the field. Textbook: *Breed and Hosmer's Principles and Practice of Surveying, Vol. I.* (Not given in 1922.)

**1·04. Underground Surveying.** This course of 120 hours, lectures, recitations, fieldwork and drafting immediately follows course 1·03. The fieldwork consists of mine surveying. The drafting-room work includes computations from original field notes and the drafting of mine plans. Textbook: *Breed and Hosmer's Principles and Practice of Surveying, Vol. I.* (Not given in 1922.)

**1·07. Plane Surveying.** At Camp Technology, East Machias, Maine. This course is given in the summer between the second and third years; it consists of 100 hours, lectures, fieldwork, and drafting. The fieldwork consists in making surveys with the compass and chain and with the transit and tape, the running of profiles and cross-sectioning with the level, and in the astronomical determination of a meridian. The work in the drafting-room consists of making computations which arise in surveying operations and of making scale drawings, profiles, and contour maps from field notes. Textbook: *Breed and Hosmer's Principles and Practice of Surveying, Vol. I.*

**1·08. Geodetic and Topographic Surveying.** At Camp Technology, East Machias, Maine. This course is given in the summer between the second and third years; it consists of 100 hours, lectures, fieldwork, computations, and drafting. The fieldwork consists of the measurement of a base line, triangulation, and the determination of position astronomically; the making of topographic surveys with the transit; the making of large and small scale maps with the plane table; the use of the sextant in hydrographic surveys; the use of the traverse plane table in making road traverses for small scale maps. This course also includes trigonometric and barometric leveling. The work in the drafting-room consists of making the computations and drawings necessary to interpret the results of the field observations. Textbooks: *Breed and Hosmer's Principles and Practice of Surveying, Vol. II; Hosmer's Practical Astronomy.*

**1·09. Geodetic Surveying.** At Camp Technology, East Machias, Maine. This course is given in the summer between third and fourth years; it covers three weeks, 150 hours, of fieldwork and office work. This work consists of the measurement of a base line; triangulation with repeating and with direction instrument; precise and trigonometric leveling; observations for time, latitude and longitude with astronomical transit; and magnetic observations for declination, dip and intensity.

This course is an elective for a limited number of students in Course I who have satisfactorily completed the third year.

**1·11. Spherical Trigonometry.** This course covers the demonstration and application of the formulas required for the solution of right and of oblique spherical triangles. Textbook: *Passano, Trigonometry.*

**1·12. Astronomy.** This course is intended to supplement Surveying 1·00 and the subject is therefore treated from the standpoint of the engineer. The fieldwork for this course is given at Camp Technology and includes the determination of latitude, longitude, time and azimuth with the engineer's transit. Textbook: *Hosmer's Practical Astronomy.*

**1·13. Geodesy.** In this course the methods of conducting a geodetic survey are discussed in detail, and the theory of the figure of the earth

and the methods of determining it, both by arc measurements and by gravity observations, are briefly considered. Textbook, *Hosmer's Geodesy*.

**1·14. Geodesy.** This course includes the theory of higher geodesy, gravity measurements, astronomical observations, and the application of least squares to geodetic measurements. The principal part of the fieldwork corresponding with this course is given in course 1·09 — Geodetic Surveying — offered at Camp Technology. Textbooks: *Helmert's Höheren Geodäsie*, *Jordan's Handbuch der Vermessungskunde and Clarke's Geodesy*.

**1·15. Navigation.** The course covers such theory and practice of navigation as is required for examination for officers' licenses, and includes (1) use of compass, log and chart, (2) piloting, (3) dead-reckoning, (4) Mercator and Great-circle sailing, (5) observations for latitude, longitude and azimuth, and (6) Sumner's Method. Practice is given in making sextant observations. Textbook: *Bowditch's Navigator*.

**1·19. Map Reading and Topographical Drawing.** This course is devoted to the study of the different conventional signs employed in making topographical maps. Each student is required to make a number of plates, and to become reasonably proficient in the preparation of such maps. Particular attention is given to the reading of contour maps, and the solution of problems relating thereto.

**1·20. Railway Fieldwork.** At Camp Technology, East Machias, Maine. This course is given in the summer between the second and third years; it consists of eighty hours classroom and fieldwork. A survey is made for a railroad about two miles in length. A reconnaissance is first made, followed by a preliminary survey including the necessary topography to permit of determining the position of the location line; the location line is then staked out. There is also a systematic drill in the laying out of curves by various methods, including the A. R. E. A. spirals, and in setting slope stakes for grading. Sufficient class work of an elementary character is given at the Camp to supplement the fieldwork. Textbooks: *Allen's Railroad Curves and Earthwork; Allen's Field and Office Tables*.

**1·21. Railway and Highway Engineering.** This course consists of a thorough study of curves and earthwork. The first term is devoted to the mathematics of curves with applications to the location of railways, highways, sewers, pipe lines, etc. The second term is devoted principally to the methods of staking out and computing earthwork and masonry and to spirals, Y and connecting tracks. Recitation work predominates, particularly in the first term, and many problems are assigned for solution outside and in the classroom. The applications of this course are further developed by course 1·23. So much of this course as relates specifically to railways (twenty hours' class work in all) is omitted by students in Courses $I_3$, XI, $XV_1$. Textbooks: *Allen's Railroad Curves and Earthwork; Allen's Field and Office Tables*.

**1·23. Railway Drafting.** This course consists of two parts: (a) The making of a plan and a profile from the notes of a railway location survey made at Camp Technology; (b) the application of the theory of curves and earthwork taught in course 1·21 to the solution of problems in hydraulic, railway or highway construction.

**1·24. Railway and Highway Engineering.** A course in engineering organization and duties and in construction methods and estimates of cost for work below sub-grade; including clearing, grubbing, culverts, drains, handling earth in excavations and in embankments, masonry walls and abutments. Some of the methods of laying out and carrying on construction work and estimates are illustrated by a study of typical projects involving the elimination of grade crossings. Textbook: *Lavis' Railway Estimates*.

**1·25. Railway Engineering.** The subjects treated include the following: maintenance of way and structures; yards and stations; interlocking and block signals; rolling stock, including tractive effort of locomotives, and mechanics and operation of brakes; the economics of railway engineering, with a critical study of train resistance, tonnage rating and the influences of grade, distance, curvature and rise and fall on operative costs; I. C. C. accounting and public regulation. The object is to give the student a comprehensive knowledge of railway engineering. The solution of problems on signals, tractive effort, brakes, economics and railway accounting is required. Textbooks: *Willard's Maintenance of Way and Structures; Neostyled Notes on Railway Signaling and on Economics of Railway Engineering.*

**1·26. Railway Design.** A course in the drafting-room, including problems in railway location; the proportioning of culverts and water ways; the complete computation and detailed design of a division yard, including a locomotive terminal; interlocking signals and other practical railway problems involving the application of the principles taught in courses 1·21 and 1·25.

**1·27. Railway Engineering.** This course is a continuation of courses 1·25 and 1·26. Special attention is given to the design and operation of freight and passenger yards and terminals, locomotive terminals, coal handling; railroad electrification; electric railways. The principles of railway accounting, rates and public regulation and control are thoroughly discussed. Students in this course will make individual investigations and reports upon problems involving railway operation, economics and finances. This course will only be given at the option of professor in charge. Textbooks: *Droege's Passenger Terminals and Trains; Droege's Freight Terminals and Trains; Byer's Economics of Railway Operation; Reports of the American Railway Engineering Association, and various other reports and periodicals.*

**1·28. Railway Design.** This course is a continuation of course 1·26 and closely correlated with course 1·27. It includes the design of freight, passenger and locomotive terminals; grade crossing elimination; handling of traffic during construction, and cost estimates. This course will only be given at the option of the professor in charge.

**1·30. Roads and Pavements.** This course includes an outline of the principles governing the location, construction, and maintenance of roads, and the construction and maintenance of pavements for city streets. Textbook: *Blanchard's Elements of Highway Engineering.*

**1·31. Testing of Highway Materials.** In this course physical tests of various kinds of road materials are made and their value in highway construction discussed.

**1·32. Highway Transportation.** This course consists of discussion, recitations and problems on relation of highway to railroad transportation, highway legislation, traffic surveys, layout and construction of roads, types of motor vehicles, loads, pavement and grade resistances, economics of motor transport, economics of highway location.

**1·33. Highway Design.** This course involves a design for an improvement of an existing road by substitution of improved alignment, grades and new pavement suitable for assumed traffic.

**1·39. Graphic Statics.** This course aims to familiarize the student with graphical methods of dealing with forces and reactions, and of determining stresses in simple trussed structures.

**1·40. Theory of Structures.** An introductory course covering outer forces, reactions, moments and shears for fixed and moving loads, the use of influence lines, the design of steel and wooden beams and of plate girders. Textbook: *Spofford's Theory of Structures.*

**1·41. Theory of Structures.** This course is similar in scope to course 1·40, with certain minor changes. Textbook: *Spofford's Theory of Structures.*

**1·43. Materials.** This course is designed to acquaint the student with the properties of the various materials used by the engineer, such as stone, brick, cement, concrete, wood, iron and steel. Textbook: *Mills' Materials of Construction.* Second edition.

**1·44. Stationary Structures.** This course is designed to give students in electrical and mining engineering a knowledge of the fundamentals of the theory of structures. Textbook: *Spofford's Theory of Structures.*

**1·45. Theory of Structures.** This course is specially arranged for naval constructors. It is intended to give some familiarity with problems met by structural engineers and the usual methods employed by them in computing and designing structures. The subject matter includes the use of influence lines, the determination of moments and shears due to moving loads, the design of plate girders, simple trusses, columns, portals, and a brief discussion of methods employed in the calculation of indeterminate structures. Textbook: *Spofford's Theory of Structures.*

**1·48. Foundations.** This course is devoted to the study of the methods of constructing foundations for bridges, buildings and other structures. Textbook: *Jacoby and Davis' Foundations.*

**1·49. Theory of Structures.** This is an extended course, in continuation of courses 1·40 and 1·41. It treats of the computation and design of structures of wood, steel and masonry, by analytical and by graphical methods. The subjects considered are: roof and bridge trusses of various forms; trestles; earth-pressure; retaining walls; masonry dams; arches of metal, stone and concrete; and the theory of reinforced concrete design. The object is to train the student thoroughly in the application of the principles of mechanics to the design of the more common engineering structures. Textbook: *Spofford's Theory of Structures.*

**1·50. Theory of Structures.** This course is identical with the portion of 1·49 given in the first and second terms. Textbook: *Spofford's Theory of Structures.*

**1·51. Theory of Structures.** This course is identical with 1·49 in the first term; in the second term it is adapted especially to the needs of students in Architectural Engineering. Textbook: *Spofford's Theory of Structures.*

**1·52. Structural Design.** This course covers the designing and partial detailing of simple structures such as columns, roof trusses, towers, footings, etc. It is intended to illustrate and amplify the work of course 1·45 by practical design problems.

**1·53. Bridge Design.** This course aims to show the student the relations of the theory of structures to engineering practice through the preparation of designs and drawings for a plate girder railway bridge, a wooden roof truss, several reinforced concrete structures and a riveted steel truss highway bridge. Emphasis is laid on the development of careful, systematic and practical habits of computation.

**1·531. Structural Design.** This course is somewhat abridged from course 1·53 and is specially adapted to the needs of students in $I_3$.

**1·54. Structural Design.** This is a drafting-room course similar in character to course 1·53, but much shorter, and intended to give only an outline of the subject.

**1·55. Structural Design, Advanced.** This course is devoted chiefly to the design of arches of steel and reinforced concrete. Special problems may be taken by competent students.

**1·56. Advanced Structures.** Some of the subjects considered are arch bridges of steel and reinforced concrete, space framework, frameworks of high buildings, trusses of complicated types, and, in general, the entire

subject of statically indeterminate structures. Textbooks: *Mimeographed notes prepared by Professor Spofford; textbooks by various American and German authors; Monographs and Professional Papers.*

**1·58. Reinforced Concrete Design.** In this course instruction is given in the theoretical and practical principles involved in the design of structures of reinforced concrete. The problems considered are chiefly those arising in the construction of buildings. Textbook: *Concrete Engineers' Handbook, Hool and Johnson.*

**1·60. Hydrographic Surveying.** At Camp Technology, East Machias, Maine. This course is given in the summer between the second and third years; it consists of lectures, fieldwork, computations and drafting. (a) Stream Gaging.—A course designed to instruct the students in the principles underlying the art of measuring the flow of water in open channels. The equipment of the Camp includes a complete gaging station on a nearby stream, where each student is given opportunity to make several complete measurements and is instructed in the use of various current meters. (b) Soundings.— On Gardner's Lake, the student is instructed in the method of making soundings, and practices the use of the sextant and the transit in locating them. In the drafting-room a portion of the data thus secured is plotted. Textbook (for Stream Gaging only): *Hoyt and Grover, River Discharge.*

**1·62. Theoretical Hydraulics.** This course covers the principles of hydrostatic and hydrodynamic pressure; the measurement of flowing water by orifices, nozzles and weirs; flow through pipes and open channels; losses from friction and other sources; and other related topics. Textbook: *Russell's Hydraulics.*

**1·63. Theoretical Hydraulics.** A brief course, dealing with selected portions of the work given in course 1·62. Textbook: *Russell's Hydraulics.*

**1·64. Theoretical Hydraulics.** A course dealing with selected portions of the work given in course 1·62. Textbook: *Russell's Hydraulics.*

**1·65. Theoretical Hydraulics.** This course covers the principles of hydrostatics; of the measurement of flowing water by orifices, nozzles, and weirs; of flow through pipes and open channels; and of the theory of hydraulic turbines and impulse wheels. Textbooks: *Russell's Hydraulics; Daugherty's Hydraulic Turbines.*

**1·66. Advanced Hydraulics.** This course is offered primarily for those students in the graduate year who are desirous of pursuing further their studies in theoretical and applied hydraulics. The subjects treated relate in a general way to problems arising in water-supply and water-power engineering and subjects which are only fundamentally treated in 1·62 are further elaborated and discussed. The outside preparation includes a certain amount of reference study in addition to the usual problems.

**1·68. Hydraulic Engineering.** This is essentially a course in water power engineering, including a study of practice in regard to the construction and selection of hydraulic turbines and impulse wheels, the study of hydrology, effect of storage and pondage, estimates of available power, the important features of hydro-electric developments and their general arrangement. Textbooks: *Daugherty's Hydraulic Turbines; Barrows' Notes on Water Power Engineering.*

**1·69. Water Power Engineering.** (a) The theory of hydraulic turbines and impulse wheels and its practical application to their construction, their selection and testing, followed by (b) the study of certain features of hydrology including precipitation, run-off and methods of analyzing and using stream flow records with special reference to estimates of available water power. Textbook: *Barrows' Notes on Water Power Engineering.*

**1·70. Water-Power Engineering.** (a) A continuation of the study of hydrology and stream flow as affecting the design of water power plants, including methods for estimating flood flows and studies of the effect of water storage and pondage, followed by (b) a study of the principles and practice relating to the layout and main features of hydro-electric developments, including the dam, waterways, power house and tail race. Textbook: *Barrows' Notes on Water Power Engineering.*

**1·71. Water-Power Engineering.** A continuation of the work of the second term, accompanied by drafting room exercises, consisting of computations, reports and problems of design relating to hydro-electric developments. Textbook: *Barrows' Notes on Water Power Engineering.*

**1·73. Water-Power Engineering.** This course is a continuation of courses 1·69, 1·70 and 1·71, and includes, with 1·82, detailed studies and designs for some water-power project.

Studies are also made of important details of water-power developments, including their comparative economy and valuation. One or more visits are made each year to water-power plants in New England and reports are required upon important features. Reference-book: *Mead's Water-Power Engineering.*

**1·75. Hydraulic and Sanitary Engineering.** This course deals with the major features of design and practice in certain branches of hydraulic and sanitary engineering, and the applications of hydraulics thereto. It is subdivided into: (a) Irrigation. (b) Sewerage and sewage disposal. (c) Public water supplies. (d) Water power with especial attention to the hydraulic principles involved in impulse water-wheels and hydraulic turbines. Textbooks: *Metcalf and Eddy's Sewerage and Sewage Disposal; Turneaure and Russell's Public Water Supplies; Daugherty's Hydraulic Turbines.*

**1·77. Sanitary Engineering.** This course is devoted to the general principles of sanitary engineering, with especial attention to sewerage, sewage disposal, and water supply. Textbooks: *Metcalf and Eddy's Sewerage and Sewage Disposal; Swan and Horton's Hydraulic Diagrams; Kinnicutt, Winslow and Pratt's Sewage Disposal; Turneaure and Russell's Public Water Supplies.*

**1·79. Hydraulic and Sanitary Design.** In this course the time is ordinarily devoted to the general lay-out, drafting and computations for a separate sewerage system for a selected portion of a small town.

**1·80. Hydraulic and Sanitary Design.** This is a more extended course than course 1·79, and includes additional problems, such as a design for a cross-section of a large trunk sewer, a high masonry dam, or other structures required in connection with water supply or sewage disposal.

**1·81. Engineering of Water and Sewage Purification.** This course deals with the engineering features of existing works for the disposal and treatment of sewage and the purification of public water supplies, such as outfalls, sewage reservoirs, screens, settling tanks and filters. (The course will not be given in 1922–1923.)

**1·82. Water-Power Design.** This course supplements course 1·73 and is devoted to the design of works connected with water-power development.

**1·83. Sanitary Design.** This supplements course 1·81, and is devoted to the design of works connected with the treatment of sewage or the purification of public water supplies. (The course will not be given in 1922–1923.)

**1·90. Report Writing.** The purpose of this course is to train the student to make a clear and logical report, in proper form and in good English, recording the result of an actual investigation which he has made.

## MECHANICAL ENGINEERING

Many of the subjects taught by the Mechanical Engineering Department are fundamentals in nearly all of the different branches of engineering; consequently instruction is given not only to students, in Mechanical Engineering, but also to those taking Civil, Sanitary, Electrical, Chemical, Electrochemical, Architectural and Mining Engineering, and Naval Architecture and Marine Engineering.

The course in Mechanical Engineering aims first to give the student a thorough training in the fundamentals of physics, mathematics, and applied mechanics; then by means of lectures, laboratory work and drawing room work in his different professional subjects, to familiarize him with the various problems with which the mechanical engineer has to deal. He is also given training in the mechanic arts sufficient to make him familiar with the use of shop tools, foundry practice, pattern work and forging, such knowledge being essential to the successful designer of machinery.

A considerable portion of time is devoted to non-professional work in English, history, economics and allied subjects, extending through the entire course.

The work in mechanism, supplemented by a course in mechanical engineering drawing, includes the study of linkages, cams, gear teeth and valve gears of steam engines; followed by a more advanced course in the third year on the mechanisms of machine tool and automatic machinery.

The instruction in applied mechanics in the second and third years covers the fundamental principles of statics, kinetics, strength of materials and the theory of elasticity; particular attention being given to the solution of problems illustrating the application of these principles in engineering practice. The work in this course is followed by a series of lectures on engineering materials intended to familiarize the student with the physical properties of materials used in engineering work and with data upon the strength of materials obtained by means of experiments. This course is supplemented by a course in testing materials laboratory in which the student is given work illustrating the methods of making tests on various materials for the purpose of determining their physical properties and also the strength of different pieces under the conditions of practice.

The course in heat engineering covers thermodynamics, steam engines, turbines, boilers, gas engines, gas producers, heat transmission, refrigeration and power station accessories. A thorough course in theoretical hydraulics is followed by a course in hydraulic engineering in which both the estimation and utilization of hydraulic power are discussed. The courses in heat engineering and hydraulics are supplemented by a course in engineering laboratory work extending through the latter half of the third year and through two terms of the fourth year. The work in this course is planned to follow the classroom work and thereby assist the student in getting a better grasp of the subjects taught. The laboratories are equipped to provide for an extended series of experiments on steam and its properties, steam engines, turbines, compressed air, gas and oil engines, gas producers, refrigerating machinery, hydraulics, pumps, water wheels and turbines, devices for the mechanical transmission of power, transmission and absorption dynamometers. The main power plant of the Institute is available for complete power plant tests.

The instruction in mechanic arts aims to give a systematic training in the typical operations to be performed with the different tools and appliances used in the foundry, in the forge shop, in the machine shop and in wood working. The student is taught how to sharpen and to adjust all edge tools used, also the proper speeds, cutting angles and feeds for the

various materials worked. In order to make a student familiar in as short a time as possible with the different operations and with the different methods used in any branch of the work, every problem given him is so chosen as to bring in each time one or more new operations.

The instruction is mainly by lecture, each new operation being described and discussed just before the work is to be undertaken; notes and textbooks are also used. Supplementary illustrated lectures are given in connection with many of the courses descriptive of industrial appliances and methods of production used in large establishments.

The professional work of the fourth year includes courses in machine design, power plant design, refrigeration, internal combustion engines; the design and equipment of a manufacturing plant including a study of structural details and heating and ventilating equipment and problems in financing and the management of such an establishment; courses in dynamics of machinery and mechanics of engineering which involve the application of the principles of mechanics in more advanced engineering problems.

At the beginning of the second term of the fourth year, a student has to decide whether to take the general course with choice of two professional electives, or to take one of the four options offered.

These options — 1, Automotive Engineering; 2, Engine Design; 3, Textile Engineering; 4, Ordnance Engineering, differ from the general course in that the time alloted to electives has been definitely assigned to the main subject of the option. The time allotted in the third term to the design of an industrial plant has also been assigned to the main subject of the options.

**2·00. Mechanism.** This course includes a systematic study of the forms and motions of various mechanisms occurring in machines, independently of their strength, such as rolling cylinders and cones, belting, screws, cams, and wheel trains and the design of gear teeth. Textbook: *Elements of Mechanism, Schwamb, Merrill and James.*

**2·01. Mechanism.** A continuation of course 2·00 covering linkages, and the theory and practice of designing valve gears for steam engines. Textbooks: *Elements of Mechanism, Schwamb, Merrill and James; Mechanism of Steam Engines, James and Dole.*

**2·02. Mechanism.** A brief course covering parts of courses 2·00 and 2·01, not including valve gears. Textbook: *Elements of Mechanism, Schwamb, Merrill and James.*

**2·05. Mechanism of Machines.** The subject matter of this course supplements the work in pure mechanism. The discussion is intended to familiarize the student with the practical applications of mechanical movements to various classes of machinery, such as, machine tools, textile machinery, shoe machinery, etc. The practical advantages and disadvantages of the different mechanisms are taken up, together with such details as methods of reducing friction, providing for wear, etc. Textbook: *Notes and Lithographs, Mechanical Engineering Department.*

**2·06. Design of Automatic Machinery.** This course is a continuation of the course in Automatic Machinery, the discussions including more complex mechanisms and the design of an automatic machine.

**2·10. Mechanical Engineering Drawing.** A course of sixty hours of drafting-room exercises giving training in the solution of practical problems supplementary to the course in Mechanism, such as problems in belting, the design of cams and in the velocities and accelerations of moving parts. Textbook, *Working Drawings of Machinery, James and Mackenzie.*

**2·11. Mechanical Engineering Drawing.** A course of thirty hours of drafting-room exercises, devoted to work supplementary to the course

in Mechanism, including the solution of problems dealing with velocities, accelerations, and forces in various linkages, the design of gear teeth and in investigating, by means of drafting board constructions, the operation of certain types of valve gears for steam engines. Textbook: *Working Drawings of Machinery, James and Mackenzie.*

**2·12. Machine Drawing.** A course of sixty hours of drafting-room exercises and lectures. Each student is furnished with blue print details of some machine, or portion of a machine, which he has never seen, and he is required to make an assembly drawing of the same. He is thus given practice in reading drawings and in building up a general drawing from details. Two or more lectures are given on processes for reproducing drawings, such as blue printing, zinc plate and wax plate engraving and half-tone work. Textbook: *Working Drawings of Machinery, James and Mackenzie.*

**2·13. Machine Drawing.** A course of thirty hours of drawing-room exercises devoted to more advanced work, making detail sketches and drawings of machine parts. Textbook: *Working Drawings of Machinery, James and Mackenzie.*

**2·14. Machine Drawing.** A course of forty-five hours of drawing-room exercises devoted to making detail and assembly drawings. Textbook: *Working Drawings of Machinery, James and Mackenzie.*

**2·20. Applied Mechanics (Statics).** This course includes a study of the resolution and composition of forces by analytical and graphical methods; the laws of equilibrium of force systems with their application in determining the reactions at the supports and the stresses in various types of frames; the analysis of distributed forces; determination of centers of gravity, moments and products of inertia and radii of gyration of plane areas and solids; principal axes and principal moments of inertia in two dimensions only. Textbook: *Applied Mechanics Vol. I, Fuller and Johnston.*

**2·202. Applied Mechanics (Statics and Kinetics).** This course includes a study of the resolution and composition of forces by analytical and graphical methods; the laws of equilibrium of force systems with their application in determining the reactions at the supports and the stresses in various types of frames; the analysis of distributed forces; determination of centers of gravity, moments and products of inertia and radii of gyration of plane areas and solids; principal axes and principal moments of inertia in two dimensions only; also a study of kinetics of solid bodies in plane motions, including the application of the principles of momentum and kinetic energy and the determination of work and power. Textbook: *Applied Mechanics, Vol. I, Fuller and Johnston.*

**2·203. Applied Mechanics (Statics and Kinetics).** This course is a study of the application of the principles of statics and kinetics covering course 2·20 and a portion of 2·21. The course is arranged especially for and restricted to students in course VI-A. Textbook: *Applied Mechanics Vol. I, Fuller and Johnston.*

**2·204. Applied Mechanics (Statics).** This is an elementary course including the study of the principles of statics, center of gravity, moment of inertia, especially adapted to the needs of students in course $IV_1$ and is open to students in this course only.

**2·21. Applied Mechanics (Kinetics — Strength of Materials).** This course comprises a study of the principles of kinetics of solid bodies with applications in cases involving motion in a plane, including the application of the principles of momentum and kinetic energy and the determination of work and power. The latter part of the course is devoted to a discussion of the physical properties of materials; the components of stress and strain in bodies subjected to tension, compression and shear and the relations

between stress and strain in various cases. Textbook: *Applied Mechanics Vol. II, Fuller and Johnston.*

**2·211. Applied Mechanics (Strength of Materials).** This course is devoted to a study of the physical properties of materials, stresses and strains in bodies subjected to tension, compression and shear; the common theory of bending, including shearing forces, bending moments, distribution of normal and shearing stresses, equation of the elastic curve, and the determination of slopes and deflections in beams; a study of stresses due to combination of bending and axial loads. Textbook: *Applied Mechanics Vol. II, Fuller and Johnston.*

**2·212. Applied Mechanics (Strength of Materials).** The first part of this course is devoted to a discussion of the physical properties of materials and to the study of fundamental relations between the components of stress and strain in bodies subjected to uniform stress or to uniformly varying stresses; followed by the application of these principles in the common theory of bending with a study of shearing forces, bending moments, the distribution of normal and shearing stresses; the equation of the elastic curve and the determination of slopes and deflections in beams; and the stresses due to combinations of bending and axial loads. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·213. Applied Mechanics (Strength of Materials).** This course is devoted to the study of the strength of materials, similar to but somewhat shorter than course 2·212. Textbook: *Applied Mechanics, Vol. II, Johnston.*

**2·214. Applied Mechanics (Strength of Materials).** This course is devoted to a study of the strength of materials and covers a portion of the work given in 2·211 and is especially adapted to the needs of the students in course $IV_1$.

**2·22. Applied Mechanics (Strength of Materials).** This course comprises a study of the common theory of bending, including shearing forces, bending moments, the distribution of normal and shearing stresses, the equation of the elastic curve and the determination of slopes and deflections in beams; a study of stresses due to a combination of bending and axial loads; the theory of columns, and the methods of determining the strength of columns under working conditions; the stresses and deformation in shafting and bars subjected to torsion. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·221. Applied Mechanics (Strength of Materials).** This course is devoted to the study of strength of materials similar to that in course 2·22, especially adapted to the needs of students in course I. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·222. Applied Mechanics (Strength of Materials).** This course is a continuation of course 2.21, and includes the study of the theories for determining the strength of columns the torsion theory and the methods of obtaining the stresses and deformation in shafting and bars subjected to torsion; the three moment theorem with applications; and the application of graphical methods in the solution of problems in statics. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·223. Applied Mechanics (Strength of Materials).** This course is a continuation of 2·213 and covers a portion of the work given in course 2·222. Textbook: *Applied Mechanics, Vol. II, Johnston.*

**2·224. Applied Mechanics (Strength of Materials, Graphical Statics).** This course is a continuation of 2·214 and also includes a study of the applications of the principles of graphical statics, especially adapted to the needs of students in course $IV_1$.

**2·225. Applied Mechanics (Strength of Materials, Graphic, Static).** This course is a continuation of 2·211 and includes the study of the theories

for determining the stresses in columns, the torsion theory; and also graphical methods of obtaining stresses in frames and simple trusses and the deflection of beams. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·23. Applied Mechanics (Strength of Materials).** This course includes a study of the theorem of three moments with applications to beams and other members where continuity exists; the theory of torsion; the application of graphical methods in the solution of various problems in Statics and Strength of Materials. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·231. Applied Mechanics (Strength of Materials).** This course includes a study of the theorem of three moments with applications to beams and other members where continuity exists; the application of graphical methods in the solution of problems in Statics and Strength of Materials; a brief discussion of the theories for determining the stresses in flat plates. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·232. Applied Mechanics (Strength of Materials).** This course includes a study of the Theory of Elasticity as applied to cases involving plane stress and plane strain with applications in determining stresses and strains in shafting and bars subjected to combined bending and torsion, helical springs, cylinders and flat plates. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·233. Applied Mechanics.** This course includes the study of the theorem of three moments with applications to beams and other members where continuity exists; the theory of reinforced concrete beams and columns as applied in the determination of stresses in slabs, T beams and columns; and a brief course in the kinetics of solids. Textbook: *Applied Mechanics, Vol. II, Fuller and Johnston.*

**2·24. Applied Mechanics (Kinetics).** This course includes the study of the application of the principles of kinetics in problems involving the determination of forces, acting upon, and the stresses within the moving parts of machines, the problems chosen being such as are commonly met with in engineering practice. Both analytical and graphical methods are used. Textbook: *Applied Mechanics, Vol. I, Fuller and Johnston.*

**2·25. Dynamics of Machines.** A study of the forces involved in the moving parts of machinery, particularly reciprocating engines — graphical and analytical methods of determining accelerating forces are studied, with special application to the inertia problems of crank-and-connecting rods, fly-wheels, cams and governors, dynamometers and the measurement of power are also included.

**2·262. Mechanics of Engineering.** This course and course 2·263 is devoted to the application of the principles of mechanics in the solution of problems of value to the mechanical engineer; including reinforced concrete beams and columns and more advanced problems in statics, kinetics, work and power, and strength of materials. Particular attention is paid to various problems arising in the design and operation of heavy ordnance. Textbook: *Applied Mechanics, Fuller and Johnston.*

**2·263. Mechanics of Engineering.** A continuation of 2·262.

**2·271. Theory of Elasticity.** This course includes a study of the fundamental principles of the mathematical theory of elasticity as applied to cases involving plane stresses and plane strain. The following points are covered: definition of stress; equality of shear stresses on planes at right angles; stress components on any plane in terms of stress components on planes at right angles; principal stresses; ellipse of stress; principal stresses in terms of stress components on any two planes at right angles; planes of maximum shear; obliquity of stress; planes of maximum obliquity; conjugate stresses; ratio of conjugate stresses; strain components; principal

strains; relations of stress and strain components; elastic constants; general equations of equilibrium. The application of the foregoing is illustrated in the solution of problems. The deduction of the formulas for stresses, strains and distortions in cylinders, cylinder ends and spheres completes the course. Textbooks: *Applied Mechanics, Vol. II, Fuller and Johnston; Ordnance and Gunnery, Tschappat; Notes.*

**2·272. Theory of Elasticity.** This course is a continuation of course 2·271 and is devoted to the application of the principles of the theory of elasticity, to the design of compound cylinders such as are used in gun construction and includes the design of guns composed of two, three and four cylinders. A careful study is made of shrinkages and the effect of variation in shrinkage on the stresses in different parts of a gun. A study of the design of wire-wrapped guns completes the course.

**2·28. Advanced Mechanics and Theory of Elasticity.** This course is a study of some of the more advanced problems in dynamics and strength of materials including a detailed study of the general theory of elasticity and applications. The work is planned to suit special needs of the student, especially in connection with his research work.

**2·292. Ordnance Engineering.** A course of ten lectures with ten hours' preparation, these lectures being given by the regular staff officer detailed to Technology as the representative of the Ordnance Department. Twenty hours devoted to lectures and calculations on gun design.

**2·293. Ordnance Engineering.** A course of twenty lectures and twenty hours' preparation, together with forty hours devoted to drawing and design. The work takes up the construction of recoil and counter-recoil mechanisms. Calculations of stresses in gun carriages, foundations, gear trains, roller bearings, foundation bolts will also be considered. Each student is required to make a complete set of calculations of the work assigned him under the headings noted above.

**2·302. Materials of Engineering.** This course is devoted to a discussion of the relationship existing between constitution and microstructure, the effect of change of composition, hot and cold work and heat treatment upon the physical properties of iron, steel bearing metals and other alloys. Textbook: *Materials of Construction, Mills.*

**2·303. Materials of Engineering.** This course is devoted to the study of the manufacture, physical properties and testing of iron, steel, timber, cement, concrete, brick, plaster, lime and other materials. Methods of testing and specifications are also discussed. Textbook: *Materials of Construction, Mills.*

**2·31. Materials of Engineering.** This course consists of twenty hours of conference with forty hours' outside study, the time being devoted to a discussion of the testing and specifications of materials. This course is open only to officers of the United States Navy.

**2·32. Materials of Engineering.** This course is similar to course 2·303. Textbook: *Materials of Construction, Mills.*

**2·33. Materials and Heat Treatment.** This course is devoted to the study of the physical properties and heat treatment of the metals used in cylinders, shafts, valves, bearings, frames, drop forgings, etc.

**2·34. Physical Metallurgy.** A course for advanced students extending through one, two or three terms of the graduate year, consisting of conferences and laboratory work, involving investigations of the structure and physical properties of iron, steel and other metals and the changes when the materials are subjected to mechanical work, distortion, alternating stresses and heat treatment.

**2·351. Testing Materials Laboratory.** This course and course 2·352 is devoted to the study of the behavior of engineering materials under stress

including tests of concrete and fabrics. Some attention is also given to the microscopic examination of non-metallic materials.

**2·352. Testing Materials Laboratory.** A continuation of course 2·351.

**2·36. Testing Materials Laboratory.** This course is devoted to the study of methods of making physical tests for the properties of materials.

**2·37. Testing Materials Laboratory.** This course is devoted to the study of methods of making physical tests for the properties of materials and is somewhat more extended than course 2·36.

**2·38. Testing Materials Laboratory (Concrete.)** This course is devoted to the study of the materials used in concrete, both plain and reinforced; the selection of a proper aggregate from materials that may be available, their treatment for various purposes and methods of proportioning.

**2·40. Heat Engineering.** This course begins a detailed study of the laws of thermodynamics and their application to engineering problems. It includes a discussion of the physical properties of gases, and of saturated and superheated vapors — especially of air and steam. The student learns to use equations, vapor tables and diagrams through independent solution of drill and engineering problems. Textbooks: *Thermodynamics of the Steam Engine, Peabody; The Temperature Entropy Diagram, Berry; Problems in Heat Engineering, Miller, Riley and Berry.*

**2·41. Heat Engineering.** This course includes a description of boilers, mechanical stokers, fuel and ash conveyers, superheaters, feed water heaters, economisers, pumps, traps, fans, piping and various other accessories of steam boiler plants. Textbook: *Steam Boilers, Peabody and Miller.*

**2·411. Heat Engineering.** This course includes about one-half of the subject matter contained in courses 2·41 and 2·43. Textbooks: *Illustrations of Steam Engines, etc., Mechanical Engineering Department. Steam Boilers, Peabody and Miller.*

**2·42. Heat Engineering.** This course includes discussion of the flow of fluids, the throttling calorimeter, the steam injector and turbines, and a study of the ideal and actual cycles of hot air, internal combustion and vapor engines together with an analysis of the nature and magnitude of the various losses affecting the efficiencies of the various machines. Textbooks: *Thermodynamics of the Steam Engine, Peabody; The Temperature Entropy Diagram, Berry; Problems in Heat Engineering, Miller, Riley, Berry.*

**2·43. Heat Engineering.** This course includes a description of different types of steam and internal combustion engines, large pumping engines, steam turbines, condensers, cooling towers and power station accessories. Textbook: *Illustrations of Steam Engines, etc., Mechanical Engineering Department.*

**2·432. Heat Engineering.** The first part of this course forms a continuation of the description of turbines begun in 2·43. The rest deals with the principal types of gas, gasoline and oil engines, together with their fuel and ignition systems and auxiliary apparatus. Gas producers and the principles of combustion are also discussed. Application is made of the thermodynamic principles involved but the course is mainly descriptive and is illustrated by lantern slides.

**2·44. Heat Engineering.** This course includes a thermodynamic study of gas compressors and motors, of the transmission of gases through pipe lines, of cooling towers, of heating and ventilation problems, of multiple evaporators, etc. Textbooks: *Thermodynamics of the Steam Engine, Peabody; The Temperature Entropy Diagram, Berry; Problems in Heat Engineering, Miller, Riley, Berry.*

**2·45. Heat Engineering.** This course begins the discussion of reversed (power-consuming) thermodynamic processes as illustrated in the Kelvin warming engine and the various refrigerative machines. Particular attention is given to both large and domestic units operated on the compression system for various kinds of refrigerants. Warehouse construction, refrigeration and ventilation are also considered. Textbooks: *Thermodynamics of the Steam Engine, Peabody; The Temperature Entropy Diagram, Berry; Problems in Heat Engineering, Miller, Riley, Berry.*

**2·451. Heat Engineering.** A discussion of the laws governing heat transmission through warehouse walls, insulated pipes, rectangular furnaces, etc., under conditions of steady temperatures, including a study of the form factor, of analytical and graphical methods for determining the mean temperature difference, and of the influence of velocity, density, temperature, etc., upon the surface coefficient. This is followed by a number of lectures on Heating and Ventilation. This part of the course includes a discussion of the engineering principles underlying a correct practice of heating and ventilating work, the different systems of heating and ventilating, air washing, etc., and the design and plans of the essential parts of a heating and ventilating system for a mill. Textbook: *Notes prepared for class.*

**2·46. Heat Engineering.** This course begins with a study of the steam and mechanical equipment of a Power Station; it includes in addition, descriptions of different types of steam engines, internal combustion engines, turbines, condensers, cooling towers, pumps, etc. This course is then followed by a detailed study of the design of valve gears for steam engines, both the Reuleaux and the Zeuner methods being used; then follows a detailed study of the laws of thermodynamics and their application to engineering problems. The course includes a discussion of the physical properties of gases and of saturated vapors. Textbooks: *Thermodynamics of the Steam Engine, Peabody; Mechanism of Steam Engines, James & Dole; Illustrations of Steam Engines, etc., published by the Mechanical Engineering Department.*

**2·47. Heat Engineering.** This course is a continuation of 2·46 and includes a study of superheated vapors, mixtures of air and vapors, flow of compressible fluids through orifices, discussion of air compressors, power of engines, turbines, ranking efficiencies. Textbooks: *Thermodynamics of the Steam Engine, Peabody; Mechanism of Steam Engines, James & Dole; Illustrations of Steam Engines, etc., published by the Mechanical Engineering Department.*

**2·48. Heat Engineering.** This course includes a description of the cycles of gas engines, refrigerating machines, engine economies, elementary principles of heating and ventilation; steam boilers of various types, also includes a description of boilers, mechanical stokers, fuel and ash conveyors, superheaters, feed water heaters, economizers, pumps, traps, fans, piping and various other accessories of steam boiler plants. Textbooks: *Steam Boilers, Peabody and Miller: Thermodynamics of the Steam Engine, Peabody; or Gebhardt's Steam Power Plant Engineering.*

**2·50. Heat Engineering.** This course includes portions of courses 2·40 and 2·41. Textbooks: *Thermodynamics of the Steam Engine, Peabody; Steam Boilers, Peabody and Miller; Problems in Heat Engineering, Miller Riley, Berry.*

**2·51. Heat Engineering.** This course includes parts of courses 2·42 and 2·43. Textbooks: *Thermodynamics of the Steam Engine, Peabody; Steam Boilers, Peabody and Miller; Problems in Heat Engineering, Miller, Riley, Berry.*

**2·52. Heat Engineering.** This course includes parts of courses 2·44 and 2·45. Textbooks: *Thermodynamics of the Steam Engine, Peabody; Steam Boilers, Peabody and Miller; Problems in Heat Engineering, Miller, Riley, Berry.*

**2·53. Power in Mining.** The work in this course covers the elements of thermodynamics, including perfect gases, saturated and superheated vapors, and the flow of fluids, followed by the study of the principles and details of boilers, steam engines, steam turbines, internal combustion engines, air compressors, and other power plant apparatus. Textbook: *Heat Engines, Allen and Bursley.* (Given first term 1922–23. Discontinued after 1922–23.)

**2·54. Advanced Heat Engineering.** This course includes a thermodynamic study of absorption refrigerating systems, certain aspects of the compression system not covered in 2·45, a discussion of theoretical and practical problems in the manufacture of ice, the liquefaction of gases. It also includes a discussion of the laws of heat transmission as illustrated in steam condensers, feed water heaters, brine coolers, radiators, steam boilers, engine cylinders, cooling of castings, freezing of ice, etc. It includes the application of Fourier's series to cases involving fluctuating temperature conditions. Textbook: *Notes prepared for class.*

**2·55. Heat Engineering.** This course deals with the utilization of energy in the power plant of a torpedo. It 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.

**2·57. Mechanical Equipment of Buildings, Heating and Ventilation.** This course gives the student a training in the thermodynamics of gases, saturated and superheated steam, sufficient to enable him to obtain a working acquaintance with the essential engineering principles underlying the correct practice of heating and ventilating work, which forms a part of the course. The course also includes a discussion of the various steam and mechanical appliances used in connection with the equipment of buildings. Textbook: *Notes prepared for class.*

**2·58. Power Plant Design.** The work of the course consists in making the working drawings necessary to show the location of boilers, engines, auxiliaries, piping, coal pockets, etc., for a power house and also drawings and calculations of some of the details. Textbook: *Notes on Power Plant Design, Miller.*

**2·602. Engineering Laboratory.** This course and 2·603 is devoted in the second and third terms to elementary experiments necessary for a complete knowledge of methods of testing, the work being arranged to supplement the course in Heat Engineering. It includes the use of the indicator, determination of horse power, setting of different types of valves, measurement of engine clearance, calibration of pressure and vacuum gages, use of friction brakes, testing of different types of calorimeters, measurement of the flow of steam and air, power and economy tests of simple engines. Textbook: *Power Test Code of the American Society of Mechanical Engineers.*

**2·603. Engineering Laboratory.** See course 2·602.

**2·604. Engineering Laboratory.** This course is intended for men who are allowed only one term of Engineering Laboratory and covers portions of courses 2·602; 2·603, and 2·61; the elementary experiments are emphasized and enough of the more advanced work taken to exemplify the methods

of testing the more common steam and hydraulic machinery. Textbook: *Power Test Code of American Society of Mechanical Engineers.*

**2·605. Engineering Laboratory.** This is a brief course being part of course 2·604. Course 2·605 and 2·612 are together the equivalent of 2·604.

**2·606. Engineering Laboratory.** An elementary course covering a part of course 2·602 and 2·603.

**2·607. Engineering Laboratory.** A short course to supplement the work in course 2·57.

**2·608. Engineering Laboratory.** This course is similar to course 2·60, but the work is all done in one term.

**2·61. Engineering Laboratory.** This course is a continuation of course 2·602; 2·603, and is designed to make the student familiar with the standard methods of testing ordinary steam and hydraulic machinery, to teach him to think systematically and accurately on such matters and to accustom him to the assumption of engineering responsibility. A few students work together under the direction of an instructor. Each student writes a complete report of the test, giving required results, arrangement of apparatus, method of testing and details of computation. The work in the course includes experiments in hydraulics, tests on air compressors, hydraulic machinery and experiments in heat measurements. Textbook: *Power Test Code of American Society of Mechanical Engineers.*

**2·611. Engineering Laboratory.** This course covers parts of courses 2·61 and 2·62. Textbook: *Power Test Code of American Society of Mechanical Engineers.*

**2·612. Engineering Laboratory.** A brief course covering a part of course 2·61. Textbook: *Power Test Code of American Society of Mechanical Engineers.*

**2·613. Engineering Laboratory.** This course covers part of course 2·61.

**2·614. Engineering Laboratory.** This course is part of course 2·62.

**2·62. Engineering Laboratory.** This course is a continuation of course 2.61 and is conducted in the same manner, covering more advanced work along the same lines including a steam boiler test. Textbook: *Power Test Code of American Society of Mechanical Engineers.*

**2·621. Engineering Laboratory.** A brief course consisting of exercises in gas analysis and a steam boiler test. Textbook: *Power Test Code of American Society of Mechanical Engineers.*

**2·631. Gas Engine Laboratory.** This course, which is of five weeks' duration, or one hundred and ninety hours, is given from September 7 to October 11, inclusive, and consists in the stripping and assembling of different types of gasolene engines and accessories used in the Ordnance Department, United States Army. Complete efficiency tests are made on these engines. A considerable amount of time is spent both on operation and on what is known as " Troubles " with the idea of familiarizing the men with the various troubles which are likely to interfere with the operation of an engine. This course open only to Army Officers. Notes prepared by the instructor in charge will be used. Textbooks: *Automobile and Air Craft Engines, Judge; The Gasolene Motor, Heldt; Electrical Equipment, Heldt; catalogues and instruction books published by manufacturers of engines and accessories.*

**2·64. Engineering and Hydraulic Laboratory.** This course is designed to make the student familiar with the standard method of testing the simpler steam and hydraulic machinery, particularly as applied to Civil Engineering. Textbook: *Power Test Code of American Society of Mechanical Engineers.*

**2·65. Steam and Hydraulic Laboratory.** This course is similar to course 2·64 but more time is devoted to hydraulic experiments, particularly

to the testing of impulse and reaction turbines. Textbook: *Power Test Code of American Society of Mechanical Engineers.*

**2·66. Power Laboratory.** This course consists of twenty two-hour exercises in the laboratory, with forty hours outside work on calculations and reports. The object of the course is to familiarize the student with the method of testing various types of power equipment and the proper method of writing a report of such tests. In addition to this, attempt will be made to familiarize the men with the operation of pumps and engines. This course open only to Army Officers. No textbooks required.

**2·67. Ordnance Engineering.** *Summer Course.* The summer course in Ordnance Engineering extends from the first Tuesday in August to the end of the third week in September, with a total of two hundred and eighteen hours. The first one hundred and eight hours of the course are devoted to the application of the fundamental principles of statics and kinetics, including the determination of centers of gravity and moments of inertia in problems similar to those which arise in the design of ordnance. The course includes the combination and resolution of forces and couples in a single plane, in parallel planes and in nonparallel planes; the determination of centers of gravity and moments of inertia of areas and solids, including principal axes and radii of gyration; a study of impulse and momentum, work and energy, power, the laws of friction with applications in the case of the inclined plane, the wedge, the screw; a study of gear trains and other means for transmitting power and friction losses therein; D'Alembert's Principle and applications to bodies having motion of translation or rotation and combined translation and rotation; the laws of impact, with applications.

The remaining one hundred and ten hours are devoted mainly to the study of strength of materials, the study of stresses and strains in bodies subjected to uniform stress, including the effect of changes in temperature; the common Beam Theory, including the determination of shearing forces and bending moments, slopes and deflections under different systems of loading by analytic and also graphic methods; the Column Theory, the three-moment equation, and the effect of combined bending and axial loading; the Torsion Theory, with application in the designing of shafts and springs. The problems in the course are taken to illustrate as far as possible actual cases arising in the design of gun mounts. Textbooks: *Applied Mechanics, Vols. I and II, Fuller and Johnston.* Reference books: *Strength of Materials, Morley; Strength of Materials, Boyd; Elementary Dynamics, Routh.*

**2·681. Ordnance Engineering.** This course is a continuation of the summer course in Ordnance Engineering, includes a study of the three-moment theorem, with applications to continuous beams subjected to distributed and concentrated loads; the analysis of stresses due to combined torsion and bending, with applications in the design of open or closed coiled helical springs; stresses in curved bars and box applications in the design of links and hooks; the design of box and plate girders; recoil systems and counter-recoil mechanisms; the mechanics of interior ballistics, including a study of the relation of time, velocity, space and gas pressure during the travel of a projectile in the bore of a gun; method of calculating free recoil and retarded recoil; the design of hydraulic recoil cylinders, including the calculation of throttling grooves; design of counter-recoil springs and hydro-pneumatic counter-recoil systems. Textbooks: *Ordnance and Gunnery, Tschappat.* Reference books: *Theory of Recoil of Guns, Rausenberger; Stresses in Wire-Wrapped Guns, Ruggles; Graphic Representation of Pressures and Shrinkages in Built-Up Guns, Nulton; Railway Artillery; Handbook of Ordnance Data.*

**2·682. Ordnance Engineering.** This course is a continuation of course 2·68a and comprises a study of the stresses in parts of different mounts including a field gun carriage barbette and railway mount; the design of traversing and elevating mechanisms; the analysis of the recoil and counter-recoil systems, and the forces acting in a disappearing gun mount.

**2·683. Ordnance Engineering.** This course is a continuation of course 2·68b in which the work outlined in that course is completed, and in addition the course includes a study of the form of rifling grooves; the equation of the developed curve of rifling on a plane surface; types of projectiles; stresses in the walls of different types due to rotation and due to impact.

**2·685 Interior Ballistics.** This course covers the study of pressures developed by powders, development of the pressure volume curve and the discussion of formulas for determining velocity of a projectile in a gun.

**2·69. Textile Engineering.** A course of thirty lectures on the machinery employed in the production of textile fabrics; the process being studied from the bale to the finished cloth.

In addition fifty hours are divided between design and special work assigned in the Textile testing laboratory; this work involving the determination of the strength twist elasticity and the moisture content of fabrics and yarn.

**2·702. Machine Design.** The work of this course and that of 2·703 embraces typical problems in machine design which may be solved by the application of the principles of statics. As an introduction the student is required to make complete calculations and drawings for a fire-tube, water-tube or marine boiler, a vulcanizer, stand-pipe or steel stack. In this connection the shells of cylinders, riveted joints, and the staying of flat surfaces are thoroughly discussed. The remainder of the time is spent in the design of one of the simpler machines in which the stresses are statically determinate, such as a punch, shear, press or riveter. Graphical methods are employed for the analysis of motions and the determination of forces wherever possible. Textbook: *Design of Steam Boilers and Pressure Vessels, Haven and Swett.*

**2·703. Machine Design.** See under 2·702.

**2·704. Machine Design.** This course is similar to 2·702 and 2·703, but briefer and adapted more directly to questions relating to manufacture and duplication of parts. Textbook: *Notes on Machine Design.*

**2·71. Machine Design.** The course consists of the design of machines involving dynamic forces. Such a machine as a power-driven punch, press or rock crusher is chosen as a type and its various proportions as far as possible are calculated by rational methods. The stiffness and strength of shafting, belts, ropes, stresses in flywheels, force fits, balancing, journals, and bearings and stresses in moving parts are discussed at length. A complete set of drawings and calculations for a complicated machine of the above type forms the conclusion of this course. Textbook: *Notes prepared for class.*

**2·711. Machine Design.** This course is a continuation of 2·704.

**2·72. Machine Design.** This course is a continuation of course 2·71, covering more advanced work along the same lines.

**2·732. Engine Design.** A course of lectures and drafting-room exercises in the design of reciprocating engines. Typical engines are studied with reference to special requirements of the services in which they operate, and to shop methods of construction, as well as the way which the thermodynamic and mechanical problems are worked out. A detailed study is made of the principles of mechanical balancing and other scientific features of design applicable to reciprocating engines in general.

**2·733. Engine Design.** An extension of 2·732 requiring the same as preparation, and consisting of lectures and drafting-room exercises. A problem is assigned on the design of an engine, usually a high-speed steam engine or a Diesel engine. The student makes the necessary calculations for dimensions and lays out the principal parts of the engine.

**2·74. Advanced Machine Design.** This course includes a systematic application of the principles of Applied Mechanics to the design of machines of complicated character. The subjects of centrifugal effects, balancing, lubrication and combined stresses are treated at considerable length. *Library Research.*

**2·751. Automatic Machinery.** This course includes a discussion of a number of fully automatic machines representative of various classes of machinery, such as wire-working machinery, can-making and canning machinery, printing machinery, machine tools, weighing, package and wrapping machinery, etc. In connection with the course a motion chart and the layout for some simple automatic machine are worked out in the drafting-room.

**2·752. Mechanical Equipment of Buildings.** This course covers a description and discussion of the general principles of construction of the mechanical equipment of large office buildings, including such subjects as elevators, pneumatic systems of dust collection, water-heating systems, sewage disposal, etc.

**2·753. Steam Turbine Engineering.** A study of the different types of modern steam turbines, by means of lectures and discussions. Their theory, construction and operation are taken up in sufficient detail to make the student familiar with the best practice. Problems illustrating simple design and the thermodynamics of steam turbines are worked out. Turbine economics and the special features of turbine auxiliaries are considered. The course assumes a knowledge of the steam turbine and nozzle work taken in Heat Engineering of the third year.

**2·754. Fire Protection Engineering.** The growing demand for men equipped with a knowledge of fireproofing and fire protective apparatus renders it necessary to make a special study of this branch. The erection, installation and operation of protective devices is carefully considered. A study is also made of safety applicances, both in connection with fire as well as in relation to machines of hazardous character. A number of problems are worked out, showing how modern shops and mills may be safeguarded against fire in the most effective manner. Textbook: *Crosby-Forster-Fiske, Handbook of Fire Protection.*

**2·755. Heat Transmission.** A discussion of the laws governing heat transmission through warehouse walls, insulated pipes, rectangular furnaces, etc., under conditions of steady temperatures, including a study of the form factor, of analytical and graphical methods for determining the mean temperature difference, and of the influence of velocity, density, temperature, etc., upon the surface coefficient. (Not given after 1923; subject matter included in course 2·452.)

**2·756. Heat Treatment.** A course consisting of conferences and laboratory work, dealing with the physical properties of iron, steel and other metals and the changes which these properties undergo when the materials are subjected to heat treatment. *Notes prepared for class.*

**2·757. Internal Combustion Engines.** This course is in extension of 2·43m, and takes up gas, gasolene and oil engines for all purposes, stationary, marine, automobile and aëro engines. Various textbooks are used, and reference made to current technical publications. Detailed study is made of the action taking place within the engine cylinder, as influenced by kind of fuel, method of mixing and igniting, jacket cooling and internal cooling,

and valve control. Valve gears for four-cycle engines, and several types of ported cylinders for two-cycle engines are examined at some length. The common arrangements of multi-cylinder engines are studied with reference to fuel supply, ignition, regularity of torque, balance of moving parts and power calculations. Gaseous and liquid fuels are discussed, including carburation and the different methods of injecting and atomizing non-volatile fuels in Diesel and other oil engines. Attention is given to starting and reversing systems, air compressors, scavengers, pumps, superchargers and other accessories. A further study of gas producers is also included in this course.

**2·758. Locomotive Engineering.** This course includes the study of locomotive construction from detail drawings of modern steam locomotives, the general principles of locomotive design, the calculation of stresses in the principal parts of the engine, locomotive testing and the coal and water consumption and efficiency of different types; also, the operation of modern air brake systems.

**2·759. Refrigeration.** This course is a continuation of 2·45. It includes a discussion of multiple effect receivers and compressors, a study of the properties of various brine solutions and other problems encountered in the manufacture of ice.

**2·7510. Theory of Elasticity.** This course includes a study of the Mathematical Theory of Elasticity with applications in determining stresses and strains in simple and compound cylinders, and flat plates; special emphasis is laid on problems arising in the design of ordnance. (Not given after 1923, subject matter included in 2·332.)

**2·76. General Engineering Lectures.** This course covers matters of general engineering interest, such as the development and construction of the steam or electric locomotive, the description of a modern manufacturing plant, the motive power of ships, the construction of aëroplanes, etc., the subject matter being varied from time to time.

**2·77. Industrial Plants.** This course and the following course 2·78 are devoted to a study of problems involved in the capitalization and organization of a modern manufacturing plant and planning, construction and equipment of the buildings required. The subjects included may be grouped as follows: (a) Financial organization, capitalization, promoting. (b) Organization of the industry including the office and engineering department, methods of superintendence, employment and cost of labor, scheduling of work, process mapping or routing, systems of compensation and efficacious conditions of labor, cost accounting and current methods of efficiency engineering. (c) Planning the layout of the plant, the distribution of power, the type and form of the building. (d) The design and planning of the foundations and the structure of a brick and timber or brick and steel mill, including necessary calculations. (e) The design, calculations and plans for the principal parts of a steel frame for a mill and for the floor beams and columns for a reinforced concrete structure. (f) The mechanical equipment of the building. Textbook: *Notes prepared for class.*

**2·78. Industrial Plants.** A continuation of course 2·77. Textbook: *Notes prepared for class.*

**2·792. Automotive Engineering.** This course and 2·793 include the general principles of motor vehicle construction and operation, the theory and design of the engine, transmission and chassis, and the application of fundamental principles of current practice. A large portion of the time in the third term is given to design.

**2·793. Automotive Engineering.** Continuation of course 2·792.

**2·80. Forging.** This course includes systematic instruction in the

use of each tool, the study of each material worked, with an explanation of its various grades and of the proper methods of working each, and the discussion of methods of making large forgings. The ground covered includes instruction in the building and care of fires, heating, drawing, forming, bending and twisting, upsetting, upsetting while bending, upsetting for square corners, punching, bolt making, welding, chain making, and the construction of hooks and ring bolts. The work in steel includes drawing, forming, welding, refining and tempering, and spring and tool making. Training is given in the use of the power hammer, and drop forging is also included.

**2·801 and 2·802. Forging.** This course covers the same ground as 2·80, but is given in two terms.

**2·81. Forging.** This course covers nearly the same ground as that of course 2·80.

**2·82. Foundry.** This is a course in the foundry. Instruction is first given in cutting over and tempering sand and the use of moulders' tools, making two and three-part green sand moulds and making, baking, and testing cores. Ramming, venting, facing, spruing, use of risers, the clamping and weighing of moulds, stopping off, bedding, loose-piece moulding, and use of chills are considered in proper order. This work is followed by exercises in multiple and duplicate production by use of snap flasks, slip jackets and machines, such as the power squeezer, hinged turn-over, and jarring stripping plate moulding machines. The mounting and gating of wood and metal patterns on plates, the use of follow boards, and making of sand and plaster matches is described and illustrated by examples. Castings are first made in white metal for practice, then in brass and in cast iron, when the students are taught pouring and the running of metal furnaces.

The laboratory work is supplemented by illustrated lectures on loam, large floor and sweep moulding, steel and aluminum casting, foundry appliances and modern methods of production. Textbook: *Notes prepared for class.*

**2·83. Foundry.** A brief course covering a part of the work given in course 2.82.

**2·831. Foundry.** This course is similar to but slightly more extended than course 2·83.

**2·84. Pattern Making.** The course begins with the elements of joinery and wood-turning and leads to work in pattern making. The exercises include sawing, planing, chiseling, boring, etc.; laying out work; jig, band and circular sawing; lathe work, including center, chuck and face plate turning. Thorough training is given in the adjustment, use, sharpening and care of wood-working tools, machines and appliances.

In the making of patterns and core boxes, the principles of moulding are carefully considered. The projects include patterns of pipe-fittings, valves, pulleys, gears, hangers, machine parts, etc. The laboratory work is supplemented by illustrated lectures on the construction and foundry application of solid, split and loose-piece patterns; large complete, part and skeleton patterns for floor, loam and sweep work; master and metal patterns; mounting of patterns on plates and their preparation for use on moulding machines. Textbook: *Notes prepared for class.*

**2·86. Vise and Bench Work.** A course in mechanical processes where the tools are guided principally by hand. The instruction is given by lectures and demonstration, supplemented by the textbook. The course is arranged to advance the students in a logical, systematic and progressive manner and in the shortest time. Each student is required to do problems which involve the application of the following principles and processes:

Laying out work, angles of cutting tools, grinding tools, chipping cast iron, chipping key ways, pneumatic chipping and drilling, classification of files, filing and fitting cast-iron and steel machine parts, alignment and babbitting of bearings, scraping machine slides, bronze and babbitt bearings, steam-pipe fitting by hand and machine, pipe bending; measuring hardness, of metals with the scleroscope; drilling, reaming, counterboring and tapping; grinding drills, taps and counterbores by hand and machine; belt lacing; electric and oxyacetylene welding. Textbook: *Principles of Machine Work, Smith.*

**2·87. Vise and Bench Work.** This course is similar to course 2·86, but shorter.

**2·871. Vise and Bench Work.** This is a brief course covering part of the work given in course 2·87. Textbook: *Principles of Machine Work, Smith.*

**2·88. Machine Tool Work.** This course and the following courses 2·90 and 2·92 are devoted to instruction and practice in the use of machine tools. Instruction is given, when necessary, in the mechanism of the machine-tools used and careful attention is paid to the various adjustments for the work in hand. The different measuring tools and devices, with the advantages, methods of use and limits of accuracy of each, are considered. As each cutting tool is taken up, its cutting angles and general adjustments are discussed, together with the " feeds " and cutting speeds suitable for each material worked and for each machine. The course includes instruction in centering, squaring, straight and taper turning and fitting, outside and inside screw cutting, chucking, reaming, finishing and polishing, drilling, tapping, mandrel making, grinding and lapping, boring, brass turning and finishing, ornamental turning, planing flat and V surfaces, fitting, the use of the milling machine, gear-cutting, tool-making, including taps, drills, reamers, milling cutters and cylindrical gages. Textbook: *Advanced Machine Work, Smith.*

**2·881. Machine Tool Work.** This course consists of one hundred and twenty hours devoted to hand and machine processes. The work starts with hand processes as follows: Laying out of work, angles of cutting tools, grinding tools and drills, chipping cast iron, chipping keyways, pneumatic chipping and drilling, accurate drilling, reaming and tapping; scraping flat surfaces; classification of files; hand and machine filing on cast iron, steel and wrought iron; alignment, babbitting and scraping bearings; steam pipe fitting and pipe bending, oxyacetylene welding and cutting; electric welding and the use of the scleroscope for measuring the hardness of common metals and hardened, tempered and heat-treated steels. This is followed by instruction and practice in the use of machine tools. Instruction is given in the mechanism of the machine tools used and in the various adjustments for the work in hand. The different measuring tools and devices, with the advantages, methods of use and limits of accuracy of each, are considered. Careful attention is given to the proper cutting speeds and feeds, together with the cutting tools and cutting angles for different kinds of material. The materials used for the problems are cast iron, machine steel and tool steel, using cutting tools of carbon steel, high-speed steel and stellite. The problems include instruction in centering, squaring, straight and taper turning and fitting, screw cutting, polishing, chucking, drilling, tapping, reaming, mandrel making, grinding and lapping, boring, gear cutting, planing flat and angular surfaces, planing keys and keyways, milling keyways, tool making, including making taps, milling cutters and cylindrical gages, hardening and case hardening, and oil and color tempering. The machines used are, engine lathe, speed lathe, centering machine, milling machine, drilling

machine, planer, shaper, cylindrical cutter, and surface grinding machines, automatic gear cutting machine, gear shaper, thread milling machine and broaching machine. Instruction is given in the use of gages for the standardization of machine parts, including limit gages, cylindrical ring and taper gages, screw pitch gages, American and Swedish gages, standard precision measuring machine and lead test indicator. This course open only to United States Army Officers. Textbook: *Advanced Machine Work, Smith.*

**2·89. Machine Tool Work.** Instruction is given in general machine-tool work, consisting of centering, straight and taper turning and fitting, screw cutting, chucking, finishing, accurate drilling, tapping, cylindrical grinding, shaping and planing, plain and index milling and gear cutting. Textbook: *Advanced Machine Work, Smith, Smith.*

**2·90. Machine Tool Work.** This course is a continuation of course 2·88. Textbook: *Advanced Machine Work, Smith.*

**2·91. Machine Tool Work.** This course and the following course 2·91a is a brief course in machine tool work consisting of instruction in lathe work covering centering, straight turning, screw cutting, chucking and finishing. Textbook: *Advanced Machine Work, Smith.*

**2·911. Machine Tool Work.** This course is a continuation of course 2·91. Textbook: *Advanced Machine Work, Smith.*

**2·92. Machine Tool Work.** This is a continuation of course 2·90. Textbook: *Advanced Machine Work, Smith.*

**2·95. Vise and Bench and Machine Tool Work.** A brief course covering a small portion of courses 2·871 and 2·88. Textbook: *Advanced Machine Work, Smith.*

**2·951. Vise and Bench and Machine Tool Work.** A brief course covering a small portion of courses 2·871 and 2·89. Textbook: *Advanced Machine Work, Smith.*

**2·96. Mechanical Laboratory.** A brief course in foundry practice and the use of hand and machine tools, similar to parts of courses 2·82, 2·86, 2·88 and 2·90. Textbook: *Advanced Machine Work, Smith.*

**2·97. Machine Tool Work.** This is a brief course in machine tool work similar to a part of the work in course 2·90. Textbook: *Advanced Machine Work, Smith.*

## MINING, METALLURGY AND GEOLOGY

### Mining and Metallurgy. Course III

The study of Mining and Metallurgy covers such a large field of technical endeavor that the courses given cannot follow the details of the several branches. The aim of all instruction is to ground the student in the fundamental principles of the professional studies, and to train his mind and hand that he may be a close observer, a good reasoner and a conscientious worker.

Instruction is given by lectures and recitations, by laboratory work and by summer schools. Work in the department covers studies in mining, ore-dressing, metallurgy, metallography and assaying. With these are interwoven auxiliary courses in physics, chemistry, mineralogy, geology, and in civil, mechanical and electrical engineering. All students in the department follow the same studies for the first and second years; differences in the options become marked in the third and fourth years.

There are two options. The first covers mining engineering, but it is also sufficiently broad to allow the graduate to enter metallurgical work if necessary. Option 2 is designed for the metallurgist and emphasizes the fundamental sciences and arts on which metallurgy depends. A short

course in mining is, however, included, and options allow the taking of lectures on geology and mineral deposits. Opportunity is offered for advanced studies leading to the degrees of Master of Science and Doctor of Science.

For the section of Geology and Geological Engineering, see page 110.

**3·01. Mining Engineering.** This course includes a brief preliminary discussion of mining machinery in general and a few typical ore occurrences; a consideration of mineral lands and their tenure, with the laws relating to them; and the methods of prospecting, including prospecting drills.

**3·02. Mining Engineering.** This is a course on breaking ground and methods of mining, following course 3·01; it includes rock drills, compressors, explosives; methods of tunnel driving and shaft sinking; timbering of underground workings; the various methods of working stopes and rooms for ore and coal; and hydraulicking and dredging of placer deposits.

**3·03. Mining Engineering.** This course, which continues the subject of mining, is devoted mainly to machinery and apparatus for handling ore and water; it includes tramming, haulage, hoisting, drainage and pumping, ventilation, breathing apparatus, explosions, mine fires, lighting and access.

**3·04. Mining Engineering.** After the detailed study of mining (courses 3·01–3·03) this course is devoted to the broader aspects of the profession and touches upon the miner's health, welfare and safety; State regulations, sampling and reporting; mine accounts and cost systems; contracts; and mining from the investment viewpoint, including costs, losses and smelter deductions, calculations of extractions and final net values and profits.

**3·05. Mining Engineering.** This is a brief course touching upon only such operations and apparatus in courses 3·01–3·04 as are of special importance from the viewpoint of the metallurgist.

**3·06. Mining Engineering, Advanced.** This course is devoted to lectures, conferences, assigned readings, drawing and calculations; it is designed to supplement the undergraduate work of courses 3·01–3·04 by covering details and solving problems omitted previously for lack of time. Considerable latitude is allowed the student, in time allotment and in his choice of ore mining or coal mining or of any special division of the subject. In general, a considerable portion of the time may be devoted to the design of a mine plant, starting with certain assumed conditions.

**3·21. Ore Dressing.** This course logically follows course 3·02 and deals with the mechanical concentration of the mine ore to save the values from the waste. The greater part of the time is devoted to wet gravity concentration and flotation, including crushing machinery, screens, classifiers, jigs, vanners, tables and flotation machines. Amalgamation, pneumatic, electrostatic and other minor processes are also discussed, as well as accessory apparatus, mill principles and typical mill flow-sheets. It is aimed to correlate the lectures with the laboratory course 3·22. Text-book: *Richards' Text-book of Ore Dressing.*

**3·22. Ore-Dressing Laboratory.** This course gives the student an opportunity to become familiar with the principles and actual operation of ore-dressing apparatus. The class usually makes two mill runs, one on gold ore using stamps, amalgamated plate, vanner, classifier and canvas table, and the other on a lead ore using trommel, classifier, jigs and tables. In addition, individual tests are made on crushing machines, sizing screens, hydraulic classifiers, magents, flotation machines, etc. One very important part of this work carried out by the student is the cleaning up, weighing, sampling and analyzing of all the products, the computation of results and the preparation of written reports which are discussed at the weekly seminars.

**3·23. Ore Dressing.** The ground covered in the lectures embodies the principles of ordinary wet gravity concentration, flotation, amalgamation and magnetic separation. The most important crushing and concentrating machines of interest to the metallurgists are treated briefly. The laboratory work covers three seven-hour periods for three weeks, and three seminars of one hour; it is practically identical with that of course 3·22 with the exception that lack of time prevents the student from cleaning up his products and preparing reports. Textbook: *Richards' Textbook of Ore Dressing.*

**3·24. Ore Dressing, Advanced.** This course, somewhat variable in scope and time allotment, is devoted to lectures, conferences and assigned readings covering ground omitted in course 3·21. About one hundred hours out of the total time are usually devoted to the design of a mill under certain assumed conditions.

**3·31. Fire Assaying.** This course consists of one lecture, one recitation and one seven-hour laboratory exercise a week. In the lectures are discussed the sampling of ores and bullion, the assaying of ores for gold, silver and lead, and of bullions, solutions, mattes 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. Textbook: *Bugbee, Fire Assaying.*

**3·32. Fire Assaying and Metallurgical Laboratory.** This is a composite course, consisting of an elementary course in fire assaying followed by a brief laboratory course in fire metallurgy.

The course in fire assaying covers only the assay of ores for silver, gold and lead. The work in fire metallurgy is similar to that of course 3·54. May not be given unless six or more apply.

**3·33. Fire Assaying, Advanced.** This is an advanced course in the theory and practice of fire assaying, which includes practice, with works — methods for gold and silver not included in course 3·31; the fire assay for tin, mercury and members of the platinum group of metals; also a certain amount of research.

**3·41. Metallurgy.** This course with courses 3·42 or 3·421 and 3·43 covers briefly the entire field of metallurgy. In the first term the subjects studied are general metallurgy, copper, gold and silver. The laboratory work in course 3·54 runs parallel with the classroom work in course 3·41. Textbooks: *Hofman, General Metallurgy; Metallurgy of Copper; Thomson, Stamp Milling and Cyaniding.*

**3·42. Metallurgy.** This course covers the metallurgy of lead, zinc and aluminum, and deals with fuels and refractory materials. The laboratory work of 3·55 runs parallel with the lectures. Textbooks: *Hofman, Metallurgy of Lead; General Metallurgy.*

**3·421. Metallurgy.** This course finishes non-ferrous metallurgy and deals with lead, zinc and minor metals. Laboratory work 3·55 runs parallel with the lectures. Textbook: *Hofman, Metallurgy of Lead.*

**3·43. Metallurgy: Iron and Steel.** The course covers a study of physical and chemical properties of iron and its alloys, and the production of pig iron, steel and wrought iron. Stress is laid in the classroom mainly upon principles; the processes are given in outline and studied in detail by the student in assigned treatises and periodicals. The lectures are supplemented by visits to plants; seminars are held to discuss the information obtained in these visits.

This course is recommended for Army and Navy Officers requiring a

knowledge of iron and steel for ordnance or structural purposes. Textbook: *Stoughton, The Metallurgy of Iron and Steel.*

**3·431. Metallurgy: Iron and Steel.** The classroom work for this course is given with course 3·43. The assigned readings and plant visits required in course 3·43 are omitted. Textbook: *Stoughton, The Metallurgy of Iron and Steel*

**3·44. Metallurgy: General, Zinc and Minor Metals.** This course covers in a general manner the properties of metals and metallic compounds, treats in detail fuels and refractories, discusses the principles which govern pyro-hydro- and electro-metallurgical processes and considers typical metallurgical apparatus. In zinc and minor metals the work supplements that given in course 3·421. Textbook: *Hofman, General Metallurgy, Zinc and Cadmium.*

**3·45. Metallurgy of Iron and Steel, Advanced.** This course is library and conference work aiming to give a more detailed knowledge of the subject than is possible in 3·43.

**3·46. Metallurgical Plant Design.** This course aims to make the student conversant with some construction details of metallurgical plants. It involves the fundamental calculations for a given problem, the study of detail in working drawings, followed by the preparation of drawings of a plant as a whole and of some of the apparatus in detail.

**3·47. General Metallurgy, Advanced.** This course is a combination of lecture, conference and reading, in which students who have had the undergraduate course of General Metallurgy can carry further their study of the subject as a whole or of several of its branches

**3·48. Non-Ferrous Metallurgy, Advanced.** The aim of this course is to furnish facilities for a detailed study of the metallurgy of some non-ferrous metals. It consists of lectures, conferences and reading.

**3·49. Metallurgy of Common Metals.** This course is designed for engineering students who do not expect to practice metallurgy as a profession. It consists of two lectures per week in the second and third terms and treats at varying lengths of iron and steel, copper, lead, zinc, aluminum, antimony, tin and nickel. The discussion covers sources, methods of extraction, physical properties of metals, principal uses, origin and effect of impurities, refining, industrial alloys, etc. Optional in third or fourth year.

**3·54, 3·55. Metallurgical Laboratory and Reports.** Copper ores are roasted and leached by different methods and metallic copper is refined by fire and electrolysis. The leaching of gold and silver ores begun in 3·54 is continued. The student obtains experience in plant methods for wet assay by analyzing ores and solutions from his tests.

**3·56. Metallurgical Plants.** This course consists of drafting room, library and conference work. Details of apparatus, plant arrangement and operations are studied and presented at occasional seminars. Considerable latitude is allowed in a choice of subject.

For men in the R. O. T. C. the work will be continued in the third term, taking sixty hours from thesis time, and will specialize in furnaces and apparatus for ordnance production.

**3·59. Metallurgical Calculations.** This course deals numerically with the physical and chemical phenomena in metallurgical operations, mainly along thermal lines. Special attention is given to thermal efficiencies and to calculations of thermal balances of a number of processes. Reference book: *J. W. Richards' Metallurgical Calculations.*

**3·61–3·62. Metallography.** This course continues through two terms, with the second term given up to laboratory work. The course covers the properties of metals, the constitution of alloys and metallurgical

compounds, and the influences of thermal treatment. The laboratory exercises cover the preparation and microscopical examination of samples of different grades of iron and steel, and of some of the leading industrial non-ferrous alloys; they include the study of changes in structure by mechanical stress and heat treatment, and the preparation of photo-micrographs. Textbook: *Sauveur, Metallography and Heat Treatment of Iron and Steel.*

**3·63. Metallography.** This course is similar to that of Metallography, courses 3·61–3·62, only shorter, the aim being to familiarize non-metallurgical students with the fundamental principles of the subject.

## ARCHITECTURE

### (Including the Division of Drawing)

Two professional options are offered by the Department: (1) General Architecture, (2) Architectural Engineering. Although the graduates of both options must coöperate in order to produce an architectural structure, the two courses differ essentially in the details of their curricula, the first placing emphasis on design, the second on engineering.

The courses included in the curricula naturally divide themselves into three groups: (a) those deemed essential for all graduates of the Department, the general subjects such as English and history, economics, drawing, mathematics, mechanics, descriptive geometry and perspective; certain professional and semi-professional subjects, as history of civilization, art and architecture, and philosophy of architecture, office practice, professional relations and lectures on building construction; (b) those developed especially for the option in General Architecture; (c) those developed for students in Architectural Engineering.

In the General Option is included a minimum of the science of construction, sufficient as a basis for the needs of the ordinary architect but in no sense attempting to give a training in engineering. In the Engineering Option is included enough of the study of art and composition to give the student an insight into the ideals of the architect but with no attempt to give a creative power in design.

It is the conviction of the Department that today no one man can become a master in these two great branches of the profession, and that in all practical design the architect should be in association with a competent and sympathetic engineer.

In all professional work the methods of instruction are, so far as possible, individual. Even in such courses as Architectural History and European Civilization and Art, which must be presented in the lecture room, written exercises and required personal conferences keep the instructor in touch with the progress of each student. In the courses in Design and Freehand Drawing individual criticism and correction form to a very large extent the basis of instruction.

As we believe that the function of the architectural school is to give training in fundamentals, our efforts are concentrated upon imparting to the student a very clear understanding of the general principles of the subject, and upon training his powers of analysis and application. It is believed undesirable, in fact dangerous, to spend too much time upon the hampering limitations of ordinary practice before the student has acquired sufficient knowledge of the subject to discriminate between the general and the special case.

Daily progress and attention to work is insisted upon, and the results of class exercises during the term are considered quite as trustworthy a

measure of a student's development and power as are the formal examinations.

The student is strongly advised to spend a part of the summer vacation in an office. The experience that he gets there of practical problems and conditions will be a great aid to him in a clearer understanding of the value of his school work.

**4·02. Freehand Drawing.** The work consists of drawing from the cast (architectural ornament and the human figure), and in making numerous quick sketches. It is the fundamental drill for all the Freehand Drawing courses.

**4·03. Freehand Drawing.** This course is a continuation of Freehand Drawing 4·02. The work includes drawing from the cast and architectural ornament in charcoal and in wash; also quick sketching direct from the human figure.

**4·04. Life Class.** This course is a continuation of Freehand Drawing 4·03. The work consists of drawing from the nude, memory drawing, and direct pen-and-ink sketching from the figure.

**4·05. Life Class and Decorative Design.** This advanced work is open only to students who have passed with a clear record 4·04. In this class the students make life-sized drawings from the nude, and study the principles of decorative figure design. This course also includes outdoor sketching from architectural subjects.

**4·06. Water Color.** The purpose of this course is to impress the student with the importance of combining good drawing, values and color as applied to architectural subjects. Color-principles and color-harmony will be studied so as to give the student a practical and artistic base upon which to build. Sketching out of doors will be undertaken in simple values from the point of view that landscape is the proper background for architecture.

Supplementing the course each student is encouraged to make at least twelve sketches from nature, as vacation work, to be submitted in the fall for criticism. This is to induce the student to acquire the habit of observation until it becomes an instinct. These sketches are not in any sense intended to be pictures, but first studies with true values and simple planes well indicated.

**4·11. Shades and Shadows.** This course gives the principles of descriptive geometry methods in casting the conventional shadows used in architectural design. These are supplemented by short methods useful in practice. Textbook: *H. W. Gardner, Notes on Shades and Shadows.*

**4·12. Perspective.** A series of lectures and classroom exercises. In the second term are considered the fundamental phenomena of appearance, the general theory of conical projection and its application to perspective, the method of revolved plan upon which all shorter methods are based, curves and apparent distortion.

In the third term the course is continued with the study of direct division, direct measurement, relations between lines and points in the vanishing-point diagram, the cubic system, method of perspective plan, and shadows. Textbook: *Principles of Architectural Perspective, Lawrence.*

**4·14. Applied Perspective.** This course is planned to give the student practice in the composition and rendering of architectural perspective drawings.

**4·211. Office Practice.** This course consists of lectures and exercises in the drafting-room, to illustrate the principles governing the making of working drawings, details and specifications. Plans of executed work are examined and discussed, and, wherever practicable, visits are made to the buildings under discussion. The character and use of building

materials are discussed, with special reference to their influence upon architectural design. This course should enable a student without previous office experience to be of some value as a junior assistant in an architect's office during his vacation periods. Textbook: *Frame Construction Detail*, National Lumber Manufacturers' Association.

**4·212. Office Practice.** This course includes an analysis of the methods followed in architects' offices in the preparation of plans and specifications as well as details for a good building, accompanied by weekly visits to such a building under construction in or near Boston.

**4·22. Professional Relations.** This course is designed to give an understanding of the professional character of the practice of architecture. In it are discussed the personal, ethical, business and legal relations of the architect with clients, builders, craftsmen, engineers, etc., with whom he has to work in the practice of his profession; also the relations that should exist between the architect, his professional organizations and the community in which he lives. References are made to legal handbooks upon the laws governing architecture and building, and to the various documents that are issued by the American Institute of Architects. The students are encouraged to take part in the discussions and to express their personal opinions. Textbooks: *Handbook of Professional Practice*, American Institute of Architects; *Law of Architecture and Building, Clinton H. Blake, Jr.*

**4·30. Theory of Design.** Being a series of lectures and talks with the lantern on the elements of architecture and the first principles of composition.

**4·41. Architectural History.** This course consists of a series of lectures, illustrated by the stereopticon, devoted to Assyrian, Persian, Greek and Roman architecture. *Reference reading.*

**4·42. Architectural History.** This course is a continuation of course 4·41, devoted to Byzantine, Romanesque, Gothic and Renaissance architecture.

**4·46. European Civilization and Art.** This course treats of the rise of civilization and of its westward expansion through the Mediterranean basin. The racial, economic, religious and political elements in this development are carefully traced, and upon the background thus gained the art of each successive epoch is studied and general esthetic principles are discussed. As the students in Course IV have a specialized course in the History of Architecture, attention is here particularly concentrated upon sculpture. The lectures are very fully illustrated by lantern slides, supplemented by collections of photographs and by reference to the original works and casts contained in the Boston Museum of Fine Arts. Textbooks: *Breasted, Ancient Times: Tarbell, Greek Art.*

**4·47. European Civilization and Art.** In this course a survey of the civilization and art of the later Hellenic and Roman world is followed by outlines of medieval history and a brief study of Byzantine, Gothic and Early Renaissance art. Method and apparatus as in course 4·46, of which this course forms a continuation. Textbook: *Breasted, Ancient Times.*

**4·51. Philosophy of Architecture.** This course consists of a series of conferences in which architecture is considered from a theoretical rather than an historical point of view. The course serves to supplement the drafting-room instruction in design in furnishing a résumé of the fundamental principles of architecture and its relationship to civilization and the other arts allied with architecture.

**4·61. Landscape and Civic Design.** This course is intended to acquaint the students with the principles that are characteristic of problems peculiar to the landscape architect and town planner, the purpose being to so equip the architect that he may the better coöperate with

either engineer, landscape architect or town planner, rather than to prepare him to supplant any one of them. The course is given in lectures accompanied by reading and by work at the draughting board.

**4·63. Architectural Humanities.** Together with Landscape and Civic Design this course is intended primarily for seniors, but will likewise be required of graduate students who cannot present evidence of corresponding work covered previously. It is composed of lectures by speakers of distinction in different fields not strictly architectural, but so related to architecture as to be valuable to students about to assume their professional responsibilities; for example, Honorable George McAneny, former Borough President of Manhattan, on Civic Opportunities; William A. Starrett, Vice-President of Fuller Construction Company, on Architect, Engineer and Contractor; Professor G. C. Whipple, of Harvard University, on Public Health, etc.

**4·71. Design I.** This course is given by means of individual instruction in the drafting-room and by criticism of the student's work before the class. By means of simple problems in architectural composition the qualities of mind required in the profession of the architect are cultivated in the student. This course also serves to train him in the methods of studying architectural composition and to teach him the principles of academic rendering. Textbook: *Gromort, Elements of Classic Architecture.*

**4·72. Design II.** This course is a continuation of course 4·71.

**4·73. Design III.** This course is a continuation of course 4·72. It includes the preparation of the graduating thesis.

**4·74. Design.** This course is a continuation of 4·73, and includes the study of the composition of groups of buildings.

**4·80. Building Construction.** This course consists of lectures and recitations planned to give the student a general understanding of the different types of building construction, the typical forms of elementary structures, and some idea of arrangements and proportions imposed by the use of different kinds of material.

**4·81. Constructive Design.** A course in the methods of analysis and computation required in elementary architectural construction, treating of the theory of construction, loads, reactions, the design of beams, columns and various details. Textbook: *Mimeograph Notes.*

**4·82. Constructive Design.** A continuation of course 4·81, including the study and design of a wooden roof truss, a problem in slow-burning construction, simple steel framing and simple reinforced concrete. Textbook book: *Mimeograph Notes.*

**4·90. Structural Drawing.** This course is intended to supply the preliminary knowledge of structural steel shapes and familiarity with the use of steel handbooks necessary for the study of structural design, and to give some practice in drawing. Advantage is taken of opportunities to view the work of the template and fabricating shops in one or more visits to a structural steel plant. Some typical shop drawings of a structural steel building frame are made, including the details of a plate girder.

**4·91. Structural Design.** A consideration of fundamental problems in structural design with emphasis on the analysis of such problems and the adaptation to their solution of principles already acquired in the study of mathematics and applied mechanics. Elementary forms in wood, cast iron and steel are studied. Textbook: *Mimeograph Notes.*

**4·92. Structural Design.** A continuation of 4·91, consisting of problems in architectural construction, including plate and box girders, riveted trusses, wind pressure and general framing in steel; floor systems, columns and footings in reinforced concrete, with attention given to the effect of continuity of beams and rigidity of connections, also special problems

arising in the design of stairs, floor openings, roofs, walls and partitions. Great importance is placed upon the study of details, and carefully worked out and dimensioned drawings are made. One hundred hours in the second term are devoted to the work in concrete. Textbook: *Mimeograph Notes.*

## CHEMISTRY

Instruction in general Inorganic Chemistry is given to all students in regular courses except that of Architecture, throughout the first year. The course is designed not only to impart a knowledge of the principles of the science and of the descriptive chemistry of the metallic and non-metallic elements, but to constitute an introduction to scientific methods of experimentation, observation and reasoning. Special effort is, therefore, made to impress upon the student the importance of neatness, accuracy and thoughtfulness in connection with his laboratory practice, and to point out the value for later professional work in all courses of intelligent observation and ability to interpret the meaning of observed phenomena.

The instruction in chemical subjects is continued in the Courses in Chemistry, Physics, Biology and Public Health and Geology, and in those of Mining, Sanitary, Electrochemical and Chemical Engineering and in Option 3 of the Course in Engineering Administration. It includes Analytical, Theoretical, Organic and Industrial Chemistry, as well as opportunity for elective courses in such specialized lines as gas, oil, air, water, food, sugar and proximate technical analysis. In all of these subjects classroom instruction is combined with laboratory work. Students in the courses in Chemistry and Chemical Engineering devote, as a rule, more time to these subjects than students in other courses, and their work is, accordingly, somewhat more advanced.

The opportunities for research work under the direction of the instructors in the various branches enumerated above are unusually extensive, and the general and special laboratories are well equipped for advanced work of this character.

The aim throughout all the courses of chemical instruction is to teach the student self-reliance, to inculcate habits of accurate thought and work, and to afford such a training as will fit him to cope successfully with new scientific and technical problems.

**5·01, 5·02, 5·03. Chemistry.** This course deals with the fundamental principles of chemical science and with the descriptive chemistry of the more common elements and their important compounds.

During the second and third terms (courses 5·02, 5·03) those students who have elected courses in which chemical subjects are continued beyond the first year are given a laboratory course in synthetic inorganic chemistry, while students taking the other engineering courses devote their time to a study of certain special applications of chemistry to engineering problems. Textbook: *Norris, A Textbook of Inorganic Chemistry for Colleges.*

**5·05. Inorganic Chemistry I.** This course is designed to strengthen and broaden the student's knowledge of inorganic chemistry. The outside preparation consists in the reading of assigned portions of a standard textbook. The classroom exercises are intended to assist the student in correlating his knowledge in such a way as to increase its utility, and to assist him in logical deduction and reasoning.

**5·06. Inorganic Chemistry II.** The aim of this course, which consists in part of informal conferences, is to study in a comparative way the physical and chemical properties of the elementary substances and their more important compounds. Relationships indicated by the periodic system and the electromotive series are emphasized, and the effect on the change

in properties which accompanies change in valence is discussed. Attention is given, also, to the more important results of recent investigations in inorganic chemistry.

**5·08. Preparation of Inorganic Compounds.** The laboratory work consists of the extraction of certain of the less common elements from their ores, the study of the typical reaction of these elements, the preparation of certain inorganic compounds which exist in several modifications and the preparation of complex substances. An attempt is made to introduce a spirit of research into the work. In the classroom the chemical principles illustrated by the work are discussed. Textbook: *Laboratory Methods of Inorganic Chemistry*, by H. and W. Biltz, translated by William T. Hall and A. A. Blanchard.

**5·09. Theories and Applications of Catalysis.** This course is designed to furnish a systematic description of our knowledge of catalytic phenomena, including all recent developments. The various theories regarding the mechanism of catalytic action as well as the choice and function of catalysts in industrial processes such as the manufacture of sulphuric acid, fixation of nitrogen, hardening of oils, vulcanization of rubber, synthesis of alcohol, saponification of fats, electrochemical operations, etc., will be fully discussed. Attention will also be given to the use of catalysts in typical operations of organic chemistry such as oxidation, hydrogenation and dehydrogenation, hydration and dehydration, polymerization, etc.

**5·10. Qualitative Analysis.** This course is intended to emphasize the principles involved in chemical analysis, to broaden the student's knowledge of inorganic chemistry, to develop deductive reasoning power and to give practice in manipulation. After a series of preliminary experiments, illustrating principles and giving practice in writing equations, the student is required to analyze unknown industrial products such as minerals, pigments, slags and alloys. The student reports not only upon his qualitative results, but also upon the proximate amounts of each element present. Not only is the educational value of the course broad, but it serves as a necessary introduction to the study of quantitative analysis. Textbooks: *Qualitative Analysis, A. A. Noyes; Analytical Chemistry, Vol. I, Treadwell-Hall.*

**5·121. Quantitative Analysis.** This course is devoted to elementary volumetric analysis. The work is regarded as a preliminary training for the more advanced work and the time is spent upon simple quantitative analyses which are typical of the subdivisions of the subject. Great stress is laid upon the accuracy, care and integrity necessary for successful quantitative work; and, as in the instruction in qualitative analysis, the chief endeavor is to promote thoughtful and intelligent workmanship. Special attention is given to stoichiometry and the modern theories of solutions as applied to quantitative analysis. Textbook: *Quantitative Analysis, Talbot.*

**5·122. Quantitative Analysis.** This course is a continuation of 5·121, but deals with gravimetric analysis.

**5.13. Quantitative Analysis.** In this course the principles involved in the methods of analysis are discussed in detail and the applications of these principles to problems other than those being carried out by the student in the laboratory are also considered.

The laboratory work of this course includes the analysis of silicates, minerals, ores, alloys and industrial products. The instruction is intended primarily to fit the student to judge intelligently of the adaptability and accuracy of the processes employed, rather than to furnish detailed directions for specific analyses, and to afford him some general experience with the methods employed for the accurate and rapid control of commercial

products. Textbooks: *Quantitative Analysis, Fay; Analytical Chemistry, Vol. II, Treadwell-Hall.*

**5·14. Analytical Chemistry.** A special course arranged for fourth year men who are registered in Course X-A. The lectures give instruction in special analytical processes which are met with in plant practice. The laboratory work affords experience in rapid, accurate, commercial methods and is designed to train a small group of men to carry on efficiently a large number of analyses of the same kind without special or expensive apparatus, and to meet laboratory conditions of the practice school in X-A. Textbook: *Special Notes and References.*

**5·15. Qualitative Analysis of Rare Metals.** This course is given for advanced students; the work includes the testing of recently developed methods and the investigation of new precedures for the separation and detection of the rarer metals.

Students are expected to understand the chemical principles involved in the reactions used, and are required to examine chemical literature and to make reports concerning characteristic reactions of some of the metals.

**5·17. Methods of Electrochemical Analysis.** The classroom work consists of a review of the electrochemistry of aqueous solutions with particular reference to the Nernst theorem. The important technical applications are discussed and problems given for home study. In the laboratory a number of typical electrolytic determinations are made, some of which involve the careful regulation of the cathode potential. One or more electrometric titrations are made. Textbook: *Quantitative Analysis by Electrolysis, A. Classen–W. T. Hall.*

**5·19. Chemical Literature.** This course is devoted to the reading of technical chemical literature in German and French, and to practice in the use of the libraries for the purpose of compilation of journal literature on scientific topics.

**5·20. Water Supplies.** This course consists of thirty hours of laboratory practice in the chemical examination of potable waters and of sewages; and of ten lectures in which the methods of analysis and the sanitary significance of the results are discussed. Textbook: *Woodman and Norton, Air, Water and Food.*

**5·21. Industrial Water Analysis.** This course comprises a study of the methods of selection and treatment of water for industrial purposes. Special attention is given to the analysis and treatment of boiler waters.

**5·22. Water Supplies and Wastes Disposal.** This course deals with the chemical problems involved in modern methods of selection and treatment of potable waters and the disposal and the purification of wastes. Textbook: *Woodman and Norton, Air, Water and Food.*

**5·25. Chemistry of Foods.** A course designed to introduce the student to the methods generally employed in determining the character, purity and nutritive value of common food materials. The extent, character and legal status of food adulteration are discussed, and analyses made of typical food products. Textbook: *Woodman and Norton, Air, Water and Food.*

**5·26. Food Analysis, Advanced.** This course is designed to illustrate the manner of attacking the chemical problems arising in connection with State and municipal food control. In addition to the laboratory practice, each student is expected to present in conference a detailed written report concerning some particular food material, its forms of adulteration and the most rapid as well as systematic method of detecting them, accompanied by actual figures obtained in the laboratory. Some attention is devoted also to the system of food inspection and to a critical study of methods of food analysis. Textbook: *Woodman, Food Analysis.*

**5·27. Chemistry of Plant and Animal Life.** The physical and chemical properties of substances occurring in plants and animals, such as fats, carbohydrates, proteins, purin and pyrimidine derivatives, anthocyanins, and alkaloids will be considered, together with the chemical reactions by which these substances are synthesized and the changes of composition which they undergo. The physicochemical phenomena of osmotic pressure, of adsorption, of diffusion and of the colloidal condition will be discussed. Catalysis, neutrality of cell contents, chemical coördination, chlorophyll, hæmoglobin, fertilizers, chemotherapy, chemical structure and pharmacological action, the proximate analysis of plant and animal products, and the elements of toxicological analysis will also be considered. Reports of assigned topics will be required.

**5·29. Optical Methods in Chemical Analysis.** This course comprises standardization of saccharimeters by quartz-plate readings; determinations of specific rotary powers, double polarization, the quotient of purity; and practice in the calculations of optical analysis, with special reference to the use of the polariscope and refractometer as applied to sugars, starches, essential oils and the like. Textbook: *Rolfe, The Polariscope in the Laboratory.*

**5·30. Proximate Technical Analysis.** In this course the student selects a subject, consults the literature relating to it, presents the results of his reading before the class for criticism and suggestion, and then applies the method as thus worked up, in the laboratory. Among the topics studied are alkaloids, asphalt, oils of all kinds, paints, paper, inks, rubber, soaps, tanning materials and the like. The course is designed to develop a critical spirit of investigation, rather than merely to study the technique of analytical methods.

**5·31. Gas Analysis I.** This course considers the qualitative and quantitative analysis of the various gases, the technical analysis of commonly occurring gaseous mixtures, such as illuminating and fuel gas, gases from acid chambers and chimney gas, and the consideration of losses due to waste gases. Textbook: *Gill, Gas Analysis for Chemists, or Gas and Fuel Analysis for Engineers.*

**5·32. Gas Analysis II.** This course consists of ten three-hour exercises in the analysis of gases, with the use of methods and apparatus which admit of a high degree of precision.

**5·33. Gas and Fuel Analysis.** This course discusses the origin, manufacture, properties, uses and analysis of the various fuels; also smokeless combustion, and the considerations involved in the economical application of fuel. Given in connection with Engineering Laboratory. Textbook: *Gill, Gas and Fuel Analysis for Engineers.*

**5·341. Applied Chemistry.** This course deals with the properties, testing and applications of paints, oils, varnishes, lubricants and wood preservatives. Alloys, bearing metals, boiler scale and corrosion of metals are also discussed.

**5·342. Applied Chemistry.** This course is similar in character to course 5·341. Laboratory work can be had in place of lectures.

**5·343. Engineering Chemistry.** An elementary course designed to give the engineer an insight into the chemistry involved in the production and use of illuminating gas, alcohol, paper, ink, leathers, rubber, animal, vegetable and mineral oils, paints, varnishes, starch, sugar and explosives. Textbook: *Rogers, Elements of Industrial Chemistry.*

**5·35. Testing of Oils.** This course covers the mechanical and chemical testing of the mineral, animal and vegetable oils, with the purpose of detecting adulteration, and of determining their applicability and their

safety, from the point of view of the manufacturer and of the insurance underwriter. Textbook: *Gill, Handbook of Oil Analysis.*

**5·361. Testing of Oils.** This course is similar to 5·36, special attention being paid to lubricating oils and the needs of the engineer. Textbook: *Gill, Short Handbook of Oil Analysis.*

**5·37. Chemistry of Road Materials.** This course is intended for civil engineers, and deals with the applications and tests of bitumens, tars, oils, paints and chemicals used in the preservation of roads and road structures. Textbook: *Blanchard, Highway Engineers' Pocket Book.*

**5·40. Special Methods and Instruments.** This course deals with the use of the microscope, polariscope and saccharimeter, refractometer, viscosimeter, turbidimeter, nitrometer and precision centrifuge, and a study of their application to problems in technical practice. *Neostyled Notes.*

**5·41. Metallography I.** In this course, the general methods used in the study of alloys, the construction and interpretation of equilibrium diagrams and the relations between the constitution of alloys and their physical properties are considered. The iron-carbon diagram is studied in detail with its application to the heat treatment and the use of steel. Textbooks: *Williams, Metallography; Fay, Microscopic Examination of Steel.*

**5·42. Metallography Ia.** This course is similar to course 5·41, but intended only for students entering from other colleges.

**5·43. Metallography II.** This is an advanced course of lectures, conferences and reports in which special problems of scientific and industrial interest are discussed in detail.

**5·50. Organic Chemistry. (Brief Course.)** This course is designed for students who will not pursue the study of organic chemistry further; it includes a general discussion of the most important facts in the chemistry of the compounds of carbon. The typical methods of preparation and the chemical and physical properties of the various classes of compounds are presented, and a brief account is given of the source and technical preparation of the simpler substances of commercial importance. Textbook: *Moore, Outlines of Organic Chemistry.*

**5·51. Organic Chemistry I.** This is an extensive course in which the general principles of organic chemistry and the properties of important compounds receive thorough discussion. The lectures are fully illustrated by experiments. Textbook: *Cohen, Theoretical Organic Chemistry.*

**5·52. Organic Chemistry II.** For admission to this course students must have completed satisfactorily a year's work in organic chemistry. The important principles of the science are emphasized from a more mature point of view than is possible when the subject is approached for the first time. The usual classification of compounds into the aliphatic and aromatic series is discarded, and the properties of the compounds containing the important radicals are studied in a comparative way. Emphasis is placed on the study of unsaturation, the influence of structure and substituents on the activity of radicals, and the application of the methods of physical chemistry to the solution of problems in organic chemistry.

**5·53. Organic Chemistry III.** This is primarily a graduate course designed to supplement the instruction received by students who have the equivalent of Organic Chemistry I. Important topics, varied from year to year, are presented in lectures accompanied by assigned reading and discussion. The year 1922–23 will be devoted to a systematic study of the Chemistry of the Heterocyclic Compounds. Textbook (recommended, but not required) *Meyer and Jacobson, Lehrbuch, Volume II, part 3.* (Veit, Leipzig.)

**5·54. Industrial Organic Chemistry.** The purpose of the course is to give those who are interested in organic chemistry a comprehensive survey of the various industries in which it is used. Among the topics which will be studied are: sugar and starch industries, distillation of wood, technical treatment and uses of rubber, some products derived from coal-tar, manufacture of inks, textile industries, fats, waxes and essential oils, organic medicinal chemicals, etc. Emphasis will be placed on the organic chemistry involved in these operations, but a description of the technical operations sufficiently detailed to make the discussion complete will also be given.

**5·55. Organic Qualitative Analysis.** This is a laboratory course for advanced students in the use of systematic methods for the identification of organic compounds continuing through two terms. Textbook (recommended, but not required): *Mulliken, Identification of Pure Organic Compounds.*

**5·561. Organic Chemical Laboratory.** This course includes three kinds of laboratory practice. (a) Organic preparations. In this the student becomes familiar with the more common methods of manipulation and the more important synthetic processes, while the application of theory to the work in hand is constantly emphasized by regular conferences with individual students. (b) Identification of organic compounds. This part of the work has a similar educational value to that afforded by qualitative analysis in the inorganic field. Similar methods are pursued. (c) Ultimate analysis. This portion of the work (now given only in Course V) gives drill in combustion and the method of Carius. In these fundamental operations the student is expected so to overcome all sources of error as to acquire confidence in his results. Textbook: *Gattermann, Practical Methods of Organic Chemistry.*

**5·562. Organic Chemical Laboratory.** This course provides laboratory practice based upon theoretical instruction given in course 5·50. The kind and quantity of work are widely varied, according to the professional course which the student is pursuing.

**5·57. Synthetic Methods in Organic Chemistry.** This is a course for graduate students specializing in organic chemistry. Standard methods of organic synthesis will be discussed, particular attention being given to the relation of the reagent to the structure of the product and to the varied reactivity of similar groups. The course is intended as an introduction to organic research, inasmuch as it aims to describe the means whereby substances of desired structure may be deliberately synthesized.

**5·58. Recent Developments in Organic Chemistry.** This course is designed to bridge the gap between the textbooks and the current journals, and so to awaken in the student the desire to read for himself. It is also open to those members of the instructing staff who wish to keep in touch with what is being done in the organic field. This course will be given in any term when applied for by six regular students who desire to do the required reading. It will also be given for a smaller number of regular students if there are enough habitual listeners to make a total attendance of twenty.

**5·59. Selected Topics in Organic Chemistry.**

**5·59a. Chemistry of Dyes.** This is an illustrated course of lectures for graduate students on the organic chemistry of the synthetic dyestuffs and their intermediates. Synthetic methods, physical, chemical and tinctorial properties, structure, and chromaphore theory and classification are systematically discussed, and their significance in the development of the color and textile industries is indicated. Textbook (recommended, but not required): *Caine and Thorpe, The Synthetic Dyestuffs.*

**5·59b. Chemistry of Powder and Explosives.** In this course the various types of propellent powder will be considered, their history, manufacture, properties, testing and manner of use. Initiators and commercial and military high explosives will be discussed, particular emphasis being given to their chemical reactions and to their properties with reference to current theories of explosives.

**5·59c. Determination of Chemical Constitution for Organic Compounds.** This is a course for graduate chemical students in which, aided by numerous illustrative problems drawn from classic researches, many of the more practical general methods for establishing the exact constitution of organic substances of previously undetermined chemical structure will be thoroughly discussed.

**5·63. Thermodynamics and Chemistry.** This course is mainly for students taking physical chemistry as a major subject. An acquaintance with the elements of physical chemistry is presupposed. An extended examination is made of the fundamental equations of thermodynamics, and of their applications to physicochemical changes, to chemical equilibria, and to electrochemistry. Numerous problems are solved. Textbook: *MacDougall, Thermodynamics and Chemistry.*

**5·64. Conference on Current Literature in Physical Chemistry.** Brief oral reports, by the members of the conference, on the current literature of physical chemistry, mainly from the French and German journals.

**5·65. Chemical Principles I.** In this course only the more important general principles of chemistry are considered, but these are treated with great thoroughness, and are illustrated by applying them to a variety of problems, which the students are required to solve. These problems are discussed in detail, the aim being to develop power to use the principles, rather than merely to impart a knowledge of the phenomena. The topics considered in the course are the pressure-volume relations of gases, the kinetic theory, the energy relations of gases, the properties of solution related to molal composition, the conduction of electricity in solutions, the ionic theory, the mass-action law applied to the rate and equilibrium of chemical changes, heterogeneous equilibrium from the phase-rule standpoint, and thermochemistry. The laboratory course serves to emphasize the principles of the subject, rather than to teach physicochemical methods of measurement; and for this reason it is closely correlated with the classroom work. The principles are, however, illustrated by the determination of physicochemical constants; for example, of vapor-density and molecular-weight, vapor-pressure, freezing-point, transference-numbers, conductivity and ionization, of rates of reaction, of the equilibrium-constants of gaseous, dissolved, and solid substances, and of thermochemical constants. Textbook: *Noyes and Sherrill, An Advanced Course of Instruction in Chemical Principles.*

**5·651. Chemical Principles.** This course, adapted to the needs of students in Course X, differs from 5·65 in the following respects. Certain topics are dealt with more briefly, and the time thus gained is devoted to a consideration of the maximum work obtainable from chemical changes and its relation to the equilibrium conditions of such changes. Especial emphasis is placed upon the effect of temperature on chemical equilibrium. Textbook: *Noyes and Sherrill, An Advanced Course of Instruction in Chemical Principles.*

**5·66. Chemical Principles.** This course is open only to graduate students from other colleges who have already taken a descriptive course in physical chemistry, which is not accepted as the equivalent of 5·65. Especial emphasis is placed on the practical application of principles, as illustrated by problems, which the students are required to solve. The subject matter

corresponds to that described under 5·65 and 5·67, but is adapted to the more advanced viewpoint of the graduate student. Textbook: *Noyes and Sherrill, An Advanced Course of Instruction in Chemical Principles.*

**5·67. Chemical Principles II.** This course is a continuation of course 5·65, and is conducted in the same general way. The principles of electrochemistry and of thermodynamic chemistry are developed from the free-energy viewpoint. The topics considered in electrochemistry are: the electromotive force of voltaic cells and the separate electrode and liquid potentials which constitute it; electrode-potentials in relation to the equilibrium of oxidation and reduction reactions; electrolysis in relation to electromotive force; and concentration and gas polarization. In thermodynamic chemistry the free-energy decrease attending isothermal chemical changes, or the maximum work obtainable from them, is considered in relation to the equilibrium conditions of such changes; and from the effect of temperature on free energy is derived that of chemical equilibrium. Textbook: *Noyes and Sherrill, An Advanced Course of Instruction in Chemical Principles.*

**5·68. Thermochemistry and Chemical Equilibrium.** In this course the more important principles of physical chemistry are discussed. The topics considered are the pressure-volume relations of gases, solutions, elements of thermochemistry, the phase rule, the mass-action law applied to homogeneous and heterogeneous equilibria, the effect of pressure and of temperature on chemical equilibria, the elements of electrochemistry and the energy obtainable from chemical change. These principles are illustrated and emphasized by numerous problems which are solved independently by the students and afterwards discussed in the classroom.

**5·69. Colloidal Chemistry.** In this course the behavior and properties of substances in the colloidal state are considered in relation to the surface effects upon which they largely depend. The topics discussed are surface tension, adsorption, contact catalysis, Brownian movement, and methods of preparation and properties of disperse systems, such as foams, emulsions, suspensions, colloidal solutions and gels. The lectures are illustrated by experiments. For general outside reading, which is required, specific assignments are given to standard textbooks, and to the current chemical literature for special topics.

**5·70. The Logic of Scientific Inquiry.** One evening a week (7·30 to 9·30) throughout the academic year. The seminar is devoted to a discussion of the methods which are used in making an inquiry into the phenomena of nature, to a discussion of the uses of reasoning and of the relations between logic and experiment.

Members of the Institute staff and others engaged in scientific inquiry will speak, and the talks will be followed by informal discussions. A knowledge of the general history of science is desirable but not necessary. Graduate students in any of the departments of the Institute, members of the instructing staff, and properly qualified seniors will be admitted to the course after consultation with the instructor in charge.

**5·71. Physical Chemistry Seminar.** The classes are of an informal nature and include discussion of the assigned reading. Many of the topics are brought up to date by assignments in the current literature, sometimes of definite articles for review, sometimes of a general topic which the student is expected to follow up by a search of the abstract journals. While the text serves as a general outline of the work, certain topics chosen entirely outside of the text are considered in relation to physical chemistry as a whole. The course is given only in case a sufficient number of students apply in time to arrange for it. Textbook: *Nernst, Theoretical Chemistry, Seventh English Edition.*

**5·72. Radiochemistry and Atom Structure.** This course is given as a seminar in which original articles, on atomic structure and radiochemistry, by Rutherford, Soddy, Moseley, Lewis, Langmuir, etc., are read and discussed. Not given in 1922–23.

**5·731. Thermodynamics I; Free-Energy.** In this course the thermodynamics of chemical reactions is presented from the free-energy viewpoint. Methods for calculating free-energy values from equilibrium data and electromotive force, and the effect of temperature on free-energy, and therefore on chemical equilibrium, are considered in detail. Definite problems serve as a basis for discussion, and are so selected that the student acquires an insight into a general plan for working out a complete system of free-energy values. From these values, the equilibrium constants of all chemical reactions can be calculated at different temperatures.

**5·732. Thermodynamics II; General Theory.** The principal general equations of thermodynamics from the entropy point of view will be developed. Some applications of the equations to phenomena relating to the general properties of substances will be studied. Emphasis will also be placed on the importance to the " third law " of the temperature functions of the specific heats of substances. The aim throughout the course will be to emphasize the fundamental and philosophical aspects of thermodynamics.

**5·74. Kinetic Theory of Gases, Liquids and Solids.** In this course those ideas and theories will be discussed which seek to account for the physical properties of substances from a kinetic point of view. The methods of mathematical analysis which are particularly adapted to this particular field will first be considered, after which the results obtained by their application to several molecular models will be examined. Van der Waal's ideas and his equation, and its later development by Van Laar, which attempt to account for the properties of non-perfect gases and the continuity of the three states of aggregation, will receive detailed attention. Recent attempts to use an atom model suggested by the work of Bohr and others will be considered, and a general comparison finally made showing how well the existing quantitative data can be accounted for by the most recent developments of the kinetic theory. Textbook: *J. H. Jeans, Dynamic Theory of Gases.*

**5·75. Atomic Structure.** The indications concerning the nature of the atom, shown by researches in radiation, radioactivity and allied fields are outlined in an essentially non-mathematical manner. With these indications is compared the evidence of chemical and electrochemical knowledge. Lastly the usefulness of a theory of atomic structure, in interpreting chemical facts, and particularly the nature of valence, is discussed.

**5·76. Sub-Atomic Chemistry.** This course for graduate students will extend throughout the year and will embrace the following topics. In the first term, the methods of separation and identification of the radio elements and physical methods of determining atomic and sub-atomic masses and dimensions; in the second term, the application of quantum hypothesis to radiation, photoelectric effect, and to the Bohr atom model, and in the third term, theories of atomic structure — particularly the Lewis-Langmuir theory — with especial regard to its chemical significance. Textbooks: *Soddy, The Chemistry of the Radio Elements; Milliken, The Electron; and Original Articles in Scientific Journals.*

**5·80. Special Courses in Chemistry and Explosives for Ordnance Officers.**

**5·80a. General Chemistry.** Lectures during the first term on the fundamentals of inorganic and of organic chemistry, the gas-law, vapor density, electrolysis, the mechanism of reactions, etc. Particular attention

will be given to principles important for an understanding of the manufacture and functioning of explosives, and these will be illustrated by problems. Important technical processes, the manufacture of sulphuric acid, nitric acid, chlorine, chlorates, ammonia, the fixation of nitrogen and the distillation of coal tar and of petroleum, will be treated in detail. Textbook, *Modern Inorganic Chemistry, J. W. Mellor.*

**5·80b. Chemistry of Powder and Explosives.** Lectures during the second term, devoted to the manufacture, testing and use of powder and explosives. Their chemical properties will be discussed in their bearing upon availability, method of manufacture, manner of storage and of use. Black powder, nitrocellulose powders, nitroglycerine powders, flashless powder and flashless charges, fulminate, azide, primers, high explosives, aromatic nitro-compounds and those derived from other sources, dynamite, chlorate explosives, and pyrotechnic devices, will be discussed. Textbooks: *Organic Chemistry, J. F. Norris; Laboratory Experiments on the Class Reactions and Identifications of Organic Substances, Noyes and Mulliken; Mimeograph Notes; Courses of Instruction in Chemistry and Explosives, Davis.*

**5·80c. Theory of Explosives.** Lectures during the third term on the phenomena of explosions and the thermochemistry of explosives. Illustrated by problems.

**5·80d. General Chemistry Laboratory.** To accompany 5·80a, laboratory exercises in the preparation of technically important or typical inorganic and organic substances, together with experiments to determine the purity of the raw materials and of the final products.

**5·80e. Explosives Laboratory.** Exercises in the preparation and testing of explosive substances. Analysis of black powder and smokeless powder, preparation of picric acid, TNT, tetryl, etc., heat-test, etc. One or two afternoons will be devoted to practical experiments on the force of explosives, their sensitiveness to shock. The course will familiarize the student officers with the chemical and physical properties of explosives and with the methods by which these properties are examined.

**5·84. Industrial Applications of Chemical Principles.** In this course a few important industrial processes are studied from the standpoint of general chemistry. Particular attention is directed to determine the theoretical maximum efficiency in each case and methods of attaining it.

**5·90. Research Problem.** The laboratory problems assigned in this course are of the nature of minor researches, which are intended to give the student an opportunity to test his ability to do work of an original character. In connection with this work carefully written reports are required upon the journal literature relating to the topics in hand, and a formal record of results obtained in the laboratory must be presented for acceptance. The student may select a problem in inorganic, organic or physical chemistry as he may prefer.

**5·93. History of Chemistry.** This course is devoted to the historical development of the science and to the life and work of the great men who have contributed to this development. The student is required to do extensive reading and to make oral as well as written reports upon the details of classical investigations.

**5·94. Recent Developments in Chemistry.** During the first and second terms, weekly meetings of this course are held at which reports and reviews of topics of current interest are presented by members of the instructing staff or graduate students.

**5·95. Thesis.** As a part of the requirements for graduation each student is required to present a written thesis based upon an investigation carried on under the direction of a member of the instructing staff. So

far as possible, each student is allowed to select the field of chemistry in which to carry on his investigation.

**5·96. Thesis Reports.** A series of classroom exercises at which students are required to report upon the progress of the investigations upon which their theses are to be based. These reports are subject to criticism and suggestion from members of the class and of the instructing staff.

**5·97. Journal Meeting in Organic Chemistry.** The instructing corps and graduate students in organic chemistry meet once a week to discuss current publications.

**5·98. Research.** The research required as a part of the requirements for any of the advanced degrees may be taken in any of the following divisions of the Department: inorganic, physical, organic, or applied chemistry. In its general character the work must be of such a grade as to demonstrate the fitness of the student to carry on original investigations with a reasonable degree of independence but in consultation with the member of the staff having the research in charge.

**5·991. Research Conferences in Physical Chemistry.** The researches in progress in the Research Laboratories of physical chemistry are discussed by those who are at work upon them.

**5·992. Research Conferences in Organic Chemistry.** The researches in progress in the Research Laboratories of organic chemistry are discussed by those who are at work upon them.

## ELECTRICAL ENGINEERING

The instruction in Electrical Engineering aims to give a foundation in those general principles of electricity and magnetism upon which the development and advancement of the electrical art, in all its various phases, have been shown to rest. Coördinated with this instruction in the theory of electricity and magnetism and enforcing it, are courses on the larger problems of engineering, together with the work in the laboratories, embracing a detailed study of the instruments, methods, and plant used in modern electrical engineering practice, special emphasis being laid throughout on a study of sources of error, economy of time, and precision of results.

The unusually extensive equipment of the Augustus Lowell Laboratory of Electrical Engineering makes it possible to familiarize the undergraduate student with the various types of apparatus and the engineering methods with which he will be brought into contact in his later professional work, and also affords opportunity for graduate students to carry out original investigations. The latter opportunities are enhanced by the great libraries and research laboratories of the Department.

Excursions to important industrial works with which the vicinity of Boston abounds keep the students in touch with present practice in electrical engineering.

In Course VI-A the instruction and experience in shop processes and shop management are added to the scientific instruction of Course VI.

The Option in Electrical Communication is exhibited on page 22.

**6·00. Principles of Electrical Engineering (Electric and Magnetic Circuits).** A course of recitations and problems devoted to fundamental concepts of electrical engineering and to the laws of the electric and magnetic circuits. Textbook: *Timbie and Bush, Principles of Electrical Engineering.*

**6·01. Principles of Electrical Engineering (Direct-Current Machinery).** A course of recitations and supervised problem work devoted to the principles underlying the construction and performance of direct-

current machinery. Textbook: *Langsdorf, Principles of Direct-Current Machines.*

**6·02. Principles of Electrical Engineering (Variable and Alternating Currents).** A course of recitations and supervised problem work devoted to variable and alternating currents. Textbooks: *R. R. Lawrence, Principles of Alternating Currents; W. V. Lyon, Problems in Electrical Engineering.*

**6.03. Principles of Electrical Engineering (Alternating-Current Machinery).** A course of recitations and supervised problem work devoted to the discussion of polyphase alternating currents and the various types of alternating-current machinery for the generation, transmission and distribution of power. Textbooks: *R. R. Lawrence, Principles of Alternating Currents; R. R. Lawrence, Principles of Alternating-Current Machinery; W. V. Lyon, Problems in Alternating-Current Machinery.*

**6·031. Principles of Electrical Engineering (Alternating-Current Machinery).** A course of recitations and supervised problem work, similar to course 6·03 and a portion of course 6·04, but with less attention paid to details.

**6·04. Principles of Electrical Engineering (Alternating-Current Machinery).** A continuation of course 6·03. A course of recitations and supervised problem work devoted to the discussion of the various types of alternating-current machinery for the generation, transmission and distribution of power and a discussion of transients in transformers and alternators. Textbooks: *R. R. Lawrence, Principles of Alternating-Current Machinery; W. V. Lyon, Problems in Alternating-Current Machinery.*

**6·041. Principles of Electrical Engineering (Alternating-Current Machinery and Electric Transmission).** A course of recitations and supervised problem work devoted to the continued study of alternating-current machinery and to problems involved in the electric transmission of energy.

**6·05. Principles of Electrical Engineering (Transmission Problems).** A course of recitations and supervised problem work devoted to the consideration of the electrostatic circuit, particularly with regard to its application to the dielectric stresses in insulators and cables, the phenomena of electrostatic and magnetic induction in transmission lines, corona and corona loss. A brief discussion of the electrical and mechanical calculations of transmission lines and graphical methods as applied to such problems is included. Textbook: *Jackson, Alternating Currents and Alternating Current Machinery.*

**6·06. Principles of Electrical Engineering (Transmission Problems).** A continuation of course 6·05. A course of recitations and supervised problem work devoted to the consideration of power factor correction and unbalanced loads on transmission lines and economic considerations of electric-power transmission.

**6·101. Principles of Electrical Engineering** (Electric and Magnetic Currents). First half of course 6·00, given at the works of Coöperating Company.

**6·11. Principles of Electrical Engineering.** Last half of course 6·00 and first half of course 6·01.

**6·111. Principles of Electrical Engineering** (Direct-Current Machinery). First half of course 6·01, given at works of Coöperating Company.

**6·112. Electrical Engineering** (Direct-Current Machinery). Second half of course 6·01, given at works of Coöperating Company.

**6·12. Electrical Engineering** (Direct-Current Machinery and Alternating Currents). Second half of course 6·01 and first half of course 6.02.

**6·121. Principles of Electrical Engineering** (Alternating and Variable

Currents). Second half of course 6·02, given at works of Coöperating Company.

**6·131. Principles of Electrical Engineering** (Alternating-Current Polyphase Circuits). First half of course 6·03, given at works of Coöperating Company.

**6·14. Principles of Electrical Engineering** (Alternating-Current Machinery). Last half of course 6·03 and first half of course 6·04.

**6·141. Principles of Electrical Engineering.** First half of course 6·04, given at works of Coöperating Company.

**6·142. Principles of Electrical Engineering.** Last half of course 6·04, given at works of Coöperating Company.

**6·15. Principles of Electrical Engineering** (Alternating-Current Machinery and Power Transmission). Last half of course 6·04 and first half of course 6·05.

**6·151. Principles of Electrical Engineering** (Transmission Problems). First half of course 6·05, given at works of Coöperating Company.

**6·152. Principles of Electrical Engineering** (Transmission Problems). Last half of course 6·05, given at works of Coöperating Company.

**6·16. Principles of Electrical Engineering.** Last half of course 6·05 and first half of course 6·06.

**6·161. Principles of Electrical Engineering** (Transmission Problems). First half of course 6·06, given at the works of the Coöperating Company.

**6·162. Principles of Electrical Engineering** (Transmission Problems). Last half of course 6·06, given at the works of the Coöperating Company.

**6·20. Electric Transmission Equipment.** A course of lectures and recitations devoted to the design, construction and characteristics of the equipment employed in the electrical transmission of energy. *Hayes, Switching Equipment for Power Control.*

**6·21. Industrial Applications of Electric Power.** A course of lectures on electric-motor drive, electric lighting and electric heating in industrial plants and for industrial purposes.

**6·22. Central Stations.** A course of lectures dealing with the design, construction and operation of electric-power generating stations, accompanied by relevant problems in engineering economics.

**6·23. Central Station Design.** In this course particular attention is given to the study and projection of load curves, the economic selection of site and machinery, the arrangement of plant and a statistical analysis of the cost of electric energy.

**6·231. Central Stations.** A course of lectures on the design, construction and operation of electric-power generating stations, being a condensation of courses 6·22 and 6·23.

**6·24. Electric Railways.** A course of lectures and recitations relating to the construction, equipment and operation of different types of electric railways, together with related problems in power transmission and generation. Textbook: *Buck, The Electric Railway.*

**6·25. Dynamo Design.** A course of exercises discussing direct-current machines and alternating-current transformers. Materials of construction, methods of construction, and the influence of the various factors in design on manufacture and operation are considered. Textbook: *Alex. Gray, Electric Machine Design.*

**6·26. Dynamo Design.** A course of exercises treating the design of synchronous and induction machinery, primarily a continuation of 6·25 but also complete within the term. Textbook: *Alex. Gray, Electric Machine Design.*

**6·27. Illumination.** A course of lectures and recitations devoted to the production, measurement and distribution of light. The various types

of lighting unit, the characteristics of each and its appropriateness for different purposes, *e.g.*, industrial lighting, commercial lighting, street lighting, etc., are discussed. Considerable time is devoted to the bearing of good illumination on industrial production, sanitation and factory welfare, also to industrial codes and the relation of the state to proper industrial, street and automobile headlighting.

**6·28. Electrical Communication III.** This course deals with transmission by means of telephone and telegraph circuit, and by means of radio. The laboratory work includes measurements of voltage and current upon several types of artificial lines, and the comparison of measured results with those deduced theoretically. The course is divided as follows: (a) Wire Transmission; summer and repeated in first term. (b) Wire Transmission; second term. (c) Radio Transmission; second term, repeated in third term. Parts a and c satisfy the requirements of the Signal Corps, R. O. T. C. Textbooks: *Hill, Telephone Transmission; Morecroft, Principles of Radio Communication.*

**6·29. Storage Batteries.** A course dealing with the theory, construction, care and application of storage batteries. Ten lectures, accompanied by laboratory work. To be given in one term of fourth year if applied for by six or more students.

**6·30, 6·31, 6·32. Electrical Communication.** This course deals with the principal systems of electrical telegraphy and telephony (using wires and radio) in practical use with reference to the principles and modes of application. Part (a) deals principally with wire telegraphy, part (b) with wire telephony and part (c) with radio.

**6·33. Communications Laboratory.** This course consists of measurements on artificial transmission lines with a comparison of computed results. Considerable time is devoted to radio measurements. Not given in 1922–23.

**6·38. Electric Wiring and Lighting of Buildings.** A course of lectures on the design of electric wiring and lighting systems for buildings. Textbook: *Cook, Interior Wiring.*

**6·40. Elements of Electrical Engineering.** A course of recitations and problems relating to the general principles involved in the generation, distribution and utilization of electric power. Textbook: *Hudson, Engineering Electricity.*

**6·41. Elements of Electrical Engineering.** A course of recitations and problems relating to the general principles of the electric and magnetic circuit and their applications to the generation, distribution and utilization of direct-current power. Textbook: *Hudson, Engineering Electricity.*

**6·42. Elements of Electrical Engineering.** A course of recitations and problems relating to the applications of the general principles of the electric and magnetic circuit to the generation, distribution and utilization of alternating-current power. Textbook: *Hudson, Engineering Electricity.*

**6·431, 6·432. Elements of Electrical Engineering.** A course of recitations and problems relating to the general principles involved in the generation, distribution and utilization of electric power with special application to Ordnance service. Textbook: *Hudson, Engineering Electricity.*

**6·44. Electric Transmission and Distribution of Energy.** A course devoted to an analysis of the electric circuit and the problems of electric transmission and distribution of energy. Textbook: *Jackson, Alternating Currents and Alternating-Current Machinery.*

**6·45. Alternating Currents and Alternating-Current Machinery. A**

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course devoted to the principles of alternating currents and alternating-current machinery. Given especially for students in Course XIII-A. Textbook: *Gray, Principles and Practice of Electrical Engineering.*

**6·46. Alternating-Current Machinery and Its Applications.** A continuation of course 6·45. A course devoted to the principles and performance of alternating machinery with special reference to mechanical and naval problems. Textbook: *Gray, Principles and Practice of Electrical Engineering.*

**6·50. Electrical Engineering Seminar.** A series of conferences of the instructing staff and all men pursuing graduate work in the branches relating to electrical engineering, for the purpose of reviewing problems of timely interest in electrical engineering. Continued through the year.

**6·51. Alternating Currents.** A graduate course concerned chiefly with the transmission of power by alternating currents. The long transmission line in the steady state, transients in networks and surges on long lines are treated mathematically, by laboratory work and by special problems.

**6·52. Alternating-Current Machinery.** A graduate course of conferences dealing with the advanced analysis of the theory and performance of alternating-current machinery.

**6·53. Public Service Companies.** A graduate course of lectures and conferences on organization and management of such companies, accompanied by extensive assigned reading and examination of operating records.

**6·54. Power Stations and Distribution Systems.** A graduate course consisting of the examination of a project relating to the generation and distribution of the electric power and the preparation of a report dealing with the preliminary design and estimate of cost.

**6·55. Electric Railways.** A graduate course of lectures and problems on the application of electricity to the propulsion of railway trains. Special attention is paid to the predetermination of size of equipment and energy requirements, the relative advantage of steam and electricity for propulsion, the various systems of electric traction, and to the making of estimates of the cost of construction and operation. Textbooks: *Buck, The Electric Railway; Richey, Electric Railway Handbook.*

**6·56. Electrical Communication of Intelligence.** A graduate course on the thory of telegraphy and telephony by wires and radio communications, including the problems of wave transmission of sinusoidal and non-sinusoidal impulses and trains, line loading, repeating vacuum tube effects and radio transmission. Laboratory work will be associated with the lectures.

**6·57. Illumination.** An advanced course in the study of light sources, light distribution, and illumination design. The spectrophotometric study of sources, as well as the photometric examination of larger luminaires and the use of special photometric devices will be included. This course is intended for those who have completed 6·27 or its equivalent.

**6·69. Electrical Engineering Laboratory.** A course of ten laboratory and twenty class room exercises concerned with the application of the fundamental laws of the electric and magnetic current to technical electrical measurements. Textbook: *F. A. Laws, Electrical Measurements; Special Directions for Measurements Division.*

**6·70, 6·71a, b, 6·72a, b, 6·73a, b, 6·74. Electrical Engineering Laboratory.** A course devoted to study of technical electrical measurements and dynamo-electric machinery. For purposes of administration, the work is divided into two parts. (a) Technical Electrical Measurements.— The work in technical electrical measurements consists of six exercises in the first term of the third year, five in the second term of the third year, five in

the third term of the third year and three in the first term of the fourth year. Particular attention is given to tests to determine the character and behavior of the materials of electrical engineering under various circumstances and to the study of electrical measuring instruments. The laboratory exercises are supplemented by a series of conferences in which the general subject of technical electrical measurements is discussed. (b) Dynamo-Electric Machinery.— The work in dynamo electric machinery consists of five exercises in the second term of the third year, five in the third term of the third year, seven in the first term of the fourth year, and ten in the second term of the fourth year. The tests in the third year include the determination of the characteristics, efficiency, regulation, and heating of direct-current machinery. In the fourth year tests for efficiency, heating, regulation and the like are made on alternating-current machines.

The laboratory exercises are supplemented by conferences. Preliminary reports prepared in the classroom at specially assigned hours are submitted by students before performing each experiment in the laboratory. Textbook: *Laws, Electrical Measurements; Special Directions for Measurements Division, Electrical Engineering Laboratory.*

**6·75, 6·76a, 6·76b, 6·77, 6·78. Electrical Engineering Laboratory.** The subject matter is abbreviated from that of course 6·70–6·74.

**6·80. a, b. Electrical Engineering Laboratory.** This course is intended for those students who desire to do more than the regularly required amount of undergraduate work in the Electrical Engineering Laboratory. The experiments are arranged to suit the requirements of the individual student.

**6·81, 6·82, 6·83a, 6·83b, and 6·84. Electrical Engineering Laboratory.** A course of laboratory exercises devoted to the study of technical electrical measurements and dynamo-electric machinery. The subject matter is similar to that in courses 6·70–6·74.

**6·85. Electrical Engineering Laboratory.** A course of ten exercises designed to familiarize students with the elements of technical electric measurements and with the characteristics and operation of the ordinary types of electrical machinery. Textbook: *Electrical Engineering Laboratory Experiments, published by Electrical Engineering Department,* 1919; *Instructions for Students in Dynamo Laboratory.*

**6·86. Electrical Engineering Laboratory.** A course of seven laboratory exercises in subject matter similar to that of course 6·85.

**6·87. Electrical Engineering Laboratory.** A course of ten experiments in the fourth year, designed to illustrate the operating characteristics of the common forms of alternating-current machinery and the execution of some of the more important acceptance tests. Textbooks: *Electrical Engineering Laboratory Experiments, published by Electrical Engineering Department,* 1919; *Instructions for Students in Electrical Engineering Laboratory,* 1920, *Third Edition.*

**6·88. Electrical Engineering Laboratory.** A course of ten exercises designed to familiarize the students with the characteristics and operation of the ordinary types of electrical machinery. Textbooks: *Electrical Engineering Laboratory Experiments, published by the Electrical Engineering Department,* 1919; *Instructions for Students in Dynamo Laboratory, Third Edition,* 1920.

**6·90. Technical Electrical Measurements.** A course of ten exercises devoted to the study of electrical measuring instruments and the materials of electrical engineering.

**6·91, 6·92. Electrical Engineering Laboratory.** A course devoted to the study of electrical measurements and the testing of dynamo machinery In electrical measurements the students calibrate portable indicating instru.

ments of the types later used in the testing of dynamo machinery. Watt-hour meters and instrument transformers are also calibrated. The oscillograph is used to determine the wave forms in various circuits.

In dynamo machinery, operating tests are made on shunt, series, compound and interpole motors, on shunt and compound generators singly and in parallel, on the balancer set and the three-wire system. The operating characteristics of the above are determined by means of load and no-load runs. Heat run acceptance tests are made. Transformers, alternators, induction and synchronous motors as well as other types are tested for performance characteristics.

The laboratory work is supplemented by trips to various power houses and electrical manufacturing plants.

Each laboratory exercise is preceded by a conference, and a preliminary report is prepared by the student. In the final report, which is written under supervision, the student is required to analyze and explain the results obtained in the tests. Textbooks: *Electrical Engineering Laboratory Experiments published by Electrical Engineering Department* 1919; *Instructions for Students in Dynamo Laboratory, Third Edition*, 1920.

**6·95. Electrical Testing (Advanced).** An advanced laboratory course intended as an introduction to more elaborate work of special investigation. Each student is assigned a particular problem and is expected to work out carefully the experimental process involved so that a just estimate of the value may be reached. To facilitate this work, a very complete collection of instruments and standards has been provided.

**6·96. Electrical Engineering Laboratory (Advanced).** The work of this course is specially arranged for each student, and deals particularly with the more advanced problems of alternating currents and alternating-current machinery.

## BIOLOGY AND PUBLIC HEALTH

In the work of this Department some knowledge of chemistry and physics is indispensable by way of preparation, and hence no biological course is open to first-year students. In the second year, second term, a course in general biology is given followed in the third term by botany and zoölogy, while in the third and fourth years instruction in professional subjects is provided, chiefly for students of biology and public health, industrial biology, chemistry, sanitary engineering, geology and general engineering. The subjects fall somewhat naturally into four groups: First, the *general biological*, including the fundamental courses in biology, botany, zoölogy, anatomy and physiology; second, the *bacteriological* group, including general bacteriology and its professional and technical applications in the laboratory; third, the *public health* group, in which broad applications to community life and public and social welfare are considered. The fourth group includes the technical subjects of most importance in *food conservation* and manufacture. The whole aim of the instruction in the lower years is to give a solid foundation; in later years, to develop professional attainment.

The second option, industrial biology, is designed especially for those who wish to enter the broad field of food engineering. Although as prescribed the course meets the requirements of the fishery industries, a substitution of technical subjects in other branches of the food industries may be made and thus prepare students for technical careers in the packing industries in general. In this option the departments of mechanical engineering and engineering administration supply the necessary engineering

and business subjects to fit men thoroughly for the industries to be served.

**7·01. General Biology.** An introduction to the study of living things. It consists essentially of a general discussion of the fundamental facts and principles common to all the biological sciences. The course is elementary and preparatory in character and in aim. Textbook: *Sedgwick and Wilson, General Biology.*

**7·02. Elements of Biology.** A briefer course of the same character as course 7·01, arranged especially for students in Sanitary Engineering.

**7·03. Theoretical Biology.** An advanced course of 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 three major problems discussed are — heredity, morphogenesis and immunity. Special reading assigned. Textbook: *Castle, Genetics and Eugenics.*

**7·04. Botany, Cryptogamic.** Beginning with the lowest forms of vegetable life, the various groups of algæ and fungi are systematically studied and afterwards, higher cryptograms. Some attention is also paid to the structure and development of flowering plants. Textbook: *Coulter, Barnes and Cowles, Textbook of Botany, Volume I.*

**7·05. Zoology, Invertebrate.** A systematic course in the study of the lower animals, laying special stress upon the economic aspects of the subject. Textbook: *Kingsley, Hertwig's Manual of Zoölogy.*

**7·06. Microscopy of Waters.** The aim of this course is to give first-hand knowledge of the organisms commonly found in waters of varying quality. The treatment of water by copper sulphate, aëration, etc., is also discussed. Methods of microscopical examination are taught and practical laboratory work is required. Textbook: *Whipple, The Microscopy of Drinking Water.*

**7·07. Parasitology.** A course on invertebrate zoölogy with special reference to the parasitic forms and their relation to disease in man and the domestic animals. Lectures with demonstrations. Textbook: *A. C. Chandler, Animal Parasites and Human Disease. Wiley,* 1918.

**7·10. Anatomy and Histology.** A course on the comparative anatomy of vertebrates, including man, together with the development of the body and the microscopical anatomy of each of the principal organs. An important feature is practice in embryological and histological technique. Each student makes a series of preparations for his own use. This course affords a sound basis for the subsequent study of human anatomy, physiology, personal hygiene and public health. Textbooks: *Wilder, History of the Human Body; Kingsley, Guides to Dissection, the Dogfish; Bigelow, Directions for Dissection of the Cat; Lewis & Stohr, Textbook of Histology; Harman, Laboratory Outlines for Embryology.*

**7·16. Introduction to Fisheries.** A general survey and history of the world's fisheries. Geographical distribution of food fish, their enemies, natural history, and relation to environment, migrations, and breeding habits. Textbook: *Cobb* (not yet published).

**7·17. Fish Culture.** Two lectures a week on the rearing of fresh-water and marine fish, clams, oysters and lobsters, including methods of taking and fertilizing the eggs, design, construction and management of hatching apparatus, and the care and transportation of the young fry.

**7·18. Applied Ichthyology.** Lectures, recitations or conferences and laboratory work throughout the third year of the advanced course on economically important fishes and shell-fish. The course will include the anatomy and developments of food fishes, their rate of growth, seasonal distribution, breeding places, feeding grounds, food, enemies, diseases

and parasites; also methods of capture, kinds of bait used and a description of the various types of fishing vessels, their equipments, etc. The conservation of the fisheries, and the protection of fishing grounds against pollution and other destructive agencies will be discussed.

In the laboratory students acquire first-hand knowledge of the structure and developmental stages of selected types, and practice in determining species. Animals that serve as food for economic fishes will be examined. Visits to fish wharves, and fishing vessels, the larger markets, and the federal and state hatcheries, with the taking of notes and writing reports, will form an important part of the course.

**7·20. General Physiology.** A course dealing with the general principles of animal physiology.

**7·22. Personal Hygiene.** 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.

**7·25. Nutrition.** Lectures and discussions of outside reading on the science of Nutrition, practical studies of nutritional requirements, and exercises in determining diets in sickness and health. Such subjects as Basal Metabolism, maintenance requirements, adequate and inadequate diets for men, women and children are taken up. The work of the diet and food clinic, foods of the foreign born, infant feeding, etc., are discussed. Practical work in compiling a food index and bibliography are required. The course is designed to give a working knowledge of the subject based on modern theories rather than to cover the subject from a purely theoretical or historical point of view. Textbook: *Science of Nutrition, Lusk; Food and the War, United States Food Administration.*

**7·27. Biochemistry.** This course deals with the more important phases of biological chemistry. The substances occurring in the protoplasm of plants and animals, and the processes of digestion, absorption, metabolism and excretion are discussed. Respiration and oxidation are treated from the chemical standpoint. The phenomena of osmotic pressure, adsorption, diffusion, and of the colloidal condition are considered from the standpoint of the biologist. Recent work on bacterial metabolism, on ptomaines, toxins, and chemotherapy is outlined. When taken as a graduate course further assigned work will be required. Textbook: *Hammarsten, Textbook of Physiological Chemistry.*

**7·28. Selected Topics in Biochemistry.** In this course biochemical methods of attack in different laboratories are considered as well as more complicated problems which could not be discussed in the more elementary course (Biochemistry, course 7·27), such as the general question of neutrality in the body, enzyme action, autolysis, cell contents, gastro-intestinal reactions, internal coördination, growth, chemistry of immunity, of chlorophyll and of plant syntheses.

**7·29. General Biology and Bacteriology.** An elementary course dealing with the fundamental principles of biology, the behavior of living matter, growth, etc., and the general relation of micro-organisms to chemical changes such as fermentation, putrefaction and disease. Textbooks: *Sedgwick and Wilson, General Biology; Jordan, General Bacteriology.*

**7·30. Bacteriology.** A fundamental course in the biology of the bacteria, with thorough study of selected types. The second and third terms are devoted to the special study of the bacteriology of water, sewage, air and foods. Textbooks: *Jordan, General Bacteriology, Saunders,* 1919; *Prescott and Winslow, Bacteriology of Water and Sewage, Wiley,* 1915; *Tanner, Bacteriology and Mycology of Foods, Wiley,* 1919.

**7·31. Elements of Bacteriology.** This course for students in sanitary

engineering presents the general structure, behavior and distribution of bacteria, and their relation to disease, as well as the essentials of bacteriological technique. It is a prerequisite for bacteriology of water and sewage. Textbook: *Jordan, General Bacteriology, Saunders,* 1919.

**7·32. Bacteriology of Water and Sewage.** A course dealing with the practical methods of examination of water, sewage and sewage effluents with laboratory work. Special attention is given to standard methods in engineering practice, and to proper interpretation of results. Textbook: *Prescott and Winslow, Elements of Water Bacteriology, Wiley,* 1915.

**7·36. Industrial Microbiology.** This treats of fermentation industries, food preparations, and the industrial and economic applications of Microbiology in agriculture and the manufacture of biochemical preparations. Industrial alcohol, vinegar, and the leather and food industries are especially considered, as well as enzymes and their technical applications. Textbook: *Marshall, Microbiology; Blakiston,* 1919. Numerous other books for collateral reading.

**7·37. Technology of Fishery Products.** The methods of curing and preservation of fishery products. Refrigeration, dehydration, salting and canning are studied from the bacteriological, chemical and nutritional aspects. Utilization of by-products will also be considered.

**7·38. Public Health Laboratory Methods.** In this course the practical methods in use in state and municipal bacteriological laboratories are considered. Training is given in the cultural diagnosis of diphtheria, examination of specimens for tuberculosis, the Widal reaction in typhoid fever, the microscopical diagnosis of malaria, the complement fixation test, etc. Textbooks: *Park and Williams, Pathogenic Microörganisms, Lea and Febiger; Hiss and Zinsser, A Textbook of Bacteriology, D. Appleton and Company.*

**7·40. Oceanography.** A survey of the physiography of the seas and lakes with special reference to distribution of food animals, and the relation of currents, shoals and deeps to such distribution.

**7·50. Infection and Immunity.** This course deals with the fundamental biological facts of infection, resistance and immunity. The biological characteristics of infectious diseases of special interest to the sanitarian, are considered in detail. Textbooks: *Park and Williams, Pathogenic Microörganisms, Lea and Febiger; Hiss and Zinsser, A Textbook of Bacteriology, D. Appleton and Company.*

**7·53. Industrial Hygiene and Sanitation.** The various prejudicial effects of factory life upon health, including occupational accident, industrial poisoning and the effects of defective ventilation and of dusty trades upon the prevalence of tuberculosis and other diseases. Special attention is given to factory sanitation and to the problems of health administration in industry. Textbook: *Price, The Modern Factory.*

**7·54. Problems and Practice in Public Health.** Lectures and discussions on the causes, history, investigation and control of epidemics caused by polluted water, milk, foods, etc., and on current public health problems.

**7·56. Sanitary Science and Public Health.** Lectures (illustrated) on health and disease, parasitism, toxins and antitoxins, resistance and immunity vaccination, epidemiology, preventive sanitation and preventive hygiene.

**7·58. Vital Statistics.** Lectures and problems by which the student acquires a working knowledge of statistical methods, consideration of errors, and the preparation, graphic representation and critical analysis of data.

**7·64. Municipal Sanitation.** Lectures and problems dealing with the general principles of sanitation as applied to the community, and includ-

ing housing, street cleaning, waste disposal, water supply and sewerage sewage disposal, etc.

**7·67. Plant Sanitation.** A consideration of the application of the general principles of sanitation, water supply, waste disposal, etc., to plants or factories utilizing decomposable materials.

**7·80. Biological Colloquium.** A semi-weekly meeting of the officers and fourth year and graduate students. Each one presents from time to time reports of his own investigations or digests of current scientific literature, and receives friendly criticism as to his conclusions or his manner of presentation or both.

The following subjects are offered as General Studies. For description of courses see Division of General Studies, pages 117-123.

**GS71. Principles of Biology and Heredity.**
**GS72. Industrial Aspects of Bacteriology.**
**GS73. Sanitary Science and Public Health.**

## PHYSICS

**(Including Electrochemical Engineering and Aeronautical Engineering)**

The position of Physics in science and engineering is so fundamental that it is imperative to offer a course in Physics, both theoretical and industrial, wherein the instruction shall be so organized as to carry the study of the basic sciences, mathematics, physics, and chemistry, through the junior and into the senior year. The student thus equipped is fitted to apply his knowledge in a broad way to existing industries or to conduct scientific investigations for the industry of the future and for science itself. A considerable part of the senior year's work is left elective so that the student may be free to follow his own bent. Substitutions for some of the required studies may also be allowed by the Head of the Department for sufficient reason.

*Option* 1. *Industrial Physics.* The demand for the industrial physicist is great and increasing. Large corporations have already come and smaller ones are rapidly coming to realize that they must have in their employ men capable of dealing with old and new problems of which the solution involves a thorough knowledge of physical instruments, of physical properties of matter, and of methods of scientific procedure. To enable the student to fit readily into the industry, a large amount of engineering work is offered in the senior year, in part at the expense of continued work in science.

*Option* 2. *Theoretical Physics.* Our higher institutions of learning, great business concerns like the United States Government, and the General Electric Company, maintain large research laboratories where the pure scientist shall carry on investigations for the future in addition to the present. To fit students for these activities the option in theoretical physics continues the work in pure physics to the end of the senior year instead of turning aside in large part into engineering as does Option 1.

The Department reserves the right to limit admission to Course VIII above the sophomore year to that number of students (at present about twelve or fifteen in each class) who may be properly trained with the professional equipment available. The limitation, if necessary, will be effected by the selection of the applicants of highest grade.

## ELECTROCHEMICAL ENGINEERING

The Course in Electrochemical Engineering aims to provide a fundamental training in the Principles of Electrical Engineering together with a broad knowledge of Chemistry, upon which as a foundation the more specialized work of theoretical and applied Electrochemistry is based. The demand for men with a training along the above lines is steadily increasing as electrochemical and electric furnace operations become more and more general. The large Industrial Research laboratories also offer excellent opportunities for Electrochemical Engineers.

The instruction in Electrochemistry extends throughout the third and fourth years. A large amount of time is devoted to laboratory work for which purpose two laboratories, established in connection with the Rogers Laboratory of Physics, have been especially equipped for carrying out all types of electrochemical and electric furnace operations. Owing to the limited capacity of these laboratories, however, the number of students who can be admitted is necessarily restricted. In the senior year students in course XIV are allowed considerable option in the choice of studies in the Departments of Electrical Engineering, Chemical Engineering and Metallurgy.

## AERONAUTICAL ENGINEERING

In addition to the Special Course in Aeronautical Engineering arranged for the United States Navy, described in the pamphlet on graduate study and open to civilian students, only by special permission various courses in Aeronautics are open to properly prepared undergraduates who may have free time available. Arrangements to accommodate such students can best be made in course IX-B, General Engineering.

**8·011, 8·012, 8·013. Physics.** Statics, kinetics and light.

**8·021, 8·022, 8·023. Physics.** Electricity, magnetism, electromagnetism and heat.

**8·04. Precision of Measurements.** Textbook: Goodwin's *Precision of Measurements and Graphical Methods.* (Not offered in 1922–1923.)

**8·06. Color and Acoustics.** A discussion of topics of especial interest to students of architecture.

**8·09. Physical Instruments.** Training in the construction of physical apparatus.

**8·10. Physics Literature.** Practice in reading physics in French or German. Textbook: Current physics texts or journals.

**8·11. Heat Measurements.** The theory and practice of heat measurements, particularly for industrial problems.

**8·12. Heat Measurements.** An abbreviation of course 8·11.

**8·13. Heat Measurements.** Selected experiments given as a part of various engineering courses.

**8·14. Heat Measurements II.** Continuation of 8·11 or 8·12.

**8·15. Theory of Heat.** Discussions of the physical basis of heat measurements. Textbook: *Preston, Theory of Heat.* (Not offered in 1922–1923.)

**8·16. Photography.** Lectures and laboratory practice in photographic manipulations. The lectures are open to all students interested. Textbook: Derr, *Photography for Students.*

**8·17. Geometrical Optics.** The theory of mirrors, prisms, and lenses, the design of lenses and the study of optical apparatus. The lectures are open to all students interested.

**8·171. Geometrical Optics (Ordnance).** An extension of 8·17 with special study of the optical instruments used in military service.

**8·18. Physical Optics.** Lectures, recitations and laboratory work in the wave-theory of light, diffraction, reflection and refraction, dispersion and polarization.

**8·20. Electricity.** An intermediate course in electricity and electrical measurements followed by twenty lessons on modern atomic views of electricity, the electron, photoelectric effect, radio-activity and discharge in gases.

**8·211. Electron Theory.** A course of lectures and recitations devoted to a discussion of the modern atomic views of electricity, the electron and its various physical manifestations, particularly those of growing importance to the electrical industry.

**8·212. Electron Apparatus.** The laboratory work is devoted to the study and use of various new types of apparatus in which electronic and thermionic phenomena predominate. The recitations are based on the laboratory work.

**8·231, 8·232, 8·233. Theoretical Physics.** Mechanics (first term) electricity and electromagnetic theory (second term), physical thermodynamics (third term).

**8·24. Rigid Mechanics.** The solution of problems in continuation of M29.

**8·27. Electrodynamics.** The solution of problems in Jeans' *Electricity and Magnetism* in continuation of 8·20 and 8·23.

**8·28. Electromagnetic Theory.** Continuation of 8·20 and 8·23, a study of recent developments. (Not offered in 1922–1923.)

**8·29. Applied Electromagnetism.** Chiefly a study of the work of Oliver Heaviside. (Not offered in 1922–1923.)

**8·30. Constitution of Matter.** Lectures, assigned reading and conferences. (Not offered in 1922–1923.)

**8·34. Miscroscope Theory and Photomicrography.** Theory of the microscope with laboratory work in photomicrography and in the use of the ultra-violet microscope.

**8·35. Optical Measurements.** Spectrophotometry, spectroscopy, polarimetry, etc. Short investigations with precision apparatus. Textbook: *Special Notes and reference to Standard Treatises.*

**8·36. Theory of Light.** Mathematical discussions parallel to 8·35.

**8·38. Waves.** Discussion of the differential equation of waves, of initial conditions and of boundary conditions.

**8·39. Kinetic Theory and Correlation.** Kinetic theory of gases in the second term is followed by a term on the theory of correlation and a general discussion of statistical methods in science.

**8·40. Sound.** Physical theory and industrial applications.

**8·41. Physical Materials.** Discussion of materials with respect to various physical properties, thermal, electric, etc., of importance in pure or applied physical research.

**8·43. Photo-Electricity.** Theory and laboratory work on the optical method of determining stress and strain.

**8·57. Aeronautical Instruments.** General description of common instruments. (Not offered in 1922–1923.)

**8·58. Aeronautical Instruments.** Theory, design and construction of instruments. (Not offered in 1922–1923.)

**8·59. Aeronautics.** A comprehensive course containing material from 8·61, 8·62 and 8·63.

**8·591. Aeronautics.** Similar to 8·59, but more general, including airplane design.

**8·60. Airplane Design.** General theory of the design of airplanes, including calculations of stresses, stability, and performance. Textbook: *Pippard and Pritchard, Aeroplane Structures.*

**8·601. Airplane Designing.** Actual practice in design. Each student carries through the design of two airplanes.

**8·602. Airplane Designing.** Similar to 8·601, but shorter.

**8·61. Airship Design.** Theory of the design of non-rigid and rigid airships, including calculations of the strength and deformations of the envelope.

**8·611. Airship Designing.** Actual practice in design, including stress calculations. Each student carries through the design of a non-rigid airship.

**8·62. Aerial Propellers.** Theory and practice of propeller design by several methods. Each student will design a propeller for his airplane. Textbook: *The Design of Screw Propellers for Aircraft, H. C. Watts.* (Longman.)

**8·63. Aeronautical Research Methods.** Lectures on aeronautical laboratories and their equipment and on methods of free-flight testing.

**8·631. Aeronautical Laboratory.** Training in the use of wind tunnels, especially as applied to problems of airplane and airship design.

**8·64. Aeronautical Laboratory, Advanced.** A continuation of 8·63 and 8·631. Devoted chiefly to the design of equipment and the planning of research methods.

**8·65. Advanced Airplane Structures.** This course is devoted to the examination of new methods in structural analysis and to original work on analyses of greater refinement than those ordinarily made. Particular attention is paid to the applications of the generalized three-moment equation and the method of least work.

**8·66. Advanced Airplane Design.** Special topics in stability and control and advanced points in lay-out of airplanes for specific purposes are considered in this course. The work includes problems and preparation of designs.

**8·67. Advanced Wing Theory.** Selected advance topics in continuation of course M43.

**Research Courses.** In these courses the students work individually, and the amount of work in each term is optional jointly with the student and professor.

**8·70. Research in Mathematical Physics.**
**8·71. Research in Electrochemistry.**
**8·72. Research in Industrial Physics.**
**8·73. Photographic and Optical Research.**
**8·75. Research in Applied Electrochemistry.**
**8·76. Research in Electricity and Magnetism.**
**8·77. Thermal Research.**
**8·78. Aeronautical Research.**

**8·80. Principles of Electrochemistry.** The fundamental principles of physics and chemistry underlying electrochemical phenomena are discussed from the standpoint of thermodynamics and kinetics. The instruction is by lectures, recitations and problems, accompanied in the third term by experiments illustrating such matters as the electrical conductivity of solutions, transference and electrolysis. Textbook: Washburn's *Principles of Physical Chemistry.*

**8·82. Electrochemistry II.** In this concluding course in Electrochemistry the topics discussed are the elements of the electron theory, theories of the voltaic cell, polarization and electrolysis, the principles involved in the corrosion, electro-deposition, and refining of metals, and the energy relations underlying the mutual transformations of chemical and electrical energy. Textbook: Le Blanc, *Electrochemistry;* Allamand, *Applied Electrochemistry* for reference.

**8·83. Electrochemistry III.** Continuation of Electrochemistry II, with emphasis on organic materials.

**8·85. Applied Electrochemistry.** A course devoted to a consideration of the industrial applications of electrochemistry. The subjects discussed include the theory and construction of different types of electric furnaces, electro-metallurgical processes, accumulators and primary bat-

teries, and the electrolytic production of chemical compounds. The work of the third term consists in working out the details of design of one or more electrochemical plants for specific processes. Textbook: Thompson, *Applied Electrochemistry.*

**8·86. Electrochemical Laboratory.** This course is carried on in conjunction with course 8·82. The work is strictly quantitative and includes measurements of electrical conductance, single potentials, decomposition voltages, overvoltages, polarization, and practice in electro-analysis. *Admission will be limited to the capacity of the laboratory.* Textbooks: *Special Notes; Ostwald-Luther's Physico-Chemisch Messungen.*

**8·87. Applied Electrochemical Laboratory.** This course affords practice in the construction and use of various types of electric furnace together with efficiency tests on their output. Arc, resistance, and induction types of furnace are provided. The production of steel, ferrosilicon, calcium, carbide, carborundum and aluminum are among the processes studied. Efficiency tests on technical processes involving electrolytic oxidation and reduction are also included, *e.g.*, the production of caustic, pigments, etc. *Admission limited to the capacity of the laboratory.* Text: *Neostyle notes.*

**8·89. Electric Furnaces.** This course is 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. The course consists of descriptive lectures on electric furnace operation accompanied by a selected number of laboratory exercises described under 8·87. *Offered only in the first term,* for other than Course VIII Students. Textbook: Thompson, *Applied Electrochemistry* and *Neostyle notes.*

**8·90. Elements of Electrochemistry.** This course deals with the fundamental principles of electrochemistry and their industrial applications for students who desire a general survey of this subject but who have had no previous preparation in physical chemistry. The laboratory work consists in the electric furnace experiments of 8·87. Textbooks: Le Blanc, *Electrochemistry;* Thompson, *Applied Electrochemistry.*

**8·93. Colloquium.** Students present before the class for discussion, reviews of current articles on electrochemistry appearing in the English and foreign journals, and memoirs on assigned topics.

**8·98. Glass Blowing.** In this course students are taught how to manipulate glass and make such simple apparatus, electrodes, etc., as are likely to be needed in electrochemical research. It is given by special arrangement during any term, and is offered only to fourth year and special students in Course XIV.

The following subjects are offered as General Studies. For description of courses see Division of General Studies, pages 117-123.

**GS65. Sound and Music.**
**GS66. Descriptive Astronomy.**
**GS67. Meteorology.**

## GENERAL SCIENCE, ENGINEERING AND MATHEMATICS

### Courses IX-A, IX-B, IX-C

### General Science IX-A

This course, largely elective in the senior year, is planned to offer, first, a substantial education along scientific lines, and to provide subsequently, through its electives, for a more intensive training in some one branch of science or in closely inter-related sciences. There is, also, an

opportunity to elect a substantial amount of such humanistic studies as English, Modern Language, History, Economics and Social Science.

The course offers, in other words, an opportunity for a broad training in science without sharp specialization. Such a course possesses many advantages in view of the ever increasing inter-relations of the various sciences, and should prove particularly valuable to those who have not fully decided upon any particular line of specialization, or to those who intend to specialize in graduate work later.

The choice of electives in the third and fourth years must in all cases be approved by the Professor in charge of Course IX.

### General Engineering IX-B

This course is designed to meet the needs of those who desire a training in fundamental engineering subjects, and who either do not wish to specialize in any particular branch of engineering to the extent demanded by one of the regular engineering courses, or who may wish to follow out some line or lines of work not provided for by the schedule of any particular engineering course.

A schedule, except for that portion listed as elective, has been prepared and is offered as one suitable for a broad training in engineering. There is also opportunity for the election of economic and business subjects, or of courses in literature and modern languages.

In all cases the choice of electives must be approved by the Professor in charge of Course IX.

**Aeronautical Engineering.** Undergraduates intending to specialize later in Aeronautical Engineering may register in Option IX-B, and will choose their electives from courses having a special bearing on aeronautical work. The choice of these electives should be made in consultation with the Faculty in Aeronautics.

### Mathematics IX-C

The Institute offers exceptional opportunities for the study of mathematics particularly as applied to scientific and engineering work.

The accompanying schedule outlines a course of study leading to the Bachelor's degree for men who desire to specialize in Applied Mathematics. It is a course well adapted to serve as a preparation for later specialization in pure mathematics, in mathematical-physics, or along lines of experimental physics or engineering requiring a high degree of proficiency in mathematics.

Considerable latitude in the choice of subjects is provided for in the electives of the junior and senior years in order that the student shall be able to take, if he so desires, a considerable amount of work in general studies, or in scientific and engineering subjects in which mathematics play an important part, in addition to his purely mathematical courses. For example, he may elect courses in Thermo-dynamics, Mechanics, Electricity, or in Physical Chemistry.

While a definite schedule for the second year is offered, any student who has completed satisfactorily the work of the first two years in any of the professional courses of the Institute, or their equivalent, provided always that a creditable record has been obtained in mathematics and physics, may be admitted to the work of the junior year in this Option.

## CHEMICAL ENGINEERING

The course in Chemical Engineering is designed to give the student a thorough foundation in chemistry and in the elements of mechanical and

electrical engineering, followed by training in the special field of chemical engineering, *i. e.*, in the solution of the engineering problems of chemical industry. The instruction of the first two years is therefore wholly in other departments, and of the third year mainly so. The professional instruction within the department begins with Industrial Chemistry in the third year and is followed with Chemical Engineering and laboratory work in the fourth.

Because of the composite character of the course, it is impossible to include in the undergraduate instruction material other than the fundamentals required in professional work. On this account, special attention is given to post-graduate courses, and the student who hopes to attain professional leadership should plan for a post-graduate year leading to the Master's Degree.

Laboratory instruction in Chemical Engineering is carried out mainly in the School of Chemical Engineering Practice, located in seven industrial plants in Buffalo, New York; Bangor, Maine; and Everett, Mass. This school has facilities for only a limited number of students and its privileges are restricted to those whose work at the Institute has, in the opinion of the Department, shown marked promise of professional success. The work of the Practice School may be taken either as a part of a post-graduate program leading to the Master's Degree (X-A) or as the last two terms of the undergraduate course (X-B).

**10·11. Problems of the Chemical Engineer.** In this descriptive course are developed the field of activity of the chemical engineer and the preparation along both chemical and engineering lines which the practice of the profession requires.

**10·15. Thesis Reports and Memoirs.** This course consists of a series of reports by the students on the progress of their theses, and if time permits, a series of memoirs on timely subjects presented before the rest of the students and the instructing staff.

**10·21. Industrial Chemistry.** In this course, and the two following, the more important industrial chemical processes, including metallurgy, 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 interrelationship of the different industries as to raw materials, sources of energy, and standard types of apparatus is developed and a general survey of the field obtained. Textbook: Thorp, *Outlines of Industrial Chemistry*.

**10·22. Industrial Chemistry.** A continuation of course 10·21.

**10·23. Industrial Chemistry.** A continuation of course 10·22.

**10·25. Industrial Stoichiometry.** A course in the stoichiometric calculations connected with the processes of chemical industry. The subject matter is an expansion of the problem work of courses 10·21–10·23. The course is intended especially for college men who have had descriptive industrial chemistry.

**10·31. Chemical Engineering. (Flow of Heat and Dynamics of Fluids.)** A course of lectures and recitations devoted to the study of the basic laws involved and their application to industrial practice.

**10·32. Chemical Engineering. (Subdivision and Separation of Solids.)** A continuation of course 10·31. A course of lectures and recitations covering crushing and grinding, screening, sedimentation, filtration, conveying, etc.

**10·33. Chemical Engineering. (Evaporation, Distillation and Drying.)** A continuation of course 10·32. A course of lectures and recitations devoted to the laws governing vaporization phenomena, with applications to industrial practice.

**10·34. Chemical Engineering. (Flow of Heat, Dynamics of Fluids, and Subdivision of Solids.)** This, and the course following, duplicate 10·31, 10·32 and 10·33.

**10·35. Chemical Engineering. (Separation of Solids, Evaporation, Distillation and Drying.)** A continuation of course 10·34.

**10·36. Chemical Engineering.** A general survey of the field of chemical engineering, and an introduction to the topics covered by courses 10·31, 10·32, 10·33.

**Chemical Engineering II.** The purpose of these courses is to study thoroughly and in detail special phases of chemical engineering. Each course is devoted to a single topic, and each may be taken independently of the others. 10·43 includes gas washing, solvent recovery, etc.

**10·41. Distillation and Evaporation.**

**10·42. Drying.**

**10·43. Extraction.**

**10·44. Combustion.**

**10·47. Chemical Engineering Design.** This course aims to prepare for 10·48 and 10·49 those post-graduate students who have not had training in the School of Chemical Engineering Practice. The work involves detailed study of special design problems in flow of heat and flow of fluids.

**10·48. Chemical Engineering Design.** This course of lectures and conferences is planned to develop original power in the solution of problems, to give experience in the selection, criticism, interpretation, and use of material available in the literature, and to emphasize the technique of the laboratory methods of obtaining needed data. Especial attention is paid to graphical methods. The subject matter of the course will vary from year to year, and will be selected from any suitable branch of applied chemistry.

**10·49. Chemical Engineering Design.** A continuation of course 10·48.

**10·51. Industrial Chemical Laboratory.** In this course, the work consists in 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.

The process is first examined in the light of available literature, and is analyzed as to the probable factors which enter into its successful operation. Commencing with the preparation of the raw material it is next carried out in a quantitative manner in the laboratory on as large a scale as is consistent with reasonable accuracy and despatch. Each chemical operation is analytically controlled, rapid methods of the requisite accuracy being employed. The physical properties of the solutions, precipitates, and final products are critically observed and the choice of the apparatus to be recommended is based upon quantitative experimentation carried out in the laboratory. Finally, each student submits a technical report upon the process and plant, complete with blue prints of the layout and estimate of costs. Questions of labor, depreciation, interest, and insurance are discussed in the class, and so far as is possible are involved in the students' reports.

**10·52. Chemical Engineering Laboratory.** The course involves experiments in the flow of gases and liquids, in filtration, evaporation, drying, combustion and electric furnace work.

**10·61. Materials of Construction.** This course treats of the mechanical properties and chemical resistance of the commercial materials of construction. Special attention is given to the corrosion of metals and to the properties and uses of amorphous solids.

**10·62. Applied Chemical Thermodynamics.** This course presents those elements of thermochemistry and thermodynamics which are of most importance in the field of chemical engineering.

**Industrial Chemistry II.** A series of graduate courses covering the following subjects:

**10·70. Sulphuric Acid.**
**10·71. Glass and Ceramics.**
**10·72. Iron and Steel.**
**10·73. Starch and Cellulose.**
**10·74. Petroleum.**
**10·75. Nitrogen Fixation.**
**10·77. Rubber.**
**10·78. Textiles and Dyeing.**
**10·79. Paints, Oils and Varnishes.**

**10·91. Research Conferences.** Regular conferences are held with research students by the Staff of the Research Laboratory of Applied Chemistry and of the Laboratories of Chemical Engineering in which the work is conducted.

**10·93. Automotive Fuel Problems.** A course discussing the principles of the design of internal combustion engines from the standpoint of fuels, with particular reference to the reactions in the cylinders and distributing systems.

**10·94. Organization and Methods of Industrial Research.** The course covers the details of the organization of various types of laboratories, and the methods of attack used in industrial problems. Specific problems of industrial importance are then submitted to each member of the class who is asked to outline in detail for criticism of the class the method of attack suggested for its solution.

**10·95. Applied Colloid Chemistry.** A study of the application of colloid chemistry to various chemical industries, including: A brief survey of the general principles of colloid chemistry with special reference to their industrial application; a discussion of various colloid problems involved in the industries; and a consideration of the important research problems in applied colloid chemistry now pressing for solution.

**10·95a. Applied Colloid Chemical Laboratory.**

**10·96. Principles of Organic Electrochemistry.** This course discusses the reversible and irreversible phenomena related to electrode processes in the field of organic electrochemistry.

**10·99. Seminar in Chemical Engineering.** A series of talks by members of the staff and others on timely subjects in chemical engineering.

## SANITARY ENGINEERING. Course XI.

(See description under Civil and Sanitary Engineering, pages 49-55.)

## Geology and Geological Engineering, Course XII.

This section of the Department offers courses which lead to the degree of Bachelor of Science in Geology, and after graduate studies to the degrees of Master of Science, Doctor of Philosophy and Doctor of Science.

The growth of economic geology is a comparatively recent development. There exists now a broad demand for men who have made a special study of the practical application of geology to metal mining, to non-metallic products like clay and building stone, to petroleum and coal, and to engineering works and hydrology. Such men must have an education in engineering subjects along with their geological training, and it is just this which is provided for in this course. Among its graduates are many of the most prominent practical geologists of the present day.

For a long time there has existed a demand for teachers in the various branches of geology and for those who desire to devote themselves to teaching, the degree of Bachelor of Science in Geology is a stepping stone to the higher degrees necessary for such work.

The subjects in Course XII, during the first and second years, do not

differ from those arranged for Mining Engineering (Course III), but in the third and fourth years the studies diverge. Mineralogy, petrography, geology in all its branches, including physiography, geological surveying and economic geology, are included in the curriculum. In view of the growing importance of the geology of coal and petroleum special lecture courses are established for this branch of the science. The examination, sampling and valuation of ore deposits is also emphasized.

Ample provision is made for graduate studies for the candidates desiring to obtain the higher degrees and for special students. The subjects for this advanced work include microscopic analysis, mineralogy and crystallography, chemical mineralogy, advanced petrography, advanced economic geology, geology of America and Europe, geology of igneous rocks, paleontology and organic evolution.

A beneficial coöperation in graduate studies has been established with the Department of Geology of Harvard University by which advanced students are allowed to attend Harvard courses in subjects not regularly given at the Institute and vice versa. Among such Harvard courses open to advanced students are geometrical crystallography, geology of igneous rocks, physiography and climatology offered respectively by Professors Charles Palache, Reginald A. Daly, Wallace W. Atwood and R. DeC. Ward.

The courses offered in this Department to students of other branches of engineering may be divided in four sections.

1. Students in Course III (Mining Engineering), Options 1 and 3, are instructed in mineralogy, petrology, geology (dynamic, structural and historical), geological surveying and economic geology. Students in Option 2 receive instruction in mineralogy.

2. Students in Courses I and XI (Civil and Sanitary Engineering) take dynamic and stratigraphic geology and field geology.

3. Students in chemistry and physics are offered courses in mineralogy, crystallography and microscopic analysis.

4. Students in all departments except I, III, and XI may select, among their general studies, a course in general geology or evolution comprising three terms.

**12·01. Mineralogy.** This course consists principally of a laboratory study of the metallic minerals and their determination. Textbooks: *The Study of Minerals, Rogers; Manual of Determinative Mineralogy, Warren.*

**12·02. Mineralogy.** This course is a continuation of course 12·01.

**12·03. Mineralogy.** This consists principally of a laboratory study of the important minerals and their determination, but includes the elements of crystallography. Textbook: *The Study of Minerals, Rogers.*

**12·15. Petrography.** This course consists largely of the microscopic study of minerals and rocks, but lays particular emphasis on the systematic description and classification of rocks. Textbooks: *Petrographic Methods, Weinschenk and Clark or Optical Mineralogy, Winchell; Petrology for Students, Harker.*

**12·16. Petrography (Advanced).** This course consists of the study of selected suites of rocks, reading of petrographic literature, and the preparation of a written report on at least one suite of rocks.

**12·17. Chemical Mineralogy and Petrology.** This course consists of a consideration of the physico-chemical aspects of various mineralogical and petrologic problems. The work takes the form of a seminar and considerable outside reading is required. It may be given only in alternate years.

**12·19. Crystallography.** This course consists of a brief treatment of the elements of geometrical crystallography and the salient features of

physical and chemical crystallography. This is given as a part of course 12·03.

**12·20. Physical and Chemical Crystallography.** This course is conducted as a seminar supplemented by laboratory work. It may be given only in alternate years.

**12·21. Optical Crystallography.** The optical properties of crystals with special reference to their determination with the aid of the polarizing microscope.

**12·30. Geology.** (Dynamical.) A course in General Geology. Textbook: *Pirsson and Schuchert, Textbook of Geology, Pt. I.*

**12·301. Geology.** A course in General Geology adapted to the needs of Civil Engineers. Textbook: *Pirsson and Schuchert, Textbook of Geology, Pt. I.*

**12·31. Geology.** Continuation of 12.30. A course in Historical Geology. Textbook: *Pirsson and Schuchert, Textbook of Geology, Pt. II.*

**12·311. Geology.** A brief lecture course in geology of building materials. Laboratory study of structural geology and interpretation of geologic maps and of common rocks.

**12·32. Geology.** A course designed to teach the principles of geological observation in the field, and the interpretation of geologic maps.

**12·321. Geology.** Lectures on application of geology to engineering. Geologic field trips.

**12·33. Geology, Field.** This course is designed to teach the student practical methods of geologic mapping in the field.

**12·34. Geological Surveying.** In this course the student is required to make a detailed geological map of a selected area. A written report stating the results of the field work is required.

**12·341. Geological Surveying.** Similar in plan to course 12·34, but more extensive.

**12·35. Geological Surveying (Advanced).** A research course in the field investigation of assigned geologic problems.

**12·40. Geology, Economic.** A course of lectures presenting the principles of ore deposits as well as the occurrence and origin of metallic ores. Textbook: *Lindgren, Mineral Deposits.*

**12·41. Geology, Economic.** Lectures on non-metallic deposits with a laboratory course consisting of the determination and description of complex ores and altered rocks with and without the aid of the microscope.

**12·42. Geology, Applied Economic.** A course describing methods of examination and valuation of ore deposits and placers.

**12·43. Geology, Economic (Advanced).** Laboratory study of specimens or suites of specimens from mineral deposits; metallographic and petrographic work; discussion of special topics; graphic problems; history of science of mineral deposits.

**12·44. Geology of Coal and Petroleum.** A course which presents in detail the geological relations of petroleum and coal deposits.

**12·441. Valuation of Oil Lands and the Construction of Oil Maps.** An advanced course describing methods of investigation of oil lands.

**12·442. Petroleum Production.** Describes the methods of extraction and transportation of petroleum.

**12·45. Geology of Clay, Cement and Building Stones.** Description of occurrence, qualities and testing of building materials.

**12·46. Geology of Soils and Soil Examination.** An account of the origin, constitution and examination of soils, methods of soil mapping.

**12·47. Engineering Geology.** This course considers the relations of geologic processes and structures to engineering operations.

**12·50. Geology, Historical.** An extension of course 12·31, including

a study of the more common fossils. Textbook: *Grabau, Historical Geology.*

**12·51. Paleontology.** A course designed to give a knowledge of the past life of the earth through a comparison with living plants and animals. Textbook: *Shimer, Introduction to the Study of Fossils.*

**12·52. Paleontology (Advanced).** This course consists largely of laboratory work and assigned reading upon some aspect of index fossils, stratigraphy or evolution of fossil of living forms.

**12·53. Index Fossils.** A course in the determination of the geologic age of rock formations through a study of their included organic remains. Textbook: *North American Index Fossils, Grabau and Shimer.*

**12·55. Organic Evolution (Advanced).** A course of reading and discussion upon various phases of organic evolution.

**12·60. Physiography.** A study of the characteristics and development of land forms and the methods of interpretation of topographic maps.

**12·61. Hydrology.** Occurrence, composition and utilization of underground waters; methods of field examination.

**12·62. Geological Seminar.** A course of reading and reports based upon various phases of geologic literature.

**12·621. Geological Seminar, Advanced.** A course of reading and reports based upon various phases of geologic literature. For graduate students.

**12·63. Geology of North America.** A course on the physiography, stratigraphy, igneous bodies and general geologic structures of North America.

**12·64. Geology of Europe.** A course similar in plan to course 12·63 but dealing with the continent of Europe.

The following subjects are offered as General Studies. For description of Courses see Division of General Studies, pages 117-123.

**GS60. Geology.**
**GS61. Structural and Historical Geology.**
**GS64. Organic Evolution.**

## NAVAL ARCHITECTURE AND MARINE ENGINEERING

The instruction in Naval Architecture and Marine Engineering is intended for those who expect to be ship-designers, shipbuilders, shipmanagers, or marine engine builders or who desire to enter allied industries. The special work of the regular course is given in the form of lectures and recitations, and drawing and computation, during the second, third and fourth years of the course.

**13·01. Naval Architecture.** This course covers the general theory of naval architecture, including displacement and stability of ships, trim, grounding, docking, launching, tonnage and freeboard and theory of waves. Textbook: *Naval Architecture, Peabody.*

**13·02. Naval Architecture.** This course covers rolling of ships and methods of controlling rolling, resistance and propulsion of ships by paddle wheels, propellers and sails; method of making power and speed trials. Strength of ships structural and local, flooding calculations, design to fulfil given conditions. Textbook: *Naval Architecture, Peabody.*

**13·11. Theory of Warship Design.** This course includes a historical account and a discussion of the evolution of the modern warship; preliminary design, comprising determination of the principal elements of design, construction of lines, stability, distribution of weights, weight calculation, and watertight subdivision; structural design of warships, comprising materials used in hull construction, strength calculations,

general and local, riveted joints, and main structural features. Textbook: *Modern History of Warships, Hovgaard, Spon, London; General Design of Warships, Hovgaard, Spon, London; Structural Design of Warships, Hovgaard, Spon, London; Speed and Power of Ships, D. W. Taylor, Wiley, N. Y.*

**13·12. Theory of Warship Design.** This course includes: preliminary design and installation of boilers, engines, and propellers, as far as this work concerns the naval architect; coaling and coal stowage; liquid fuel: rudders and steering gear: drainage; ventilation, and heating of warships: anchors and anchor gear; towing and warping: boats and boat handling appliances: artillery and its installation; stresses in gun turrets; ammunition and its stowage and transport on board ships; torpedo installations: protection against artillery and submarine attack; conning towers.

**13·14. Shipyard Practice.** This course consists of lectures dealing with industrial organization, management, operation, equipment, and practice of ship and navy yards as applied to warship construction and repair.

**13·15. Shipyard Organization and Management.** This course deals with the division of authority and responsibility of the various officials; their duties and necessary qualifications; the efficient handling of labor and materials; the sequence of work; recording of wages; materials and costs, also methods of estimating costs for tendering.

**13·21. Warship Design.** In this course the first term and about one-half of the second term are occupied by design work of a general and introductory nature. After that the students commence to prepare a preliminary design of a warship.

**13·22. Warship Design.** This course is a continuation and completion of the design of a warship.

**13·31. Ship Construction.** This course covers the historical development of ship construction. Description of various types and methods of construction together with arrangement, equipment and operation of shipyards.

**13·32. Ship Construction.** This course deals with the construction of ships in detail with special reference to the requirements of Registration Societies.

**13·33. Ship Construction.** This course is a continuation of 13·32.

**13·35. Merchant Shipbuilding.** This course deals with the design and construction of merchant vessels with special reference to their employment as auxiliaries during war time, and re-conditioning for their original work when the war service is completed.

**13·41. Ship Drawing.** This course gives instruction in drawing and fairing ships' lines, and in the use of instruments.

**13·42. Ship Drawing.** This course gives instruction in drawing lines for definite displacement and longitudinal center of buoyancy, midship section with scantlings, calculations for displacement, center of buoyancy, metercenters, etc.

**13·43. Ship Drawing.** In this course the design of a ship is carried to completion, with calculations of stability, weight, trim, strength, etc. General and special plans of details are required, also model making and lining off.

**13·45. Model Making.** The student is required to make a model from the lines prepared by him in 13·42, such assistance being given as he may require.

**13·51. Marine Engineering.** This course describes marine engines and discusses methods of proportioning marine engines and determining

stresses in them; and also the vibration of ships and balancing engines. Textbook: *Marine Engineering, Peabody.*

**13·52. Marine Engine Design.** This course deals with the computations and drawings for a marine engine. Textbook: *Marine Engineer's Handbook, Sterling.*

**13·53. Marine Engineering.** This course is similar to course 13·51 except that it deals with naval engines. Textbook: *Marine Engineering, Peabody.*

**13·55. Marine Engine Design.** This course is similar to course 13·52 except that it applies to naval engines. Textbook: *Marine Engineer's Handbook, Sterling.*

**13·60. Steam Turbines.** This course gives descriptions and methods of computing steam turbines, especially as applied to marine propulsion. Textbook: *Steam Turbines; Peabody.*

## DRAWING

The work of this division includes preparatory courses in mechanical drawing, elementary machine, architectural, and freehand drawing, and descriptive geometry, leading to the various courses in applied drawing offered by the professional departments. The instruction therefore largely concerns the technique and principles of representation in general, rather than specific applications.

The course in mechanical drawing includes practice in the precise pencilling and finished inking of instrumental construction and irregular curves and in simple lettering and tracing as a basis for the work which follows.

Special importance is attached to the study of descriptive geometry, both as embracing the principles of geometrical representation and as a means of developing the power to visualize objects or lines in space. Illustrations of the practical application of its principles are afforded by the solution of problems taken from engineering and architectural practice.

**D101. Mechanical Drawing.** Instruction is given during the first five weeks of the term in the correct use of drafting instruments and materials. Drawings are made in pencil and in ink, on paper and on tracing cloth. Practice is given in lettering. Neatness and accuracy are required. Textbook: *Mimeograph Notes.*

**D122, 123. Machine Drawing, Elementary.** A course running through the second and third terms, giving the elementary instruction required for machine drawing. It includes isometric, oblique, and simple perspective projection, the construction of conics and rolled curves, the making of dimensioned sketches from machine parts and of accurate detail drawings from the sketches. Textbook: *James and Mackenzie, Working Drawings of Machinery.*

**D132, 133. Architectural Drawing, Elementary.** A continuation of D101, running through the second and third terms in which the students continue their practice in drafting through the use of architectural forms. Measured sketches are made from actual buildings, which serve as a basis from which to develop carefully rendered scale drawings. Textbook: *G. Gromort, Elements of Classic Architecture.*

**D151, 152, 153. Freehand Drawing, Elementary.** A course giving elementary instruction in careful observation and accurate sketching in pencil from simple models and simple architectural details. Accuracy of proportion, simplicity of presentation, and unity of the whole are emphasized.

**D171, 172, 173. Descriptive Geometry.** The course begins with the fourth week of the first term and continues through the first year. It consists of thirty hours each term, devoted to short lectures and individual classroom instruction. Especial emphasis is placed upon the ability to visualize the problems and the processes of solution.

The first term includes a study of the fundamental conceptions of orthographic projection and fundamental problems on lines, planes and solids.

The second and third terms continue the study through the more complex phases of the science, including sections, developments, tangent lines and planes, and intersections of surfaces of revolution. Textbook: *Kenison and Bradley, Descriptive Geometry.*

**D191. Descriptive Geometry (College Class).** An intensive course covering in one term the complete requirement in first year descriptive geometry, open to graduates from other colleges; also, by permission from the head of the division of drawing, to students from other colleges not graduates, who enter the Institute with advanced standing. Students with failures in descriptive geometry will not be admitted. Textbook: *Kenison and Bradley, Descriptive Geometry.*

**D201. Descriptive Geometry.** A continuation of D173 providing additional practice and applications and covering in greater detail, the study of tangent planes, intersection of surfaces of revolution, and practical applications. Textbook: *Kenison and Bradley, Descriptive Geometry.*

**D211. Descriptive Geometry.** A continuation of D173 similar to D201 but including the subject of warped surfaces, and required as preparation for D252. Twenty-five hours of this course must be taken by all students of course I who take D191. Textbooks: *Kenison and Bradley, Descriptive Geometry; Mimeograph Notes.*

## ECONOMICS

In this Department is grouped the instruction given in general economics to students in all courses, and also the more specialized subjects provided for the course in Engineering Administration (XV). All courses, except XV, take political economy (Ec31, 32, 33) in the third year, and opportunity will also be given to select a general option study in the field of Economics, as political and social problems, and banking and finance.

Students in course XV begin political economy in the second year, but owing to the requirement of subsequent studies in business economics, devote but two terms, instead of three, to this preliminary course.

The courses in accounting, cost accounting, banking, statistics, industrial organization, securities and investments, industrial relations, business management, and business law, are designed more particularly for students in Engineering Administration, and should not be applied for except with special permission of the Department.

**Ec22, 23. Political Economy.** This course is not so extensive in its scope as Political Economy Ec31, 33, 32. More emphasis is placed upon fundamental principles, and less time is devoted to such subjects as money, banking, trusts, labor problems, etc., which are covered by special courses in the last two years of course XV.

**Ec31, 32, 33. Political Economy.** This course is elementary but comprehensive. It consists of an analysis and description of the existing economic structure of society, a brief study of economic theory and the application of that theory to some of the more important economic questions. Special attention is given in Ec33 to fundamental business processes

including principles of accounting, corporate organization and finance, credit and banking, labor problems, and business management.

**Ec37. Banking.** In this course the following topics will be considered: credit instruments, credit documents, national banks, state banks, trust companies, savings banks, different kinds of loans, securities for loans, credit statements, the bank statement, the money market, relation of the treasury and crop movement to money market, clearing house, domestic and foreign exchange.

**Ec38. Securities and Investments.** This course treats of (1) different kinds of securities: government, railroad, industrial, public utility, etc.; (2) investment analysis; (3) stock and produce exchanges, brokerage and speculation.

**Ec46. Industrial Relations.** This course is intended to familiarize the student with the more important problems which arise out of the relation of employer and employee under present conditions of industry. In addition to a consideration of the organizations and policies of the parties to the contract of employment, it deals with matters of public policy such as labor legislation, social insurance, immigration, and industrial education.

**Ec50. Accounting.** This course is not designed to make bookkeepers, auditors, or accountants in any professional sense, but is concerned primarily with the analysis of financial reports. Instruction will deal with such matters as double entry book-keeping, the significance of assets and liabilities, good-will, the construction and interpretation of the balance sheet and of the profit and loss statement.

**Ec51. Cost Accounting.** In this course the following topics are considered: methods of determining costs of materials, processes of labor and machines; the distribution of direct costs and overhead expenses; cost data to secure efficiency; shipping orders; inventories; recording and payment of wages.

**Ec56. Industrial Organization.** This course deals with corporate organization and control, with some attention to other forms of business. Consideration is given to the procedure and problems of incorporation, the relationships of the parties in the corporation, and combinations of corporations in our large industrials. Public utility corporations are studied briefly with the view of presenting the relations of public service corporations and the public.

**Ec57. Industrial Organization.** This course is intended to acquaint the student with the fundamental principles of corporation finance. The various types of corporate securities are examined, the financial problems of the promoter, the incorporators and the later management are studied and illustrations are drawn from concrete cases throughout.

**Ec60. Business Law.** This course deals with contracts, agency, negotiable instruments, patent law and trademarks.

**Ec65. Statistics.** In this course elementary instruction is given in the construction of statistical tables and charts, official sources of commercial and financial statistics of the United States, and the interpretation of such material.

**Ec70, 71, 72, 73. Business Management.** This course deals with the activities of an individual business. The following topics are considered: organization, plant location, layout and equipment, purchasing, transportation and traffic, inspection, stores, design, scientific management, time, motion and fatigue study, production control, office organization, location, layout and equipment, credit and collections, insurance, marketing and sales engineering, including product and market analysis,

budgets, quotas, statistics, standards, market structures, sales organization, sales management, sales campaigns, sales promotion, advertising.

The following subjects are offered as General Studies. For description of courses see Division of General Studies, pages 117-123.

**GS20. Political and Social Problems.**
**GS22. Marketing Methods.**
**GS23. Production Methods.**
**GS25. Investment Finance.**
**GS26. Banking and Finance.**
**GS27. Economics of Corporations.**

## ENGLISH AND HISTORY

The work in English is designed to arouse in the student an interest in the important problems of modern life, and through the interest thus stimulated to train him in oral and written expression. The instruction is given by lectures, and in sections which offer frequent opportunity for class discussion and for oral presentation of topics prepared by students. The written work is for the most part in the form of reports, in which emphasis is put on the clearness and accuracy of expression which are essential in the work of a professional man.

The instruction given by the Department in literature and history is planned so that the student may acquire an understanding of the main currents of thought of the last one hundred and fifty years as they have expressed themselves in the events, the institutions, and the literature of that period. Significant works of literature which interpret phases of political, economic and social life are read and discussed concurrently with an historical study of the times. By this correlation of the work in literature and history, — on which as has already been indicated the work in composition is based,— it is hoped that the student may gain a broad and vital comprehension of the main forces working in life and society today.

**EH11. English and History.** With this course begins the work in English and History required in the first year. It covers European History of the last hundred years and is conducted by recitations, lectures and conferences, with oral and written reports. Textbook: *Hayes, A Political and Social History of Modern Europe, Vol. 2. (Macmillan.)*

**EH12. English and History.** This course is a continuation of EH11. Textbook: *Hayes, A Political and Social History of Modern Europe, Vol. 2. (Macmillan.)*

**EH13. English and History.** This course is a continuation of EH11 and 12, and consists of a study of recent problems in the government and history of the United States. Textbook: *Frederick L. Paxson, Recent History of the United States.*

**E15. Special Composition.** This course may be required at any time after the first year of any student who shows inability to write clear and correct English. It consists of theme work and consultation, and is continued in each case as long as the needs of the student require.

**EH21. English and History.** This course is the first term of a course given throughout the second year, designed to study the main currents of thought in England during the Nineteenth Century. In the first term representative political writings are studied. Written and oral reports are required. Textbooks: *Political Thought of an Age of Revolution; Mill's Essay on Liberty.*

**EH22. English and History.** This course is a continuation of EH21. This term is devoted mainly to the conflict of political and eco-

nomic principles that marked the first half of the Nineteenth Century in England. Written and oral reports are required. Textbook: *Carlyle, Past and Present.*

**EH23. English and History.** This course is a continuation of EH22. This term is devoted to a study of the influence of the development of science upon English literature and thought. Written and oral reports are required. Textbook: *The Voice of Science in Nineteenth Century Literature.*

**E31a. English (Committee Work).** A course in the development of co-operative thinking and cultivation of the "group spirit" by means of committee reports on vital and timely subjects and acceptance or constructive amendment by the class, of what each report recommends.

**E31b. English (Business English).** A study of the principles of effective, business-like expression; and practice, both written and oral, in the expression of those principles. Lectures, recitations, business letters, oral and written reports. Textbook: *Opdycke and Drew, Commercial Letters.*

**E32. English.** This course consists of oral and written discussion of problems of literature and science based on the reading of English essayists of the Nineteenth Century. Its purpose is to give students practice in oral and written discussion of the ideas suggested by the reading. Textbook: *Steves and Ristine, Representative Essays in Modern Thought.*

**E33. Report Writing.** This course makes a study of the various types of engineering reports, with practice in the investigation of subjects, the arrangement of material, and its presentation in good report form.

**E35. English (Contemporary Literature).** A brief study of the various types of contemporary novels, dramas and short stories with a view to critical appreciation of these forms of literature. Lectures, discussion and written reports and criticisms.

The following subjects are offered as General Studies. For description of courses see Division of General Studies, pages 117-123.

**GS40. English (Contemporary Drama).**
**GS41. English (Contemporary English Literature).**
**GS42. English (Contemporary European Literature).**
**GS43. English (American Literature).**
**GS45. Advanced English Composition.**
**GS46. Public Speaking.**
**GS47. Informal Public Speaking.**
**GS48. Appreciation of Music.**
**GS49. Development of Music.**
**GS50. Fine Arts in Modern Life.**
**GS52. Lincoln and the Period of the Civil War.**
**GS53. Industrial History of the United States.**
**GS54. The Engineering Field.**
**GS55. The Human Factor in Business.**
**GS56. Engineering Publicity.**

## GENERAL STUDIES

This division includes those courses of a general and essentially non-technical character which are offered for the purpose of giving the student an opportunity of broadening his education. They are designed to introduce him to fields of thought and interests outside of his chosen special field of professional work.

Four terms of General Study courses are required in the junior and

senior years, but each student is free to elect from among the courses listed below such as appeal to his particular personal tastes and interests. A considerable variety of subjects are offered, grouped for convenience under the headings: Social, Political, Economic and Business Subjects; Literature, English, History and Fine Arts; Science; Foreign Literature. The list may be modified or extended from year to year.

With the approval of the professor in charge of the division, other non-technical subjects of suitable character may be substituted for those listed. College graduates or others who have taken elsewhere a satisfactory equivalent of liberal studies may be excused from further requirements in General Studies.

For the year 1922-1923 the following subjects are offered:

## SOCIAL, POLITICAL, ECONOMIC AND BUSINESS SUBJECTS

| First Term | Second Term | Third Term |
|---|---|---|
| The Engineering Field GS54 | The Human Factor in Business GS55 | Engineering Publicity GS56 |
| Political and Social Problems GS20 | International Law and American Foreign Policy GS3 | Banking and Finance GS26 |
| Marketing Methods GS22 | Investment Finance GS25 | Economics of Corporations GS27 |
| | Production Methods GS23 | Business and Patent Law GS4 |

## LITERATURE, ENGLISH, HISTORY AND FINE ARTS

| | | |
|---|---|---|
| English (Contemporary Drama) GS40 | English (Contemporary English Literature) GS41 | English (Contemporary European Literature) GS42 |
| Advanced English Composition GS45 | Public Speaking GS46 | English (American Literature) GS43 |
| Lincoln and the Period of the Civil War GS52 | Development of Music GS49 | Advanced English Composition GS45 |
| Appreciation of Music GS48 | | Informal Public Speaking Committee Reports and Discussions GS47 |
| | | Industrial History of the United States GS53 |
| | | Fine Arts in Modern Life GS50 |

## SCIENCE

| | | |
|---|---|---|
| Geology GS60 | Structural and Historical Geology GS61 | Organic Evolution GS64 |
| Sound and Music GS65 | Descriptive Astronomy GS66 | Meteorology GS67 |
| Principles of Biology and Heredity GS71 | Industrial Aspects of Bacteriology GS72 | Sanitary Science and Public Health GS73 |
| History of Science GS1 | History of Science GS2 | |
| | Psychology GS5 | |

## FOREIGN LITERATURE

| | | |
|---|---|---|
| French GS82, 83<br>German GS91, 94, 95 | French GS82, 83<br>German GS91, 92, 94, 95, 96, 97 | French GS82, 83<br>German GS91, 92, 94, 95, 96, 97 |

**GS1. History of Science.** A course of twenty illustrated lectures dealing with the development and decline of Greek science, the transmission of science into Western Europe, and the science of the Renaissance. Emphasis is placed mainly on mathematics and the sciences nearly related to it.

**GS2. History of Science.** A course of twenty illustrated lectures dealing with the development of several different fields of science from the seventeenth century onward. The subjects treated will vary somewhat from year to year but are expected to include the beginnings of the calculus and analytic geometry, the transition from alchemy to chemistry, the growth and redivision of astronomical theory and the development of modern theories of evolution.

**GS3. International Law and American Foreign Policy.** This course will consist of lectures by the instructor, and of special reports by the students. The reports will relate in part to present day topics of discussion in International Law, and in part to leading principles of American Foreign Policy, such as Arbitration, The Monroe Doctrine, The Open Door, Asiatic Immigration, Pan-American Questions, and to matters in which the United States is co-operating with European governments, such as the action taken by the Arms Conference. The work of the Hague Conferences and of the League of Nations will be considered as stages in the modern movement for a better world organization. Textbook: *Wilson and Tucker's International Law.*

**GS4. Business and Patent Law.** A general course in business law with five or six of the exercises devoted to the principles of patent law.

**GS5. Psychology.** A course covering the general principles of psychology.

**GS20. Political and Social Problems.** The content of this course will change from year to year. It includes such topics as immigration, national budget, tariff, civil service, railroad regulation, industrial relations, etc. The work is conducted by means of oral discussion and written reports on assigned reading in public reports and periodicals, supplemented by lectures, some of which are given by officials or experts in the special fields covered.

**GS22. Marketing Methods.** Following such study of the economics of marketing as is necessary for an adequate understanding of the larger aspects of marketing, emphasis is placed on the methods by which economic goods are distributed. The course includes discussion of sales organization, sales engineering and co-ordination of sales and production in the marketing of fabricated products. Agencies for creating demand and for supplying demand are discussed. Modern practices in organization, equipment and operating methods in the fields of sales operation, advertising, merchandising and warehousing are treated in detail.

**GS23. Production Methods.** Emphasizes methods of organizing and directing the activities and functions of production in manufacturing. Considers the control of equipment, materials, product quality, product quantity and personnel. Equipment control is discussed in relation to building location and type, machinery and tool selection and arrangement, and the use of service equipment. Material control comprises a study of purchasing, traffic, stores, and intra-factory transportation

methods. Product quality control considers the factors of design and engineering, inspection, salvage and the utilization of by-products. Product quantity control covers the work of planning, scheduling and dispatching and will survey several representative control structures now in successful operation. Personnel control deals with the methods of employment, labor maintenance and the technique of the executive.

**GS25. Investment Finance.** This course will consider briefly (1) the legal rights conferred upon the owners of securities of various types; (2) the basis for credit offered by issuing corporations of various kinds: government, railroad, public utility, industrial, etc.; (3) the construction of bond tables, interest formulas, sinking fund calculation, serial bonds, amortization, and the mathematical theory of investment; (4) the stock exchanges, brokerage, speculation and the various kinds of business houses which deal in securities and investments.

**GS26. Banking and Finance.** This course considers the subject of banking in less technical form than Ec37. There is also a treatment of the investment and security market and the more elementary portions of corporation finance.

**GS27. Economics of Corporations.** The types of business organization are discussed in this course with special emphasis upon the corporation. Consideration is given to the internal organization of the corporation, especially on the financial side: promotion, underwriting, marketing of securities, the financial problems of a going concern, bankruptcy and receivership are studied in turn. The course closes with a discussion of public service corporations and a brief examination of the trust movement. Textbook: *Lough, Business Finance.*

**GS40. English (Contemporary Drama).** An untechnical discussion of notable living playwrights and their work, here and abroad.

**GS41. English (Contemporary English Literature).** This course treats of a dozen of the most important English men of letters from 1890 to today.

**GS42. English (Contemporary European Literature).** An introductory study of some of the chief figures in European literature of the last few decades and today.

**GS43. English (American Literature).** From the Civil War, with especial emphasis on the period since 1900.

**GS45. English (Advanced English Composition).** This course is designed primarily for students who wish to do advanced work in composition under direction and criticism. It will be so planned as to allow much individual freedom in the choice of materials, and men desirous of experimenting with the essay or the short story, or with technical description or exposition, may do much of their writing in any one of these fields.

**GS46. English (Public Speaking).** The object of the course is to set forth the principal matters of technique on which the art of speaking in public is based, and to provide training for the individual members of the class.

**GS47. English (Informal Public Speaking; Committee Reports and Discussion).** This course gives training in the preparation and oral presentation of committee reports. These reports serve as a basis for class discussion.

**GS48. Appreciation of Music.** This course is intended to give students the elementary historical and theoretical knowledge necessary for intelligent listening to music. It takes up the forms and types of composition commonly heard in concerts. The work includes lectures, required reading, and weekly written reports, besides the usual class tests. Musical illustrations are performed in the class room.

**GS49. Development of Music.** This course takes up the main historical factors in the development of modern music in chronological order, beginning with Palestrina and going to the present day. The work includes lectures, required reading, weekly written reports, class tests, and musical illustrations in the class room which the students are required to criticize and analyze. Textbook: *How Music Developed, W. J. Henderson.*

**GS50. The Fine Arts in Modern Life.** The course aims to develop the habit and faculty of noticing visible beauty in contemporary art, in public monuments and museum collections, and more especially in one's personal environment, such as costume, furnishing and decoration of the home, books, pictures, magazines, the theatre. The history of art is studied with a brief text in order to make the appreciation of contemporary work more discriminating. Textbook: *Reinach, Apollo, the Story of Art. Scribners.*

**GS52. Lincoln and the Period of the Civil War.** This course consists of a study of the life of Abraham Lincoln and his relation to the times. Textbook: *Charnwood, Life of Lincoln.*

**GS53. Industrial and Social History of the United States.** The purpose of this course is to give a general survey of the industrial and agricultural history of the United States from colonial times to the present, with attention also to the social history of the American people. Textbook: *E. L. Bogart, Economic History of the United States.*

**GS54. The Engineering Field.** This course attempts to give information as to conditions in the practical world, the handling of typical engineering and administrative problems, and the policies of some of the large companies employing engineers. The lectures are given by engineers and administrators in actual practice. The ground is covered in part by oral and written reports. The course is offered under the auspices of The Associated Industries of Massachusetts.

**GS55. Human Factor in Business.** This course attempts to cover in outline such problems as the selection and training of subordinates and workers, housing, feeding, and welfare, co-operation and morale. These topics are treated on the human side, and with only such attention to detail as would interest one looking forward to the possible executive control of the enterprises in production or construction that an Institute graduate would naturally enter. The ground is covered in part by oral and written reports. There are occasional talks by employment and service managers.

**GS56. Engineering Publicity.** The chief object of this course is to give some notion of how salesmanship and presentation are applied by engineers. It touches on the following problems: advertising service; advertising and marketing the technical product; engineering journals; correspondence, the psychology of appeal. The ground is covered in part by oral and written reports. There are occasional talks by advertising men and engineers in practice.

**GS60. Dynamical Geology.** A consideration of the forces which have molded the earth to its present form and are now constantly modifying it. Textbook: *Clelland, Geology, Physical and Historical.*

**GS61. Structural and Historical Geology.** A study of the structure of the earth and the history of its changing continents, ocean basins, and its evolving life forms. Textbook: *Clelland, Geology, Physical and Historical.*

**GS64. Organic Evolution.** A study of the evolution of life throughout the past history of the earth with a discussion of the underlying laws operating today and with especial reference to the various avenues along which man is evolving. Textbook: *Organic Evolution, Lull.*

**GS65. Sound and Music.** A general discriptive treatment with some experimental lectures.

**GS66. Descriptive Astronomy.** A general survey, illustrated, of the facts and theories relative to the solar system and sidereal universe.

**GS67. Meteorology.** A general descriptive account of atmospheric phenomena with special emphasis on the conditions of importance to aeronautics.

**GS71. Principles of Biology and Heredity.** A course of twenty lectures illustrated by demonstrations, charts and lantern slides. This is a cultural course intended for students who have had little or no previous training in biology. It will give a broad view of the fundamental principles of the subject, including the properties of living matter, movement, nutrition, growth and reproduction; a general account of form and structure of plants and animals, their classification, habits and habitat, migrations, and geographical distribution. The questions of sex and heredity will be treated at length, and there will be a brief treatment of the races of mankind and of organic evolution.

**GS72. Industrial Aspects of Bacteriology.** A discussion of the relation of bacteria and allied microörganisms to productive processes in agriculture and industry. The role of the bacteria in soil fertility, in nitrogen fixation and other constructive processes, as well as the effect of undesirable types of microörganisms will be considered. Special attention will be given to the fermentation processes in different industries whereby microbes are made to work as chemical reagents. The course will be illustrated by demonstrations and lantern slides.

**GS73. Sanitary Science and Public Health.** Lectures (illustrated) on health and disease, parasitism, toxins and anti-toxins, resistance and immunity vaccination, epidemology, preventive sanitation and preventive hygiene.

**GS82. French.** This general course offers rapid reading of modern French prose dealing with the history of France, French life and institutions, scientific matter in French. In each term there will be a brief review of grammatical principles, with practice in useful vocabulary and sentence formation. Each term may be taken independently. Textbook: *Levy, French Composition;* selected reading matter from the works of *Balzac, Loti, Taine, Renan, A. France.*

**GS83. French.** This is a literary course: a brief survey of French literature with the reading of some prose masterpieces. Such topics as the following will be discussed: the literature of the middle ages; the Renaissance; classicism; the romantic movement; realism; naturalism; art for art's sake; impressionism and symbolism. Each term may be taken independently. Textbook: Special reading matter from one period, or one form of French literature.

**GS91. German.** This course forms a brief introduction to the German literature of the Eighteenth and Nineteenth Centuries. It is given in brief lectures in German with readings from standard works. The course is conducted mainly in German.

**GS92. German.** This course consists of lectures on the German drama with a considerable amount of reading from characteristic plays, beginning with Schiller's " Don Karlos." This course is conducted mainly in German.

**GS94. German.** This course consists wholly of exercises without preparation. It is distinctively a sight reading course for practice in rapid reading. The selections are from current periodicals.

**GS95. German.** This course consists of lectures and readings on the life and work of the most important German men of science. As far as practicable the exercises are conducted in German.

**GS96. German.** This course consists of lectures and readings with a study of the development of the Faust legend. Opportunity is offered for theme-writing and discussion in German.

**GS97. German.** This is a practical course in commercial correspondence. Under normal conditions a foreign correspondent will be provided for each member of the class.

## MODERN LANGUACES

The study of Modern Languages at the Institute has two objects: that of enabling the student to make use of the languages as instruments in scientific research, and that of giving him general training and culture. It aims to give sufficient facility with modern texts to use them without the necessity of translating, and as much familiarity with the spoken language as the individual aptitude of the student and the time available permit. From the beginning as much of the classroom work as possible is carried on in the language taught. Occasional talks therein are also given, and writing from dictation is frequently practised.

A sound knowledge of grammar is attained by the careful analysis of parts of the texts read, and by oral and written illustrative exercises. To make these of value a good pronunciation is essential, and this is striven for through constant practice in the classroom. In addition to a deeper knowledge of the language and literature, the advanced courses aim to impart succinctly familiarity with the character, customs, traditions, spirit, history and development of the peoples and countries whose language is studied.

In the designation of courses the grades of Elementary and Intermediate correspond, respectively, to the definitions of the Modern Language Association of America.* All other courses are of advanced grade.

**L11. German.** This course is intended to prepare students to fulfill the entrance requirement in German. A study of grammatical forms, syntax and vocabulary, through composition exercises and rapid reading, forms the basis of the work. Textbooks: *Vos, Essentials of German (Holt & Co.); Vogel, Storm's Geschichten aus der Tonne (Heath & Co.); Whitney, Gerstäcker's Irrfahrten (Holt & Co.).*

**L12. German.** Similar to L11, with additional and varied readings.

**L21. German.** This course includes a systematic review of grammar. The reading, scientific as well as literary, gradually becomes more difficult, while the syntax, idioms and synonyms of the language are carefully studied. By 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. Textbooks: *Hauff's Lichtenstein, Vogel (Heath & Co.); Wright, German Science Reader (Holt & Co.); Kip, Scientific German Reader (Oxford Press).*

**L22. German.** Similar to L21, with additional and varied readings.

**L31. German.** This course is wholly devoted to exercises in scientific German. Selections are made from current scientific journals, and the latest textbooks.

**L32. German.** This course consists wholly of exercises in scientific German on physical, chemical, biological and geological subjects. As far as practicable the exercises are conducted in German.

**L33. German.** This course is wholly devoted to exercises in scientific German on physical, physico-chemical and electro-chemical subjects.

The work is partly based on selections from current scientific journals. As far as practicable the exercises are conducted in German.

**L37. German.** Similar to L31, arranges for students in course X.

**L43. German.** This course comprises composition, pictation, reading, lectures and conversation. The work is partly based on current newspaper and magazine articles.

**L61. French.** This course is designed to enable students to fulfill the entrance requirement in French. The program consists of training in pronunciation, elementary grammar, and easy reading matter. The last term will include the reading of some technical French. Textbooks: *Fraser and Squair, French Grammar*; *Olmstead and Barton, French Reader*; *Lavisse, Histoire de France* (*Heath*); *Bowen, First Scientific French Reader* (*Heath*).

**L62. French.** This course consists of recitations partly conducted in French. It comprises a continuation of the study of grammar, translation into French of connected passages, reading and translation of some standard modern authors, reading of scientific French. Textbooks: *Carnahan, Short French Review Grammar* (*Heath*); *François, Alternative Exercises for Introductory French Prose Composition* (*American Book Co.*); *Selected Reading Texts; Bazin, Les Oberlé*; *Bowen, Scientific French Reader.*

**L63. French.** This course is planned to suit the needs of course IV. Some of the reading matter will deal with architectural subjects. Textbooks: *Levy, French Composition; George Riat, Paris* (*Les Villes d' Art Célèbres*).

**L64. French.** This course consists of reading and translation of technical Franch.

**L67. French.** Similar to L61, with additional and varied readings.

**L71. French.** This course consists of the reading of French prose of a varied nature, part of which deals with description of French cities, cathedrals, chateaux, etc. Practice in pronunciation and conversational phrases useful for travel is given. Textbooks: *Hill and Smith, French Composition* (*Holt*); such reading matter as *Emile Gebhart, Florence; Besnard, Le Mont-Saint-Michel; Gautier, Voyage en Espagne; Hugo, Notre Dame de Paris.*

***Report of the Committee of Twelve.**

**L81. Spanish.** This elementary course consists of pronunciation, elementary grammar, and easy reading matter and practice in conversational phrases useful for travel. Textbook: *Hills and Ford, First Spanish Course* (Heath); *Pittaro, Spanish Reader.*

The following subjects are offered as General Studies. For description of courses see Division of General Studies, pages 117-123.

**GS82. French.**
**GS83. French.**
**GS91. German.**
**GS92. German.**
**GS94. German.**
**GS95. German.**
**GS96. German.**
**GS97. German.**

## MATHEMATICS

Great importance is attached to the study of mathematics, both as a means of general education and as a necessary basis for further instruction in engineering and other subjects. Students in most of the regular courses study mathematics throughout the first two years, beginning with

a combined course in elementary calculus and analytic geometry extending through the first year. The second year work is devoted mainly to integral calculus and elementary differential equations with systematic study of applications. From the outset, care is taken to present both underlying principles and a great variety of concrete applications, the latter connecting the mathematical instruction closely with the professional studies. The instruction is given mainly by recitations in small sections, the number of the students in a section being about twenty-five. Students having time and interest for the study of mathematics beyond the prescribed limits are offered opportunity for more advanced work, and the Institute offers exceptional opportunities for advanced and elective work in applied mathematics.

Undergraduates wishing to specialize in Mathematics are referred to the recently adopted option in IX-C in General Science.

The Department possesses an excellent library, containing about twenty-five hundred carefully selected volumes and an extensive collection of models, which are of special interest and value in connection with the more advanced courses.

**M11. Calculus and Analytic Geometry.** An elementary presentation of the fundamental ideas of the calculus: derivatives, differentials, maxima and minima, integration, with application to simple problems of geometry and mechanics. Textbook: *Woods and Bailey, Elementary Calculus.*

**M12. Calculus and Analytic Geometry.** Graphical representation and differentiation of algebraic and trigonometric functions with applications. Textbook: *Woods and Bailey, Elementary Calculus.*

**M13. Calculus and Analytic Geometry.** Graphical representation and differentiation of logarithmic and exponental functions with applications; series, partial differentiation; methods of integration. Textbook: *Woods and Bailey, Elementary Calculus.*

**M15. Slide Rule.** Four exercises and lectures on the use of the slide rule.

**M21. Calculus.** Mainly the integral calculus of functions of one variable including methods of integration; definite integrals; geometrical applications to areas and lengths of plane curves, volumes of solids of revolution, and other volumes which can be found by a single integration; and mechanical applications to work, attraction, pressure, and centers of gravity and pressure. The division of topics between Mathematics M21 and Mathematics M22 varies from year to year. Textbook: *Woods and Bailey, Analytic Geometry and Calculus.* 1922–1923.

**M22. Calculus and Differential Equations.** A continuation of Mathematics M21, mainly devoted to the study of functions of two variables and covering: elements of solid analytic geometry; partial differentiation; multiple integration, with geometrical applications to areas and volumes, and with mechanical applications to attraction, moments of inertia, and centers of gravity; infinite series and the elements of differential equations. Work in nomographic charts and empirical equations is also included. Textbooks: *Woods and Bailey, Analytic Geometry and Calculus* (1922–1923); *Lipka, Graphical and Mechanical Computation.*

**M23. Differential Equations.** Applications of differential equations to numerous problems of physics and mechanics. Textbook: *Phillips, Differential Equations.*

**M26. Theory of Probability and Methods of Least Squares.** A brief course devoted to a discussion of the general principles and the more common scientific and engineering applications of the Method of Least Squares. Textbook: *Bartlett, Method of Least Squares.*

**M27, 28, 29. Statics, Kinematics, Dynamics.** A problem course in mechanics open to students who are taking or who have completed M22.

**M35. Differential Equations of Electricity.** This course deals mainly with the equations which the student of electricity meets in his work. These equations will be discussed from the general point of view, but specific applications will be made to electrical problems.

**M36, 37, 38. Advanced Calculus and Differential Equations.** Taylor's Formula with applications to approximations in calculus and analysis, partial differentiation, complex numbers, vectors, total and partial differential equations, Bessel's functions, calculus of variations, line, surface and space integrals. Textbook: *Wilson, Advanced Calculus.*

**M41. Applications of Calculus.** Similar to M23, but especially adapted to the needs of students in chemical engineering.

**M43. Theoretical Aeronautics.** Open to third and fourth year students.

**M45. Fourier's Series; LaPlace's Coefficients.** (Topics in Partial Differential Equations.) The theory of Fourier's series, Bessel's functions, zonal and spherical harmonics, and their application to the solution of such problems in physics as can be expressed by certain partial differential equations.

**M50. Applications of Mathematics to Chemistry.** The application of thermodynamics to chemical problems.

**M54, 55. Mathematical Laboratory.** A course for practical instruction in numerical, graphical and mechanical calculation and analysis as required in the engineering or applied mathematical sciences, methods for checking the accuracy of arithmetic and logarithmic computations; numerical solution of algebraic, transcendental and differential equations; graphical methods in the processes of arithmetic, algebra, and the calculus; 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, such as slide-rules, arithmometers, planimeters and integraphs; and many kindred topics. Either term's work may be taken without the other. Textbook: *Lipka, Graphical and Mechanical Computation.*

**M56. Theory of Functions.** A study of the elementary functions — particularly the circular and hyperbolic sine, cosine, and tangent — for complex values of the variable. Development and application of the fundamental theorems of the analytic function theory.

**M57. Theory of the Gyroscope.** This course is a mathematical discussion of the gyroscope, together with its application to torpedoes and stabilizers.

**M60. Vector Analysis.** Algebraic combinations of vectors, differentiation and integration of vector functions, Green's and Stokes' theorems, potential functions, applications to geometry and physics.

**M61. Mechanics of Rigid Bodies.** Mainly a problem course in the application of the conditions of equilibrium and the equations of motion of a rigid body.

**M62. Modern Algebra.** Determinants, matrices, systems of linear equations, linear transformations, finite groups.

**M63. Higher Geometry.** Coördinate systems, geometry of $n$-dimensions, differential geometry, non-Euclidean geometry.

**M64. Modern Analysis.** Particular attention is given to analytical methods used in mathematical physics. The course covers the elements of theory of functions, and study of important transcendental functions. Textbook: *Whitaker and Watson, Modern Analysis.*

**M65. Analytical Mechanics.** Lagrange's and Hamilton's equations, Hamilton's principle, principle of least action, theory of elasticity, hydrodynamics.

**M66. Theory of Sound.** Dynamical theory of vibrating systems and the propagation of waves in solids and fluids.

**M67. Heat Conduction.** Fourier's Series, theory of the steady state and the flow of heat in one or more dimensions, with application to physics and engineering.

**M68. Thermodynamics.** The general theory of thermodynamics founded on the two fundamental laws.

**M69. Statistical Mechanics.** A study of average properties in a system of a large number of degrees of freedom, with application to kinetic theory and the theory of radiation.

**M70. Theory of Relativity and Gravitation.** Einstein's theory of space, time and gravitation with applications to mechanics and electromagnetic theory.

**M71. Mathematics of Investment.** Such topics as compound interest, annuities, stock and bond problems, capitalization, amortization, sinking funds, etc.

**M72. Differential Equations.** This course is given during the summer to students from the United States Army, the total time being about two hundred and thirty hours. The work starts with a review of calculus, including differentiation, differential properties of curves, rates, maxima and minima, integration, multiple integration, geometrical, mechanical and physical problems; then differential equations of the first order, special types of second order equations, linear equations with constant coefficients, variable coefficients, exact linear and simultaneous linear equations. The application of the calculus and differential equations is illustrated by various problems such as rate of change, rate of cooling, variation of pressure with altitude, variation of concentration, flow of heat, simple harmonic motion, damped vibrations, bending of beams, deflection of columns, equilibrium of cables, rotation of fluids, motion of projectiles, motion with friction, masses coupled together, rotation of rigid bodies, combined translation and rotation, impulse and collision, electric circuits, and coupled circuits. Lastly, the methods of computation and approximation, including Taylor's and Maclaurin's series, Simpson's rule, finite differences, use of mechanical integrator, construction and use of nomographic charts. Textbooks: *E. B. Wilson, Advanced Calculus; H. B. Phillips, Differential Equations; Joseph Lipka, Graphical and Mechanical Computations.*

**M73. Rigid Dynamics.** A course involving the fundamental mechanical principles on the mechanics of rigid bodies.

## MILITARY SCIENCE AND TACTICS

In conformity with the requirements of the Acts of Congress* of July 22, 1862, and August 30, 1890, and Section 1225 of the Revised Statutes of the United States, as amended by Acts of Congress, approved November 3, 1893, and the Acts of the General Court of Massachusetts

*For the endowment, support and maintenance of at least one college whose leading object shall be, without excluding other scientific and classical studies, including military science, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislature of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life. An officer of the regular army with the rank of professor has the work in charge. On the graduation of every class he is required by statute to obtain from the President and report to the Adjutant General of the Army the names of such students belonging to the class as have shown special aptitude for military service and to furnish a copy of this report to the Adjutent General of the State.

in furtherance thereof, the Institute provides instruction in Military Science and Tactics. In addition to the above, and under the provisions of the National Defence Act, an Act of Congress of June 3, 1916, and subsequent acts amendatory thereto, five units of the Senior Division of Reserve Officers' Training Corps have been established.

Male students who take a majority of their studies in the first and second year, or either of these years, are required to satisfactorily complete the military requirements. Aliens, students found physically unfit for military service, and students with military training equivalent to that prescribed by the two-year Basic Course are exempt from military service. Students will be excused from taking portions of the Basic Course in which they demonstrate proficiency. Students desiring relief from any part of the military requirement should consult the Professor of Military Science and Tactics immediately upon registration. Excuses in writing will be issued to such students as are found to be entitled to exemption. No student will be considered relieved from the military requirement without written authority.

The great demand for technically trained officers in the more scientific branches of the Army was most evident during the recent war. The majority of the courses at the Institute, and the excellent facilities available in connection therewith, afford the student an admirable preparation for the scientific duties of an officer of a technical arm of the service. Accordingly, the military training prescribed at Technology is designed to impart the specialized knowledge most essential to supplement the general technical education of the student so as to render his services of the maximum value to the country in time of war as an officer of Coast Artillery, Engineers, Ordnance, Signal Corps or Air Service.

Having satisfactorily completed the two-year compulsory course in military training, the student may elect either of the following options:

1. He may discontinue all further military work; or

2. He may volunteer to pursue the Advanced Course of the Reserve Officers' Training Corps. This binds him to attend one six-week R. O. T. C. summer camp. During the third and fourth academic years, he is required to attend certain additional military instruction. In recognition of his service, the Federal Government allows him commutation of subsistence (amounting at present to 40 cents per day) during his junior and senior years, including the vacation period which intervenes between them; transports him to and from the summer camp, and during the period while he is on duty thereat, feeds and clothes him, provides him with all books and equipment, and supplies quarters and medical attendance. Upon graduation from the Institute he is eligible to receive a Reserve commission for a period of five years in the United States Army, but continues in civil life, subject to call as an officer in time of war, or for not more than fifteen days' service in any year in time of peace. Under present conditions, students who elect to pursue the Advanced Course receive not only their complete support for one six-week period, but in addition are paid over $270 in cash. This is, in effect, a military scholarship, open to all students who are citizens of the United States, physically sound, have made a satisfactory record in their compulsory military training, and display such physical, mental and moral qualifications as, in the judgment of the Professor of Military Science, render them suitable candidates for a commission. The right is reserved to discharge from the Advanced Course any student who is guilty of misconduct, or whose work in any department of the Institute falls below standard, or who is found in any way unfit or unsuitable for the commission for which he is a candidate.

**MS11. Military Science, Junior Freshmen.*** (Required in all courses.)

This course is composed of two weeks of Military Courtesy and Discipline; two weeks of Organization; Administration and Supply; four weeks of Military Law and Rules of Land Warfare and two weeks interior Guard Duty.

**MS12. Military Science, Junior Freshmen.*** (Required in all courses.) This course is composed of ten weeks of Infantry Drill, School of Soldier, Squad, Platoon and Company. Duties of N. C. O's. at Drill, students being detailed in turn to command units of the Company, Ceremonies.

**MS13. Military Science, Junior Freshmen.*** (Required in all courses.) This course is composed of five weeks of Infantry Drill. Students commanding squad, section, platoon and company; three weeks of Hygiene, Sanitation and First Aid, and two weeks of Signal Communication for all Arms.

**MS21. Freshman Military Science.** (Required in all courses.) This course is composed of five weeks of infantry drill, followed by five weeks lectures on Military Courtesy and Discipline, Hygiene, Sanitation and First Aid.

**MS22. Freshman Military Science.** (Required in all courses.) This course embraces lectures on organization, military law, guard duty and signal communication for all arms.

**MS23. Freshman Military Science.** (Required in all courses.) This course continues the infantry drill work started in the first term, and is given over entirely to that subject. As far as practicable freshmen will get experience as officers and as non-commissioned officers.

**MS24. Advanced Coast Artillery (a).** (Optional.) This course extends throughout the junior year, and is required only of students who elect to pursue the advanced course for this arm. Three hours per week are required — one of which is recitation and two outside preparation. The subjects are Orientation, Gunnery and Coast Artillery Material. Students desiring information further than this should consult the Professor of Military Science.

**MS25. Advanced Coast Artillery (b).** (Optional.) This course is a continuation in the senior year of the work started during the junior year. The subjects are Ordnance and Gunnery, Gunnery and Employment of Coast Artillery. See remarks under course 24 above. Courses 24 and 25 with a six-weeks summer camp qualify students for a commission in the Reserve Corps.

**MS26. Advanced Engineering (a).** (Optional.) See remarks under course 24 above. This course includes the study of various field fortifications, demolitions, roads and bridges, etc., comprised in work of the Engineers in wartime.

**MS27. Advanced Engineering (b).** (Optional.) See remarks under course 25 above. This course continues with problems and work of Engineers in war time, with special attention to general construction methods, seacoast fortifications, and relation of Engineers to other branches of the service.

**MS28. Advanced Ordnance.** Open to students in courses II, $III_2$, V, VI-A, X and $XV_2$ subject to certain limitations. In view of the intimate relation between the work of the Ordnance Department and general industry, advanced Ordnance instruction is given by introducing Ordnance subject matter in appropriate subjects of the above courses, by special instruction in that phase of Ordnance Engineering bearing directly on the course the student is following, for which full academic credit is given, and by a brief course of general lectures on Ordnance subjects given by the Ordnance Officer assigned to the Military Science Department. Further information may be obtained from the Professor of Military Science.

* These courses when completed are the equivalent of MS21, 22, 23.

**MS29. Advanced Ordnance.** A continuation of MS28. See description of courses listed above and MS25.

**MS31. Sophomore Military Science.** (Required in all courses.) This course includes a study of small arms and of minor tactics.

**MS32. Sophomore Military Science.** (Required in all courses.) This course includes Field Engineering, Military History and Policy of the United States.

**MS33. Sophomore Military Science.** (Required in all courses.) This course includes map reading and sketching and an option of Coast Artillery material and Motor Transport or general Air Service subjects or Signal Corps instruments.

**MS35. Advanced Signal Corps (a).** (Optional.) See remarks under course 24. Open to students in courses VI, VI-A, VIII and XIV. This course aims to train the student for duty as a company officer with signal troops of a combat organization in the field rather than as a specialist expert on a single phase of Signal Corps work.

**MS36. Advanced Signal Corps (b).** (Optional.) See remarks under course 25 above. Students fulfill the requirement of this course by taking one hundred and eighty hours of the course in Electrical Communication (6·28a and c) or its equivalent.

**MS37. Advanced Air Service (a).** (Optional.) See remarks under course 24 above. This course includes observation of artillery fire, and observation for infantry, machine guns, aërial navigation, telephone, telegraph, radio instruments and aërial photography.

**MS38. Advanced Air Service (b).** (Optional.) See remarks under course 25 above. This course includes study of aërial gas engines and airplane construction.

## PHYSICAL TRAINING

The gymnasium of the Institute is located on the third floor of the Walker Memorial Building fronting on the Esplanade, east of the educational buildings. This gymnasium affords ample accommodation for the training of classes in gymnastics and indoor games.

The gymnasium is open to all students free of charge, and the instruction is especially arranged to fit individual needs. Bronze medals, known as the Cabot Medals for Improvement in Physical Development, are awarded to the five or six men showing the greatest physical improvement for the year. These medals are the gift of the late Samuel Cabot, for many years a member of the Corporation of the Institute.

The Athletic Field gives an opportunity for track-team contests and inter-class games. This field is provided with a quarter-mile running track, straight-away tracks for one hundred yards and two hundred twenty yard dashes, tennis courts, etc. It is under the direction of an Advisory Council on Athletics, composed of alumni and undergraduate students.

**PT15. Physical Training.** Four lectures on the relation of exercise to health and on personal hygiene are given to the first-year class at the beginning of the school year, and all first-year men take a physical examination during the first month from which anthropometric charts are plotted. The class is then divided into four sections for gymnastic exercise, each section having two hours a week for the last five weeks of the first term, two hours a week for the second term and two hours a week for the first five weeks of the third term under the direction of the instructor. All students taking a majority of their studies in the first year, are required to take these lectures and exercises. Regular exercises on the various athletic teams may be substituted for gymnasium work.

## PROFESSIONAL SUMMER SCHOOLS

To bring the students into closer relations with the practical side of their professions, professional summer schools are held in the departments of Civil Engineering, Mining, Metallurgy and Geology, and Chemistry. The students, accompanied by instructors, give their time to field-work, or visit and report on mines or industrial establishments.

**Summer School of Civil Engineering.**—With the exception of brief courses in the manipulation and use of the tape, compass, transit and level, the entire field-work in surveying and railroad engineering is given at Camp Technology on the shore of Gardner's Lake near the village of East Machias, Maine. This locality is well adapted for the carrying out of all the operations involved in the various problems of plane surveying; for performing the field-work necessary for the making of large and small scale topographic maps; and for the making of railroad location surveys. Gardner's Lake is specially favorable for carrying on the field-work necessary to hydrographic surveying. The Machias and East Machias rivers are available for stream gaging, by means of floats and by the various types of meters. Some of the smaller streams afford opportunity for weir measurements.

The camp property comprises about eight hundred and fifty acres of rolling land in the form of a strip varying in width from one-fourth to one mile with a shore line of five miles on the lake. The main group of buildings consists of an administration building connected by covered passages with buildings on either side and in the rear. This group of buildings contains three recitation rooms accommodating some one hundred and thirty students, a drafting-room with space for seventy-two students, a dining-room seating one hundred and sixty, office accommodations for an instructing force of twenty-four, an office for the camp physician, a large lounge room, three sleeping rooms, a camp store and post office, an instrument room, kitchen, icehouse, toilet room and lavatories, and a dormitory for the service staff. Sleeping accommodations are provided by tents with raised wooden floors, each tent furnished with cots and other necessary furniture. In addition to the tents, a wooden barracks building furnishes additional sleeping accommodations for sixteen; this building also provides drafting space for twenty-four and contains a classroom accommodating thirty students. The camp is equipped with sanitary facilities of the most approved type, a wholesome water supply from driven wells and an electric-light plant. A physician is in constant attendance throughout the camp session.

The camp is primarily intended for students of courses I, XI, and XV, option 1, who are required to attend during the months of August and September following their sophomore year. A limited number of students from other courses having the requisite preparation may be admitted by petition. Students in courses III and XII will hereafter be required to take a course in surveying combined with practice in mine surveying in the summer following their third year at an iron mine in New Jersey near Dover. Visits to mines and instruction in field geology will form part of the summer's work, which will occupy about eight weeks. Owing to this change there will be no regular summer school of surveying for these courses during the summer of 1922.

The fee is **$71** for 1·07, 1·08, 1·20 and 1·60. An additional charge of $30 is made for 1·09. The cost of camp operation and maintenance is shared equally by those in attendance.

**Summer School of Surveying.** — Students in courses VI and XV, option 2, are required to take the course in Surveying 1·001 in the early part of the summer following their second year. The instruction is given in Cambridge and vicinity. The fee for this course is **$15.**

# COURSES OF STUDY TABULATED

## SUBJECTS OF INSTRUCTION

The number to the left is the subject number. The numbers under the title are the numbers of the preparatory subjects. Those in italics indicate subjects to be taken simultaneously. To the right of the subjects are noted the Professional Courses which prescribe the subject and the year and term in which the subject is taught. Under the heading " Term and Hours of Exercise and Preparation " the first number shows the hours assigned to Lecture or Recitation in the term of ten weeks, the second the time assigned to preparation. Underneath the first number are the hours for laboratory, drawing or field exercises. To the extreme right is given the name of the teacher in charge of the subject.

Laboratory fees and tuition charges for required Summer Courses will be found on pages 163–166.

### ENTRANCE REQUIREMENTS

**(For description see Circular of General Information)**

**M1** ALGEBRA
**M2** PLANE GEOMETRY
**M3** SOLID GEOMETRY
**M4** TRIGONOMETRY
**E1** ENGLISH
**H1** HISTORY
**L61** FRENCH (Elementary)
**L62** FRENCH II
**L11** GERMAN (Elementary)
**L21** GERMAN II
**800e** PHYSICS
**500e** CHEMISTRY

## CIVIL ENGINEERING — 1·00–1·99

| *No.* | *Subject and Preparation* | *Taken by* | *Year* | *Term and Hours of Exercise and Preparation* 1st Term | 2d Term | 3d Term | *Instructor in Charge* |
|---|---|---|---|---|---|---|---|
| 1·00 | Surveying and Plotting.... M13, D173 | I, IX-B<br>XI<br>XV$_1$ | 2<br>2 | . . . . | 30–60<br>20–40 | 2– 0<br>28<br>12–20<br>28 | Robbins |
| 1·001 | Surveying and Plotting.... M13, D173 | III$_2$<br>VI, XV$_2$ | Summer School 60 — 15 | | | | Hosmer |
| 1·01 | Surveying Instruments..... M13, D173 | XIII | 2 | . . . . | . . . . | 4– 0<br>16 | Robbins |
| 1·02 | Surveying..... M13, D173 | II<br>IV$_2$ | 2<br>3 | 10– 0<br>20<br>10– 0<br>20 | . . . . | . . . . | Howard |
| 1·03 | Surveying..... M22, D173 | III$_1$; XII | 3 | Summer Camp | | 40– 0<br>200 | Howard |
| 1·04 | Underground Surveying.... 1·03 | III$_1$; XII | 3 | Summer Camp | | 20– 0<br>100 | Howard |
| 1·07 | Plane Surveying..... 1·00, M22 | I, XI, XV$_1$<br>IX-B Optional | 2 | Camp Technology 100 hours | | | Robbins |
| 1·08 | Geodetic and Topographic Surveying..... *1·07*, 8·021 | I, XI, XV$_1$<br>IX-B Optional | 2 | Camp Technology 100 hours | | | Robbins |
| 1·09 | Geodetic Surveying..... 1·13 | I Elective | 3 | Camp Technology 150 hours | | | Hosmer |
| 1·11 | Spherical Trigonometry.... M4 | I, IX-B,<br>XV$_1$ | 2<br>2 | 10–20<br>. . . . | . . . .<br>10–20 | . . . .<br>. . . . | Hosmer |
| 1·12 | Astronomy..... *1·00*, 1·11 | I, IX-B, XI<br>XV$_1$ | 2 | . . . . | 30–30 | . . . . | Hosmer |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 1·13 | Geodesy. M22, 1·12 | I | 2 | .. .. | .. .. | 30–30 | Hosmer |
| 1·14 | Geodesy. 1·13 | I (Elective) | G | .. .. | .. .. | 30–30 | Hosmer |
| 1·15 | Navigation. 1·11 | Elective<br>VII$_3$ | 2<br>3 | .. ..<br>.. .. | .. ..<br>.. .. | 20–40<br>20–40 | Hosmer |
| 1·19 | Map Reading and Topographical Drawing. 1·00 | I, IX-B, XI | 2 | .. .. | .. .. | 6–0<br>24 | Howard |
| 1·20 | Railway Fieldwork. 1.00, *1·07* | I, XI, XV$_1$ | | Camp Technology 80 hours | | | Babcock |
| 1·21 | Railway and Highway Engineering. M21, 1·00, 1·20 | I$_{1,2}$<br>I$_3$; XV$_1$<br>XI | 3<br>3<br>3 | 30–55<br>20–40<br>20–40 | 30–30<br>20–30<br>20–25 | .. ..<br>.. ..<br>.. .. | Breed |
| 1·23 | Railway Drafting. 1·20, *1·21* | I$_{1,2}$<br>XI | 3<br>3 | 60– 0<br>60– 0 | 60– 0<br>50– 0 | .. ..<br>.. .. | Babcock |
| 1·24 | Railway and Highway Engineering. 1·20, 1·21, 2·221 and 1·30 for I$_3$ | I$_3$, XV$_1$ | 4 | 30–45 | .. .. | .. .. | Breed |
| 1·25 | Railway Engineering. 1·24 | I$_3$a | 4 | .. .. | 20–40 | 30–50 | Breed |
| 1·26 | Railway Design. 1·23, *1·25* | I$_3$a | 4 | .. .. | 40– 0 | 40– 0 | Breed |
| 1·27 | Railway Engineering. 1·25, 1·26 | Elective | G | 20–40 | 20–40 | 20–40 | Breed |
| 1·28 | Railway Design. 1·26, *1·27* | Elective | G | 30 | 30 | 30 | Breed |
| 1·30 | Roads and Pavements. 1·21 | I$_{1,2}$, XI | 3 | .. .. | .. .. | 20–20 | Breed |
| 1·31 | Testing of Highway Materials. 1·30, 2·36 | I$_3$b | 4 | .. .. | 0–15<br>15 | .. .. | Breed |
| 1·32 | Highway Transportation. 1·24, 1·31, 5·37 | I$_3$b | 4 | .. .. | .. .. | 30–50 | Breed |
| 1·33 | Highway Design. 1·23, 1·24, *1·32* | I$_3$b | 4 | .. .. | .. .. | 40– 0 | Breed |
| 1·39 | Graphic Statics. 8·013 | I | 2 | .. .. | 40–20 | .. .. | Bowman |
| 1·40 | Theory of Structures. 2·21, *2·221* | I$_{1,2}$; IX-B<br>XV$_1$ | 3<br>3 | .. ..<br>.. .. | .. ..<br>.. .. | 40–80<br>40–75 | Bowman |
| 1·41 | Theory of Structures. 2.21, *2·22* or *2·221* | I$_3$, IV$_2$; XI | 3 | .. .. | 20–40 | 20–40 | Sutherland |
| 1·43 | Materials. 2·21, *2·22* or *2·221* | I; IV$_2$; XI; XV$_1$<br>III$_{1,2}$ | 3<br>3 | .. ..<br>.. .. | .. ..<br>.. .. | 20–40<br>30–50 | Sutherland |
| 1·44 | Stationary Structures. 2·21, *2·22* | III$_3$<br>VI (Optional)<br>VI-A (A)<br>VI-A (B) | 4<br>4<br>3<br>4 | .. ..<br>.. ..<br>Summer<br>30–50 | .. ..<br>.. ..<br>30–50<br>.. .. | 30–50<br>30–50<br>.. ..<br>.. .. | Luther |
| 1·45 | Theory of Structures. 2·21 | XIII-A | G | 20–40 | 30–60 | .. .. | Luther |
| 1·48 | Foundations. 1·40 or 1·41 or 1·44 | I; IV$_2$; XV$_1$ | 4 | 10–15 | .. .. | .. .. | Spofford |
| 1·49 | Theory of Structures. 1·40 or 1·41, 1·43 | I$_{1,2}$ | 4 | 40–80 | 50–100 | 30–60 | Spofford |
| 1·50 | Theory of Structures. 1·40 or 1·41, 1·43 | I$_3$; XI, XV$_1$ | 4 | 40–80 | 50–100 | .. .. | Spofford |
| 1·51 | Theory of Structures. 1·40 or 1·41, 1·43 | IV$_2$ | 4 | 40–80 | 50–100 | .. .. | Spofford |
| 1·52 | Structures (Design). *1·45* | XIII-A | G | .. .. | 30– 0 | .. .. | Bowman |
| 1·53 | Bridge Design. *1·49* | I$_{1,2}$ | 4 | 50– 0 | 60– 0 | 70– 0 | Bowman |
| 1·531 | Structural Design. 1·49 or 1·50 | I$_3$ | 4 | 50– 0 | 60– 0 | 30– 0 | Bowman |
| 1·54 | Structural Design. *1·50* | XI, XV$_1$ | 4 | .. .. | 40– 0 | 20– 0 | Bowman |
| 1·55 | Advanced Structural Design 1·49; 1·53 or 4·92; 1·58, *1·56* | Elective | G | .. .. | 60– 0 | 60– 0 | Sutherland |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 1·56 | Advanced Structures..... 1·49, 1·53 | Elective | G | 30–90 | 30–90 | 30–90 | Spofford |
| 1·58 | Reinforced Concrete Design 1·49 or 1·50 or 1·51 | Elective | G | 60–30 | .. .. | .. .. | Sutherland |
| 1·60 | Hydrographic Surveying... *1·07, 1·08* | I; XI; XV$_1$ | | Camp Technology 75 hours | | | Luther |
| 1·62 | Theoretical Hydraulics..... 2·21 | I$_{1,2}$; XI | 4 | 40–80 | .. .. | .. .. | Russell |
| | | XV$_1$ | 4 | 40–70 | .. .. | .. .. | |
| | | I$_3$ | 3 | .. .. | .. .. | 40–60 | |
| 1·63 | Theoretical Hydraulics..... 2·21 | IV$_3$; XIII | 4 | .. .. | 20–40 | .. .. | Russell |
| 1·64 | Theoretical Hydraulics..... 2·21 | IX-B | 3 | .. .. | .. .. | 30–50 | Russell |
| | | III$_3$ | 4 | .. .. | .. .. | 30–40 | |
| | | XV$_3$ | 3 | .. .. | .. .. | 30–60 | |
| | | II | 3 | .. .. | .. .. | 20–40 | |
| | | VI | 4 | 20–40 | 20–40 | .. .. | |
| 1·65 | Theoretical Hydraulics.... 2·20 | VI-A (B) | 4 | .. .. | .. .. | 40–80 | Russell |
| | | VI-A (A) | 5 | Summer | | 40–80 | |
| | | VI-A (A) | | .. .. | 40–80 | .. .. | |
| 1·66 | Hydraulics, Advanced..... 1·62 or equivalent | Elective | G | .. .. | 20–60 | .. .. | Russell |
| 1·68 | Hydraulic Engineering..... 1·62 or 1·64 | II; XV$_3$ | 4 | 30–45 | .. .. | .. .. | Barrows |
| | | XV$_1$ | 4 | .. .. | .. .. | 30–60 | |
| 1·69 | Water Power Engineering.. 1·62 or 1·64 or 1·65 | I$_3$ | 4 | 30–60 | .. .. | .. .. | Barrows |
| 1·70 | Water Power Engineering.. 1·69 | I$_3$ | 4 | .. .. | 30–60 | .. .. | Barrows |
| | | VI (Optional) | 4 | .. .. | .. .. | 30–60 | |
| 1·71 | Water Power Engineering.. 1·70 | I$_3$ | 4 | .. .. | .. .. | 20–20 | Barrows |
| 1·73 | Water Power Engineering.. 1·44 or 1·49 or 1·50; 1·62 or 1·65, 1·71, *1·82* | Elective | G | 30–60 | 30–60 | 60 30–60 | Barrows |
| 1·75 | Hydraulic and Sanitary Engineering..... 1·62 | I$_1$ | 4 | 30–45 | 30–50 | 30–60 | Sampson |
| 1·77 | Sanitary Engineering..... *1·62* | XI | 4 | 20–40 | 20–40 | 40–80 | Sampson |
| 1·79 | Hydraulic and Sanitary Design..... 1·75 | I$_1$ | 4 | .. .. | .. .. | 30– 0 | Sampson |
| 1·80 | Hydraulic and Sanitary Design..... 1·77 | XI | 4 | .. .. | 20– 0 | 60– 0 | Sampson |
| 1·81 | Engineering of Water and Sewage Purification..... 1·75 or 1·77 | Elective | G | 20–40 | 20–40 | .. .. | |
| 1·82 | Water Power Design..... *1·73* | Elective | G | 60– 0 | 60– 0 | 60– 0 | Barrows |
| 1·83 | Sanitary Design..... *1·81* | Elective | G | 60– 0 | 60– 0 | 60– 0 | |
| 1·90 | Report Writing..... EH23 | Elective in I; XI | 4 | .. .. | .. .. | 30–30 | Babcock |

## MECHANICAL ENGINEERING — 2·00–2·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 2·00 | Mechanism..... D101, D171, M11 | II; VI; VI-A; XIII; XV$_3$ | 2 | 30–60 | .. .. | .. .. | Merrill |
| 2·01 | Mechanism..... 2·00 | II; VI; VI-A; XIII; XV$_3$ | 2 | .. .. | 30–60 | .. .. | Merrill |
| 2·02 | Mechanism..... D101, D171, M11 | I; XI; XV$_1$ | 2 | 30–45 | .. .. | .. .. | Merrill |
| | | IX-B | 2 | 30–50 | .. .. | .. .. | |
| | | VIII$_3$, VIII | 2 | 30–60 | .. .. | .. .. | |
| | | III, X | 2 | .. .. | .. .. | 30–60 | |
| | | XIV | Summer School | | | 35–55 | |
| | | XV$_3$ | 2 | 30–30 | .. .. | .. .. | |
| 2·05 | **Mechanism of Machines... 2·00** | II | 3 | 30–40 | .. .. | .. .. | Swett |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 2·06 | Design of Automatic Machinery. 2·05, 2·23 | II | G | Any term, 180 hours | | | Swett |
| 2·10 | Mechanical Engineering Drawing. D123, D172, *2·00* | II; VI; IX-B; XIII XV₂ | 2 | 60– 0 | .. .. | .. .. | James |
| 2·11 | Mechanical Engineering Drawing. 2·10, *2·01* | II | 2 | .. .. | 30– 0 | .. .. | James |
| 2·12 | Machine Drawing. D123 | VI-A | 2 | 60– 0 | .. .. | .. .. | James |
| | | II | 2 | .. .. | .. .. | 60– 0 | |
| | | VI; XIII; XV₂ | 2 | .. .. | 60– 0 | .. .. | |
| | | IX-B | 2 | .. .. | 30– 0 | 30– 0 | |
| 2·13 | Machine Drawing. 2·12 | II | 3 | 30– 0 | .. .. | .. .. | James |
| | | XV₂ | 2 | .. .. | .. .. | 30– 0 | |
| 2·14 | Machine Drawing. D123 | III₂ | Summer School | | 45– 0 | | James |
| 2·20 | Applied Mechanics (Statics) M22, 8·012 | I; IV₂, VI; VIII; IX-B; XI; XIII; XV₁; XV₂ | 2 | .. .. | .. .. | 30–60 | Johnston |
| | | III; XIV; X; XV₂ | 3 | 30–60 | .. .. | .. .. | |
| | | | 3 | .. .. | .. .. | 30–60 | |
| 2·202 | Applied Mechanics M22, 8·012 | II | 2 | .. .. | .. .. | 40–60 | Johnston |
| 2·203 | Applied Mechanics. 8·021, *M22* | VI-A | 2 | .. .. | 40–80 | .. .. | Johnston |
| 2·204 | Applied Mechanics. M13 | IV₁ | 2 | 30–50 | .. .. | .. .. | Johnston |
| 2·21 | Applied Mechanics. (Kinetics — Strength of Materials) 2·20 | I; VI; IX-B; XI; XIII XV₁; XV₂ | 3 | 30–60 | .. .. | .. .. | Johnston |
| | | III | 3 | .. .. | 30–60 | .. .. | |
| | | X | 4 | 30–60 | .. .. | .. .. | |
| 2·211 | Applied Mechanics. (Strength of Materials) 2·20 | VIII, IV | 3 | 30–60 | .. .. | .. .. | Johnston |
| | | XIV | 3 | .. .. | 30–60 | .. .. | |
| | | XV₂, X-B | 4 | 30–60 | .. .. | .. .. | |
| 2·212 | Applied Mechanics. 2·202 | II | 3 | 40–60 | .. .. | .. .. | Johnston |
| | | VI-A (B) | 2 | 60– 0 | .. .. | .. .. | |
| 2·213 | Applied Mechanics. 2·203 | VI-A (A) | 3 | 30–60 | .. .. | .. .. | Johnston |
| | | VI-A (B) | 3 | .. .. | 30–60 | .. .. | |
| 2·214 | Applied Mechanics. 2·204 | IV₁ | 2 | .. .. | 30–50 | .. .. | Johnston |
| 2·215 | Applied Mechanics. | IV₂ | 3 | 30–60 | .. .. | .. .. | |
| 2·22 | Applied Mechanics. 2·21 | IX-B | 3 | .. .. | 30–60 | .. .. | Johnston |
| | | XIII; XV₂ | 3 | .. .. | .. .. | 30–60 | |
| | | III | 3 | .. .. | 30–50 | .. .. | |
| | | VI | 4 | .. .. | 30–60 | .. .. | |
| | | X | Any term 30–60 | | | | |
| | | X-B | | | | | |
| 2·221 | Applied Mechanics. (Strength of Materials) 2·21 | I; XI; XV₁ | 3 | .. .. | 20–30 | 20–30 | Johnston |
| 2·222 | Applied Mechanics. 2·212 | II | 3 | .. .. | 40–60 | .. .. | Johnston |
| 2·223 | Applied Mechanics. | VI-A (A) | 3 | .. .. | .. .. | 30–50 | Johnston |
| 2·224 | Applied Mechanics. 2·214 | IV₁ | 2 | .. .. | .. .. | 30–50 | |
| 2·226 | Applied Mechanics. 2·211 | IV | 3 | .. .. | 30–60 | .. .. | Johnston |
| 2·23 | Applied Mechanics. (Strength of Materials) 2·22 | XV₂ | 3 | .. .. | .. .. | 30–50 | Fuller |
| 2·231 | Applied Mechanics. (Strength of Materials) 2·22 | XIII | 3 | .. .. | .. .. | 30–60 | Fuller |
| 2·232 | Applied Mechanics. 2·222 | II | 3 | .. .. | .. .. | 30–50 | Fuller |
| 2·235 | Applied Mechanics. 2·22 | IV₂ | 3 | .. .. | .. .. | 30–60 | Fuller |
| 2·24 | Applied Mechanics. (Kinetics) 2·22 | VI (Optional) | 3 | .. .. | .. .. | 30–50 | Fuller |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 2·25 | Dynamics of Machines.... 2·23, 2·42 | II | 4 | 30–40 | .. .. | .. .. | Riley |
| 2·262 | Mechanics of Engineering.. 2·25 | II | 4 | .. .. | 20–30 | .. .. | Fuller |
| 2·263 | Mechanics of Engineering.. 2·25 | II | 4 | .. .. | .. .. | 20–40 | Fuller |
| 2·271 | Theory of Elasticity..... | Army Ord. | 4 | .. .. | 30–60 | .. .. | Fuller |
| 2·272 | Theory of Elasticity..... | Army Ord. | 4 | .. .. | .. .. | 30–60 | Fuller |
| 2·28 | Advanced Mechanics and Theory of Elasticity..... 2·262, 2·263 | II | G | 30–90 | 30–90 | 30–90 | Fuller |
| | | U.S.N. Ord. | 4 | 30–60 | 30–60 | .. .. | |
| 2·292 | Ordnance Engineering..... 2·232 | II, R.O.T.C. | 4 | .. .. | 10-10 20 | Ord. Officer | Fuller |
| 2·293 | Ordnance Engineering..... 2·232, 2·292 | II, R.O.T.C. | 4 | .. .. | .. .. | 10–20 40 | Haven |
| 2·302 | Materials of Engineering... 2·22 | II; IX-B; XIII | 3 | .. .. | 20–20 | .. .. | R. S. Williams |
| | | | 4 | .. .. | 20–20 | .. .. | |
| 2·303 | Materials of Engineering... 2·302 | II; IX-B | 3 | .. .. | .. .. | 20–20 | Hayward |
| | | XIII | 4 | .. .. | .. .. | 20–20 | |
| 2·31 | Materials of Engineering... | II, Torpedo | 4 | 20–40 | .. .. | .. .. | Hayward |
| 2·32 | Materials of Engineering... 2·22 | $XV_2$ | 3 | .. .. | .. .. | 20–40 | Hayward |
| 2·33 | Materials and Heat Treatment..... 2·302, 2·352 | $II_{1,2}$ | 4 | .. .. | .. .. | 20–10 | Hayward |
| 2·34 | Physical Metallurgy..... 2·302 | II | G | 20–20 80 | 20–20 80 | 20–20 80 | Fay |
| 2·351 | Testing Materials Laboratory 2·22, 2·303 | II; IX-B | 4 | 20–10 | .. .. | .. .. | Hayward |
| 2·352 | Testing Materials Laboratory 2·351 | II; | 4 | .. .. | 20–20 | .. .. | Hayward |
| | | IX-B | 4 | .. .. | 20–10 | .. .. | |
| 2·36 | Test. Materials Laboratory 2·22 or 2·221 | I; III; XI; XIV | 3 | .. .. | .. .. | 20–10 | Hayward |
| | | $XV_2$ | 4 | 20–10 | .. .. | .. .. | |
| | | $XV_1$; $XV_3$ | 4 | .. .. | 20–10 | .. .. | |
| | | VI-A (B) | 4 | .. .. | .. .. | 20–20 | |
| | | VI-A (A) | 5 | Summer | 20–20 | .. .. | |
| | | VI-A (A) | 4 | .. .. | 20–20 | .. .. | |
| | | X | 4 | .. .. | .. .. | 20–10 | |
| 2·37 | Testing Materials Laboratory 2·22 | $IV_2$ | 4 | 30–10 | .. .. | .. .. | Hayward |
| | | XIII | 4 | 30–15 | .. .. | .. .. | |
| 2·38 | Testing Materials Laboratory (Concrete)..... 2·22 | $IV_2$ | 4 | 5–10 25 | .. .. | .. .. | Hayward |
| 2·40 | Heat Engineering..... M22, 8·023 | II; IX-B | 3 | 30–60 | .. .. | .. .. | Berry |
| | | XIII; $XV_2$ | | | | | |
| | | $III_2$; U.S.N. (Torpedo) | 4 | 30–60 | .. .. | .. .. | |
| 2·41 | Heat Engineering..... 2·01, 2·11 | II; IX-B; $XV_2$ | 3 | 20–10 | .. .. | .. .. | Miller |
| | | $III_2$ | 4 | 20–10 | .. .. | .. .. | |
| | | $III_{1,2}$ | 3 | 20–10 | .. .. | .. .. | |
| 2·411 | Heat Engineering..... 2·01 | XIII | 3 | 20–20 | .. .. | .. .. | Taft |
| 2·42 | Heat Engineering..... 2·40, 2·41 | II; IX-B; XIII; $XV_2$; | 3 | .. .. | 30–60 | .. .. | Berry |
| | | $III_2$; U.S.N. (Torpedo) | 4 | .. .. | 30–60 | .. .. | |
| 2·43 | Heat Engineering..... 2·41 | II; IX-B; $XV_2$; XIV | 3 | .. .. | 20–10 | .. .. | Taft |
| | | $III_2$ | 4 | .. .. | 20–10 | .. .. | |
| 2·432 | Heat Engineering..... 2·43, 2·42 | II | 3 | .. .. | .. .. | 20–10 | Riley |
| 2·44 | Heat Engineering..... 2·42, 2·43 | II | 3 | .. .. | .. .. | 20–30 | Berry |
| | | U.S.N. (Torpedo) | 4 | .. .. | .. .. | 20–40 | |
| 2·451 | Heat Engineering..... 2·44, 2·603 | II; $VII_2$ | 4 | 20–30 | .. .. | .. .. | Berry |
| 2·452 | Heat Engineering..... 2·45 | II | 4 | .. .. | 20–20 | .. .. | Berry |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 2·46 | Heat Engineering..... M22, 2·02, 8·023 | I; XI; Army Ord. | 4 | 30–60 | .. .. | .. .. | Miller |
| | | III$_{1,2}$; X; | | | | | Taft |
| | | XV$_{1,2}$; | 3 | 30–60 | .. .. | .. .. | |
| 2.47 | Heat Engineering..... 2·46 | I; XI; Army Ord. | 4 | .. .. | 30–60 | .. .. | Miller |
| | | III$_{1,2}$; X; | | | | | |
| | | XV$_{1,2}$ | 3 | .. .. | 30–60 | .. .. | |
| 2·48 | Heat Engineering..... 2·47 | I; XI; | 4 | .. .. | .. .. | 30–30 | Miller |
| | | Army Ord. | 4 | .. .. | .. .. | 30–60 | |
| | | X; XV$_{1,2}$ | 3 | .. .. | .. .. | 30–30 | |
| | | XIV | 3 | .. .. | .. .. | 20–20 | |
| 2·50 | Heat Engineering..... M 23, 8·023, 2·01 | VI; VI-A (A); VII$_2$; | 3 | 30–60 | .. .. | .. .. | Taft |
| | | VI-A (B) | 3 | .. .. | 30–60 | .. .. | |
| | | VI | 3 | .. .. | 30–60 | .. .. | |
| 2·51 | Heat Engineering..... 2·50 | VI-A (A) VII$_2$ | 3 | .. .. | .. .. | 30–60 | Taft |
| | | VI | 3 | .. .. | .. .. | 30–60 | |
| 2·52 | Heat Engineering..... 2·51 | VI-A (A) | 4 | Summer | 30–60 | .. .. | Taft |
| | | VI-A (B) | 4 | 30–60 | .. .. | .. .. | |
| 2·53 | Power in Mining..... 8·023, 3·02, M22 | III$_{1,2}$ | 4 | 40–40 | .. .. | .. .. | Jones |
| 2·54 | Advanced Heat Engineering | II | G | 30–90 | 30–90 | 30–90 | Berry |
| 2·55 | Heat Engineering..... 2·42 | U.S.A. (C.A.) U.S.N. (Torpedo) | Sp. | .. .. | .. .. | 30–60 | Berry |
| 2·57 | Mechanical Equipment of Buildings, Heating and Ventilation ..... 8·023 | IV$_2$ | 4 | .. .. | .. .. | 40–40 | Holt |
| 2·58 | Power Plant Design..... 2·45 | II | 4 | .. .. | .. .. | 10–50 0 | Miller |
| 2·602 | Engineering Laboratory.... 2·40, 2·42 | II; XV$_2$ | 3 | .. .. | 20–10 | .. .. | Eames |
| 2·603 | Engineering Laboratory.... 2·40, 2·42 | II, XV$_2$ | 3 | .. .. | .. .. | 20–10 | Eames |
| 2·604 | Engineering Laboratory.... 2·40, 2·42 | XV$_2$ | 4 | .. .. | .. .. | 60–30 | Eames |
| | | VI | 4 | 40–30 | .. .. | .. .. | |
| 2·605 | Engineering Laboratory.... 2·50, 2·51 | VI-A (B) | 4 | .. .. | .. .. | 40–30 | Eames |
| | | VI-A (A) | 4 | .. .. | 40–30 | .. .. | |
| | | VI-A (A) | 5 | Summer | | 40–30 | |
| | | IX-B; X | 4 | 40–20 | .. .. | .. .. | |
| 2·606 | Engineering Laboratory.... 2·40, 2·42 | III$_2$ | 4 | .. .. | .. .. | 20–10 | Eames |
| | | III$_{1,2}$ | 3 | .. .. | .. .. | 20–20 | |
| 2·607 | Engineering Laboratory.... 2·57 | IV$_2$ | 4 | .. .. | .. .. | 10– 0 | Eames |
| 2·608 | Engineering Laboratory.. 2·40, 2·42 | XIII | 3 | .. .. | .. .. | 40–20 | Eames |
| 2·61 | Engineering Laboratory.... 2·603 | II | 4 | 40–40 | .. .. | .. .. | Eames |
| 2·611 | Engineering Laboratory.... 2·603 | XV$_2$ | 4 | 40–40 | .. .. | .. .. | Eames |
| 2·612 | Engineering Laboratory.... 2·605 | X | 4 | .. .. | 20–10 | .. .. | Eames |
| 2·613 | Engineering Laboratory.. 2·608 | XIII | 4 | 20–20 | .. .. | .. .. | Eames |
| 2·614 | Engineerimg Laboratory... 2·613 | XIII | 4 | .. .. | 20–20 | .. .. | Eames |
| 2·62 | Engineering Laboratory..... 2·61 | II | 4 | .. .. | 40–40 | .. .. | Eames |
| 2·621 | Engineering Laboratory.... 2·611 | XV$_2$ | 4 | .. .. | 20–10 | .. .. | |
| 2·631 | Gas Engine Laboratory.... 2·46, 2·47, 2·48 | Army Ord. | | Summer, 214 hours | | | Fales |
| 2·64 | Engineering and Hydraulic Laboratory..... 2·46, 1·62 | I$_{1,2}$;XI;XV$_1$ | 4 | .. .. | .. .. | 30–30 | Eames |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 2·65 | Steam and Hydraulic Laboratory. 1·62, 2·46 | $I_3$ | 4 | . . . . | . . . . | 40–40 | Eames |
| 2·66 | Power Laboratory. 2·46, 2·47, *2·48* | Army Ord. | 4 | . . . . | . . . . | 40–40 | Eames |
| 2·67 | Ordnance Engineering | Army Ord. | | Summer, 218 hours | | | Holmes Hayward |
| 2·681 | Ordnance Engineering | Army Ord. | 4 | 40–80 | . . . . | . . . . | Fuller |
| 2·682 | Ordnance Engineering. 2·681 | Army Ord. | 4 | . . . . | 30–50 | . . . . | Fuller |
| 2·683 | Ordnance Engineering. 2·682 | Army Ord. | 4 | . . . . | . . . . | 20–20 | Fuller |
| 2·685 | Interior Ballistics | Ord. U.S.N. | | . . . . | . . . . | 30–30 | |
| 2·69 | Textile Engineering. 2·754 | $II_3$ | 4 | . . . . | . . . . | 30–30 50 | Haven |
| 2·702 | Machine Design. 2·12, 2·21, 2·22, 2.43 | II | 3 | . . . . | 10– 0 20 | . . . . | Swett |
| 2·703 | Machine Design. 2·702 | II | 3 | . . . . | . . . . | 10– 0 20 | Swett |
| 2·704 | Machine Design. 2·12, 2·22 | $XV_2$ | 4 | 20–10 40 | . . . . | . . . . | Swett |
| 2·71 | Machine Design. 2·703 | II | 4 | 20– 0 40 | . . . . | . . . . | Haven |
| 2·711 | Machine Design. 2·704 | $XV_2$ | 4 | . . . . | 20– 0 40 | . . . . | Haven |
| 2·72 | Machine Design. 2·71 | II | 4 | . . . . | 20– 0 40 | . . . . | Haven |
| 2·732 | Engine Design. 2·25, 2·45, 2·71 | $II_2$ | 4 | . . . . | 40– 0 | . . . . | Riley |
| 2·733 | Engine Design. 2·732 | $II_2$ | 4 | . . . . | . . . . | 60–20 | Riley |
| 2·74 | Advanced Machine Design. 2·72 | II | G | 100– 0 | 100–0 | 100–0 | Haven |
| 2·751 | Automatic Machinery. 2·05, 2·222 | II (Elective) | 4 | . . . . | 20–20 | 20–20 | Swett |
| 2·752 | Mechanical Equipment of Buildings. 2·23, 2·44 or 2·48 | II, $XV_2$ (Elective) | 4 | . . . . | . . . . | 20–20 | Holt |
| 2·753 | Steam Turbine Engineering 2·44, 2·48, 2·52 | II | 4 | . . . . | 20–20 | . . . . | Taft |
| 2·754 | Fire Protection Engineering 2·23, 2·303, 2·352 | II (Elective) | 4 | . . . . | 20–20 | . . . . | Haven |
| 2·755 | Heat Transmission. 2·44 or 2·48 or 2·52 | II (Elective) | 4 | . . . . | 20–20 | . . . . | Berry |
| 2·756 | Heat Treatment. 2·302, 2·352 | II (Elective) | 4 | . . . . | 10– 0 30 | 10– 0 30 | Hayward |
| 2·757 | Internal Combustion Engines 2·25, 2·432 | II (Elective) | 4 | . . . . | 20–20 | 20–20 | Riley |
| | | XIII-A | 4 | . . . . | . . . . | 20–20 | |
| 2·758 | Locomotive Engineering. 2·23 or 2·232 | II (Elective) | 4 | . . . . | 40– 0 | 40– 0 | Fuller |
| 2·759 | Refrigeration. 2·45 | II; $VII_2$ | 4 | . . . . | . . . . | 20–20 | Berry |
| 2·7510 | Theory of Elasticity. 2·23 | II (Elective) | 4 | . . . . | 20–20 | . . . . | Fuller |
| 2·76 | General Engineering Lectures 2·23, 2·44 | II; $XV_2$ | 4 | . . . . | 10– 0 | . . . . | Fuller |
| 2·77 | Industrial Plants. 2·23, 2·44 | II | 4 | . . . . | 50–35 | . . . . | Haven |
| 2·78 | Industrial Plants. 2·23, 2·44 | II (General) | 4 | . . . . | . . . . | 20–10 40 | Haven |
| 2·792 | Automotive Engineering. 2·25, 2·45 | $II_1$ | 4 | . . . . | 20–20 | . . . . | Park |
| 2·793 | Automotive Engineering. 2·792 | $II_1$ | 4 | . . . . | . . . . | 20–20 40 | Park |
| 2·80 | Forging. D123 | XIII | 2 | . . . . | 10– 0 50 | . . . . | Lambirth |
| 2·801 | Forging | II | 2 | 5– 0 25 | . . . . | . . . . | Lambirth |
| 2·802 | Forging | II | 2 | . . . . | 5– 0 25 | . . . . | Lambirth |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 2·81 | Forging..... D123 | III₁ | 4 | .. .. | .. .. | 10– 0 30 | Lambirth |
| 2·82 | Foundry..... D123 | II | 2 | .. .. | 20– 0 40 | .. .. | O'Neill |
| | | XIII | 2 | 20– 0 40 | .. .. | .. .. | |
| 2·83 | Foundry..... D123 | VI | 2 | 10– 0 20 | .. .. | .. .. | O'Neill |
| | | X | 4 | 10– 0 20 | .. .. | .. .. | |
| 2·831 | Foundry..... D123 | III₂ | 4 | 10– 0 30 | .. .. | .. .. | O'Neill |
| | | IX-B | 2 | 10– 0 30 | .. .. | .. .. | |
| 2·84 | Pattern Making..... 2·82 | II | 2 | .. .. | .. .. | 20– 0 30 | O'Neill |
| 2·86 | Vise and Bench Work..... D123 | II; XIII | 3 | 10– 0 30 | .. .. | .. .. | Littlefield |
| 2·87 | Vise and Bench Work..... D123 | VI | 2 | 10– 0 20 | .. .. | .. .. | Littlefield |
| 2·871 | Vise and Bench Work..... D123 | XIV | 2 | 5– 0 15 | .. .. | .. .. | Littlefield |
| 2·88 | Machine Tool Work..... 2·86 | II; XIII | 3 | .. .. 0– 0 | 10– 0 30 | .. .. | R. H. Smith |
| 2·881 | Machine Tool Work..... | Army Ord. | 4 | 120 | .. .. | .. .. | R. H. Smith |
| 2·89 | Machine Tool Work..... 2·87 | VI | 2 | .. .. | 20– 0 40 | .. .. | English |
| 2·90 | Machine Tool Work..... 2·88 | II; XIII | 3 | .. .. | .. .. | 10– 0 30 | R. H. Smith |
| 2·91 | Machine Tool Work..... 2·871 | XIV | 2 | .. .. | 5– 0 15 | .. .. | R. H. Smith |
| 2·911 | Machine Tool Work..... 2·91 | XIV | 2 | .. .. | .. .. | 5– 0 15 | R. H. Smith |
| 2·92 | Machine Tool Work..... 2·90 | II; XIII | 4 | 10– 0 20 | .. .. | .. .. | R. H. Smith |
| 2·95 | Vise and Bench and Machine Tool Work..... D123 | X | 4 | .. .. | 10– 0 20 | .. .. | R. H. Smith |
| | | IX-B | 2 | .. .. | 10– 0 20 | 10– 0 20 | |
| 2·951 | Vise and Bench and Machine Tool Work..... D123 | XV₂ | 4 | .. .. | 10– 0 30 | .. .. | R. H. Smith |
| 2·96 | Mechanical Laboratory.... D123 | XV₂ | | Summer Course 20–0 | | 55 | |
| 2·97 | Machine Tool Work..... 2·95 or 2·96 | X | 4 | .. .. | .. .. | 10– 0 20 | R. H. Smith |
| | | XV₂ | 3 | 10– 0 20 | .. .. | .. .. | |

## MINING ENGINEERING AND METALLURGY — 3·00–3·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 3·01 | Mining Engineering..... 1·04, 8·023, 12·02, 12.30, D173 | III (Elective) | G | .. .. | 30–30 | .. .. | Locke |
| 3·03 | Mining Engineering..... 3·02 | III₁, ₂ | 4 | 20–20 | .. .. | .. .. | Locke |
| 3·04 | Mining Engineering..... 3·03 | III₁, ₂ | 4 | 40–55 | .. .. | .. .. | Locke |
| 3·05 | Mining Engineering..... 12·01 | III (Elective) | G | .. .. | 30–30 | .. .. | Locke |
| 3·06 | Mining Engineering (Adv.) 3·04 | III (Elective) | G | 200 hours | | | Locke |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 3·21 | Ore Dressing. 3·02 | III$_1$ | 3 | .. .. | 40–40 | .. .. | Locke |
| | | III$_{1,\,3}$ | 4 | .. .. | 40–30 | .. .. | |
| | | III (Elective) | G | .. .. | 40–40 | .. .. | |
| | | XII | 3 | .. .. | 40–30 | .. .. | |
| 3·22 | Ore Dressing Laboratory. 3·31, 5·13, *3·21* | III$_1$ | 3 | .. .. | 10–20 70 | .. .. | Locke |
| | | III$_{1,\,3}$ | 4 | .. .. | 10–10 70 | .. .. | |
| 3·23 | Ore Dressing. 3·05, 3·31 | III$_2$ | 3 | .. .. | 20–40 20 | .. .. | Locke |
| | | III$_2$ | 4 | .. .. | 25–10 20 | .. .. | |
| 3·24 | Ore Dressing (Adv.). 3·21, 3·22 | III (Elective) | G | 200 hours | | | Locke |
| 3·31 | Fire Assaying. 5·122, 12·02 | III$_{1,\,3}$ | 3 | 20–20 70 | .. .. | .. .. | Bugbee |
| 3·32 | Fire Assaying and Metallurgical Laboratory. 5·122 | XIV (Optional) | 4 | 20–20 40 | .. .. | .. .. | Bugbee |
| 3·33 | Fire Assaying (Adv.). 3·31 | III (Elective) | G | 200 hours | | | Bugbee |
| 3·43 | Metallurgy of Iron and Steel 3·41, 3·44 | III (Elective) | G | .. .. | .. .. | 25–80 15 | Hayward |
| 3·44 | Metallurgy: General, Zinc and Minor Metals. | III (Elective) | G | .. .. | .. .. | 40–40 | Hofman |
| 3·45 | Metallurgy of Iron and Steel (Adv.). (Elective) | | | | | | |
| 3·46 | Metallurgical Plant Design 3·42, 3·43, 3·44, 3·59 | III (Elective) | G | 200 hours | | | Hayward, Bugbee |
| 3·47 | General Metallurgy (Adv.). | III (Elective) | G | any term 40–80 | | | Hayward |
| 3·48 | Non-Ferrous Metallurgy (Adv.). | III (Elective) | G | any term 40–80 | | | Hayward |
| 3·49 | Metallurgy of Common Metals. | All Courses except III (Elective) | 3,4 | .. .. | 20–20 | 20–20 | Hayward |
| 3·54 | Metallurgical Laboratory and Reports. 3·31, 3·41 | III (Elective) | G | 10–10 80 | .. .. | .. .. | Hofman |
| 3·55 | Metallurgical Laboratory and Reports. 3·31, 3·41, 3·42 | III (Elective) | G | .. .. | 10–15 70 | .. .. | Hayward |
| 3·56 | Metallurgical Plants. | III$_2$ | 4 | .. .. | 40–40 | .. .. | Hayward |
| 3·59 | Metallurgical Calculations. 3·41 and 3·42 or 3·44 | III$_{1,\,2}$ | 4 | 20–20 | .. .. | .. .. | Hayward |
| 3·61 | Metallography. 3·43 or 3·431 | III$_2$ | 3 | .. .. | 60–20 | .. .. | Hayward |
| | | III$_2$ | 4 | 60–20 | .. .. | .. .. | |
| 3·62 | Metallography. 3·61 | III$_2$ | 3 | .. .. | 20– 0 | .. .. | Hayward |
| | | III$_2$ | 4 | 20– 0 | .. .. | .. .. | |
| 3·63 | Metallography. 3·43 or 3·431 | III$_1$ | 4 | 10–10 10 | .. .. | .. .. | Hayward |

## ARCHITECTURE — 4·00–4·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 4·02 | Freehand Drawing. D153 | IV$_1$ | 2 | 40– 0 | 40– 0 | 40– 0 | Brown |
| 4·03 | Freehand Drawing. 4·02 | IV$_1$ | 3 | 40– 0 | 40– 0 | 40– 0 | Brown |
| 4·04 | Life Class. 4·03 | IV$_1$ | 4 | 60– 0 | 60– 0 | 60– 0 | Brown |
| 4·05 | Life Class and Decorative Design. 4·04 | IV$_1$ | G | 60– 0 | 60– 0 | 60– 0 | Brown |
| 4·06 | Water Color. *4·02* | IV$_1$ | 2 | 20– 0 | 20– 0 | 20– 0 | Brown |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 4·11 | Shades and Shadows. D133, D173 | IV | 2 | 30–10 | . . . . | . . . . | Gardner |
| 4·12 | Perspective. D101, D171 | IV$_1$ | 1 | . . . . | 10–30 | 10–20 | Lawrence |
| | | IV$_2$ | 2 | . . . . | 10–30 | . . . . | |
| 4·14 | Applied Perspective. 4·13 | IV$_1$ | 3 | 20– 0 | 20– 0 | 20– 0 | Gardner |
| 4·211 | Office Practice. D133, D153 | IV$_1$ | 2 | . . . . | 40– 0 | 40– 0 | Jenney |
| | | IV$_2$ | 3 | 80– 0 | . . . . | . . . . | |
| 4·212 | Office Practice | IV$_1$ | | Summer 100 hours | | | Jenney |
| 4·22 | Professional Relations. 4·211 | IV$_1$ | 4 | 10– 5 | 10– 5 | 10–10 | Jenney |
| | | IV$_2$ | 3 | 10– 5 | 10– 5 | 10–10 | Ferrand |
| 4·30 | Theory of Design | IV$_1$ | 1 | 10–20 | 10–20 | 10–20 | Remington |
| 4·41 | Architectural History | IV | 1, 2 | 20–40 | 20–40 | 20–40 | Putnam |
| 4·42 | Architectural History. 4·41 | IV | 3 | 10–20 | 20–40 | 20–30 | Putnam |
| 4·46 | European Civilization and Art. EH11 | IV | 3 | 30–40 | 30–40 | 30–40 | Sumner |
| 4·47 | European Civilization and Art. 4·46 | IV | 4 | 30–40 | 30–40 | 30–40 | Sumner |
| 4·49 | History of Renaissance Art | IV (Elective) | 4 | . . . . | . . . . | 10–10 | Walker |
| 4·51 | Philosophy of Architecture. 4·42 | IV | 4 | 10–10 | 10–10 | . . . . | Walker |
| 4·61 | Landscape and Civic Design | IV$_1$ | G | 10–10 | 10–10 | . . . . | Pray |
| 4·63 | Architectural Humanities | IV$_1$ | G | . . . . | . . . . | 10–10 | Adams |
| 4·71 | Design I. D133, D173, D153, *4·11* | IV | 2 | 100– 0 | 100–0 | 140–0 | Gardner |
| 4·72 | Design II. 4·71, 4·02, 4·06 | IV$_1$ | 3 | 140– 0 | 140–0 | 160–0 | Stearns |
| 4·73 | Design III. 4·72, 4·03 | IV$_1$ | 4 | 255– 0 | 275–0 | 330–0 | Dodge |
| 4·74 | Design (Advanced) | IV$_1$ | G | 320– 0 | 320–0 | 350–0 | |
| 4·80 | Building Construction | IV | 3 | 20–10 | . . . . | . . . . | Norton |
| 4·81 | Constructive Design. 2·22 | IV$_1$ | 3 | . . . . | . . . . | 80– 0 | Lawrence |
| 4·82 | Constructive Design. 4·81 | IV$_1$ | 4 | 60– 0 | 40– 0 | . . . . | Lawrence Norton |
| 4·90 | Structural Drawing. D173 | IV$_2$ | 3 | 40–15 | . . . . | . . . . | Norton |
| 4·91 | Structural Design. 2·22 | IV$_2$ | 3 | . . . . | 95– 0 | 70– 0 | Lawrence |
| 4·92 | Structural Design. 4·91 and 1·41 | IV$_2$ | 4 | 165–0 | 180–0 | 150–0 | Lawrence |

## CHEMISTRY — 5·00–5·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 5·01 | Chemistry. M1, E1, 8·00e, 5·00e | All courses except IV$_1$ | 1 | 40–50 40 | . . . . | . . . . | H.M.Smith |
| 5·02 | Chemistry. 5·01 | All courses except IV$_1$ | 1 | . . . . | 40–50 40 | . . . . | Mueller |
| 5·03 | Chemistry. 5·02 | All courses except IV$_1$ | 1 | . . . . | . . . . | 40–50 40 | Phelan |
| 5·05 | Inorganic Chemistry I. 8·022, 5·13 | X | 4 | . . . . | 30–45 | 30–45 | Norris |
| | | X-B | 4 | 30–45 | . . . . | . . . . | Hall Schumb |
| 5·06 | Inorganic Chemistry II. 5·13 | V | 4, G | . . . . | 20–20 | 20–20 | Norris |
| 5·08 | Preparation of Inorganic Compounds. 5·13 | (Elective) | G | . . . . | . . . . | 10–20 60 | Hall |
| 5·09 | Theories and Applications of Catalysis | V, X (Elective) | 4, G | . . . . | . . . . | 30–30 | Underwood |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 5·10 | Qualitative Analysis..... 5·03 | III | 2 | 10–20 110 | .. .. | .. .. | Fay Hall |
| | | VIII | 2 | 10–20 90 | .. .. | .. .. | Williams Hamilton |
| | | IX-A | 2 | 10–20 100 | .. .. | .. .. | |
| | | XI | 2 | 10–15 110 | .. .. | .. .. | |
| | | XII | 2 | 10–20 110 | .. .. | .. .. | |
| | | V | | Summer School | | 35–30 175 | |
| | | VII | | Summer School | | 10–20 100 | |
| | | X | | Summer School | | 35–30 175 | |
| | | XIV | | Summer School | | 35–30 155 | |
| | | XV$_s$ | | Summer School | | 35–30 175 | |
| 5·121 | Quantitative Analysis..... 5·10 | III | 2 | .. .. | 10–20 110 | .. .. | Fay Hall |
| | | V | 2 | 20–20 90 | .. .. | .. .. | Williams Hamilton |
| | | VII | | Summer School | | 10–20 100 | |
| | | VIII | 2 | .. .. | 10–10 130 | .. .. | |
| | | IX-A | 2 | .. .. | 10–10 110 | .. .. | |
| | | X | 2 | 20–20 60 | .. .. | .. .. | |
| | | XI | 2 | .. .. | 10–10 40 | 10–10 40 | |
| | | XII | 2 | .. .. | 10–20 110 | .. .. | |
| | | XIV | 2 | 20–20 70 | .. .. | .. .. | |
| | | XV$_s$ | 2 | .. .. | 10–10 70 | .. .. | |
| 5·122 | Quantitative Analysis..... 5.121 | III | 2 | .. .. | .. .. | 10–10 100 | Fay Hall |
| | | V | 2 | .. .. | 20–20 90 | .. .. | Williams Hamilton |
| | | X | 2 | .. .. | 20–20 70 | .. .. | |
| | | XII | 2 | .. .. | .. .. | 10–20 100 | |
| | | XIV | 2 | .. .. | 20–20 70 | .. .. | |
| | | XV$_s$ | 2 | .. .. | .. .. | 10–10 70 | |
| 5·13 | Quantitative Analysis..... 5·122 | V | 2 | .. .. | .. .. | 20–25 90 | Fay Hall Williams |
| | | X | 2 | .. .. | .. .. | 20–20 70 | Hamilton |
| 5·14 | Analytical Chemistry..... 5·13 | X-A | 4 | .. .. | .. .. | 10–15 50 | Fay Hamilton |
| 5·15 | Qualitative Analysis of Rare Metals..... 5·13 | (Elective) | G | 20–10 120 | .. .. | .. .. | Hall |
| 5·17 | Methods of Electrochemical Analysis..... 5·13 | (Elective) | G | .. .. | 10–20 60 | .. .. | Hall |
| 5·19 | Chemical Literature..... L11, 5·122 | V | 3 | 30–45 | .. .. | .. .. | Hall |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 5·20 | Water Supplies<br>5·121 | VII | 3 | 10–10<br>30 | .. .. | .. .. | Woodman |
| 5·21 | Industrial Water Analysis<br>5·121 | XI | 3 | .. .. | 5– 0<br>25 | .. .. | Woodman |
| 5·22 | Water Supplies and Wastes Disposal<br>5·121 | XI | 4 | 10–20<br>20 | .. .. | .. .. | Woodman |
| 5·25 | Chemistry of Foods<br>5·121, 5·50 or 5·51 | VII$_1$ | 3 | .. .. | .. .. | 20–30<br>80 | Woodman |
| | | VII$_2$ | 3 | .. .. | .. .. | 20–40<br>80 | |
| 5·251 | Chemistry of Foods<br>5·121, 5·50 or 5·51 | (Elective) | 4 | any term 10–10<br>40 | | | |
| 5·26 | Food Analysis (Advanced)<br>5·121, 5·50 or 5·51 | (Elective) | 4 | any term 10–10<br>50 | | | Woodman |
| 5·27 | Chemistry of Plant and Animal Life<br>5·50 or 5·51 | | G | .. .. | 40–80 | .. .. | Mueller |
| 5·29 | Optical Methods in Chemical Analysis<br>5·122, 8·013 | V (Elective) | 4 | any term 30–20 | | | Woodman |
| 5·30 | Proximate Technical Analysis<br>L11, 5·122, 5·50 or 5·51 | V; X; XIV (Optional) | 4 | any term 15–30<br>75 | | | Gill |
| 5·31 | Gas Analysis I<br>5·122 | III$_2$ | 3 | .. .. | .. .. | 20–10 | Gill |
| | | V | 3 | 20–10 | .. .. | .. .. | |
| 5·32 | Gas Analysis II<br>5·31 | (Optional) | 4, G | 30– 0 | .. .. | 30– 0 | Gill |
| 5·33 | Gas and Fuel Analysis<br>5·03 | II; XV$_2$ | 4 | .. .. | 10– 0<br>4 | .. .. | Gill |
| | | (Given in connection with Engineering Laboratory) | | | | | |
| 5·341 | Applied Chemistry<br>5·03 | XIII | 4 | 20–20 | .. .. | .. .. | Gill |
| 5·342 | Applied Chemistry<br>5·03 | II; XV$_2$ (Optional) | 4 | .. .. | 20–20 | 20–20 | Gill |
| 5·343 | Engineering Chemistry<br>5·03 | II; XV$_2$ (Elective) | 4 | .. .. | 20–20 | 20–20 | Gill |
| 5·36 | Testing of Oils<br>5·122, 5·50 | V; X; XIV (Optional) | 4, G | any term 30– 0 | | | Gill |
| 5·361 | Testing of Oils<br>5·03 | II; III; XII; XV$_2$ (Elective) | 4 | .. .. | 10– 5<br>25 | 10– 5<br>25 | Gill |
| 5·37 | Chemistry of Road Materials<br>5·03 | I 2b | 4 | .. .. | 20–10<br>40 | .. .. | Gill |
| | | Optional | G | .. .. | .. .. | 20–10<br>40 | |
| 5·40 | Special Methods and Instruments<br>5·122, 8·013 | V | 3 | .. .. | .. .. | 30–20 | Gill<br>Woodman |
| 5·41 | Metallography I<br>5·122 | V | 3 | .. .. | 20–20<br>20 | .. .. | Fay<br>Williams |
| | | VIII; XIV | 4 | .. .. | .. .. | 20–20<br>20 | |
| 5·42 | Metallography Ia<br>5·122 | (Elective) | G | 20–20<br>20 | .. .. | .. .. | Fay<br>Williams |
| 5·43 | Metallography II<br>5·41 | V; VIII; XIV (Elective) | 4, G | 10–10 | 10–10 | 10–10 | Fay<br>Williams |
| 5·50 | Organic Chemistry<br>5·03 | VII | 2 | 30–30 | .. .. | .. .. | Huntress |
| | | VIII | 4 | 30–30 | .. .. | .. .. | |
| | | IX-A; XI; XIV; XV$_1$ | 3 | 30–30 | .. .. | .. .. | |
| 5·51 | Organic Chemistry I<br>5·13, 8·021 | V | 3 | 40–30 | 40–30 | 30–25 | Moore |
| | | X | 3 | 40–30 | 40–30 | 30–20 | |
| 5·52 | Organic Chemistry II<br>5·51 | V; X | G | 30–30 | 30–30 | .. .. | Norris |
| 5·53 | Organic Chemistry III<br>5·51; 5·561 | (Elective) | G | 20–40 | 20–40 | .. .. | Mulliken |
| 5·54 | Industrial Organic Chemistry (Elecive) | V; X | 4, G | .. .. | 30–30 | .. .. | Underwood |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 5·55 | Organic Qualitative Analysis 5·51, 5·561 | (Elective) | G | 70– 0 | 70– 0 | .. .. | Mulliken |
| 5·561 | Organic Chemical Laboratory | V | 3 | 75– 0 | 120–0 | 145–0 | Moore |
| | 5·13-*5·51* | X | 3 | 70– 0 | 70– 0 | .. .. | |
| 5·562 | Organic Chemical Laboratory | XI | 3 | .. .. | .. .. | 60– 0 | Huntress |
| | | XIV | 3 | .. .. | 70– 0 | .. .. | |
| | *5·50* or *5·51* | XV$_3$ | 3 | 100– 0 | 40– 0 | .. .. | |
| 5·57 | Synthetic Methods of Organic Chemistry 5·51 | V; X (Elective) | G | .. .. | 20–20 | 20–20 | Davis |
| 5·58 | Recent Developments in Organic Chemistry 5·51 or equivalent | V; X; (Elective) | G | 10–20 | 10–20 | 10–20 | Moore |
| 5·59 | Selected Topics in Organic Chemistry 5·51 | (Elective) | G | | | | |
| | (a) Chemistry of Dyes | | | .. .. | .. .. | 20–20 | Mulliken |
| | (b) Chemistry of Powder and Explosives | | | 30–30 | .. .. | .. .. | Davis |
| | (c) Determination of Chemical Constitution for Organic Compounds | | | .. .. | .. .. | 10–20 | Mulliken |
| 5·63 | Thermodynamics and Chemistry | V | G | 20–40 | 20–40 | 20–40 | MacInnes Gillespie |
| 5·64 | Conferences on Current Literature in Physical Chemistry | V | G | 20–40 | 20–40 | .. .. | MacInnes |
| 5·65 | Chemical Principles I M21, 8·021, 5·122 | V | 3 | 40–58 12 | 40–58 12 | 40–58 12 | Sherrill |
| 5·651 | Chemical Principles M21, 8·021, 5·122 | X | 3 | 40–58 12 | 40–58 12 | 40–58 12 | Sherrill |
| 5·66 | Chemical Principles M21, 8·021, 5·122 | V; X | G | 40–60 | 40–60 | 40–60 | Sherrill |
| 5·67 | Chemical Principles II 5·65 | V | 4 | 30–60 10 | .. .. | .. .. | Sherrill |
| 5·68 | Thermochemistry and Chemical Equilibrium M21, 8·021, 5·122 | III$_2$ | 3 | 30–60 | .. .. | .. .. | Mueller |
| | | III | 4 | .. .. | .. .. | 30–60 | |
| | | XII; | 3 | .. .. | .. .. | 40–80 | |
| | | XV$_3$ | 3 | .. .. | .. .. | 40–75 | |
| 5·69 | Colloidal Chemistry 5·51, 5·65 | V | 4 | .. .. | 20–20 | .. .. | Sherrill |
| 5·70 | The Logic of Scientific Inquiry | (Seminar) | G | 20–20 | 20–20 | 20–20 | Davis |
| 5·71 | Physical Chemistry Seminar | V; X; XIV | G | .. .. | 30–30 | 30–30 | Millard |
| 5·731 | Thermodynamics I; Free Energy | V | G | 20–20 | .. .. | .. .. | Sherrill |
| 5·732 | Thermodynamics II; General Theory | V | G | .. .. | 20–20 | .. .. | Keyes |
| 5·74 | Kinetic Theory of Gases, Liquids and Solids M22 | | G | 20–20 | 20–20 | .. .. | Keyes |
| 5·75 | Theories of Atomic Structure 5·02 | (Elective) | 2, 3, 4 | .. .. | .. .. | 10–10 | Blanchard |
| 5·76 | Sub-Atomic Chemistry | V | G | 10–20 | 10–20 | 10–20 | Blanchard |
| 5·80 | Special Courses in Chemistry and Explosives for Ordnance Officers: | | | | | | |
| | (a) General Chemistry | | | 20–30 | .. .. | .. .. | Davis |
| | (b) Chemistry of Powder and Explosives | | | .. .. | 30–30 | .. .. | Davis |
| | (c) Theory of Explosives | | | .. .. | .. .. | 10–10 | Davis |
| | (d) General Chemistry Laboratory | | | 60– 0 | .. .. | .. .. | Davis |
| | (e) Explosives Laboratory | | | .. .. | .. .. | 100–0 | Davis |
| 5·84 | Industrial Application of Chemical Principles 5·65 or 5·66 | V; X; XIV | G | .. .. .. .. | 10–20 10–20 | ..... .. .. | Blanchard |
| 5·90 | Research Problems 5·13 | V | 4 | 160–20 | .. .. | .. .. | Norris |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 5·93 | History of Chemistry..... 5·50 or 5·51 | V | 4 | .. .. | .. .. | 30–30 | Moore |
| 5·94 | Recent Developments in Science..... | V<br>X (Elective) | 4 | 10– 0 | 10– 0 | .. .. | Schumb |
| 5·95 | Thesis..... | V | 4 | .. .. | 150-20 | 200–0 | Norris |
| 5·96 | Thesis Reports..... | V | 4 | .. .. | .. .. | 20–10 | Norris |
| 5·97 | Journal Meeting in Organic Chemistry..... | V (Elective) | G | 10–10 | 10–10 | 10–10 | Norris |
| 5·98 | Research..... | V | G | all terms | | | |
| 5·991 | Research Conferences in Physical Chemistry..... | V | G | 10–10 | 10–10 | 10–10 | Keyes |
| 5·992 | Research Conferences in Organic Chemistry..... | V | G | 10–10 | 10–10 | 10–10 | Norris |

## ELECTRICAL ENGINEERING — 6·00–6·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 6·00 | Principles of Electrical Engineering (Electric and Magnetic Circuits)..... *8·023, M23* | VI; VI-A (B)<br>XIV | 2<br>2 | .. .. | .. ..<br>.. .. | 50–70<br>40–60 | Timbie |
| 6·01 | Principles of Electrical Engineering (Direct Current Machinery)..... 6·00, *M35* | VI; XIV | 3 | 40–60 | .. .. | .. .. | Timbie |
| 6·02 | Principles of Electrical Engineering (Variable and Alternating Currents)..... 6·01 | VI<br>XIV<br>VI-A (B) | 3<br>3<br>3 | .. ..<br>.. .. | 40–60<br>40–60<br>40–60 | .. ..<br>.. ..<br>.. .. | Lawrence<br>Lyon<br>Lawrence |
| 6·03 | Principles of Electrical Engineering (Alternating Current Machinery)..... 6·02 | VI<br>VI-A (A) | 3<br>3 | .. ..<br>.. .. | .. ..<br>.. .. | 40–60<br>40–60 | Lawrence<br>Timbie |
| 6·031 | Principles of Electrical Engineering (Alternating Current Machines)..... 6·02 | XIV | 3 | .. .. | .. .. | 40–60 | Lyon |
| 6·04 | Principles of Electrical Engineering (Alternating Current Machinery)..... 6·03 | VI | 4 | 60–80 | .. .. | .. .. | Lawrence |
| 6·041 | Principles of Electrical Engineering (Alternating Current Machines and Electric Transmission)... 6·03 | XIV | 4 | 50–70 | .. .. | .. .. | Lyon |
| 6·05 | Principles of Electrical Engineering (Transmission Phenomena)..... 6·04 | VI<br>VI-A (A)<br>VI-A (A)<br>VI-A (B) | 4<br>4<br>5<br>5 | .. ..<br>.. ..<br>Summer 60–80<br>60–80 | 60–70<br>60–80<br>.. .. | .. ..<br>.. ..<br>.. .. | Dillon<br>Timbie |
| 6·06 | Principles of Electrical Engineering (Transmission Problems)..... 6·05 | VI<br>VI-A (A) | 4<br>5 | .. ..<br>.. .. | .. ..<br>60–80 | 60–80<br>.. .. | Dillon |
| 6·101 | Principles of Electrical Engineering (Electric and Magnetic Currents)..... 8·023, M22 | VI-A (A) | 2 | .. .. | .. .. | 20–40 | Timbie |
| 6·11 | Principles of Electrical Engineering..... 8.023, 6·101, *M23* | VI-A (A) | 3 | Summer 50–70 | | | Timbie |
| 6·111 | Principles of Electrical Engineering (Direct Current Machinery)..... M23, 6·00 | VI-A (B) | 3 | Summer 20–40 | | | Timbie |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 6·112 | Principles of Electrical Engineering (Direct Current Machinery) 6·00, 6·111 | VI-A (B) | 3 | 20–40 | .. .. | .. .. | Timbie |
| 6·12 | Electrical Engineering (Direct Current Machinery and Alternating Currents) 6·101, 6·11 | VI-A (A) | 3 | 40–60 | .. .. | .. .. | Timbie |
| 6·121 | Principles of Electrical Engineering (Alternating and Variable Currents) 6·12 | VI-A (A) | 3 | .. .. | 20–40 | .. .. | Timbie |
| 6·131 | Principles of Electrical Engineering (Alternating Current Polyphase Circuits) 6·02 | VI-A (B)<br>VI-A (B) | 3<br>4 | .. .. | .. .. | 20–40<br>Summer 20–40 | Timbie |
| 6·14 | Principles of Electrical Engineering (Alternating Current Machinery) 6·131 | VI-A (B) | 4 | 60–80 | .. .. | .. .. | Lawrence<br>Timbie |
| 6·142 | Principles of Electrical Engineering 6·14 | VI-A (B)<br>VI-A (B)<br>VI-A (A) | 5<br>4<br>4 | Summer 20–40<br>.. .. | 20–40 | .. .. | Lawrence<br>Timbie |
| 6·161 | Principles of Electrical Engineering (Transmission Problems) 6·05 | VI-A (A) | 4 | .. .. | .. .. | 20–40 | Dillon |
| 6·162 | Principles of Electrical Engineering (Transmission Problems) 6·16 | VI-A (B) | 5 | .. .. | 30–60 | .. .. | Timbie<br>Dillon |
| 6·20 | Electric Transmission Equipment 6·05 | VI; VI-A (Elective) | 4 | .. .. | .. .. | 30–60 | Dillon |
| 6·21 | Industrial Applications of Electric Power 6·05 | XIII; VI; VI-A (Optional) | 4, G | .. .. | .. .. | 30–60 | Dellenbaugh |
| 6·22 | Central Stations 2·51, 6·05 or equivalent | VI (Elective) | 4 | .. .. | 30–60 | .. .. | Nelson |
| 6·23 | Central Station Design 6·22 or equivalent | VI (Elective) | 4 | .. .. | .. .. | 30–60 | Nelson |
| 6·231 | Cnetral Stations | $I_3$; $XV_2$ | 4 | .. .. | .. .. | 30–60 | Nelson |
| 6·24 | Electric Railways 6·04 | VI (Elective) | 4 | 30–60 | .. .. | .. .. | Dillon |
| 6·25 | Dynamo Design 6·03 | (Optional) | 4, G | 30–60 | .. .. | .. .. | Dellenbaugh |
| 6·26 | Dynamo Design 6·04 | (Optional) | 4, G | .. .. | 30–60 | .. .. | Dellenbaugh |
| 6·27 | Illumination | (Elective) | | .. .. | 30–60 | 30–60 | Drisko |
| 6·28 | Electrical Communication III 6·02, 6·03 or 6·031 | VI (Optional) | 4 | .. .. | .. .. | .. .. | Tucker |
| | (a) Wire Transmission | | | 30–60 | .. .. | .. .. | |
| | (b) Wire Transmission | | | .. .. | 30–60 | .. .. | |
| | (c) Radio Transmission | | | .. .. | .. .. | 30–60 | |
| 6·29 | Storage Batteries | (Optional) | 4 | One term 10–10 | | | Lawrence |
| 6·30 | Electrical Communication I. 6·00, *6·01* | VI (Optional) | 3 | 30–60 | .. .. | .. .. | Tucker |
| 6·31 | Electrical Communication I. 6·00, *6·02* | VI (Optional) | 3 | .. .. | 30–60 | .. .. | Tucker |
| 6·32 | Electrical Communication I. 6·00, *6·03* | VI (Optional) | 3 | .. .. | .. .. | 30–60 | Tucker |
| 6·33 | Electric Wiring and Lighting of Buildings 8·023 | $IV_3$ | 3 | .. .. | 10–20 | .. .. | Hudson |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 6·40 | Elements of Electrical Engineering. 8·023 | XV$_1$ | 3 | 30–40 | .. .. | .. .. | Hudson |
| 6·41 | Elements of Electrical Engineering. 8·023 | I; VIII; | 3 | 30–45 | .. .. | .. .. | Hudson |
| | | IX-B | 3 | 30–60 | .. .. | .. .. | |
| | | II; XIII | 4 | 30–45 | .. .. | .. .. | |
| | | III | 4 | 30–45 | .. .. | .. .. | |
| | | X | 3 | .. .. | .. .. | 30–40 | |
| | | XV$_{2,3}$ | 3 | .. .. | .. .. | 30–45 | |
| 6·42 | Elements of Electrical Engineering. 6·41 | I; VIII | 3 | .. .. | 30–45 | .. .. | Hudson |
| | | II; XIII | 4 | .. .. | 30–45 | .. .. | |
| | | III | 4 | .. .. | 30–45 | .. .. | |
| | | IX-B | 3 | .. .. | 30–60 | .. .. | |
| | | X | 4 | 30–40 | .. .. | .. .. | |
| | | XV$_2$ | 4 | 30–45 | .. .. | .. .. | |
| | | XV$_3$ | 4 | 30–40 | .. .. | .. .. | |
| 6·431 | Elements of Electrical Engineering. | Army Ord. | | 40–40 | .. .. | .. .. | Hudson |
| 6·432 | Elements of Electrical Engineering. | Army Ord. | | .. .. | 30–30 | .. .. | Hudson |
| 6·44 | Electric Transmission and Distribution of Energy... 6·42 | I$_3$ | 4 | 30–60 | .. .. | .. .. | Dillon |
| | | XV$_3$ | 4 | .. .. | 30–45 | .. .. | |
| 6·45 | Alternating Currents and Alternating Current Machinery. | XIII-A | 4 | 30–60 | .. .. | .. .. | Lawrence |
| 6·46 | Alternating Current Machinery and Its Applications. 6·45 | XIII-A | 4 | .. .. | 30–60 | .. .. | Lawrence |
| 6·50 | Electrical Engineering. Seminar | | G | 50– 0 | 50– 0 | 50– 0 | Jackson |
| 6·51 | Alternating Currents. | | G | 20–70 10 | 20–70 10 | 20–70 10 | Bush |
| 6·52 | Alternating Current Machinery. | | G | 20–40 | 20–40 | 20–40 | Lyon |
| 6·53 | Public Service Companies. | | G | 100 | 100 | 100 | Jackson |
| 6·54 | Power Stations and Distribution Systems. | | G | 90 | 90 | 90 | Nelson |
| 6·55 | Electric Railways. | | G | 30–60 | 30–60 | 30–60 | Dillon |
| 6·56 | Electrical Communication of Intelligence. | | G | 90 | 90 | 90 | Kennelly |
| 6·57 | Illumination. | (Elective) | G | 90 | 90 | 90 | Drisko |
| 6·69 | Electrical Engineering Laboratory. 8·023, *6·00* or *6·11* | VI-A (B) | 2 | .. .. | .. .. | 20–40 30 | Laws |
| | | VI-A (A) | 3 | Summer 20–40 30 | | | |
| 6·70 | Electrical Engineering Laboratory (Technical Electrical Measurements). 6·00 | VI | 3 | 6–26 18 | .. .. | .. .. | Laws |
| 6·71a | Electrical Engineering Laboratory (Technical Electrical Measurements). 6·00, 6·70 | VI | 3 | .. .. | 5–20 15 | .. .. | Laws |
| 6·71b | Electrical Engineering Laboratory (Dynamo Electrical Machinery). 6·70, 6·01 | VI | 3 | .. .. | 10–25 15 | .. .. | Dillon |
| 6·72a | Electrical Engineering Laboratory (Technical Electrical Measurements). 6·71, *6·02* | VI | 3 | .. .. | .. .. | 5–20 15 | Laws |
| 6·72b | Electrical Engineering Laboratory (Dynamo Electric Machinery). 6·71, 6·01, 6·02 | VI | 3 | .. .. | .. .. | 10–25 15 | Dillon |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 6·73a | Electrical Engineering Laboratory (Technical Electrical Measurements) .... 6·72, 6·03 | VI | 4 | 0–18 12 | .. .. | .. .. | Laws |
| 6·73b | Electrical Engineering Laboratory (Dynamo Electric Machinery) ..... 6·72, *6·03*, and *6·04* | VI | 4 | 14–48 28 | .. .. | .. .. | Dillon |
| 6·74 | Electrical Engineering Laboratory (Dynamo Electric Machinery) ..... 6·73, 6·04 | VI | 4 | .. .. | 20–60 40 | .. .. | Dillon |
| 6·75 | Electrical Engineering Laboratory ..... *6·112* or 6·12 | VI-A (A) | 3 | 12–30 18 | .. .. | .. .. | Dillon |
| | | VI-A (B) | 3 | .. .. | 12–30 18 | .. .. | |
| 6·76a | Electrical Engineering Laboratory ..... 6·69, 6·121 | VI-A (A) | 3 | .. .. | .. .. | 5–20 15 | Laws |
| 6·76b | Electrical Engineering Laboratory ..... 6·75. 6·121 or *6·131* | VI-A (A) | 3 | .. .. | .. .. | 10–25 15 | Dillon |
| 6·77 | Electrical Engineering Laboratory ..... 6·76, 6·14 | VI-A (A) | 4 | Summer 20 | | | Laws |
| | | VI-A (B) | 4 | 5–25 20 | .. .. | .. .. | |
| 6·78 | Electrical Engineering Laboratory ..... 6·77, 6·14 or 6·15 | VI-A (A) | 4 | .. .. | 10–20 20 | .. .. | Dillon |
| | | VI-A (B) | 4 | .. .. | .. .. | 10–20 20 | |
| | | VI-A (A) | 4 | Summer 20 | 10–20 | | |
| 6·80a, b | Electrical Engineering Laboratory ..... | VI (Elective) | | Any term Time (specially arranged) | | | Laws Dillon |
| 6·81 | Electrical Engineering Laboratory ..... 6·00 | XIV | 3 | 30–30 | .. .. | .. .. | Laws |
| 6·82 | Electrical Engineering Laboratory ..... 6·81, 6·01 | XIV | 3 | .. .. | 8–20 12 | .. .. | Dillon |
| 6·83a | Electrical Engineering Laboratory ..... 6·82, 6·02 | XIV | 3 | .. .. | .. .. | 0–11 9 | Laws |
| 6·83b | Electrical Engineering Laboratory ..... 6·82, 6·02 | XIV | 3 | .. .. | .. .. | 8–20 12 | Dillon |
| 6·84 | Electrical Engineering Laboratory ..... 6·83, 6·031 and *6·041* | XIV | 4 | 10–30 20 | .. .. | .. .. | Dillon |
| 6·85 | Electrical Engineering Laboratory ..... 6·41, *6·42* | $I_3$ | 3 | .. .. | 10–30 20 | .. .. | Laws Dillon |
| | | II; $III_{1,2}$ | 4 | .. .. | .. .. | 10–40 20 | |
| | | $III_3$; $XV_3$ | 4 | .. .. | 10–40 20 | .. .. | |
| | | IX-B | 3 | .. .. | .. .. | 10–40 20 | |
| | | X | 4 | 10–40 20 | .. .. | .. .. | |
| | | $XV_3$ | 4 | .. .. | .. .. | 10–40 20 | |
| | | X-B | | Any term 10–40 20 | | | |
| 6·86 | Electrical Engineering Laboratory ..... 6·40 or 6·41, *6·42* | $I_{1,2}$ | 3 | .. .. | 7–29 14 | .. .. | Laws |
| | | $XV_1$ | 3 | .. .. | .. .. | 7–29 14 | Dillon |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 6·87 | Electrical Engineering Laboratory. 6·45, 6·46 | XIII-A | 4 | .. .. | .. .. | 20–40<br>30 | Dillon |
| 6·88 | Electrical Engineering Laboratory. 6·41, *6·42* | VIII | 3 | .. .. | 10–40<br>20 | .. .. | Dillon |
| 6·90 | Technical Electrical Measurements | VIII | 3 | 30–45 | .. .. | .. .. | Laws |
| 6·91 | Electrical Engineering Laboratory. 6·431, *6·432* | Army Ord. | 4 | .. .. | 10–80<br>50 | .. .. | Laws |
| 6·92 | Electrical Engineering Laboratory. 6·91 | Army Ord. | 4 | .. .. | .. .. | 10–40<br>50 | Dillon |
| 6·95 | Electrical Testing (Advanced) | | G | Specially arranged | | | Laws |
| 6·96 | Electrical Engineering Laboratory. 6·74 or equivalent | | G | Any term | | | Dillon |

## BIOLOGY AND PUBLIC HEALTH — 7·00–7·99

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7·01 | General Biology. 5·01 | VII | 2 | .. .. | 20–30<br>40 | .. .. | Horwood |
| 7·02 | Biology Elements. 5·01 | XI | 3 | 10–10<br>20 | .. .. | .. .. | Horwood |
| 7·03 | Theoretical Biology. 7·01, 7·10, 7·30, 7·50 | VII | 4 | 30–50 | .. .. | .. .. | Turner |
| 7·04 | Cryptogamic Botany. 7·01 | VII | 2 | .. .. | .. .. | 30–30<br>40 | Turner |
| 7·05 | Invertebrate Zoölogy. 7·01 | VII | 2 | .. .. | .. .. | 20–30<br>30 | Turner |
| 7·06 | Microscopy of Waters. 7·01 or 7·02 | VII; XI | 4 | .. .. | .. .. | 10–20<br>10 | Bunker |
| 7·07 | Parasitology. 7·01 | VII | 4 | .. .. | 30–60 | .. .. | Bigelow |
| 7·10 | Anatomy and Histology. 7·01 | VII$_1$ | 3 | 20–50<br>80 | 20–40<br>60 | 20–30<br>40 | Bigelow |
| 7·16 | Introduction to Fisheries. 7·01 | VII$_2$ | 2 | .. .. | .. .. | 10–20 | Bigelow |
| 7·17 | Fish Culture | VII$_2$ | 3 | .. .. | .. .. | 20–40 | Bigelow |
| 7·18 | Applied Ichthyology | VII$_2$ | 3 | 30–20<br>40 | 30–50<br>60 | 20–25<br>40 | Bigelow |
| 7·20 | Physiology. 5·50, 7·10 | VII$_1$ | 3 | .. .. | 30–50<br>20 | 30–80<br>30 | Bunker |
| 7·22 | Personal Hygiene | VII | 4 | 30–30 | .. .. | .. .. | Bunker |
| 7·25 | Nutrition | VII | G | One term 20–40 | | | |
| 7·27 | Biochemistry. 5·50 or 5·51, 5·121 | VII$_1$<br>VII$_1$ | 4, G<br>3 | 30–50<br>30–60<br>50 | .. ..<br>30–60<br>50 | .. ..<br>.. .. | Bunker |
| 7·28 | Selected Topics in Biochemistry. 7·27 | Elective | G | 20–40 | .. .. | .. .. | Bunker |
| 7·29 | General Biology and Bacteriology. 5·122 | V | 2 | .. .. | .. .. | 30–15<br>40 | Horwood |
| | | IX-A | 2 | .. .. | .. .. | 30–60<br>40 | Horwood |
| 7·30 | Bacteriology. 7·01 | VII | 3 | 40–50<br>50 | 30–40<br>50 | .. .. | Prescott |
| 7·31 | Elements of Bacteriology. 7·02 | XI | 3 | .. .. | 20–10<br>30 | .. .. | Horwood |
| 7·32 | Bacteriology of Water and Sewage. 7·31 | XI | 4 | .. .. | 10–10<br>20 | .. .. | Prescott |
| 7·36 | Industrial Microbiology. 7·30, 5·50 or 5·51 | VII$_1$ | 4 | 20–20<br>40 | .. .. | .. .. | Prescott |
| | | Optional | 4 | .. .. | 20–30<br>60 | 20–20<br>60 | |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 7·37 | Technology of Fisheries Products | $VII_3$ | 4 | 20–40<br>60 | 20–40<br>60 | 20–45<br>40 | Prescott |
| 7·38 | Public Health Laboratory Methods<br>7·30, *7·50* | $VII_1$ | 4 | . . . . | 20–20<br>40 | 20–20<br>40 | Slack |
| 7·40 | Oceanography | $VII_2$ | 2 | . . . . | 15–30<br>15 | . . . . | Prescott |
| 7·50 | Infection and Immunity<br>7·01, 7·30 | $VII_1$ | 4 | 40–40 | . . . . | . . . . | Slack |
| 7·53 | Industrial Hygiene and Sanitation<br>7·50 | $VII_1$ | 4 | . . . . | 60–60 | . . . . | Turner |
| 7·54 | Problems and Practice in Public Health<br>7·30 | $VII_1$ | 4 | . . . . | . . . . | 40–70 | Prescott<br>Turner |
| 7·56 | Sanitary Science and Public Health | $I_1$; $IV_2$; XI;<br>$XV_1$<br>VII | 4<br>3 | . . . . | . . . . | 20– 0<br>30–30 | Prescott<br>Turner |
| 7·58 | Vital Statistics<br>M22, 7·01 | $VII_1$<br>XI | 4<br>4 | 30–50<br>20–20 | . . . .<br>. . . . | . . . .<br>. . . . | Horwood |
| 7·64 | Municipal Sanitation<br>7·30 | $VII_1$ | 4 | . . . . | 60–50 | . . . . | Horwood |
| 7·67 | Plant Sanitation<br>7·30 | $VII_2$ | 4 | . . . . | 10–10 | . . . . | Prescott |
| 7·80 | Biological Colloquium | VII | 4 | 10–10 | 10–10 | 10–10 | Prescott |

## PHYSICS — 8·00–8·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 8·011 | Physics (Mechanics)<br>8·00e, M4, *M11* | All courses | 1 | 30–50<br>10 | . . . . | . . . . | Franklin |
| 8·012 | Physics (Mechanics)<br>8·011, M11 | All courses | 1 | . . . . | 30–50<br>10 | . . . . | Barss |
| 8·013 | Physics (Optics)<br>8·012, M12 | All courses except $IV_1$ | 1 | . . . . | . . . . | 30–50<br>10 | Goodwin |
| 8·021 | Physics (Electricity)<br>8·012, M13 | All courses except $IV_1$ | 2 | 30–50<br>10 | . . . . | . . . . | Franklin |
| 8·022 | Physics (Electricity)<br>M21, 8·021 | All courses except $IV_1$ | 2 | . . . . | 30–50<br>10 | . . . . | MacKinnon |
| 8·023 | Physics (Heat)<br>8·022 | All courses except $IV_1$, VI-A (A)<br>VI-A (A) | 2<br>3 | . . . .<br>Summer | . . . .<br>30–50<br>10 | 30–50<br>10 | Wilkes |
| 8·04 | Precision of Measurements<br>8·012 | (Not offered in 1922–23) | | | | | Goodwin |
| 8·06 | Color and Acoustics<br>8·022 | $IV_2$ | 3 | 10–10 | . . . . | . . . . | Derr |
| 8·09 | Physical Instruments<br>8·022 | VIII<br>IX-A | 2<br>3 | . . . . | . . . . | 0–20<br>40<br>0–20<br>40 | Franklin |
| 8·10 | Physics Literature<br>L62 or equivalent, L21 or equivalent | VIII | 2 | . . . . | 20–40 | 20–40 | Derr |
| 8·11 | Heat Measurements<br>8·023 | VIII<br>IX-B | 3<br>4 | . . . .<br>0–20<br>40 | . . . . | 10–40<br>40<br>. . . . | Wilkes |
| 8·12 | Heat Measurements<br>8·023 | XIV<br>$III_2$ | 3<br>3 | . . . . | . . . . | 0–10<br>30<br>. . . . | Wilkes |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 8·13 | Heat Measurements 8·023 | II | 4 | 0–12 12 | .. .. | .. .. | Wilkes |
| | | X | 4 | .. .. | 0–10 10 | .. .. | |
| | | X-A | G | .. .. | 0–10 10 | .. .. | |
| | | IX-A | 3 | 0–20 40 | .. .. | .. .. | |
| 8·14 | Heat Measurements 8·11 or 8·12 | VIII (Elective) | G | 10–40 40 | .. .. | .. .. | Norton |
| 8·15 | Theory of Heat | (Not offered in 1922–23) | | | | | |
| 8·16 | Photography 8·013 | VIII | 3 | 20–30 40 | .. .. | .. .. | Derr |
| 8·17 | Geometrical Optics 8·013 | VIII | 3 | .. .. | 30–60 | .. .. | Derr |
| 8·171 | Geometrical Optics | Army Ord. | G | .. .. | 30–60 30 | .. .. | Derr |
| 8·18 | Physical Optics 8·16, 3·17 | VIII | 3 | .. .. | .. .. | 20–30 40 | Derr |
| 8·20 | Electricity 6·41, 6·90, 8·022, 8·023 | VIII | 3 | .. .. | 20–40 30 | 20–40 30 | Page |
| 8·211 | Electron Theory | VI-A (A) | 4 | .. .. | 20–40 | .. .. | MacKinnon |
| | | VI-A (A) | 3 | .. .. | .. .. | 20–40 | |
| 8·212 | Electron Apparatus 8·211 | VI-A (A) | 5 | Summer, 40–20 | | | MacKinnon |
| | | VI-A (B) | 4 | 40–20 | .. .. | .. .. | |
| 8·231 | Theoretical Physics 8·022, 8·023, M23 | VIII | 3 | 30–60 | .. .. | .. .. | Barss |
| | | IX-C | 3 | 30–60 | .. .. | .. .. | |
| 8·232 | Theoretical Physics 8·022, 8·023, M23 | VIII | 3 | .. .. | 30–60 | .. .. | Page |
| | | IX-C | 3 | .. .. | 30–60 | .. .. | |
| 8·233 | Theoretical Physics 8·022, 8·023, M23 | VIII | 3 | .. .. | .. .. | 30–60 | Franklin |
| | | IX-C | 3 | .. .. | .. .. | 30–60 | |
| 8·24 | Rigid Mechanics | VIII (Elective) | G | 20–70 | 20–70 | 20–70 | |
| 8·27 | Electrodynamics | VIII; VI | G | 20–70 | 20–70 | 20–70 | |
| 8·28 | Electromagnetic Theory | (Not offered in 1922–23) | | | | | |
| 8·29 | Applied Electromagnetism | (Not offered in 1922–23) | | | | | |
| 8·30 | Constitution of Matter 8·20, 8·233 | (Not offered in 1922–23) | | | | | |
| 8·34 | Microscope Theory of Photomicrography 8·16 | Elective | G | 20–40 | .. .. | .. .. | Derr |
| 8·35 | Optical Measurements 8·18 | VIII Elective | 4 | .. .. | 0–30 60 | .. .. | Goodwin |
| | | Elective | G | .. .. | 0–30 60 | .. .. | |
| 8·36 | Theory of Light | VIII (Elective) | 4 | 30–60 | .. .. | 30–60 | Hardy |
| 8·38 | Waves | VIII (Elective) | 4 | .. .. | .. .. | 20–20 | Franklin |
| 8·39 | Kinetic Theory M26 | (Elective) | 4, G | .. .. | .. .. | 20–20 | Franklin |
| 8·40 | Sound | VIII; Army | G | .. .. | 30–60 | 10–50 30 | Barss |
| 8·41 | Physical Materials 8·80, 5·65 | Elective | 4, G | .. .. | .. .. | 20–40 | Knobel |
| 8·43 | Photo-Elasticity | VIII | G | 20–40 | 20–40 | 40–20 | Heymans |
| 8·57 | Aeronautical Instruments | (Elective) | G | Laboratory work by arrangement One term | | 20–40 30 | Young |
| 8·59 | Aeronautics 8·60 | XIII-A | G | .. .. | .. .. | 40–80 | Warner |
| 8·591 | Aeronautics M22, 2·22 | IX-B (Elective) | 4 | .. .. | 30–30 | 30–30 | Warner |
| 8·60 | Airplane Design M23, 2·23 | Aero. Eng. | G | 50–100 | 20–40 | .. .. | Warner |
| 8·601 | Airplane Design M23, 2·23 | Aero. Eng. | G | 0– 0 90 | 0– 0 120 | .. .. | Warner |
| 8·61 | Airship Design M23, 2·23 | Aero. Eng. | G | .. .. | 30–40 | 10–20 | Warner |
| 8·611 | Airship Design M23, 2·23, 8·61 | Aero Eng. | G | .. .. | 0– 0 30 | 0– 0 60 | Warner |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 8·62 | Aerial Propellers. M23, 2·23, 8·60 | Aero. Eng. | G | . . . . | . . . . | 20–30 50 | Warner |
| 8·63 | Aeronautical Laboratory. M23 | Aero. Eng. | G | 25–45 | . . . . | . . . . | Warner |
| 8·631 | Aeronautical Laboratory. M23 | Aero. Eng. | G | 0–40 35 | . . . . | . . . . | Warner |
| 8·64 | Aeronautical Laboratory (Advanced). 8·63, 8·631 | Aero. Eng. | G | . . . . | . . . . | 0–50 20 | Warner |
| 8·65 | Airplane Structures (Adv.). 8·60, 8·601 | Aero. Eng. | G | . . . . | . . . . | 20–60 | Warner |
| 8·66 | Airplane Design (Adv.). 8·60, 8·601 | Aero. Eng. | G | . . . . | . . . . | 20–40 | Warner |
| 8·67 | Wing Theory | Aero. Eng. | G | 20–50 | 20–50 | . . . . | C.L.E.Moore |
| 8·70 | Research in Mathematical Physics | In these Research courses the students work individually and the amount of work in each term is optional jointly with the student and professor | | | | | |
| 8·71 | Research in Electrochemistry | | | | | | Goodwin |
| 8·72 | Research in Industrial Physics | | | | | | Norton |
| 8·73 | Photographic and Optical Research | | | | | | Derr |
| 8·75 | Research in Applied Electrochemistry | | | | | | Thompson |
| 8·76 | Research in Electricity and Magnetism | | | | | | Page |
| 8·77 | Thermal Research | | | | | | Wilkes |
| 8·78 | Aeronautical Research | | | | | | Warner |
| 8·80 | Electrochemistry, Principles of. 8·023, M22 | XIV | 3 | 40–70 | 30–60 | 30–60 | Goodwin |
| | | VIII | 4 | 40–70 | 30–60 | 30–60 | |
| 8·82 | Electrochemistry II. 8·80 or equivalent | XIV | 4 | 30–60 | . . . . | . . . . | Goodwin |
| 8·83 | Electrochemistry III. 5·50 and 8·82 or 5·65 | Elective | 4, G | . . . . | 20–40 | . . . . | Knobel |
| 8·85 | Applied Electrochemistry. 8·82 | XIV | 4 | . . . . | 30–60 | 10–50 | Thompson |
| 8·86 | Electrochemical Laboratory *8·81* | XIV | 4 | 70– 0 | . . . . | . . . . | Goodwin |
| 8·87 | Applied Electrochemical Laboratory. *8·85* | XIV | 4 | . . . . | 70– 0 | . . . . | Thompson |
| 8·89 | Electric Furnaces. 8·023, 5·03 | | G | 10–20 30 | . . . . | . . . . | Thompson |
| 8·90 | Electrochemistry, Elements of. 8·023, 5·03 | III$_2$ | 3 | . . . . | . . . . | 30–40 20 | Thompson |
| 8·93 | Colloquium. 8·82 | XIV | 4 | . . . . | 10–10 | 10–10 | Goodwin |
| 8·98 | Glass Blowing | XIV (Optional) | 4 | 0– 0 15 | . . . . | . . . . | Thompson |

## CHEMICAL ENGINEERING — 10·00–10·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 10·11 | Problems of the Chemical Engineer. 5·03 | X | 2 | 10– 0 | . . . . | . . . . | Lewis |
| 10·15 | Thesis Reports and Memoirs | X | 4 | . . . . | . . . . | 50–30 | Lewis |
| | | X-A | G | . . . . | . . . . | 30–10 | |
| 10·21 | Industrial Chemistry. *5·51* and *5·65* | X | 3 | 40–40 | . . . . | . . . . | Lewis |
| | | XV$_3$ | 3 | 30–30 | . . . . | . . . . | |
| | | XIV | 4 | 30–30 | . . . . | . . . . | |
| | | V | 4 | 40–40 | . . . . | . . . . | |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 10·22 | Industrial Chemistry..... 10·21 | X | 3 | .. .. | 40–40 | .. .. | Lewis |
| | | XV$_3$ | 3 | .. .. | 30–30 | .. .. | |
| | | XIV | 4 | .. .. | 30–30 | .. .. | |
| | | V | 4 | .. .. | 40–40 | .. .. | |
| 10·23 | Industrial Chemistry..... 10·22 | X | 3 | .. .. | .. .. | 20–20 | Lewis |
| | | XV$_3$ | 3 | .. .. | .. .. | 30–35 | |
| | | V | 4 | .. .. | .. .. | 20–20 | |
| 10·25 | Industrial Stoichiometry.. 10·23 | X (Elective) | G | 20–40 | .. .. | .. .. | Robinson |
| 10·31 | Chemical Engineering.... 2·48, *5·65* or *5·66* | X | 4 | 30–40 | .. .. | .. .. | McAdams |
| 10·32 | Chemical Engineering.... 10·31 | X | 4 | .. .. | 30–40 | .. .. | McAdams |
| 10·33 | Chemical Engineering.... 10·32 | X | 4 | .. .. | .. .. | 30–40 | McAdams |
| 10·34 | Chemical Engineering.... 2·48, 5·65 | X-B | 3 | Summer 25–60 | | | Robinson |
| 10·35 | Chemical Engineering.... 10·34 | X-B | 4 | 40–55 | .. .. | .. .. | Robinson |
| 10·36 | Chemical Engineering.... 2·42, 5·68 | XV$_3$ | 4 | 30–30 | 30–30 | .. .. | Robinson |
| **CHEMICAL ENGINEERING II** | | | | | | | |
| 10·41 | Distillation and Evaporation..... 10·33 or 10·35 | X; X-A | G | .. .. | 30–60 | .. .. | Robinson |
| 10·42 | Drying ..... 10·33 or 10·35 | X; X-A | G | .. .. | .. .. | 30–60 | Lewis |
| 10·43 | Extraction..... 10·33 or 10·35 | X; X-A | G | .. .. | .. .. | 20–40 | Robinson |
| 10·44 | Combustion..... 10·31 or 10·34 | X; X-A | G | .. .. | 30–60 | .. .. | Haslam |
| 10·47 | Chemical Engineering Design ..... 10·34 or *10·31* | X | G | 40–80 | .. .. | .. .. | McAdams |
| 10·48 | Chemical Engineering Design ..... 10·33 or 10·35 or 10·47 | X; X-A | G | .. .. | 40–80 | .. .. | McAdams |
| 10·49 | Chemical Engineering Design..... 10·48 | X; X-A | G | .. .. | .. .. | 40–80 | McAdams |
| 10·51 | ndustrial Chemical Laboratory..... 5·122, 5·65, 10·23 | X | 4 | .. .. | 20–20 50 | .. .. | Robinson |
| | | X-B | 3 | Summer School | | 15–15 65 | |
| | | XV$_3$ | 4 | 20–20 70 | .. .. | .. .. | |
| | | V (Optional) | 4 | 20–20 70 | .. .. | .. .. | |
| | | XIV (Optional) | 4 | 20–20 70 | .. .. | .. .. | |
| | | X (Elective) | G | 20–20 70 | .. .. | .. .. | |
| 10·52 | Chemical Engineering Laboratory..... 10·33 | X (Elective) | G | .. .. | .. .. | 40–30 | Lewis |
| 10·61 | Materials of Construction. 5·65, 10·23 or 10·33 | V; X (Elective) | G | .. .. | 30–30 | .. .. | Lewis |
| 10·62 | Applied Chemical Thermodynamics..... 5·65 or 5·66 | V; X (Elective) | G | .. .. | 20–40 | 20–40 | Lewis |
| **INDUSTRIAL CHEMISTRY II** | | | | | | | |
| 10·70 | Sulphuric Acid..... 10.23 | V; X; X-A (Elective) | G | 20–40 | .. .. | .. .. | Phelan |
| 10·71 | Glass and Ceramics.... 10·23 | V; X; X-A (Elective) | G | .. .. | .. .. | 20–40 | Wilson |
| 10·72 | Iron and Steel..... 10·23 | V; X; X-A (Elective) | G | 30–60 | .. .. | .. .. | Haslam |
| 10·73 | Starch and Cellulose.... 10·23, 5·51 | V; X; X-A (Elective) | G | 20–40 | .. .. | .. .. | Venable |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 10·74 | Petroleum..... 10·23 | V; X; X-A (Elective) | G | .. .. | .. .. | 20–40 | Parsons |
| 10·75 | Nitrogen Fixation..... 10·23 | V; X; X-A (Elective) | G | .. .. | 20–40 | .. .. | Wilson |
| 10·77 | Rubber..... 10·23 | V; X; X-A (Elective) | G | .. .. | 20–40 | .. .. | Venable |
| 10·78 | Textiles and Dyeing.... | V; X; X-A (Elective) | G | .. .. | .. .. | 20–40 | Lewis |
| 10·79 | Paints, Oils and Varnishes..... | V; X; X-A (Elective) | G | .. .. | .. .. | 20–40 | Gill |
| 10·91 | Research Conferences..... a. Chemical Engineering b. Applied Chemistry | Students and Staff of Research Laboratories | G | 10–10<br>10–10 | 10–10<br>10–10 | 10–10<br>10–10 | Lewis |
| 10·93 | Automotive Fuel Problems 10·23 | V; X (Elective) | G | .. .. | 20–40 | .. .. | Barnard |
| 10·94 | Organization and Methods of Industrial Research.. 5·66 or 5·65 | V; X (Elective) | G | .. .. | 20–40 | .. .. | Wilson |
| 10·95 | Applied Colloid Chemistry 10·23, 5·65 or 5·66 | V; X (Elective) | G | .. .. | 20–40 | 20–40 | Parsons |
| 10·951 | Applied Colloid Chemical Laboratory..... *10·95* | V; X (Elective) | G | .. .. | 0–30<br>20 | 0–30<br>20 | Parsons |
| 10·96 | Principles of Organic Electro-Chemistry..... 10·23 | V; X (Elective) | G | .. .. | 20–40 | 20–40 | Horsch<br>Venable |
| 10·99 | Seminar in Chemical Engineering and applied Chemistry | X; X-A (Elective) | 4, G | 6– 0 | 6– 0 | 6– 0 | Parsons |

## GEOLOGY — 12·00–12·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 12·01 | Mineralogy..... 5·03 | III; XII | 2 | 10–10<br>50 | .. .. | .. .. | Warren |
| 12·02 | Mineralogy..... 12·01 | III | 2 | .. .. | 10–10<br>50 | .. .. | Warren |
| | | XII | 2 | .. .. | 10–10<br>50 | 10–20<br>50 | |
| 12·03 | Mineralogy..... 5·03 | V | 2 | .. .. | .. .. | 10–15<br>60 | Warren |
| 12·15 | Petrography..... 12·02, 8·013 | XII | 3 | 10–30<br>40 | 10–20<br>50 | 10–10<br>20 | Warren |
| 12·16 | Petrography (Advanced).. 12·15 | XII | G | 10–60<br>50 | 10–60<br>50 | 10–60<br>50 | Warren |
| 12·17 | Chemical Mineralogy and Petrology..... 12·16 | XII | G | .. .. | 30–60 | 30–60 | Warren |
| 12·19 | Crystallography..... 5·03, 8·013 | IX-A | 3 | .. .. | .. .. | 20–20 | Warren |
| | | Elective | | .. .. | .. .. | 20–20 | |
| 12·20 | Physical and Chemical Crystallography..... 12·19, 12·21 | Elective | G | .. .. | .. .. | 30–60<br>30 | Warren |
| 12·21 | Optical Crystallography... 8·013 | Elective | 4, G | 10–20<br>40 | .. .. | .. .. | Warren |
| 12·30 | Geology..... 12·02 | $III_1$ | 3 | 30–40<br>20 | .. .. | .. .. | Jones |
| | | IX-A; XII | | 30–40<br>20 | .. .. | .. .. | |
| 12·301 | Geology..... | $I_{1,2}$; XI | 3 | 30–20 | .. .. | .. .. | Jones |
| | | $I_2$ | 3 | 30–15 | .. .. | .. .. | |
| 12·31 | Geology..... 12·30 | $III_1$, IX-A; XII | 3 | .. .. | 30–30 | .. .. | Jones |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 12·311 | Geology. 12·301 | I; XI | S | .. .. | 10–25 | .. .. | Jones |
| | | | | | 30 | | |
| 12·32 | Geology. 12·02, 12·31 | III$_1$; XII | S | .. .. | .. .. | 40–30 | Jones |
| | | IX-A | S | .. .. | .. .. | 40–20 | |
| 12·321 | Geology. 12·301, 12·311 | I; XI | S | .. .. | .. .. | 15–30 | Jones |
| | | | | | | 15 | |
| 12·33 | Geology, Field. 1·03, 12·02, 12·32 | III$_1$, $_2$; XII | 4 | 40–20 | .. .. | .. .. | Jones |
| 12·34 | Geological Surveying. 12·33 | III$_1$, $_2$ | 4 | .. .. | .. .. | 40–30 | Jones |
| 12·341 | Geological Surveying. 12·15, 12·33 | XII | 4 | .. .. | .. .. | 80–30 | Lindgren |
| 12·35 | Geological Surveying (Advanced). 12·15, 12·34 | XII | G | 60–60 | .. .. | 60–60 | Lindgren |
| 12·40 | Geology, Economic. 12·02, 12·32 | III$_1$, $_2$ | 4 | .. .. | 50–50 | .. .. | Lindgren |
| | | XII | 4 | .. .. | 50–40 | .. .. | |
| | | III$_1$; XII | S | .. .. | .. .. | 50–60 | |
| 12·41 | Geology, Economic. 12·40 | III$_2$ | 4 | .. .. | .. .. | 20–10 | Lindgren |
| | | | | | | 20 | |
| | | XII | 4 | .. .. | .. .. | 20–30 | |
| | | | | | | 40 | |
| 12·42 | Geology, Applied Economic 12·40 | III$_2$; XII | 4 | .. .. | .. .. | 20–20 | Lindgren |
| 12·43 | Geology, Economic (Advanced). 12·40 and 12·41 | XII | G | 60–30 | 60–30 | 60–30 | Lindgren |
| 12·44 | Geology of Coal and Petroleum. 12·32 | XII Elective | 4 | 30–30 | .. .. | .. .. | Jones |
| 12·441 | Valuation of Oil Lands and the Construction of Oil Maps. 12·32 | XII Elective | 4 | .. .. | 20–20 | .. .. | Jones |
| 12·442 | Petroleum Production. 12·32 | XII Elective | 4 | .. .. | .. .. | 30–30 | Jones |
| 12·45 | Geology of Clay, Cement and Building Stone. 12·30, 12·31, 12·32. | XII Elective | 4 | .. .. | .. .. | 20–20 | Jones |
| 12·46 | Geology of Soils, and Soil Examinations. 12·30, 12·31, 12·32 | XII Elective | 4 | .. .. | .. .. | 20–20 | Lindgren |
| 12·47 | Engineering Geology. 12·30, 12·31, 12·32 | XII Elective | 4 | 20–20 | .. .. | .. .. | Jones |
| 12·50 | Geology, Historical. 12·31 | III$_2$; XII | 4 | 20–30 | .. .. | .. .. | Shimer |
| 12·51 | Paleontology. 12·31 | XII | S | 10–40 | 10–40 | .. .. | Shimer |
| | | | | 20 | 20 | | |
| 12·52 | Paleontology (Advanced). 12·51 | Elective | 4 G | .. .. | 10–10 | 10–10 | Shimer |
| | | | | | 50 | 50 | |
| 12·53 | Index Fossils. 12·51 | Elective | | .. .. | 20–30 | .. .. | Shimer |
| | | | | | 50 | | |
| 12·55 | Organic Evolution (Advanced). 12·54 | Elective | G | .. .. | .. .. | 20–40 | Shimer |
| 12·60 | Physiography. 12·30 | XII | 4 | .. .. | 10–30 | .. .. | Shimer |
| | | | | | 20 | | |
| 12·61 | Hydrology. 12·30, 12·31, 12·32 | XII | 4 | .. .. | .. .. | 20–20 | Jones |
| 12·62 | Geological Seminar. 12·02, 12·32 | XII | 4 | 30–60 | 30–60 | .. .. | Jones |
| 12·621 | Geological Seminar (Advanced). | XII | G | 30–60 | 30–60 | 30–60 | Lindgren |
| 12·63 | Geology of North America 12·32, 12·15, 12·50 | XII (Optional) | 4 | .. .. | 30–60 | .. .. | Shimer |
| 12·64 | Geology of Europe. 12·32, 12·15, 12·50 | XII (Optional) | 4 | .. .. | .. .. | 30–60 | Shimer |

## NAVAL ARCHITECTURE AND MARINE ENGINEERING
### 13·00–13·99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| 13·01 | Naval Architecture | XIII | 3 | 20–30 | 20–40 | 20–40 | Jack |
| | | XIII-A | 4 | 20–40 | 20–40 | 20–40 | |
| 13·02 | Naval Architecture 13·01 | XIII | 4 | 20–30 | 30–45 | .. .. | Jack |
| | | XIII-A | G | 20–40 | 20–40 | .. .. | |
| 13·11 | Theory of Warship Design | XIII-A | 4 | 40–40 | 40–40 | 40–40 | Hovgaard |
| 13·12 | Theory of Warship Design | XIII-A | G | 40–40 | 40–40 | 40–40 | Hovgaard |
| 13·14 | Shipyard Practice | XIII-A | 4 | .. .. | .. .. | 30–30 | Jack |
| 13·15 | Shipyard Organization and Management | XIII | 4 | .. .. | .. .. | 20–20 | Jack |
| 13·21 | Warship Design | XIII-A | 4 | 80– 0 | 80– 0 | 80– 0 | Hovgaard |
| 13·22 | Warship Design | XIII-A | G | 80– 0 | 80– 0 | 80– 0 | Hovgaard |
| 13·31 | Ship Construction | XIII | 2 | .. .. | .. .. | 20–20 | Owen |
| 13·32 | Ship Construction 13·31 | XIII | 3 | .. .. | 10–10 | 20–20 | Jack |
| 13·33 | Ship Construction 13·32 | XIII | 4 | 20–20 | 20–20 | 20–20 | Jack |
| 13·35 | Merchant Shipbuilding | XIII-A | G | 30–30 | .. .. | .. .. | Jack |
| 13·41 | Ship Drawing D173, 2·10 | XIII | 2 | .. .. | .. .. | 60– 0 | Owen |
| 13·42 | Ship Drawing 13·41 | XIII | 3 | 50– 0 | 60– 0 | 70 –0 | Owen |
| 13·43 | Ship Drawing 13·42 | XIII | 4 | 70– 0 | 50– 0 | 80 –0 | Owen |
| 13·45 | Model Making | XIII-A | 4 | .. .. | .. .. | 30– 0 | Owen |
| 13·51 | Marine Engineering 2·23, 2·411, 2·42 | XIII | 4 | .. .. | 20–40 | 20–30 | Burtner |
| 13·52 | Marine Engineering Design 13·51 | XIII | 4 | .. .. | 40– 0 | 60– 0 | Burtner |
| 13·53 | Marine Engineering | XIII-A | 4 | 30–30 | .. .. | .. .. | Keith |
| 13·55 | Marine Engine Design | XIII-A | 4 | 50– 0 | 60–30 | .. .. | Keith |
| 13·60 | Steam Turbines | XIII | 4 | 30–60 | .. .. | .. .. | Burtner |

## DIVISION OF DRAWING

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| D101 | Mechanical Drawing | All courses | 1 | 30– 0 | .. .. | .. .. | Breed |
| D122 | Elementary Machine Drawing D101 | All courses except IV | 1 | .. .. | 30– 0 | .. .. | Goodrich |
| D123 | Elementary Machine Drawing D122 | All courses except IV | 1 | .. .. | .. .. | 30– 0 | Goodrich |
| D132 | Elementary Architectural Drawing D101 | IV | 1 | .. .. | 30– 0 | .. .. | Remington |
| D133 | Elementary Architectural Drawing D132 | IV | 1 | .. .. | .. .. | 30– 0 | Remington |
| D151 | Elementary Freehand Drawing | $IV_1$ | 1 | 70– 0 | .. .. | .. .. | Remington |
| D152 | Elementary Freehand Drawing D151 | $IV_1$ | 1 | .. .. | 30– 0 | .. .. | Remington |
| D153 | Elementary Freehand Drawing D152 | $IV_1$ | 1 | .. .. | .. .. | 40– 0 | Remington |
| D171 | Descriptive Geometry M1, M2 | All courses | 1 | 30– 0 | .. .. | .. .. | Kenison |
| D172 | Descriptive Geometry D171 | All courses | 1 | .. .. | 30– 0 | .. .. | Kenison |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| D173 | Descriptive Geometry.... D172 | All courses | 1 | .. .. | .. .. | 30- 0 | Kenison |
| D191 | Descriptive Geometry (College Class)..... M1, M2 | | 1 | 50-40 | .. .. | .. .. | Goodrich |
| D201 | Descriptive Geometry.... D173 | XV$_1$ | 2 | 45- 0 | .. .. | .. .. | Kenison |
| D211 | Descriptive Geometry.... D173 | I | 2 | 60-45 | .. .. | .. .. | Bradley |

## ECONOMICS

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| Ec22 | Political Economy..... EH13 | VII$_1$; XV$_{1,2}$ | 2 | .. .. | 30-30 | .. .. | Doten |
| | | VII$_2$; XV$_2$ | 2 | 30-30 | .. .. | .. .. | Tucker |
| Ec23 | Political Economy..... Ec22 | VII$_1$; XV$_{1,2}$ | 2 | .. .. | .. .. | 30-30 | Doten |
| | | VII$_2$; XV$_2$ | 2 | .. .. | 30-30 | .. .. | Tucker |
| Ec31 | Political Economy..... EH23 | All courses except VII XV | 3 | 30-30 | .. .. | .. .. | Dewey |
| Ec32 | Political Economy..... Ec31 | All courses except VII, XV | 3 | .. .. | 30-30 | .. .. | |
| Ec33 | Political Economy..... Ec32 | All courses except VI-A | 3 | .. .. | .. .. | 30-30 | |
| | | VII,, XV VI-A (A) | 4 | Summer 30-30 | | | |
| | | VI-A (B) | 4 | 30-30 | .. .. | .. .. | |
| Ec37 | Banking..... Ec50, Ec22 | XV | 3 | 30-50 | .. .. | .. .. | Dewey |
| Ec38 | Securities and Investments Ec50, Ec23, Ec57 | XV$_{1,2}$ | 3 | .. .. | .. .. | 30-40 | Dewey |
| | | XV$_2$ | 4 | .. .. | .. .. | 30-40 | Tucker |
| Ec46 | Industrial Relations..... Ec23 or Ec33 | XV | 4 | .. .. | .. .. | 30-45 | Doten |
| Ec50 | Accounting..... EH13 | VII$_1$, XV$_{1,2}$ | 2 | 20-50 20 | .. .. | .. .. | Shugrue |
| | | VII$_2$, XV$_2$ | 2 | .. .. | .. .. | 20-50 20 | |
| | | I$_2$ | 3 | 20-50 20 | .. .. | .. .. | |
| Ec51 | Cost Accounting..... Ec50, *Ec72* | VII$_2$; XV | 4 | .. .. | 20-70 20 | .. .. | Shugrue |
| Ec56 | Industrial Organization... Ec23, Ec50 | VII$_2$; XV | 3 | 30-60 | .. .. | .. .. | Armstrong |
| Ec57 | Industrial Organization... Ec56 | VII$_2$; XV | 3 | .. .. | .. .. | 30-60 | Armstrong |
| Ec60 | Business Law..... Ec57, Ec37 | VII$_2$; XV | 4 | 20-40 | 20-40 | 20-40 | Haussermann |
| Ec65 | Statistics. Ec23 or Ec33, Ec50, Ec37 | VII$_2$; XV | 3 | .. .. | 30-20 | .. .. | Dewey |
| Ec70 | Business Management.... Ec23, Ec57, Ec50..... | VII$_2$; XV | 3 | .. .. | .. .. | 30-45 | Schell |
| | | XIII-A | 4 | .. .. | .. .. | 30-60 | |
| Ec71 | Business Management.... Ec70 | VII$_2$; XV | 4 | 30-60 | .. .. | .. .. | Schell |
| Ec72 | Business Management.... Ec71 | VII$_2$; XV | 4 | .. .. | 30-60 | .. .. | Schell |
| Ec73 | Business Management.... Ec72 | VII$_2$; XV | 4 | .. .. | .. .. | 20-25 | Schell |

## ENGLISH AND HISTORY

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| EH11 | English and History..... H1, E1 | All courses | 1 | 30–50 | .. .. | .. .. | Robinson |
| EH12 | English and History..... EH11 | All courses | 1 | .. .. | 30–50 | .. .. | Robinson |
| EH13 | English and History..... | All courses | 1 | .. .. | .. .. | 30–50 | Robinson |
| E15 | Special Composition..... | As required | | | | | Seaver |
| EH21 | English and History..... EH13 | All courses | 2 | 30–50 | .. .. | .. .. | Rogers |
| EH22 | English and History..... | All courses | 2 | .. .. | 30–50 | .. .. | Rogers |
| EH23 | English and History..... | All courses except VI-A (A) | 2 | .. .. | .. .. | 30–50 | Rogers |
| E31a | English (Committee Work) | VI-A (B) | 3 | Summer, 20–40 | | | Crosby |
| | | VI-A (A) | 2 | .. .. | .. .. | 20–40 | |
| E31b | English (Business English) | VI-A (A) | 3 | .. .. | 20–40 | .. .. | Crosby |
| | | VI-A (B) | 3 | 20–40 | .. .. | .. .. | |
| E32 | English..... | XV | 3 | .. .. | 30–60 | .. .. | Rogers |
| E33 | Report Writing..... | $XV_2$ | 3 | 30–30 | .. .. | .. .. | Prescott |
| | | $XV_{1,2}$ | 3 | .. .. | 30–30 | .. .. | |
| | | $I_2$ | 4 | .. .. | 30–30 | .. .. | |

## GENERAL STUDIES — GS1–GS99

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| GS1 | History of Science..... | All courses | 3, 4 | 20–40 | .. .. | .. .. | Tyler |
| GS2 | History of Science..... | All courses | 3, 4 | .. .. | 30–30 | .. .. | Tyler |
| GS3 | International Law and American Foreign Policy | All courses | 3, 4 | .. .. | 20–40 | .. .. | Tryon |
| GS4 | Business and Patent Law. | All courses except $IV_2$ | 3, 4 | .. .. | .. .. | 30–30 | |
| | | $IV_2$ (required) | 4 | .. .. | .. .. | 30–30 | Haussermann |
| | | XIII-A | 4 | .. .. | .. .. | 20–40 | |
| GS5 | Psychology..... | All courses | 3, 4 | .. .. | 30–30 | .. .. | |
| GS20 | Political and Social Problems..... | All courses | 3, 4 | 30–30 | .. .. | .. .. | Doten |
| GS22 | Marketing Methods..... | All courses | 3, 4 | 30–30 | .. .. | .. .. | Freeland |
| GS23 | Production Methods..... Ec31 | All courses | 3, 4 | .. .. | 30–30 | .. .. | Schell |
| GS25 | Investment Finance..... | All courses | 3, 4 | .. .. | 30–30 | .. .. | |
| GS26 | Banking and Finance..... Ec31, Ec32 | All courses | 3, 4 | .. .. | .. .. | 30–30 | Shugrue |
| GS27 | Economics of Corporations Ec31 | All courses | 3, 4 | .. .. | .. .. | 30–30 | Armstrong |
| GS40 | Contemporary Drama.... | All courses | 3, 4 | 30–30 | .. .. | .. .. | Rogers |
| GS41 | Contemporary English Literature..... | All courses | 3, 4 | .. .. | 30–30 | .. .. | Rogers |
| GS42 | Contemporary European Literature..... | All courses | 3, 4 | .. .. | .. .. | 30–30 | Rogers |
| GS43 | American Literature..... | All courses | 3, 4 | .. .. | .. .. | 30–30 | Rogers |
| GS45 | Advanced English Composition..... | All courses | 3, 4 | 30–30 | .. .. | 30–30 | Copithorne |
| GS46 | Public Speaking..... | All courses | 3, 4 | .. .. | 30–30 | .. .. | Copithorne |
| GS47 | Informal Public Speaking; Committee Reports and Discussions..... | All courses | 3, 4 | .. .. | .. .. | 30–30 | Pearson |
| GS48 | Appreciation of Music.... | All courses | 3, 4 | 30–30 | .. .. | .. .. | Roberts |
| GS49 | Development of Music... | All courses | 3, 4 | .. .. | 30–30 | .. .. | Roberts |
| GS50 | The Fine Arts in Modern Life..... | All courses | 3, 4 | .. .. | .. .. | 30–30 | Seaver |
| GS52 | History (Lincoln)..... | All courses | 3, 4 | 30–30 | .. .. | .. .. | Pearson |
| GS53 | History (Industrial and Social History of the United States)..... | All courses | 3, 4 | .. .. | .. .. | 30–30 | Faulkner |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| GS54 | The Engineering Field | All courses | 3, 4 | 30–30 | .. .. | .. .. | Robinson |
| GS55 | The Human Factor in Business | All courses | 3, 4 | .. .. | 30–30 | .. .. | Robinson |
| GS56 | Engineering Publicity | All courses | 3, 4 | .. .. | .. .. | 30–30 | Robinson |
| GS60 | Geology | All courses except I, III1, 2, IX-A, XI, XII | 3, 4 | 30–30 | .. .. | .. .. | Shimer |
| GS61 | Geology | All courses except I, III1, IX-A, XI, XII | 3 | .. .. | 30–30 | .. .. | Shimer |
| GS64 | Organic Evolution | All courses except IX-A | 3, 4 | .. .. | .. .. | 30–30 | |
| | | IX-A (Required) | 3 | .. .. | .. .. | 30–30 | Shimer |
| GS65 | Sound and Music 8·012, 8·013 | All courses | 3, 4 | 30–30 | .. .. | .. .. | Barss |
| GS66 | Descriptive Astronomy | All courses except IX-A | 3, 4 | .. .. | 24–36 | .. .. | |
| | | IX-A (Required) | 3 | .. .. | 24–36 | .. .. | Derr |
| GS67 | Meteorology 8·012, 8·013 | All courses | 3, 4 | .. .. | .. .. | 20–40 | Townshend |
| GS71 | Principles of Biology and Heredity 8·013, 8·023 | All courses | 3, 4 | 20–40 | .. .. | .. .. | Bigelow |
| GS72 | Industrial Aspects of Bacteriology | All courses | 3, 4 | .. .. | 20–40 | .. .. | Horwood |
| GS73 | Sanitary Science and Public Health | All courses | 3 | .. .. | .. .. | 30–30 | Prescott Turner |
| GS82 | French (Adv.), French History L62 or L63 | All courses | 3, 4 | 30–30 | 30–30 | 30–30 | Langley |
| GS83 | French (Adv.), French Literature L62 or L63 | All courses | 3, 4 | 30–30 | 30–30 | 30–30 | Langley |
| GS91 | German (Adv.) Literature L21 | All courses | 3, 4 | .. .. | 30–30 | .. .. | Vogel |
| GS92 | German (Adv.) L21 | All courses | 3, 4 | .. .. | 30–30 | 30–30 | Vogel |
| GS94 | German (Adv.) Sight Reading L21 | All courses | 3, 4 | 30–30 | 30–30 | 30–30 | Vogel |
| GS95 | German (Adv.) Life of German Scientific Men L21 | All courses | 3, 4 | 30–30 | 30–30 | 30–30 | Vogel |
| GS96 | German (Adv.), Faust L21 | All courses | 3, 4 | .. .. | 30–30 | 30–30 | Vogel |
| GS97 | German (Adv.), Commercial Correspondence L21 | All courses | 3, 4 | .. .. | 30–30 | 30–30 | Vogel |

## MODERN LANGUAGES

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| L11 | German (Elementary) | | | 30–60 | 30–60 | 30–60 | Vogel |
| L12 | German (Elementary) | X | 2 | 40–60 | 40–60 | 40–60 | Vogel |
| L21 | German (Intermediate) L11 | | | 30–60 | 30–60 | 30–60 | Vogel |
| L22 | German (Intermediate) | X | 2 | 40–60 | 40–60 | 40–60 | Vogel |
| L31 | German (Advanced) L21 | | 3 | 30–30 | .. .. | .. .. | Vogel |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| L32 | German (Advanced)..... L21 | | 3, 4 | .. .. | 30–30 | .. .. | Vogel |
| L33 | German (Advanced)..... L21 | | 3, 4 | .. .. | .. .. | 30–30 | Vogel |
| L37 | German (Technical) | X | 2 | 20–30 | 20–30 | 20–30 | Vogel |
| L43 | German (Advanced) L21 | (Elective) | | .. .. | 30–30 | 30–30 | Vogel |
| L61 | French (Elementary)..... | | | 30–60 | 30–60 | 30–60 | Langley |
| L62 | French (Intermediate)..... L61 | | | 30–60 | 30–60 | 30–60 | Langley |
| L63 | French (Intermediate)..... L61 | IV1 | 1 | 20–40 | 20–40 | 20–40 | Langley |
| L64 | French Technical..... L61 | | 2 | 30–50 | .. .. | .. .. | Langley |
| L67 | French (Elementary) | X | 2 | 20–30 | 20–30 | 20–30 | Langley |
| L71 | French (Advanced)..... L62 or L63 | IV1 | 2 | 20–30 | 20–30 | .. .. | Langley |
| L81 | Spanish (Elementary)..... | (Elective) | 3, 4 | 30–60 | 30–60 | 30–60 | Langley |

## MATHEMATICS

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| M11 | Mathematics (Calculus and Analytic Geometry) .... M1, M2, M3, M4 | All courses | 1 | 30–60 | .. .. | .. .. | Tyler |
| M12 | Mathematics (Calculus and Analytic Geometry)..... M11 | All courses | 1 | .. .. | 30–60 | .. .. | Bailey |
| M13 | Mathematics (Calculus and Analytic Geometry)..... M12 | All courses | 1 | .. .. | .. .. | 30–60 | George |
| M15 | Slide Rule..... | (Elective) | | Four exercises. | | | Lipka |
| M21 | Mathematics (Calculus)... M13 | All courses | 2 | 30–60 | .. .. | .. .. | Woods |
| M22 | Mathematics (Differential Equations)..... M21 | All courses | 2 | .. .. | 30–60 | .. .. | Bartlett |
| M23 | Mathematics (Differential Equations)..... M22 | All courses except IV1, V, VI-A (A), VII, X | 2 | .. .. | .. .. | 30–60 | Phillips |
| | | VI-A (A) | 3 | Summer, 30–60 | | | |
| M26 | Theory of Probability and Method of Least Squares M13 | IX-C | 4 | 20–20 | .. .. | .. .. | Bartlett |
| M27 | Mathematics (Statics)..... *M22* | (Elective) | | 30–60 | .. .. | .. .. | Moore |
| M28 | Mathematics (Kinematics). *M23* | (Elective) | | .. .. | 30–60 | .. .. | Moore |
| M29 | Mathematics (Dynamics).. *M22* | (Elective) | | .. .. | .. .. | 30–60 | Moore |
| M35 | Mathematics..... M23 | VI; VI-A (B) | 3 | .. .. | 30–60 | .. .. | |
| | | VI-A (A) | 3 | Summer, 30–60 | | | |
| M36 | Mathematics (Advanced Calculus and Differential Equations)..... M22 | VIII | 4 | 30–60 | .. .. | .. .. | Woods |
| | | IX-C | 3 | 30–60 | .. .. | .. .. | |
| M37 | Mathematics (Advanced Calculus and Differential Equations)..... M36 | VIII | 4 | .. .. | 30–60 | .. .. | Woods |
| | | IX-C | 3 | .. .. | 30–60 | .. .. | |
| M38 | Mathematics (Advanced Calculus and Differential Equations)..... M37 | VIII | 4 | .. .. | .. .. | 30–60 | Woods |
| | | IX-C | 3 | .. .. | .. .. | 30–60 | |

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| M41 | Mathematics (Applied).... M22 | X; X-B | 4 | 30–60 | .. .. | .. .. | Hitchcock |
| M43 | Theoretical Aeronautics... | IX-C | 4 | 30–60 | 30–60 | 30–60 | Moore |
| M45 | Fourier's Series..... | (Elective) | | 20–60 | 20–60 | 20–60 | Wiener |
| M50 | Applications of Mathematics to Chemistry..... M22 | (Elective) | G | .. .. | 30–60 | .. .. | Hitchcock |
| M54 | Mathematical Laboratory. M22 | IX-B; IX-C | 4 | .. .. | 20–40 | .. .. | Lipka |
| | | (Elective) | 3,4,G | .. .. | 20–40 | .. .. | |
| M55 | Mathematical Laboratory.. | IX-B; IX-C | 4 | .. .. | .. .. | 20–40 | Lipka |
| | | (Elective) | 3,4,G | .. .. | .. .. | 20–40 | |
| M56 | Theory of Functions..... | (Elective) | | .. .. | 20–60 | 20–60 | Rutledge |
| M57 | Theory of the Gyroscope.. | Navy Ordnance | | .. .. | .. .. | 20–40 | |
| | | Navy Torpedo | | .. .. | .. .. | 20–40 | |
| M60 | Vector Analysis..... | (Elective) | | 20–60 | .. .. | .. .. | Zeldin |
| M61 | Mechanics of Rigid Bodies | (Elective) | | .. .. | 20–60 | .. .. | Moore |
| M62 | Modern Algebra..... | (Elective) | | .. .. | .. .. | 20–60 | Rutledge |
| M63 | Higher Geometry..... | (Elective) | | 20–60 | 20–60 | 20–60 | Woods |
| M64 | Modern Analysis..... | (Elective) | | 20–60 | 20–60 | 20–60 | Woods |
| M65 | Analytical Mechanics..... | (Elective) | | 20–60 | 20–60 | 20–60 | |
| M66 | Theory of Sound..... | (Elective) | | 20–60 | .. .. | .. .. | |
| M67 | Heat Conduction..... | (Elective) | | .. .. | 20–60 | .. .. | |
| M68 | Thermodynamics..... | (Elective) | | .. .. | 20–60 | .. .. | Phillips |
| M69 | Statistical Mechanics..... | (Elective) | | .. .. | .. .. | 20–60 | Phillips |
| M70 | Theory of Relativity and Gravitation..... | (Elective) | | 20–40 | 20–40 | .. .. | Moore Phillips |
| M71 | Mathematics of Investment..... | (Elective) | | Any term, 20–60 | | | Taylor |
| M72 | Differential Equations..... | Army Ord. | | Summer, 229 hours | | | |
| M73 | Rigid Dynamics..... | XIII-A | G | .. .. | 20–40 | 30–60 | |

## PHYSICAL TRAINING

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| PT15 | Physical Training..... | All courses | 1 | 10– 0 | 20– 0 | 10– 0 | Kanaly |

## MILITARY SCIENCE AND TACTICS

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| MS11 | Military Science*..... | 1 J. G. | | 30– 0 | .. .. | .. .. | |
| MS12 | Military Science*..... | 1 J. G. | | .. .. | 30– 0 | .. .. | |
| MS13 | Military Science*..... | 1 J. G. | | .. .. | .. .. | 30– 0 | |
| MS21 | Freshman Military Science | All courses | 1 | 30– 0 | .. .. | .. .. | |
| MS22 | Freshman Military Science | All courses | 1 | .. .. | 30– 0 | .. .. | |
| MS23 | Freshman Military Science (Drill only) | All courses | 1 | .. .. | .. .. | 30– 0 | |
| MS24 | Advanced Coast Artillery (a)..... 21-22-23, 31-32-33 | Optional | 3 | 10–20 | 10–20 | 10–20 | |
| MS25 | Advanced Coast Artillery (b)..... 21-22-23, 31-32-33 and 24 | Optional | 4 | 10–20 | 10–20 | 10–20 | |
| MS26 | Advanced Engineering (a) 21-22-23, 31-32-33 | Optional | 3 | 10–20 | 10–20 | 10–20 | |

* These courses when completed are the equivalent of MS21, 22, 23.

| No. | Subject and Preparation | Taken by | Year | Term and Hours of Exercise and Preparation 1st Term | 2d Term | 3d Term | Instructor in Charge |
|---|---|---|---|---|---|---|---|
| MS27 | Advanced Engineering (b) 21-22-23, 31-32-33 and 26 | Optional | 4 | 10–20 | 10–20 | 10–20 | |
| MS28 | Advanced Ordnance (a) 21-22-23, 31-32-33 | Optional | 3 | .. .. | .. .. | 10–20 | |
| MS29 | Advanced Ordnance (b) 21-22-23, 31-32-33, 28 | Optional | 4 | 30–60 | ** | ** | |
| MS31 | Sophomore Military Science | All courses | 2 | 30– 0 | .. .. | .. .. | |
| MS32 | Sophomore Military Science | All courses | 2 | .. .. | 30– 0 | .. .. | |
| MS33 | Sophomore Military Science | All courses except VI-A (A) | 2 | .. .. | .. .. | 30– 0 | |
| | | VI-A (A) | 3 | Summer, 30–0 | | | |
| MS35 | Advanced Signal Corps (a) 21-22-23, 31-32-33 | Optional | 3 | 20–10 | 10–20 | 10–20 | |
| MS36 | Advanced Signal Corps (b) 21-22-23, 31-32-33 and 35 | Optional | 4 | 30–60 | (Subject 628) | | 30–60 |
| MS37 | Advanced Air Service (a) 21-22-23, 31-32-33 | Optional | 3 | 10–20 | 10–20 | 10–20 | |
| MS38 | Advanced Air Service (b) 21-22-23, 31-32-33 and 37 | Optional | 4 | 10–20 | (Subject 859) | 20–30 | 20–30 |

** Special electives pertaining to Ordnance required in 4th year, average approximately 30–60 hours, for which full academic credit is allowed.

# LABORATORY FEES

The following Laboratory Fees will become effective on and after October 1, 1922. These fees are subject to revision due to any additions or changes in courses, etc.

## CIVIL ENGINEERING

| Subject No. | Subject | Term 1 | Term 2 | Term 3 |
|---|---|---|---|---|
| 131 | Testing of Highway Materials | .... | $3.00 | .... |

## MECHANICAL ENGINEERING

| Subject No. | Subject | Term 1 | Term 2 | Term 3 |
|---|---|---|---|---|
| 2·292 | Ordnance Engineering | .... | $4.00 | .... |
| 2·293 | Ordnance Engineering | .... | .... | $8.00 |
| 2·34 | Physical Metallurgy | $16.00 | 16.00 | 16.00 |
| 2·351 | Testing Materials Laboratory | 4.00 | .... | .... |
| 2·352 | Testing Materials Laboratory | .... | 4.00 | .... |
| 2·36 | Testing Materials Laboratory | 4.00 | 4.00 | 4.00 |
| 2·37 | Testing Materials Laboratory | 6.00 | .... | .... |
| 2·38 | Testing Materials Laboratory | 5.00 | .... | .... |
| 2·602 | Engineering Laboratory | .... | 4.00 | .... |
| 2·603 | Engineering Laboratory | .... | .... | 4.00 |
| 2·604 | Engineering Laboratory | .... | .... | 12.00 |
| 2·605 | Engineering Laboratory | 8.00 | .... | 8.00 |
| 2·606 | Engineering Laboratory | .... | .... | 4.00 |
| 2·607 | Engineering Laboratory | .... | .... | 2.00 |
| 2·608 | Engineering Laboratory | .... | .... | 8.00 |
| 2·61 | Engineering Laboratory | 8.00 | .... | .... |
| 2·611 | Engineering Laboratory | 8.00 | .... | .... |
| 2·612 | Engineering Laboratory | .... | 4.00 | .... |
| 2·613 | Engineering Laboratory | 4.00 | .... | .... |
| 2·614 | Engineering Laboratory | .... | 4.00 | .... |
| 2·62 | Engineering Laboratory | .... | 8.00 | .... |
| 2·621 | Engineering Laboratory | .... | 4.00 | .... |
| 2·64 | Engineering and Hydraulic Laboratory | .... | .... | 6.00 |
| 2·65 | Steam and Hydraulic Laboratory | .... | .... | 8.00 |
| 2·66 | Power Laboratory | .... | .... | 8.00 |
| 2·69 | Textile Engineering | .... | .... | 10.00 |
| 2·756 | Heat Treatment | .... | 6.00 | 6.00 |
| 2·78 | Industrial Plants | .... | .... | 8.00 |
| 2·80 | Forging | .... | 10.00 | .... |
| 2·801 | Forging | 5.00 | .... | .... |
| 2·802 | Forging | .... | 5.00 | .... |
| 2·81 | Forging | .... | .... | 6.00 |
| 2·82 | Foundry | 8.00 | 8.00 | .... |
| 2·83 | Foundry | 4.00 | .... | .... |
| 2·831 | Foundry | 6.00 | .... | .... |
| 2·84 | Pattern Making | .... | .... | 8.00 |
| 2·86 | Vise and Bench Work | 6.00 | .... | .... |
| 2·87 | Vise and Bench Work | 4.00 | .... | .... |
| 2·871 | Vise and Bench Work | 2.00 | .... | .... |
| 2·88 | Machine Tool Work | .... | 6.00 | .... |
| 2·89 | Machine Tool Work | .... | 8.00 | .... |
| 2·90 | Machine Tool Work | .... | .... | 6.00 |
| 2·91 | Machine Tool Work | .... | 3.00 | .... |
| 2·911 | Machine Tool Work | .... | .... | 3.00 |
| 2·92 | Machine Tool Work | 4.00 | .... | .... |
| 2·95 | Vise and Bench and Machine Tool Work | .... | 4.00 | 4.00 |
| 2·951 | Vise and Bench and Machine Tool Work | .... | 6.00 | .... |
| 2·97 | Machine Tool Work | 4.00 | .... | 4.00 |

## MINING ENGINEERING AND METALLURGY

| Subject No. | Subject | Term 1 | Term 2 | Term 3 |
|---|---|---|---|---|
| 3·22 | Ore Dressing Laboratory | .... | $4.00 | .... |
| 3·23 | Ore Dressing | .... | 1.00 | .... |
| 3·31 | Fire Assaying | $4.00 | .... | .... |
| 3·32 | Fire Assaying and Metallurgical Laboratory | 2.00 | .... | .... |
| 3·54 | Metallurgical Laboratory and Reports | 4.00 | .... | .... |
| 3·55 | Metallurgical Laboratory and Reports | .... | 4.00 | .... |
| 3·61 | Metallography | 8.00 | 8.00 | .... |
| 3·62 | Metallography | 4.00 | 4.00 | .... |
| 3·63 | Metallography | 2.00 | .... | .... |

## CHEMISTRY

| Subject No. | Subject | | Term 1 | Term 2 | Term 3 |
|---|---|---|---|---|---|
| 5·01 | Chemistry | | $2.00 | .... | .... |
| 5·02 | Chemistry | | .... | $2.00 | .... |
| 5·03 | Chemistry | | .... | .... | $2.00 |
| 5·08 | Preparation of Inorganic Compounds | | .... | .... | 3.00 |
| 5·10 | Qualitative Analysis | III | 5.50 | .... | .... |
| | | VIII | 4.50 | .... | .... |
| | Courses | IX-A | 5.00 | .... | .... |
| | | XI | 5.50 | .... | .... |
| | | XII | 5.50 | .... | .... |
| 5·121 | Quantitative Analysis | III | .... | 5.50 | .... |
| | | V | 4.50 | .... | .... |
| | | VIII | .... | 6.50 | .... |
| | | IX-A | .... | 5.50 | .... |
| | Courses | X | 3.00 | .... | .... |
| | | XI | .... | 2.00 | 2.00 |
| | | XII | .... | 5.50 | .... |
| | | XIV | 3.50 | .... | .... |
| | | XV$_3$ | .... | 3.50 | .... |
| 5·122 | Quantitative Analysis | III | .... | .... | 5.00 |
| | | V | .... | 4.50 | .... |
| | | X | .... | 3.50 | .... |
| | Courses | XII | .... | .... | 5.00 |
| | | XIV | .... | 3.50 | .... |
| | | XV$_3$ | .... | .... | 3.50 |
| 5·13 | Quantitative Analysis | V | .... | .... | 4.50 |
| | | X | .... | .... | 3.50 |
| 5·14 | Analytical Chemistry | | .... | .... | 2.50 |
| 5·15 | Qualitative Analysis of Rare Metals | | 6.00 | .... | .... |
| 5·17 | Methods of Electrochemical Analysis | | .... | 3.00 | .... |
| 5·20 | Water Supplies | | 1.50 | .... | .... |
| 5·21 | Industrial Water Analysis | | .... | 1.00 | .... |
| 5·22 | Water Supplies and Wastes Disposal | | 1.00 | .... | .... |
| 5·25 | Chemistry of Foods | | .... | 4.00 | .... |
| 5·251 | Chemistry of Foods | | Any term | | 2.00 |
| 5·26 | Food Analysis (Advanced) | | Any term | | 2.50 |
| 5·29 | Optical Methods in Chemical Analysis | | Any term | | 1.50 |
| 5·30 | Proximate Technical Analysis | | Any term | | 4.00 |
| 5·31 | Gas Analysis I | | 1.00 | | 1.00 |
| 5·32 | Gas Analysis II | | 1.50 | .... | 1.50 |
| 5·361 | Testing of Oils | | .... | 1.00 | 1.00 |
| 5·37 | Chemistry of Road Materials | | .... | 2.00 | 2.00 |
| 5·40 | Special Methods and Instruments | | .... | .... | 1.50 |
| 5·41 | Metallography I | | .... | 1.00 | 1.00 |
| 5·42 | Metallography I-a | | 1.00 | .... | .... |
| 5·55 | Organic Qualitative Analysis | | 3.50 | 3.50 | .... |
| 5·561 | Organic Chemical Laboratory: | | | | |
| | Courses | V | 4.00 | 6.00 | 7.00 |
| | | X | 3.50 | 3.50 | .... |
| 5·562 | Organic Chemical Laboratory: | | | | |
| | | XI | .... | .... | 3.00 |
| | Courses | XIV | .... | 3.00 | .... |
| | | XV$_3$ | 5.00 | 1.50 | .... |

## CHEMISTRY (Continued)

| Subject No. | Subject | Term 1 | 2 | 3 |
|---|---|---|---|---|
| 5·65 | Chemical Principles I | $1.00 | $1.00 | $1.00 |
| 5·651 | Chemical Principles | 1.00 | 1.00 | 1.00 |
| 5·67 | Chemical Principles | 1.00 | .... | .... |

## ELECTRICAL ENGINEERING

| Subject No. | Subject | Term 1 | 2 | 3 |
|---|---|---|---|---|
| 5·90 | Research Problem | $8.00 | .... | .... |
| 6·51 | Alternating Currents | 3.00 | $3.00 | $3.00 |
| 6·69 | Electrical Engineering Laboratory | .... | 9.00 | 9.00 |
| 6·70 | Electrical Engineering Laboratory | 5.00 | .... | .... |
| 6·71a | Electrical Engineering Laboratory | .... | 4.50 | .... |
| 6·71b | Electrical Engineering Laboratory | .... | 4.50 | .... |
| 6·72a | Electrical Engineering Laboratory | .... | .... | 4.50 |
| 6·72b | Electrical Engineering Laboratory | .... | .... | 4.50 |
| 6·73a | Electrical Engineering Laboratory | 4.00 | .... | .... |
| 6·73b | Electrical Engineering Laboratory | 8.00 | .... | .... |
| 6·74 | Electrical Engineering Laboratory | .... | 12.00 | .... |
| 6·75 | Electrical Engineering Laboratory | 5.00 | 5.00 | .... |
| 6·76a | Electrical Engineering Laboratory | .... | 4.50 | 4.50 |
| 6·76b | Electrical Engineering Laboratory | .... | 4.50 | 4.50 |
| 6·77 | Electrical Engineering Laboratory | 6.00 | 6.00 | .... |
| 6·78 | Electrical Engineering Laboratory | .... | 6.00 | 6.00 |
| 6·80a, b | Electrical Engineering Laboratory | 20 cents a laboratory hour | | |
| 6·81 | Electrical Engineering Laboratory | 9.00 | .... | .... |
| 6·82 | Electrical Engineering Laboratory | .... | 4.00 | .... |
| 6·83a | Electrical Engineering Laboratory | .... | .... | 3.00 |
| 6·83b | Electrical Engineering Laboratory | .... | .... | 4.00 |
| 6·84 | Electrical Engineering Laboratory | 6.00 | .... | .... |
| 6·85 | Electrical Engineering Laboratory | 6.00 | 6.00 | 6.00 |
| 6·86 | Electrical Engineering Laboratory | .... | 4.50 | 4.50 |
| 6·87 | Electrical Engineering Laboratory | .... | 4.50 | 9.00 |
| 6·88 | Electrical Engineering Laboratory | .... | 6.00 | .... |
| 6·90 | Technical Electrical Measurements | 9.00 | .... | .... |
| 6·95 | Electrical Testing | 20 cents a laboratory hour | | |
| 6·96 | Electrical Engineering Laboratory | 20 cents a laboratory hour | | |

## BIOLOGY AND PUBLIC HEALTH

| Subject No. | Subject | Term 1 | 2 | 3 |
|---|---|---|---|---|
| 7·01 | General Biology | .... | $2.00 | .... |
| 7·02 | Biology Elements | $1.00 | .... | .... |
| 7·04 | Cryptogamic Botany | .... | .... | $2.00 |
| 7·05 | Invertebrate Zoology | .... | .... | 1.50 |
| 7·06 | Microscopy of Waters | .... | .... | 2.00 |
| 7·10 | Anatomy and Histology | 5.00 | 5.00 | 5.00 |
| 7·18 | Applied Ichthyology | 5.00 | 5.00 | 5.00 |
| 7·20 | Physiology | .... | 3.00 | 3.00 |
| 7·27 | Biochemistry | 5.00 | 5.00 | 5.00 |
| 7·29 | General Biology and Bacteriology | .... | .... | 2.00 |
| 7·30 | Bacteriology | 5.00 | 5.00 | 3.00 |
| 7·31 | Elements of Bacteriology | .... | 2.00 | .... |
| 7·32 | Bacteriology of Water and Sewage | .... | 2.00 | .... |
| 7·36 | Industrial Microbiology (Optional) | 4.00 | .... | .... |
| 7·37 | Technology of Fisheries Products | 4.00 | 4.00 | 2.00 |
| 7·38 | Public Health Laboratory Methods | .... | 2.00 | 2.00 |

## PHYSICS

| Subject No. | Subject | Term 1 | 2 | 3 |
|---|---|---|---|---|
| 8·011 | Physics | $2.00 | .... | .... |
| 8·012 | Physics | .... | $2.00 | .... |
| 8·013 | Physics | .... | .... | $2.00 |

## PHYSICS (Continued)

| Subject No. | Subject | Term 1 | 2 | 3 |
|---|---|---|---|---|
| 8·021 | Physics | $2.00 | .... | .... |
| 8·022 | Physics | .... | $2.00 | .... |
| 8·023 | Physics | .... | .... | $2.00 |
| 8·09 | Physical Instruments | .... | .... | 8.00 |
| 8·11 | Heat Measurements | 8.00 | .... | 8.00 |
| 8·12 | Heat Measurements XIV | .... | .... | 6.00 |
| 8·12 | Heat Measurements III$_2$ | .... | 8.00 | .... |
| 8·13 | Heat Measurements | 2.00 | 2.00 | .... |
| 8·14 | Heat Measurements | 8.00 | .... | .... |
| 8·16 | Photography | 8.00 | .... | .... |
| 8·18 | Physical Optics | .... | .... | 8.00 |
| 8·20 | Electricity | .... | 6.00 | 6.00 |
| 8·35 | Optical Measurements | .... | 12.00 | .... |
| 8·57 | Aeronautical Instruments | Any term | | 6.00 |
| 8·63 | Aeronautical Laboratory | 5.00 | .... | .... |
| 8·631 | Aeronautical Laboratory | 7.00 | .... | .... |
| 8·64 | Aeronatucial Laboratory | .... | .... | 4.00 |
| 8·86 | Electrochemical Laboratory | 14.00 | .... | .... |
| 8·87 | Applied Electrochemical Laboratory | .... | 14.00 | .... |
| 8·89 | Electric Furnaces | 6.00 | .... | .... |
| 8·90 | Electrochemistry, Elements of | .... | .... | 4.00 |
| 8·98 | Glass Blowing | 3.00 | .... | .... |

## CHEMICAL ENGINEERING

| Subject No. | Subject | Term 1 | 2 | 3 |
|---|---|---|---|---|
| 10·51 | Industrial Chemical Laboratory X | .... | $2.50 | .... |
| | Industrial Chemical Laboratory XV$_2$, V, XIV | $3.50 | .... | .... |
| 10·52 | Chemical Engineering Laboratory | .... | .... | $2.00 |
| 10·95 | Applied Colloid Chemical Laboratory | .... | 1.00 | 1.00 |

## GEOLOGY

| Subject No. | Subject | Term 1 | 2 | 3 |
|---|---|---|---|---|
| 12·01 | Mineralogy | $5.00 | .... | .... |
| 12·02 | Mineralogy | .... | $5.00 | $5.00 |
| 12·03 | Mineralogy | .... | .... | 6.00 |
| 12·15 | Petrography | 4.00 | 5.00 | 2.00 |
| 12·16 | Petrography | 5.00 | 5.00 | 5.00 |
| 12·20 | Physical and Chemical Crystallography | .... | .... | 3.00 |
| 12·21 | Optical Crystallography | 4.00 | .... | .... |
| 12·30 | Geology | 2.00 | .... | .... |
| 12·311 | Geology | .... | 3.00 | .... |
| 12·321 | Geology | .... | .... | 1.50 |
| 12·41 | Geology, Economic III$_2$ | .... | .... | 2.00 |
| 12·41 | Geology, Economic XII | .... | .... | 4.00 |
| 12·50 | Geology, Historical | 2.00 | .... | .... |
| 12·51 | Paleontology | 2.00 | 2.00 | .... |
| 12·52 | Paleontology | .... | 5.00 | 5.00 |
| 12·53 | Index Fossils | .... | 5.00 | .... |
| 12·60 | Physiography | 2.00 | .... | .... |

## NAVAL ARCHITECTURE AND MARINE ENGINEERING

| Subject No. | Subject | Term 1 | 2 | 3 |
|---|---|---|---|---|
| 13·43 | Ship Drawing (for Modelling only, any term) | | $10.00 | |

# ALPHABETICAL LIST OF SUBJECTS WITH THEIR NUMBERS

Chemical Principles II 5·67
Chemistry, Analytical 5·14
Chemistry, General 5·01
Chemistry, General 5·02
Chemistry, General 5·03
Chemistry of Dyes 5·59a
Chemistry of Foods 5·25
Chemistry of Foods 5·251
Chemistry of Powder and Explosives 5·59b
Chemistry of Powder and Explosives 5·80b
Chemistry of Plant and Animal Life 5·27
Chemistry, Applied 5·341
Chemistry, Applied 5·342
Chemistry, Engineering 5·343
Chemistry, Inorganic, I 5·05
Chemistry, Inorganic, II 5·06
Chemistry of Road Materials 5·37
Colloid Chemical Laboratory, Applied 10·951
Colloid Chemistry, Applied 10·95
Colloidal Chemistry 5·69
Colloquium, Physical 8·93
Color and Acoustics 8·06
Communications Laboratory 6·33
Combustion 10·44
Conferences on Current Literature in Physical Chemistry 5·64
Constitution of Matter 8·30
Constructive Design 4·81
Constructive Design 4·82
Contemporary Drama GS40
Contemporary English Literature GS41
Contemporary European Literature GS42
Cost Accounting Ec51
Crystallography 12·19
Descriptive Astronomy GS66
Descriptive Geometry D171
Descriptive Geometry D172
Descriptive Geometry D173
Descriptive Geometry, College Class D191
Descriptive Geometry D201
Descriptive Geometry D211
Design I, Architectural 4·71
Design II, Architectural 4·72
Design III, Architectural 4·73
Design (Advanced) 4·74
Design of Automatic Machinery 2·06
Determination of Chemical Constitution for Organic Compounds 5·59c
Development of Music GS49
Differential Equations M23
Differential Equations M72
Distillation and Evaporation 10·41
Drying 10·42
Dynamics of Machines 2·25
Dynamo Design 6·25
Dynamo Design 6·26
Economics of Corporations GS27
Electric Furnances 8·89
Electric Railways 6·24
Electric Railways 6·55
Electric Wiring and Lighting of Buildings 6·38
Electrical Communication I 6·30
Electrical Communication I 6·31
Electrical Communication I 6·32
Electrical Communication II (Inc. Electron Theory 8·211 and Electron Apparatus 8·212)
Electrical Communication III 6·28
Electrical Communication of Intelligence 6·56
Electrical Engineering, Elements of 6·40
Electrical Engineering, Elements of 6·41
Electrical Engineering, Elements of 6·42
Electrical Engineering. Elements of 6·431
Electrical Engineering, Elements of 6·432
Electrical Engineering, Principles of 6·00
Electrical Engineering, Principles of 6·01
Electrical Engineering, Principles of 6·02
Electrical Engineering, Principles of 6·03
Electrical Engineering, Principles of 6·031
Electrical Engineering, Principles of 6·04
Electrical Engineering, Principles of 6·041
Electrical Engineering, Principles of 6·05
Electrical Engineering, Principles of 6·06
Electrical Engineering, Principles of 6·101
Electrical Engineering, Principles of 6·11
Electrical Engineering, Principles of 6·111
Electrical Engineering, Principles of 6·112
Electrical Engineering, Principles of 6·12
Electrical Engineering, Principles of 6·121
Electrical Engineering, Principles of 6·131
Electrical Engineering, Principles of 6·14
Electrical Engineering, Principles of 6·141
Electrical Engineering, Principles of 6.142
Electrical Engineering, Principles of 6·15
Electrical Engineering, Principles of 6·151
Electrical Engineering, Principles of 6·152
Electrical Engineering, Principles of 6·16
Electrical Engineering, Principles of 6·161
Electrical Engineering, Principles of 6·162
Electrical Engineering Laboratory 6·69
Electrical Engineering Laboratory 6·70
Electrical Engineering Laboratory 6·71a
Electrical Engineering Laboratory 6·71b
Electrical Engineering Laboratory 6·72a
Electrical Engineering Laboratory 6·72b
Electrical Engineering Laboratory 6·73a
Electrical Engineering Laboratory 6·73b
Electrical Engineering Laboratory 6·74
Electrical Engineering Laboratory 6·75
Electrical Engineering Laboratory 6·76b
Electrical Engineering Laboratory 6·77
Electrical Engineering Laboratory 6·78
Electrical Engineering Laboratory 6·80a, b
Electrical Engineering Laboratory 6·81
Electrical Engineering Laboratory 6·82
Electrical Engineering Laboratory 6·83b
Electrical Engineering Laboratory 6·84
Electrical Engineering Laboratory 6·85
Electrical Engineering Laboratory 6·86
Electrical Engineering Laboratory 6·87
Electrical Engineering Laboratory 6·88
Electrical Engineering Laboratory 6·91
Electrical Engineering Laboratory 6·92
Electrical Engineering Laboratory 6·96
Electrical Engineering Seminar 6·50
Electrical Power, Industrial Application of 6·21
Electrical Testing (Advanced) 6·95
Electric Transmission Equipment 6·20
Electric Transmission and Distribution of Energy 6·44
Electricity 8·20
Electrochemical Analysis, Methods of 5·17
Electrochemical Laboratory 8·86
Electrochemical Laboratory, Applied 8·87
Electrochemistry, Elements of 8·90
Electrochemistry, Principles of 8·80
Electrochemistry II 8·82
Electrochemistry III 8·83
Electrochemistry, Applied 8·85
Electrodynamics 8·27
Electromagnetic Theory 8·28
Electron Theory 8·211
Electron Apparatus 8·212
Engine Design 2·732

Engine Design 2·733
Engineering Chemistry 5·343
Engineering Geology 12·47
Engineering Field GS54
Engineering Laboratory 2·602
Engineering Laboratory 2·603
Engineering Laboratory 2·604
Engineering Laboratory 2·605
Engineering Laboratory 2·606
Engineering Laboratory 2·607
Engineering Laboratory 2·608
Engineering Laboratory 2·61
Engineering Laboratory 2·611
Engineering Laboratory 2·612
Engineering Laboratory 2·613
Engineering Laboratory 2·614
Engineering Laboratory 2·62
Engineering Laboratory 2·621
Engineering and Hydraulic Laboratory 2·64
Engineering of Water and Sewerage Purification 1·81
Engineering Publicity GS56
English and History EH11
English and History EH12
English and History EH13
English and History EH21
English and History EH22
English and History EH23
English (Contemporary Literature) E35
English (Committee Work) E31a
English (Business English) E31b
English E32
English (Report Writing) E33
English Composition (Advanced) GS45
European Civilization and Art 4·46
European Civilization and Art 4·47
Explosives Laboratory 5·80e
Extraction 10·43
Fine Arts in Modern Life GS50
Fire Assaying 3·31
Fire Assaying and Metallurgical Laboratory 3·32
Fire Assaying (Advanced) 3·33
Fire Protection Engineering 2·754
Fish Culture 7·17
Food Analysis (Advanced) 5·26
Forging 2·80
Forging 2·801
Forging 2·802
Forging 2·81
Foundations 1·48
Foundry 2·82
Foundry 2·83
Foundry 2·831
Fourier's Series M45
Freehand Drawing 4·02
Freehand Drawing 4·03
Freehand Drawing (Elementary) D151
Freehand Drawing (Elementary) D152
Freehand Drawing (Elementary) D153
French (Elementary) L61
French (Intermediate) L62
French (Intermediate) L63
French L64
French (Elementary) L67
French (Advanced) L71
French (Advanced) French History GS82
French (Advanced) French Literature GS83
Gas Analysis I 5·31
Gas Analysis II 5·32
Gas and Fuel Analysis 5·33
Gas Engine Laboratory 2·631
General Chemistry 5·80a
General Chemistry Laboratory 5·80d
General Engineering Lectures 2·76
Geodesy 1·13
Geodesy 1·14
Geological Seminar 12·62
Geological Seminar 12·621
Geological Surveying 12·34
Geological Surveying 12·341
Geological Surveying (Advanced) 12·35
Geology 12·30
Geology 12·301
Geology 12·31
Geology 12·311
Geology 12·32
Geology 12·321
Geology 12·33
Geology, Economic 12·40
Geology, Economic 12·41
Geology, Applied Economic 12·42
Geology, Economic (Advanced) 12·43
Geology of Clay, Cement and Building Stone 12·45
Geology of Coal and Petroleum 12·44
Geology GS60
Geology GS61
Geology, Historical 12·50
Geology of Europe 12·64
Geology of North America 12·63
Geology of Soil and Soil Examination 12·46
Geometrical Optics 8·17
Geometrical Optics 8·171
German (Elementary) L11
German (Elementary) L12
German L21
German (Intermediate) L22
German (Advanced) L31
German (Advanced) L32
German (Advanced) L33
German (Technical) L37
German (Advanced) L43
German (Advanced) Literature GS91
German (Advanced) GS92
German (Advanced) Sight Reading GS94
German (Advanced) Life of Scientific Men GS95
German (Advanced) Faust GS96
German (Advanced) Commercial Correspondence GS97
Glass and Ceramics 10·71
Glass Blowing 8·98
Graphic Statics 1·39
Heat Conduction M67
Heat Engineering (Heat) 2·40
Heat Engineering (Boilers and Engines) 2·41
Heat Engineering (Boiler) 2·411
Heat Engineering (Thermodynamics) 2·42
Heat Engineering (Engines) 2·43
Heat Engineering 2·432
Heat Engineering (Thermodynamics, *continued*) 2·44
Heat Engineering (Refrigeration and Gas Engines) 2·45
Heat Engineering 2·451
Heat Engineering (Valve Gear and Thermodynamics) 2·46
Heat Engineering (Boiler, Engine, etc.) 2·47
Heat Engineering (Thermodynamics, Boiler) 2·48
Heat Engineering (Thermodynamics, Boiler) 2·50
Heat Engineering (Thermodynamics, Engines) 2·51

Heat Engineering (Thermodynamics) 2·52
Heat Engineering (Advanced) 2·54
Heat Engineering 2·55
Heat Measurements 8·11
Heat Measurements 8·12
Heat Measurements 8·13
Heat Measurements 8·14
Heat Transmission 2·755
Heat Treatment 2·756
Higher Geometry M63
Highway Design 1·33
Highway Transportation 1·32
History (Lincoln) GS52
History of Chemistry 5·93
History (Industrial and Social History of the United States) GS53
History of Renaissance Art 4·49
History of Science GS1, GS2
Human Factor in Business GS55
Hydraulic Engineering 1·68
Hydraulic and Sanitary Engineering 1·75
Hydraulic and Sanitary Design 1·79
Hydraulic and Sanitary Design 1·80
Hydraulics (Advanced) 1·66
Hydraulics (Theoretical) 1·62
Hydraulics (Theoretical) 1·63
Hydraulics (Theoretical) 1·64
Hydraulics (Theoretical) 1·65
Hydrology 12·61
Illumination 6·27
Illumination 6·57
Index Fossils 12·53
Industrial Application of Electric Power 6·21
Industrial Applications of Chemical Principles 5·84
Industrial Aspects of Bacteriology GS72
Industrial Chemical Laboratory 10·51
Industrial Chemistry 10·21
Industrial Chemistry 10·22
Industrial Chemistry 10·23
Industrial Chemistry II 10·70–10·79
Industrial Hygiene and Sanitation 7·53
Industrial Microbiology 7·36
Industrial Organic Chemistry 5·54
Industrial Organization Ec56
Industrial Organization Ec57
Industrial Plants 2·77
Industrial Plants 2·78
Industrial Relations Ec46
Industrial Stoichiometry 10·25
Industrial Water Analysis 5·21
Infection and Immunity 7·50
Informal Public Speaking: Committee Reports and Discussions GS47
Inorganic Chemistry I 5·05
Inorganic Chemistry II 5·06
Inorganic Compound, Preparation of 5·08
International Law and American Foreign Policy GS3
Internal Combustion Engines 2·757
Introduction to Fisheries 7·16
Investment Finance GS25
Iron and Steel 10·73
Journal Meeting in Organic Chemistry 5·97
Kinetic Theory 8·39
Kinetic Theory of Gases, Liquids and Solids 5·74
Landscape and Civic Design 4·61
Life Class 4·04
Life Class and Decorative Design 4·05
Locomotive Engineering 2·758
Logic of Scientific Inquiry 5·70
Machine Design 2·702
Machine Design 2·703
Machine Design 2·704
Machine Design 2·71
Machine Design 2·711
Machine Design 2·72
Machine Design (Advanced) 2·74
Machine Drawing (Elementary) D122
Machine Drawing (Elementary) D123
Machine Drawing 2·12
Machine Drawing 2·13
Machine Drawing 2·14
Machine Tool Work 2·88
Machine Tool Work 2·881
Machine Tool Work 2·89
Machine Tool Work 2·90
Machine Tool Work 2·91
Machine Tool Work 2·911
Machine Tool Work 2·92
Machine Tool Work 2·97
Map Reading and Top. Drawing 1·19
Marine Engineering 13·51
Marine Engineering 13·53
Marine Engine Design 13·52
Marine Engine Design 13·55
Marketing Methods GS22
Materials 1·43
Materials of Construction 10·61
Materials of Engineering 2·302
Materials of Engineering 2·303
Materials of Engineering 2·31
Materials of Engineering 2·32
Materials and Heat Treatment 2·33
Mathematical Laboratory M54
Mathematical Laboratory M55
Mathematics (Calculus and Analytic Geometry) M11
Mathematics (Calculus and Analytic Geometry) M12
Mathematics (Calculus and Analytic Geometry) M13
Mathematics (Calculus) M21
Mathematics (Differential Equations) M22
Mathematics (Differential Equations) M23
Mathematics (Advanced Calculus and Differential Equations) M36, M37, M38
Mathematics (Applied) M41
Mathematics M35
Mathematics (Statics) M27
Mathematics (Kinematics) M28
Mathematics (Dynamics) M29
Mathematics of Investments M71
Mechanical Drawing D101
Mechanical Equipment of Buildings, Heating and Ventilation 2·57
Mechanical Equipment of Buildings 2·752
Mechanical Engineering Drawing 2·10
Mechanical Engineering Drawing 2·11
Mechanical Laboratory 2·96
Mechanics of Engineering 2·262
Mechanics of Engineering 2·263
Mechanics of Rigid Bodies M61
Mechanics and Th. of Elast. Adv. 2·28
Mechanism of Machines 2·05
Mechanism 2·00
Mechanism 2·01
Mechanism 2·02
Merchant Shipbuilding 13·35
Metallography 3·61
Metallography 3·62
Metallography 3·63
Metallography I 5·41
Metallography Ia 5·42
Metallography II 5·43

Quantitative Analysis 5·121
Quantitative Analysis 5·122
Quantitative Analysis 5·13
Qualitative Analysis of Rare Metals 5·15
Railway Design 1·26
Railway Design 1·28
Railway Drafting 1·23
Railway Engineering 1·25
Railway Engineering 1·27
Railway Fieldwork 1·20
Railway and Highway Engineering 1·21
Railway and Highway Engineering 1·24
Recent Developments in Science 5·94
Recent Developments in Organic Chemistry 5·58
Refrigeration 2·759
Reinforced Concrete Design 1·58
Report Writing 1·90
Report Writing E33
Research 5·98
Research Conferences in Physical Chemistry 5·991
Research Conferences in Organic Chemistry 5·992
Research Conferences 10·91
Research in Applied Electrochemistry 8·75
Research in Electricity and Magnetism 8·76
Research in Electrochemistry 8·71
Research in Industrial Physics 8·72
Research in Mathematical Physics 8·70
Research Problems 5·90
Rigid Dynamics M73
Rigid Mechanics 8·24
Roads and Pavements 1·30
Rubber 10·77
Sanitary Design 1·83
Sanitary Engineering 1·77
Sanitary Science and Public Health 7·56
Sanitary Science and Public Health GS73
Securities and Investments Ec38
Selected Topics in Organic Chemistry 5·59
Shades and Shadows 4·11
Ship Construction 13·31
Ship Construction 13·32
Ship Construction 13·33
Ship Drawing 13·41
Ship Drawing 13·42
Ship Drawing 13·43
Shipyard Practice 13·14
Shipyard Org. and Management 13·15
Slide Rule M15
Sound 8·40
Sound and Music GS65
Spanish L81
Special Composition E15
Special Methods and Instruments 5·40
Spherical Trigonometry 1·11
Starch and Cellulose 10·73
Statistics Ec65
Statistical Mechanics M69
Steam and Hydraulic Laboratory 2·65
Steam Turbine Engineering 2·753
Steam Turbines 13·60
Storage Batteries 6·29
Structural Design 1·531
Structural Design 1·54
Structural Design (Advanced) 1·55
Structural Design 4·92
Structural Drawing 4·90
Structures (Advanced) 1·56
Structures 1·40
Structures 1·41
Structures 1·45
Structures 1·49
Structures 1·50
Structures 1·51
Structures Design 1·52
Structures, Stationary 1·44
Sub-Atomic Chemistry 5·76
Sulphuric Acid 10·70
Surveying and Plotting 1·00
Surveying and Plotting 1·001
Surveying Instruments 1·01
Surveying 1·02
Surveying 1·03
Surveying, Underground 1·04
Surveying, Plane 1·07
Surveying, Geod. and Topo. 1·08
Surveying, Geodetic 1·09
Surveying, Hydrographic 1·60
Synthetic Methods in Org. Chemistry 5·57
Technical Electrical Measurements 6·90
Technology of Fishery Products 7·37
Testing of Highway Materials 1·31
Testing Materials Laboratory 2·351
Testing Materials Laboratory 2·352
Testing Materials Laboratory 2·36
Testing Materials Laboratory 2·37
Testing Materials Laboratory (Concrete) 2·38
Testing of Oils 5·36
Testing of Oils 5·361
Textile Engineering 2·69
Textiles and Dyeing 10·78
Theoretical Aeronautics M43
Theoretical Biology 7·03
Theoretical Physics 8·231
Theoretical Physics 8·232
Theoretical Physics 8·233
Theories and Applications of Catalysis 5·09
Theory of Design 4·30
Theory of Elasticity 2·7510
Theory of Elasticity 2·271
Theory of Elasticity 2·272
Theory of Explosives 5·80c
Theory of Functions M56
Theory of the Gyroscope M57
Theory of Heat 8·15
Theory of Light 8·36
Theory of Probability and Method of Least Squares M26
Theory of Relativity and Gravitation M70
Theory of Sound M66
Theory of Warship Design 13·11
Theory of Warship Design 13·12
Thermochemistry and Chemical Equilibrium 5·68
Thermal Research 8·77
Thermodynamics M68
Thermodynamics I 5·731
Thermodynamics II 5·732
Thermodynamics and Chemistry 5·63
Thesis 5·95
Thesis Reports 5·96
Thesis Reports and Memoirs 10·15
Valuation of Oil Lands and the Construction of Oil Maps 12·441
Vector Analysis M60
Vise and Bench Work 2·86
Vise and Bench Work 2·87
Vise and Bench Work 2·871
Vise, Bench and Machine Tool Work 2·95
Vise, Bench, Machine Tool Work 2·951
Vital Statistics 7·58
Warship Design 13·21
Warship Design 13·22
Water Color 4·06

# REQUIRED PREPARATION FOR SUBJECTS OF INSTRUCTION

Subjects of Instruction presented as preparatory subjects for dependent studies. A clear record is expected in the subjects noted below for admission to subjects printed immediately to the right of these subjects. In cases where the figures to the right are in italics, the study may be taken at the same time with the preparatory subject.

*Subjects depending upon the subjects noted in the column at the left.*

## CIVIL ENGINEERING

| | | |
|---|---|---|
| 1·00 | Surveying and Plotting | 1·07 Plane Surveying; *1·18* Astronomy; 1·19 Map Reading and Topographical Drawing; 1·20 Railway Fieldwork; 1·21 Railway and Highway Engineering. |
| 1·03 | Surveying | 1·04 Underground Surveying; 12·33 Field Geology. |
| 1·07 | Plane Surveying | *1·08* Geodetic and Topographic Surveying; *1·20* Railway Fieldwork; *1·60* Hydrographic Surveying. |
| 1·08 | Geodetic and Topographic Surveying | *1·60 Hydrographic Surveying.* |
| 1·11 | Spherical Trigonometry | 1·12 Astronomy; 1·15 Navigation. |
| 1·12 | Astronomy | 1·13 Geodesy. |
| 1·13 | Geodesy | 1·09 Geodetic Surveying; 1·14 Geodesy. |
| 1·20 | Railway Fieldwork | 1·21 Railway and Highway Engineering; 1·23 Railway Drafting; 1·24 Railway and Highway Engineering. |
| 1·21 | Railway and Highway Engineering. | *1·23* Railway Drafting; 1·24 Railway and Highway Engineering; 1·30 Roads and Pavements. |
| 1·23 | Railway Drafting | 1·26 Railway Design; 1·33 Highway Design. |
| 1·24 | Railway and Highway Engineering. | 1·25 Railway Engineering; 1·32 Highway Transportation; 1·33 Highway Design. |
| 1·25 | Railway Engineering | *1·26* Railway Design; 1·27 Railway Engineering. |
| 1·26 | Railway Design | 1·27 Railwa yEngineering; 1·28 Railway Design. |
| 1·27 | Railway Engineering | 1·28 Railway Design. |
| 1·30 | Roads and Pavements | 1·24 Railway and Highway Engineering (for $I_2$); 1·31 Testing of Highway Materials. |
| 1·31 | Testing of Highway Materials | 1·32 Highway Transportation. |
| 1·32 | Highway Transportation | *1·33* Highway Design. |
| 1·40 | Structures | 1·48 Foundations; 1·49, 1·50, 1·51 Theory of Structures. |
| 1·41 | Structures | 1·48 Foundations; 1·49, 1·50, 1·51 Theory of Structures; 4·92 Structural Design. |
| 1·43 | Materials | 1·49, 1·50, 1·51 Theory of Structures. |
| 1·44 | Stationary Structures | 1·48 Foundations; *1·73* Water Power Engineering. |
| 1·45 | Theory of Structures | 1·52 Structures (Design). |
| 1·49 | Structures | *1·53* Bridge Design; 1·531 Structural Design; 1·55 Structural Design, Advanced; 1·56 Structures, Advanced; 1·58 Reinforced Concrete Design; 1·73 Water Power Engineering. |
| 1·50 | Structures | 1·531 Structural Design; *1·54* Structural Design; 1·58 Reinforced Concrete Design; 1·73 Water Power Engineering. |
| 1·51 | Structures | 1·58 Reinforced Concrete Design. |
| 1·53 | Bridge Design | 1·55 Structural Design, Advanced; 1·56 Structures, Advanced. |
| 1·56 | Structures, Advanced | *1·55* Structural Design, Advanced. |
| 1·58 | Reinforced Concrete Design | *1·55* Structural Design, Advanced. |
| 1·62 | Hydraulics | 1·66 Hydraulics, Advanced; 1·68 Hydraulic Engineering; 1·69, 1·73 Water Power Engineering; 1·75 Hydraulic and Sanitary Engineering; *1·77* Sanitary Engineering; 2·64 Engineering; |

**CIVIL ENGINEERING (Continued)**

| | | |
|---|---|---|
| | | and Hydraulic Laboratory; 2·65 Steam and Hydraulic Laboratory. |
| 1·64 | Hydraulics | 1·68 Hydraulic Engineering; 1·69 Water Power Engineering. |
| 1·65 | Hydraulics | 1·69 Water Power Engineering; 1·73 Water Power Engineering. |
| 1·69 | Water Power Engineering | 1·70 Water Power Engineering. |
| 1·70 | Water Power Engineering | 1·71 Water Power Engineering. |
| 1·71 | Water Power Engineering | 1·73 Water Power Engineering. |
| 1·73 | Water Power Engineering | *1·82* Water Power Design. |
| 1·75 | Hydraulic and Sanitary Engineering | 1·79 Hydraulic and Sanitary Design; 1·81 Engineering of Water Sewage Purification. |
| 1·77 | Sanitary Engineering | 1·80 Hydraulic and Sanitary Design; 1·81 Engineering of Water and Sewage Purification. |
| 1·81 | Engineering of Water and Sewage Purification | *1·83* Sanitary Design. |
| 1·82 | Water Power Design | *1·73* Water Power Engineering. |

**MECHANICAL ENGINEERING**

| | | |
|---|---|---|
| 2·00 | Mechanism | 2·01 Mechanism; 2·05 Mechanism of Machines. |
| 2·01 | Mechanism | *2·10*, *2·11* Mechanical Engineering Drawing; 2·41, 2·411, 2·50 Heat Engineering. |
| 2·02 | Mechanism | 2·46 Heat Engineering. |
| 2·05 | Mechanism of Machines | 2·06 Design of Automatic Machinery; 2·751 Automatic Machinery. |
| 2·10 | Mechanical Engineering Drawing | 2·11 Mechanical Engineering Drawing; 13·41 Ship Drawing. |
| 2·11 | Mechanical Engineering Drawing | 2·41 Heat Engineering. |
| 2·12 | Machine Drawing | 2·13 Machine Drawing; 2·702, 2·704 Machine Design. |
| 2·20 | Applied Mechanics | 1·65 Hydraulics; 2·21, 2·211 Applied Mechanics. |
| 2·202 | Applied Mechanics | 2·212 Applied Mechanics. |
| 2·203 | Applied Mechanics | 2·213 Applied Mechanics. |
| 2·204 | Applied Mechanics | 2·214 Applied Mechanics. |
| 2·21 | Applied Mechanics | 1·40, 1·41 Theory of Structures; 1·43 Materials; 1·44 Stationary Structures; 1·45 Theory of Structures; 1·62, 1·63, 1·64 Hydraulics; 2·22, 2·221 Applied Mechanics; 2·702 Machine Design. |
| 2·211 | Applied Mechanics | 2·225 Applied Mechanics |
| 2·212 | Applied Mechanics | 2·222 Applied Mechanics. |
| 2·213 | Applied Mechanics | 2·23 Applied Mechanics. |
| 2·214 | Applied Mechanics | *2·224* Applied Mechanics. |
| 2·22 | Applied Mechanics | 1·41 Theory of Structures; 1·43 Materials; 1·44 Stationary Structures; 2·23, 2·231, 2·233, 2·24 Applied Mechanics; 2·302, 2·303 2·32 Materials of Engineering; 2·351, 2·36, 2·37, 2·38 Testing Materials Laboratory; 2·702, 2·704 Machine Design; 4·81 Constructive Design; 4·91 Structural Design, 8·591 Aeronautics. |
| 2·221 | Applied Mechanics | 1·24 Railway and Highway Engineering; 1·40, 1·41 Theory of Structures; *1·43* Materials; 2·36 Testing Materials Laboratory. |
| 2·222 | Applied Mechanics | 2·232 Applied Mechanics; 2·751 Automatic Machinery. |
| 2·221 | Applied Mechanics | 1·24 Railway and Highway Engineering; *1·40*, *1·41* Theory of Structures; *1·43* Materials; 2·36 Testing Materials Laboratory. |
| 2·222 | Applied Mechanics | 2·232 Applied Mechanics; 2·751 Automatic Machinery. |
| 2·23 | Applied Mechanics | 2·06 Design of Automatic Machinery; 2·25 Dynamics of Machines; 2·752 Mechanical Equipment of Buildings; 2·754 Fire Protection Engineering; 2·758 Locomotive Engineering; 2·7510 Theory of Elasticity; 2·76 General Engineering Lectures; 2·77, 2·78 Industrial Plants; 8·60, 8·611 Airplane Design; 8·61, 8·611 Airship Design; 8·62 Aerial Propellers; 13·51 Marine Engineering. |
| 2·232 | Applied Mechanics | 2·292 Ordnance Engineering; 2·293 Ordnance Engineering; 2·758 Locomotive Engineering. |

**MECHANICAL ENGINEERING (Continued)**

| | | |
|---|---|---|
| 2·25 | Dynamics of Machines | 2·262, 2·263 Mechanics of Engineering; 2·732, 2·757 Internal Combustion Engines; 2·792, 2·793 Automotive Engineering. |
| 2·262 | Mechanics of Engineering | 2·28 Advanced Mechanics and Theory of Elasticity. |
| 2·263 | Mechanics of Engineering | 2·28 Advanced Mechanics and Theory of Elasticity. |
| 2·292 | Ordnance Engineering | 2·293 Ordnance Engineering. |
| 2·302 | Materials of Engineering | 2·33 Materials and Heat Treatment; 2·34 Physical Metallurgy; 2·756 Heat Treatment. |
| 2·303 | Materials of Engineering | 2·351 Testing Materials Laboratory; 2·754 Fire Protection Engineering. |
| 2·351 | Testing Materials Laboratory | 2·352 Testing Materials Laboratory |
| 2·352 | Testing Materials Laboratory | 2·33 Materials and Heat Treatment; 2·754 Fire Protection Engineering; 2·756 Heat Treatment. |
| 2·36 | Testing Materials Laboratory | 1·31 Testing of Highway Materials. |
| 2·40 | Heat Engineering | 2·42 Heat Engineering; 2·602, 2·603, 2·604, 2·606, 2·608 Engineering Laboratory. |
| 2·41 | Heat Engineering | 2·42, 2·43 Heat Engineering. |
| 2·411 | Heat Engineering | 13·51 Marine Engineering. |
| 2·42 | Heat Engineering | 2·25 Dynamics of Machines; 2·432, 2·44, 2·55 Heat Engineering; 2·602, 2·603, 2·604, 2·606, 2·608 Engineering Laboratory; 10·36 Chemical Engineering; 13·51 Marine Engineering. |
| 2·43 | Heat Engineering | 2·432, 2·44 Heat Engineering; 2·702 Machine Design. |
| 2·432 | Heat Engineering | 2·757 Internal Combustion Engines. |
| 2·44 | Heat Engineering | 2·451 Heat Engineering; 2·752 Mechanical Equipment of Buildings; 2·753 Steam Turbine Engineering; 2·755 Heat Transmission; 2·76 General Engineering Lectures; 2·77, 2·78 Industrial Plants. |
| 2·45 | Heat Engineering | 2·452 Heat Engineering; 2·58 Power Plant Design; 2·732 Engine Design; 2·759 Refrigeration; 2·792, 2·793 Automotive Engineering. |
| 2·46 | Heat Engineering | 2·47 Heat Engineering; 2·64 Engineering and Hydraulic Laboratory; 2·65 Steam and Hydraulic Laboratory; 2·66 Power Laboratory. |
| 2·47 | Heat Engineering | 2·48 Heat Engineering; 2·66 Power Laboratory. |
| 2·48 | Heat Engineering | 2·631 Gas Engine Laboratory; 2·66 Power Laboratory; 2·752 Mechanical Equipment of Building; 2·753 Steam Turbine Engineering; 2·755 Heat Transmission; 10·31, 10·34 Chemical Engineering. |
| 2·50 | Heat Engineering | 2·51 Heat Engineering; 2·605 Engineering Laboratory. |
| 2·51 | Heat Engineering | 2·52 Heat Engineering; 2·605 Engineering Laboratory; 6·22 Central Stations. |
| 2·52 | Heat Engineering | 2·753 Steam Turbine Engineering; 2·755 Heat Transmission. |
| 2·57 | Mechanical Equipment of Buildings | 2·607 Engineering Laboratory. |
| 2·602 | Engine Laboratory | 2·61 Engine Laboratory. |
| 2·603 | Engineering Laboratory | 2·451 Heat Engineering; 2·61, 2·611 Engineering Laboratory. |
| 2·605 | Engineering Laboratory | 2·612 Engineering Laboratory. |
| 2·608 | Engineering Laboratory | 2·613 Engineering Laboratory. |
| 2·61 | Engineering Laboratory | 2·62 Engineering Laboratory. |
| 2·611 | Engineering Laboratory | 2·621 Engineering Laboratory. |
| 2·613 | Engineering Laboratory | 2·614 Engineering Laboratory. |
| 2·681 | Ordnance Engineering | 2·682 Ordnance Engineering. |
| 2·682 | Ordnance Engineering | 2·683 Ordnance Engineering. |
| 2·702 | Machine Design | 2·703 Machine Design. |
| 2·703 | Machine Design | 2·71 Machine Design. |
| 2·704 | Machine Design | 2·711 Machine Design. |
| 2·71 | Machine Design | 2·72 Machine Design; 2·732 Engine Design. |
| 2·72 | Machine Design | 2·74 Machine Design (Advanced). |
| 2·732 | Engine Design | 2.733 Engine Design. |
| 2·754 | Fire Protection Engineering | 2·69 Textile Engineering. |
| 2·792 | Automative Engineering | 2·793 Automotive Engineering. |
| 2·82 | Foundry | 2·84 Pattern Making. |
| 2·86 | Vise and Bench Work | 2·88 Machine Tool Work. |
| 2·87 | Vise and Bench Work | 2·89 Machine Tool Work. |

**MECHANICAL ENGINEERING (Continued)**

| | | |
|---|---|---|
| 2·871 | Machine Tool Work | 2·91 Machine Tool Work. |
| 2·88 | Machine Tool Work | 2·90 Machine Tool Work. |
| 2·90 | Machine Tool Work | 2·92 Machine Tool Work. |
| 2·91 | Machine Tool Work | 2·911 Machine Tool Work. |
| 2·95 | Vise, Bench and Machine Tool Work | 2·97 Machine Tool Work. |
| 2·96 | Mechanical Laboratory | 2·97 Machine Tool Work. |

**MINING ENGINEERING**

| | | |
|---|---|---|
| 3·02 | Mining Engineering | 2·53 Power in Mining; 3·03 Mining Engineering; 3·21 Ore Dressing. |
| 3·03 | Mining Engineering | 3·04 Mining Engineering. |
| 3·04 | Mining Engineering | 3·06 Mining Engineering. |
| 3·05 | Mining Engineering | 3·23 Ore Dressing. |
| 3·21 | Ore Dressing | *3·22* Ore Dressing Laboratory; 3·23 Ore Dressing; 3·24 Ore Dressing. |
| 3·22 | Ore Dressing Laboratory | 3·24 Ore Dressing Advanced. |
| 3·31 | Fire Assaying | *3·22* Ore Dressing Laboratory; 3·23, 3·24 Ore Dressing; 3·33 Fire Assaying, Advanced; 3·55, 3·54, 3·55 Metallurgical Laboratory and Reports. |
| 3·41 | Metallurgy | 3·43 Metallurgy of Iron and Steel; 3·54, 3·55 Metallurgical Laboratory and Reports; 3·59 Metallurgical Calculations. |
| 3·42 | Metallurgy | 3·46 Metallurgical Plants Design; 3·47 General Metallurgy, Advanced; 3·55 Metallurgical Laboratory and Reports; 3·59 Metallurgical Calculations. |
| 3·43 | Metallurgy of Iron and Steel | 3·46 Metallurgical Plant Design; 3·61, 3·63 Metallography. |
| 3·44 | Metallurgy, General | 3·46 Metallurgical Plant Design; 3·59 Metallurgical Calculations. |
| 3·59 | Metallurgical Calculations | 3·46 Metallurgical Plant Design. |
| 3·61 | Metallography | 3·62 Metallography. |

**ARCHITECTURE**

| | | |
|---|---|---|
| 4·02 | Freehand Drawing | 4·03 Freehand Drawing; *4·06* Water Color; 4·72 Design II. |
| 4·03 | Freehand Drawing | 4·04 Life Class; 4·73 Design II. |
| 4·04 | Life Class | 4·05 Life Class and Decorative Design. |
| 4·06 | Water Color | 4·72 Design II. |
| 4·13 | Perspective | 4·14 Applied Perspective. |
| 4·211 | Office Practice | 4·212 Office Practice; 4·22 Professional Relations. |
| 4·41 | Architectural History | 4·42 Architectural History. |
| 4·42 | Architectural History | 4·51 Philosophy. |
| 4·46 | European Civilization and Art | 4·47 European Civilization and Art. |
| 4·71 | Design I | 4·72 Design II. |
| 4·72 | Design II | 4·73 Design III. |
| 4·81 | Constructive Design | 4·82 Constructive Design. |
| 4·91 | Structural Design | 4·92 Structural Design. |
| 4·92 | Structural Design | 1·55 Structural Design (Advanced). |

**CHEMISTRY**

| | | |
|---|---|---|
| 5·00e | Entrance Chemistry | 5·01 Chemistry. |
| 5·01 | Chemistry | 5·02 Chemistry; 7·01 General Biology; 7·02 Biology, Elements of. |
| 5·02 | Chemistry | 5·03 Chemistry; 5·75 Atomic Structure. |
| 5·03 | Chemistry | 5·10 Qualitative Analysis; 5·33 Gas and Fuel Analysis; 5·341, 5·342 Applied Chemistry; 5·343 Engineering Chemistry; 5·361 Testing of Oils; 5·37 Chemistry of Road Materials; 5·50 Organic Chemistry; 8·89 Electric Furnaces; 8·90 Electrochemistry, Elements of; 10·11 Problems of the Chemical Engineer; 12·01, 12·03 Mineralogy; 12·19 Crystallography. |
| 5·10 | Qualitative Analysis | 5·121 Quantitative Analysis. |
| 5·121 | Quantitative Analysis | 5·122 Quantitative Analysis; 5·20 Water Supplies; 5·21 Industrial Water Analysis; 5·22 Water Supplies and Wastes Disposal; 5·25, 5·251 Chemistry of Foods; 5·26 Food Analysis, Advanced; 5·29 Optical Methods in Chemical Analysis; 7·27 Biochemistry. |

**CHEMISTRY (Continued)**

| | | |
|---|---|---|
| 5·122 | Quantitative Analysis | 3·31 Fire Assaying; 3·32 Fire Assaying and Metallurgical Laboratory; 5·13 Quantitative Analysis; 5·19 Chemical Literature; 5·30 Proximate Technical Analysis; 5·31 Gas Analysis I; 5·36 Testing of Oils; 5·40 Special Methods and Instruments; 5·41 Metallography I; 5·42 Metallography Ia; 5·65, 5·651, 5·66 Chemical Principles I; 5·68 Thermochemistry and Chemical Equilibrium; 7·29 General Biology and Bacteriology; 10·51 Industrial Chemical Laboratory. |
| 5·13 | Quantitative Analysis | 3·22 Ore Dressing Laboratory; 5·05 Inorganic Chemistry I; 5·06 Inorganic Chemistry II; 5·08 Preparation of Inorganic Compounds; 5·14 Analytical Chemistry; 5·15 Qualitative Analysis of Rare Metals; 5·17 Methods of Electrochemical Analysis; 5·51 Organic Chemistry I; 5·561 Organic Chemical Laboratory; 5·90 Research Problem. |
| 5·31 | Gas Analysis I | 5·32 Gas Analysis II. |
| 5·37 | Chemistry of Road Materials | 1·32 Highway Transportation. |
| 5·41 | Metallography I | 5·43 Metallography II. |
| 5·50 | Organic Chemistry | 5·25, 5·251 Chemistry of Foods; 5·26 Food Analysis, Advanced; 5·27 Chemistry of Plant and Animal Life; 5·30 Proximate Technical Analysis; 5·36 Testing of Oils; *5·562* Organic Chemical Laboratory; 5·93 History of Chemistry; 7·20 Physiology; 7·27 Biochemistry; 7·36 Industrial Microbiology; 8·83 Electrochemistry II. |
| 5·51 | Organic Chemistry I | 5·251 Chemistry of Foods; 5·26 Food Analysis, Advanced; 5·27 Chemistry of Plant and Animal Life; 5·30 Proximate Technical Analysis; 5·52 Organic Chemistry II; 5·53 Organic Chemistry III; 5·55 Organic Qualitative Analysis; *5·561* Organic Chemical Laboratory; *5·562* Organic Chemical Laboratory; 5·57 Synthetic Method of Organic Chemistry; 5·58 Recent Developments in Organic Chemistry; 5·59a Chemistry of Dyes; 5·59b Chemistry of Powder and Explosives; 5·59c Determination of Chemical Constitution for Organic Compounds; 5·69 Colloidal Chemistry; 5·93 History of Chemistry; 7·27 Biochemistry; 7·36 Industrial Microbiology; *10·21* Industrial Chemistry. |
| 5·561 | Organic Chemical Laboratory | 5·53 Organic Chemistry III; 5·55 Organic Qualitative Analysis. |
| 5·65 | Chemical Principles I | 5·67 Chemical Principles II; 5·69 Colloidal Chemistry; 5·34 Industrial Application of Chemical Principles; 8·41 Physical [illegible]; 8·83 Electrochemistry II; *10·21* Industrial Chemistry; 10·31, 10·34 Chemical Engineering; 10·51 Industrial Chemical Laboratory; 10·61 Materials of Construction; 10·62 Applied Chemical Thermodynamics; 10·94 Organization and Methods of Industrial Relations; 10·95 Applied Colloid Chemistry. |
| 5·66 | Chemical Principles II | 10·31 Chemical Engineering; 10·62 Applied Chemical Thermodynamics; 10·94 Organization and Methods of Industrial Relations; 10·95 Applied Colloid Chemistry. |
| 5·68 | Thermochemistry and Chemical Equilibrium | 10·36 Chemical Engineering. |

**ELECTRICAL ENGINEERING**

| | | |
|---|---|---|
| 6·00 | Electrical Engineering | 6·01 Electrical Engineering; 6·111 Electrical Engineering; 6·112 Electrical Engineering; 6·30, 6·31, 6·32 Electrical Communication; 6·69, 6·70, 6·71a, 6·81 Electrical Engineering Laboratory. |
| 6·01 | Electrical Engineering | 6·02 Electrical Engineering; *6·90* Electrical Communication; 6·71b, 6·72b, 6·82 Electrical Communications Laboratory. |

**ELECTRICAL ENGINEERING (Continued)**

| | | |
|---|---|---|
| 6·02 | Electrical Engineering | 6·03, 6·031, 6·131, Electrical Engineering; 6·28 Telegraph and Telephone Engineering; *6·31* Electrical Communication; 6·72a, 6·72b, 6·83b Electrical Engineering Laboratory. |
| 6·03 | Electrical Engineering | 6·04, 6·041, 6·141 Electrical Engineering Laboratory; 6·25 Dynamo Design; 6·28 Telegraph and Telephone Engineering; *6·32* Electrical Communication; 6·73a, 6·73b Electrical Engineering Laboratory. |
| 6·031 | Electrical Engineering | 6·28 Telegraph and Telephone Engineering; 6·84 Electrical Engineering Laboratory. |
| 6·04 | Electrical Engineering | 6·05, 6·151 Electrical Engineering; 6·24 Electric Railways; 6·26 Dynamo Design; *6·75b*, 6·74 Electrical Engineering Laboratory. |
| 6·041 | Electrical Engineering | 6·84 Electrical Engineering Laboratory. |
| 6·05 | Electrical Engineering | 6·06, 6·15, 6·161 Electrical Engineering; 6·20 Electric Transmission Equipment; 6·21 Industrial Application of Electric Power; 6·22 Central Stations. |
| 6·10 | Electrical Engineering | 6·12 Electrical Engineering. |
| 6·101 | Electrical Engineering | 6·11 Electrical Engineering. |
| 6·11 | Electrical Engineering | 6·12 Electrical Engineering; *6·69* Electrical Engineering Laboratory. |
| 6·111 | Electrical Engineering | 6·112 Electrical Engineering. |
| 6·112 | Electrical Engineering | *6.75 Electrical Engineering Laboratory.* |
| 6·12 | Electrical Engineering | 6·121 Electrical Engineering; 6·75 Electrical Engineering Laboratory. |
| 6·121 | Principles of Electrical Engineering | 6·76b Electrical Engineering Laboratory. |
| 6·131 | Electrical Engineering | 6·14 Electrical Engineering; 6·76b Electrical Engineering Laboratory. |
| 6·14 | Electrical Engineering | 6·142 Electrical Engineering; 6·77 Electrical Engineering Laboratory; 6·78 Electrical Engineering Laboratory. |
| 6·142 | Electrical Engineering | 6·78 Electrical Engineering Laboratory. |
| 6·15 | Electrical Engineering | 6·152 Electrical Engineering. |
| 6·151 | Electrical Engineering | 6·152, 6·16 Electrical Engineering. |
| 6·16 | Electrical Engineering | 6·162 Electrical Engineering. |
| 6·22 | Central Stations | 6·23 Central Station Design. |
| 6·40 | Electrical Engineering | 6·86 Electrical Engineering Laboratory. |
| 6·41 | Electrical Engineering | 6·42 Electrical Engineering; 6·85, 6·86, 6·88 Electrical Engineering Laboratory; 8·20 Electricity. |
| 6·42 | Electrical Engineering | 6·44 Electric Transmission and Distribution of Energy; 6·85, *6·86*, *6·88* Electrical Engineering Laboratory. |
| 6·431 | Electrical Engineering | 6·91 Electrical Engineering Laboratory. |
| 6·432 | Electrical Engineering | *6·91* Electrical Engineering Laboratory. |
| 6·45 | Alternating Currents and Alternating Current Machinery | 6·46 Alternating Current Machinery and its Applications; 6·87 Electrical Engineering Laboratory. |
| 6·46 | Alternating Current Machinery and its Applications | 6·87 Electrical Engineering Laboratory. |
| 6·69 | Electrical Engineering Laboratory | 6·76a Electrical Engineering Laboratory. |
| 6·70 | Electrical Engineering Laboratory | 6·71a, 6·71b Electrical Engineering Laboratory. |
| 6·71 | Electrical Engineering Laboratory | 6·72a, 6·72b Electrical Engineering Laboratory. |
| 6·72 | Electrical Engineering Laboratory | 6·73a, 6·73b Electrical Engineering Laboratory. |
| 6·73 | Electrical Engineering Laboratory | 6·74 Electrical Engineering Laboratory. |
| 6·74 | Electrical Engineering Laboratory | 6·96 Electrical Engineering Laboratory. |
| 6·75 | Electrical Engineering Laboratory | 6·76b Electrical Engineering Laboratory. |
| 6·76 | Electrical Engineering Laboratory | 6·77 Electrical Engineering Laboratory. |
| 6·77 | Electrical Engineering Laboratory | 6·78 Electrical Engineering Laboratory. |
| 6·81 | Electrical Engineering Laboratory | 6·82 Electrical Engineering Laboratory. |
| 6·82 | Electrical Engineering aLboratory | 6·83b Electrical Engineering Laboratory. |
| 6·83 | Electrical Engineering Laboratory | 6·84 Electrical Engineering Laboratory. |
| 6·90 | Electrical Engineering Laboratory | 8·20 Electricity. |
| 6·91 | Electrical Engineering Laboratory | 6·92 Electrical Engineering Laboratory.] |

**BIOLOGY**

| | | |
|---|---|---|
| 7·01 | General Biology | 7·03 Theoretical Biology; 7·04 Cryptogamic Botany; 7·05 Invertebrate Zoölogy; 7·07 Parasitology; 7·06 Microscopy of Waters; 7·10 |

**BIOLOGY (Continued)**

| | | |
|---|---|---|
| | | Anatomy and Histology; 7·16 Introduction to Fisheries; 7·30 Bacteriology; 7·50 Infection and Immunity; 7·58 Vital Statistics. |
| 7·02 | Biology, Elements of | 7·06 Microscopy of Waters; 7·31 Bacteriology, Elements of. |
| 7·10 | Anatomy and Histology | 7·03 Theoretical Biology; 7·20 Physiology. |
| 7·27 | Biochemistry | 7·28 Selected Topics in Biochemistry. |
| 7·30 | Bacteriology | 7·03 Theoretical Biology; 7·36 Industrial Microbiology; 7·38 Public Health Laboratory Methods; 7·50 Infection and Immunity; 7·54 Problems and Practice of Public Health; 7·64 Municipal Sanitation; 7·67 Plant Sanitation. |
| 7·31 | Bacteriology, Elements of | 7·32 Bacteriology of Water and Sewage. |
| 7·50 | Infection and Immunity | 7·03 Theoretical Biology; 7·38 Public Health Laboratory Methods; 7·53 Industrial Hygiene and Sanitation. |

**PHYSICS**

| | | |
|---|---|---|
| 8·00e | Entrance Physics | 5·01 Chemistry; 8·011 Physics. |
| 8·011 | Physics | 8·012 Physics. |
| 8·012 | Physics | 2·20, 2·202, 2·203 Applied Mechanics; 8·013, 8·021 Physics; 8·04 Precision of Measurements. |
| 8·013 | Physics | 1·39 Graphic Statics; 5·29 Optical Methods in Chemical Analysis; 5·40 Special Methods and Instruments; 8·023 Physics; 8·16 Photography; 8·17 Geometrical Optics; 12·15 Petrography; 12·19 Crystallography; 12·21 Optical Crystallography. |
| 8·021 | Physics | 1·08 Geodetic and Topographic Surveying; 5·51 Organic Chemistry I; 5·65 Chemical Principles I; 5·651, 5·66 Chemical Principles; 5·68 Thermochemistry and Chemical Equilibrium; 8·022, 8·023 Physics. |
| 8·022 | Chemistry | 5·05 Inorganic Chemistry I; 8·023 Physics; 8·06 Color and Acoustics; 8·09 Physical Instruments; 8·20 Electricity; 8·231, 8·232, 8·233 Theoretical Physics. |
| 8·023 | Physics | 2·40, 2·46, 2·50 Heat Engineering; 2·53 Power in Mining; 2·57 Mechanical Equipment of Buildings; *6·00*, 6·101, 6·11 Electrical Engineering; 6·38 Electric Wiring and Lighting of Buildings; 6·40, 6·41 Electrical Engineering; 6·69 Electrical Engineering Laboratory; 8·11, 8·12, 8·13 Heat Measurements; 8·20 Electricity; 8·231, 8·232, 8·233 Theoretical Physics; 8·80 Electrochemistry, Principles of; 8·89 Electric Furnaces; 8·90 Electrochemistry, Elements of. |
| 8·11 | Heat Measurements | 8·14 Heat Measurements. |
| 8·12 | Heat Measurements | 8·14 Heat Measurements. |
| 8·16 | Photography | 8·18 Physical Optics; 8·34 Microscope Theory of Photo-micrography. |
| 8·17 | Geometrical Optics | 8·18 Physical Optics. |
| 8·18 | Physical Optics | 8·35 Optical Measurements. |
| 8·20 | Electricity | 8·30 Constitution of Matter. |
| 8·211 | Electron Theory | 8·212 Electron Apparatus. |
| 8·233 | Theoretical Physics | 8·30 Constitution of Matter. |
| 8·60 | Airplane Design | 8·59 Aeronautics; *8·602* Airplane Designing; 8·62 Aerial Propellers; 8·65 Airplane Structures, Advanced; 8·66 Airplane Design (Advanced). |
| 8·601 | Airplane Design | 8·65 Airplane Structures, Advanced; 8·66 Airplane Design, Advanced. |
| 8·61 | Airship Design | 8·611 Airship Design. |
| 8·63 | Aeronautical Laboratory | 8·64 Aeronautical Laboratory, Advanced. |
| 8·631 | Aeronautical Laboratory | 8·64 Aeronautical Laboratory, Advanced. |
| 8·80 | Electrochemistry, Principles of | 8·41 Physical Materials; 8·82 Electrochemistry II. |
| 8·82 | Electrochemistry II | 8·83 Electrochemistry III; 8·85 Applied Electrochemistry; 8·93 Colloquium. |
| 8·85 | Applied Electrochemistry | *8·87* Applied Electrochemical Laboratory. |

## CHEMICAL ENGINEERING

| | | |
|---|---|---|
| 10·21 | Industrial Chemistry | 10·22 Industrial Chemistry. |
| 10·22 | Industrial Chemistry | 10·23 Industrial Chemistry. |
| 10·23 | Industrial Chemistry | 10·25 Industrial Stoichiometry, 10·51 Industrial Chemical Laboratory; 10·61 Materials of Construction; 10·70 Sulphuric Acid; 10·71 Glass and Ceramics; 10·72 Iron and Steel; 10·73 Starch and Cellulose; 10·74 Petroleum; 10·75 Nitrogen Fixation; 10·77 Rubber; 10·78 Textiles and Dyeing; 10·79 Paints, Oils and Varnishes; 10·93 Automotive Fuel Problems; 10·95 Applied Colloid Chemistry; 10·96 Principles of Organic Electrochemistry. |
| 10·31 | Chemical Engineering | 10·32 Chemical Engineering; 10·44 Combustion; 10·47 Chemical Engineering Design. |
| 10·32 | Chemical Engineering | 10·33 Chemical Engineering. |
| 10·33 | Chemical Engineering | 10·41 Distillation and Evaporation; 10·42 Drying; 10·43 Extraction; 10·48 Chemical Engineering Design; 10·52 Chemical Engineering Laboratory; 10·61 Materials of Construction. |
| 10·34 | Chemical Engineering | 10·35 Chemical Engineering; 10·44 Combustion; 10·47 Chemical Engineering Design. |
| 10·35 | Chemical Engineering | 10·41 Distillation and Evaporation; 10·42 Drying; 10·43 Extraction; 10·48 Chemical Engineering Design. |
| 10·47 | Chemical Engineering Design | 10·48 Chemical Engineering Design. |
| 10·48 | Chemical Engineering Design | 10·49 Chemical Engineering Design. |
| 10·95 | Applied Colloid Chemistry | 10·951 Applied Colloid Chemical Laboratory. |

## GEOLOGY

| | | |
|---|---|---|
| 12·01 | Mineralogy | 3·05 Mining Engineering; 12·02 Mineralogy. |
| 12·02 | Mineralogy | 3·31 Fire Assaying; 12·15 Petrography; 12·30, 12·32 Geology; 12·33 Geology, Field; 12·40 Geology, Economic; 12·62 Geological Seminar. |
| 12·15 | Petrography | 12·16 Petrography, Advanced; 12·341, 12·35 Geological Surveying; 12·63 Geology of North America; 12·64 Geology of Europe. |
| 12·16 | Petrography, Advanced | 12·17 Chemical Minerals and Petrography. |
| 12·19 | Crystallography | 12·20 Physical and Chemical Crystallography. |
| 12·21 | Optical Crystallography | 12·20 Physical and Chemical Crystallography. |
| 12·30 | Geology | 12·31 Geology; 12·45 Geology of Clay, Cement and Building Stone; 12·46 Geology of Soil and Soil Examination; 12·47 Engineering Geology; 12·60 Physiography; 12·61 Hydrology. |
| 12·301 | Geology | 12·311, 12·321 Geology. |
| 12·31 | Geology | 12·32 Geology; 12·45 Geology of Clay, Cement and Building Stone; 12·46 Geology of Soil and Soil Examinations; 12·47 Engineering Geology; 12·50 Geology, Historical; 12·51 Paleontology; 12·61 Hydrology. |
| 12·311 | Geology | 12·321 Geology. |
| 12·32 | Geology | 12·33 Geology, Field; 12·40 Geology, Economic; 12·44 Geology of Coal and Petroleum; 12·441 Valuation of Oil Lands and Construction of Oil Maps; 12·442 Petroleum Production; 12·45 Geology of Clay, Cement and Building Stone; 12·46 Geology of Soils and Soil Examinations; 12·47 Engineering Geology; 12·61 Hydrology; 12·62 Geological Seminar; 12·63 Geology of North America; 12·64 Geology of Europe. |
| 12·33 | Geology, Field | 12·34, 12·341 Geological Surveying. |
| 12·34 | Geological Surveying | 12·35 Geological Surveying. |
| 12·40 | Geology, Economic | 12·41 Geology, Economic; 12·42 Geology, Applied Economic; 12·43 Geology, Economic, Advanced. |
| 12·41 | Geology, Economic | 12·43 Geology, Economic, Advanced. |
| 12·50 | Geology, Historical | 12·63 Geology of North America; 12·64 Geology of Europe. |
| 12·51 | Paleontology | 12·52 Paleontology, Advanced; 12·53 Index Fossils. |
| 12·54 | Organic Evolution | 12·55 Organic Evolution Advanced. |

## NAVAL ARCHITECTURE AND MARINE ENGINEERING

| | | |
|---|---|---|
| 13·01 | Naval Architecture | 13·02 Naval Architecture. |
| 13·31 | Ship Construction | 13·32 Ship Construction. |
| 13·32 | Ship Construction | 13·33 Ship Construction. |
| 13·41 | Ship Drawing | 13·42 Ship Drawing. |
| 13·42 | Ship Drawing | 13·43 Ship Drawing. |
| 13·51 | Marine Engineering | 13·52 Marine Engine Design. |

## DRAWING

| | | |
|---|---|---|
| D101 | Mechanical Drawing | 2·00, 2·02 Mechanism; 4·12 Perspective; D122, D132 Elementary Machine Drawing. |
| D122 | Elementary Machine Drawing | D123 Elementary Machine Drawing. |
| D123 | Elementary Machine Drawing | 2·10 Mechanical Engineering Drawing; 2·12, 2·14 Machine Drawing; 2·80, 2·801, 2·802 Forging; 2·82, 2·83, 2·831 Foundry; 2·86, 2·87, 2·871 Vise, Bench and Machine Tool Work; 2·95, 2·951 Vise, Bench and Machine Tool Work; 2·96 Mechanical Laboratory. |
| D132 | Elementary Architectural Drawing | D133 Elementary Architectural Drawing. |
| D133 | Elementary Architectural Drawing | 4·11 Shades and Shadows; 4·211 Office Practice; *4·71* Design I. |
| D151 | Elementary Freehand Drawing | D152 Elementary Freehand Drawing. |
| D152 | Elementary Freehand Drawing | D153 Elementary Freehand Drawing. |
| D153 | Elementary Freehand Drawing | 4·02 Freehand Drawing; 4·211 Office Practice; *4·71* Design I. |
| D171 | Descriptive Geometry | 2·00, 2·02 Mechanism; 4·12 Perspective; D172 Descriptive Geometry. |
| D172 | Descriptive Geometry | 2·10 Mechanical Engineering Drawing; D173 Descriptive Geometry. |
| D173 | Descriptive Geometry | 1·00, 1·001 Surveying and Plotting; 1·01 Surveying Instruments; 1·02, 1·03 Surveying; 4·11 Shades and Shadows; *4·71* Design I; 4·90 Structural Drawing; 13·41 Ship Drawing D201, D211 Descriptive Geometry. |

## ECONOMICS

| | | |
|---|---|---|
| Ec22 | Political Economy | Ec23 Political Economy; Ec37 Banking. |
| Ec23 | Political Economy | Ec38 Securities and Investments; Ec46 Industrial Relations; Ec56 Industrial Organization; Ec65 Statistics; Ec70 Business Management. |
| Ec31 | Political Economy | Ec32 Political Economy. |
| Ec32 | Political Economy | Ec33 Political Economy. |
| Ec33 | Political Economy | Ec46 Industrial Relations; Ec65 Statistics. |
| Ec37 | Banking | Ec60 Business Law; Ec65 Statistics. |
| Ec50 | Accounting | Ec37 Banking; Ec38 Securities and Investments; Ec51 Cost Accounting; Ec56 Industrial Organization; Ec65 Statistics. |
| Ec57 | Industrial Organization | Ec38 Securities and Investments; Ec70 Business Management; Ec60 Business Law. |
| Ec70 | Business Management | Ec71 Business Management. |
| Ec71 | Business Management | Ec72 Business Management. |
| Ec72 | Business Management | *Ec51* Cost Accounting; Ec73 Business Management. |

## ENGLISH AND HISTORY

| | | |
|---|---|---|
| E1 | Entrance English | 5·01 Chemistry; EH11 English and History. |
| H1 | Entrance History | EH11 English and History. |
| EH11 | English and History | 4·46, European Civilization and Art; EH12 English and History. |
| EH13 | English | Ec22 Political Economy; Ec50 Accounting; EH21 English and History. |
| EH23 | English and History | 1·90 Report Writing; Ec31 Political Economy. |

## LANGUAGES

| | | |
|---|---|---|
| L11 | German I | 5·19 Chemical Literature; 5·30 Proximate Technical Analysis; L21 German. |
| L21 | German II | 8·10 Physical Literature; L31, L32, L33, L43 German. |
| L61 | French, Elementary | L62, L63 French, Intermediate; L64 French, Technical. |
| L62 | French II | 8·10 Physics Literature; L71 French, Advanced, |
| L63 | French, Intermediate | L71 French, Advanced. |

## MATHEMATICS

| | | |
|---|---|---|
| M1 | Entrance Algebra | 5·01 Chemistry; D171, D191 Descriptive Geometry; M11 Mathematics. |
| M2 | Entrance Geometry, Plane | D171 Descriptive Geometry; D191 Descriptive Geometry (College Class); M11 Mathematics. |
| M3 | Geometry Solid (Entrance) | M11 Mathematics. |
| M4 | Plane Trigonometry | 1·11 Spherical Trigonometry; 8·011 Physics; M11 Mathematics. |
| M11 | Mathematics | 2·00, 2·02 Mechanism; *8·011* Physics; 8·012 Physics; M12 Mathematics. |
| M12 | Mathematics | 8·013 Physics; M13 Mathematics. |
| M13 | Mathematics | 1·00, 1·001 Surveying and Plotting; 1·01 Surveying Instruments; 1·02 Surveying; 2·204 Applied Mechanics; 8·021 Physics; 8·04 Precision of Measurements; M21, M22 Mathematics; M26 Least Squares. |
| M21 | Mathematics | 1·21 Railway and Highway Engineering; 5·65 Chemical Principles I; 5·651, 5·66 Chemical Principles; 5·68 Thermochemistry and Chemical Equilibrium; 8·022 Physics; M22 Mathematics; M28, M29, Mathematics. |
| M22 | Mathematics | 1·03 Surveying; 1·07 Plane Surveying; 1·13 Geodesy; 2·20, 2·202, *2·203* Applied Mechanics; 2·40, 2·46 Heat Engineering; 2·53 Power in Mining; 5·74 Kinetic Theory of Gases; 6·101 Electrical Engineering; 7·58 Vital Statistics; 8·591 Aeronautics; 8·80 Electrochemistry, Principles of; M23, M36, M41 Mathematics; M50 Application of Mathematics to Chemistry; M54 Mathematical Laboratory. |
| M23 | Mathematics | 2·50 Heat Engineering; *6·00, 6·11*, 6·111 Electrical Engineering; 8·231, 8·232, 8·233 Theoretical Physics; 8·60, 8·601 Airplane Design; 8·61, 8·611 Airship Design; 8·62 Aerial Propellers; 8·63, 8·631 Aeronautical Laboratory; M35 Mathematics. |
| M26 | Theory of Probability and Method of Least Squares | 8·39 Kinetic Theory and Correlation. |
| M35 | Mathematics | *6·01* Electrical Engineering. |
| M36 | Mathematics | M37 Mathematics. |
| M37 | Mathematics | M38 Mathematics. |

T.P.-4-22-5000

## Publications of the Massachusetts Institute of Technology

# BULLETINS

## MASSACHUSETTS INSTITUTE OF TECHNOLOGY

| *Title* | *Vol.* | *No.* | *Date of Publication* |
|---|---|---|---|
| General Information Requirements for Admission | 57 | 1 | October, 1921 |
| Scholarships, Fellowships and Prizes | 57 | 1 Extra | October, 1921 |
| Directory of Officers and Students, 1921-1922 | 57 | 2 | December, 1921 |
| President's Report for 1920–1921 | 57 | 3 | January, 1922 |
| Summer Session | 57 | 4 | April, 1922 |
| Summer Surveying Courses At Camp Technology | 57 | 5 | April, 1922 |
| Courses of Study and Subjects of Instruction | 57 | 6 | April, 1922 |
| Graduate Study and Research | 57 | 7 | March, 1922 |
| School of Chemical Engineering Practice X-A | 56 | 8 | December, 1920 |