The role of civil and environmental engineers, in the broadest sense, is to apply science and technology to develop sustainable solutions to meet society's needs. Civil engineers plan, design, construct, and operate infrastructure used daily by the public and industry, such as buildings, transportation networks, water systems, and energy distribution systems. Civil engineers also work to protect public health and the environment. They work at the intersection of the built, natural, and information environments.

Today's civil and environmental engineers are also called upon by government and industry to provide leadership on complex technical and societal issues such as demands for infrastructure improvement, remediation of former industrial sites for reuse, renewable energy, climate change adaptation, provision of safe drinking water, smart transportation systems, and sustainable development.

Civil and environmental engineering requires broad technical training and strong communication skills to design and convey complex ideas to others. The Civil Engineering curriculum is intended to allow ample opportunity for students to pursue areas of personal interest. A student may choose to concentrate in a specialty area in civil engineering, to pursue a minor in one of the designated minor programs offered in the College of Engineering, or to pursue an additional major. Information on these options follows the curriculum.

The Department of Civil and Environmental Engineering offers a wide spectrum of opportunities for entry into the engineering profession, for graduate education in engineering, or entry into various other graduate and professional fields, including business, law, and medicine. While maintaining its emphasis on the fundamental understanding of the behavior of constructed facilities through the application of the physical sciences, biology, mathematics, and computing, the curriculum has continually evolved in directions that exploit advances in technology. The curriculum introduces the methods of engineering design in the first year and continues to emphasize them throughout the curriculum in both traditional and project-oriented courses. The basic undergraduate degree program leads to a B.S. in Civil Engineering. A minor in Environmental and Sustainability Studies is also available.

Central to the evolution of technology and its impact on engineering practice is the modern emphasis on the use of computers in engineering. Several courses on computer methods are required in the curriculum, and most courses offered by the department require the use of computers in applications of either analysis or design.

Our curriculum emphasizes the development of scientific inquiry in the context of applications in civil and environmental engineering. For B.S. graduates who wish to enter the engineering profession directly in such specialties as structural engineering, construction engineering, or environmental engineering, this approach to teaching allows application of the most advanced technological developments. Others who wish to pursue graduate study are prepared to engage in research on the highest level, either in traditional specialties or in emerging fields such as smart infrastructure, climate change adaptation, and micromechanics.

The Civil Engineering curriculum is intended to allow ample opportunity for students to pursue areas of personal interest. A student may choose to concentrate in a specialty area in civil engineering, to pursue a minor in one of the designated minor programs offered in the College of Engineering, or to pursue an additional major. Information on these options follows the description of the curriculum in this section. Students are encouraged to participate in research with department faculty members, explore their chosen field through internships, and take advantage of large projects and the interactions with engineers in other fields, lawyers, public officials, community members, and other stakeholders. Our curriculum provides this versatility for professional practice in civil and environmental engineering and as a strong foundation for other professional pursuits.

The Program Educational Objectives are broad statements that describe what graduates are expected to attain within a few years of graduation. The objectives of the Bachelor of Science in Civil Engineering program are to develop graduates who embody the following definitions:

- Graduates distinguish themselves within their organizations as individuals able to provide solutions to a wide range of conventional, cutting-edge, and emerging professional challenges related to one or more of the areas of the built, natural and information environments, considering sustainability principles;
- Graduates are innovative, proactive, and adaptive professionals, highly engaged in their professional communities; graduates are prepared to take on leadership positions within their organizations and communities; and
- Graduates are able to contribute and collaborate on developing solutions to local and global problems; graduates are able to cross geographic, cultural, and traditional discipline boundaries in developing solutions.

The undergraduate Bachelor of Science in Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

By the end of the B.S. program, students should have achieved the following student outcomes:

A. an ability to apply knowledge of mathematics, science and engineering
B. an ability to design and conduct experiments, as well as to analyze and interpret data
C. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
D. an ability to function on multidisciplinary teams
E. an ability to identify, formulate, and solve engineering problems
F. an understanding of professional and ethical responsibility
G. an ability to communicate effectively
H. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
I. a recognition of the need for, and an ability to engage in lifelong learning
J. a knowledge of contemporary issues relevant to engineering practice
K. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The curriculum has been designed, and is periodically evaluated and refined, to provide students instruction and experiences that lead to the development of these abilities and skills.

Minimum units required for B.S. in Civil Engineering

385

Students entering the College of Engineering declare a major near the end of the first year. First-year students take two introductory engineering courses as well as some restricted technical electives within the common foundation specified for first-year engineering students. By the end of the sophomore year, a Civil Engineering major is expected to have completed the Restricted Technical Electives in the following list and 12-100 Exploring CEE: Infrastructure and Environment in a Changing World.

### Program Educational Objectives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-101</td>
<td>Introduction to Experimental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry I</td>
<td>10</td>
</tr>
<tr>
<td>15-110</td>
<td>Principles of Computing</td>
<td>10</td>
</tr>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-122</td>
<td>Integration and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>33-141</td>
<td>Physics I for Engineering Students</td>
<td>12</td>
</tr>
<tr>
<td>33-142</td>
<td>Physics II for Engineering and Physics Students</td>
<td>12</td>
</tr>
</tbody>
</table>
Notes on Math Requirements
1. All mathematics (21-xxx) courses required for the engineering degree taken at Carnegie Mellon must have a minimum grade of C in order to be counted toward the graduation requirement for the BS engineering degree.
2. A minimum grade of C must be achieved in any required mathematics (21-xxx) course that is a pre-requisite for the next higher level required mathematics (21-xxx) course.

Sample Curriculum
This section shows the recommended four-year program of study for the BS in Civil Engineering following a typical path. The curriculum for transfer students, students with advanced placement credit, and students planning to study abroad will not follow the same path. Students need to consult the department for appropriate advising and formulation of a plan to complete the degree within eight semesters.

First Year
Fall
12-100 Exploring CEE: Infrastructure and Environment in a Changing World 12
21-120 Differential and Integral Calculus 10
33-141 Physics I for Engineering Students 12
99-10x Computing @ Carnegie Mellon 3
xx-xxx General Education Course 9

Units 46

Spring
xx-xxx Introduction to Engineering (other than CEE) 12
21-122 Integration and Approximation 10
33-142 Physics II for Engineering and Physics Students 12
09-101 Introduction to Experimental Chemistry 3
xx-xxx General Education Course 9

Units 46

Second Year
Fall
12-200 CEE Challenges: Design in a Changing World 9
12-212 Statics 9
21-259 Calculus in Three Dimensions 9
15-110 Principles of Computing 10
xx-xxx General Education Course 9
39-210 Experiential Learning I 0

Units 46

Spring
12-231 Solid Mechanics 9
12-232 Solid Mechanics Lab 3
12-271 Introduction to Computer Application in Civil & Environmental Engineering 9
21-260 Differential Equations 9
09-105 Introduction to Modern Chemistry I 10
xx-xxx General Education Course 9
39-220 Experiential Learning II 0

Units 49

Junior Year
Fall
12-301 CEE Projects: Designing the Built, Natural and Information Environments 9
12-335 Soil Mechanics 9
12-336 Soil Mechanics Laboratory 3
12-355 Fluid Mechanics 9
12-356 Financial Mechanics Lab 3
36-220 Engineering Statistics and Quality Control 9
xx-xxx Elective 1 9
39-310 Experiential Learning III 0

Units 51

Spring
12-351 Environmental Engineering 9

Units 9

Senior Year
Fall
12-401 Civil & Environmental Engineering Design * 15
12-411 Project Management for Construction 9
12-421 Engineering Economics 6
xx-xxx General Education Course 9
xx-xxx Elective 4 9

Units 48

Spring
xx-xxx General Education Course 9
xx-xxx General Education Course 9
xx-xxx Elective 6 9
xx-xxx Elective 5 9
xx-xxx Elective 7 9
xx-xxx Elective 8 9

Units 54

Notes on Electives
1. One elective must be in the basic sciences, from the following list:
   - 03-121 Modern Biology
   - 12-201 Geology
   Substitutions may be made only with the approval of the Department Head.
2. One elective course is restricted to a 600-level Civil Engineering course of at least 9 units, except 12-648 and 12-690. This Civil Engineering elective is a co-requisite for 12-401.
3. Students are encouraged to take multiple 12-6xx courses to provide them with specific civil and environmental engineering domain depth in their field(s) of interest.

Specialty Areas in Civil Engineering
Students may select a set of civil engineering and technical electives in the junior and senior years that enable them to concentrate in a specialty area, if they so desire. Some examples for grouping electives into specialty areas, together with representative course selections, are indicated below. Other possible groupings may be discussed with a faculty mentor. These specialty areas are not noted on the official transcript.

Structural Engineering
Units
12-600 AutoCAD 3
12-631 Structural Design 12
12-635 Structural Analysis 9
12-636 Geotechnical Engineering 9
12-638 Behavior of Structural Systems 9
21-241 Matrices and Linear Transformations 10
24-351 Dynamics 10

Units 62

Environmental Engineering - Air Quality
Units
09-106 Modern Chemistry II 10
12-651 Air Quality Engineering 9
12-679 Special Topics: Intro to Meteorology 12
24-425 Combustion and Air Pollution Control 9

Units 40
Environmental Engineering - Water Quality
03-121 Modern Biology 9
09-106 Modern Chemistry II 10
12-629 Environmental Microbiology for Engineers 9
12-702 Fundamentals of Water Quality Engineering 12

Environmental Engineering - Water Resources
12-636 Geotechnical Engineering 9
12-657 Water Resource Systems Engineering 9

Environmental Engineering - Energy
06-221 Thermodynamics 9
09-106 Modern Chemistry II 10
24-424 Energy and the Environment 9

Computing in Civil Engineering
12-600 AutoCAD 3
12-631 Structural Design 12
12-635 Structural Analysis 9
12-657 Water Resource Systems Engineering 9
12-659 Special Topics: Matlab 6

Construction Management
12-600 AutoCAD 3
12-606 Traffic Engineering 6
12-631 Structural Design 6
12-635 Structural Analysis 9
12-636 Geotechnical Engineering 9

Double Majors and Minors
Civil Engineering students may pursue double majors and minors in a variety of subjects, taking advantage of the free elective courses to satisfy the requirements for the major or minor. The College of Engineering has designated minors to promote flexibility and diversity among engineering students. Many Civil Engineering undergraduates pursue designated minors in areas such as Architecture, Environmental and Sustainability Studies, or Global Engineering.

Internships and Co-Operative Education Program
Students in Civil Engineering are encouraged to undertake professional internships during summer breaks. In addition, a cooperative internship program is possible for either Jan-Aug or May-Dec in the junior year. Students undertaking these 8-month professional internships would ordinarily graduate after an additional semester of study.

Integrated B.S./M.S. Program
Interested undergraduates may plan a course of study that leads to both the BS in Civil Engineering and the MS in Civil and Environmental Engineering. This course of study will ordinarily require ten semesters of study, although advanced placement or other study may reduce this time. Students can apply appropriate units earned as undergraduates for their MS program as long as they are beyond the 379 units required for the BS in Civil Engineering degree. In the ninth semester of study, students must register in graduate status. Interested students should consult their academic advisor or the CEE Department office for information about admission to the MS program.

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