Civil Engineering, B.S.

Program Educational Objectives

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:

- Contribute and collaborate on development of sustainable solutions to a wide range of conventional, cutting-edge, and emerging professional challenges on local and global scales.
- Are innovative, proactive, and adaptive professionals and leaders, in their organizations and professional communities.
- Cross geographic, cultural, and traditional discipline boundaries to develop just and equitable solutions.

The Bachelor of Science in Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org under the commission's General Criteria and Program Criteria for Civil and Similarly Named Engineering Programs.

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

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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.

Curriculum

Minimum units required for B.S. in Civil Engineering 384

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.

Restricted Technical Electives		Units
09-101	Introduction to Experimental Chemistry	3
09-105	Introduction to Modern Chemistry I	10
or 09-111	Chemical Building Blocks	
15-110	Principles of Computing	10
21-120	Differential and Integral Calculus	10
21-122	Integration and Approximation	10
21-259	Calculus in Three Dimensions	9
or 21-254	Linear Algebra and Vector Calculus for Engineers	
21-260	Differential Equations	9
33-141	Physics I for Engineering Students	12
33-142	Physics II for Engineering and Physics Students	12

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		Units
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
99-101	Core@CMU	3
xx-xxx	General Education Course	9
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Spring		Units
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
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Sophomore Year

Fall		Units
12-200	CEE Challenges: Design in a Changing World	9
12-212	Statics	9
12-233	CEE Infrastructure Systems in Action	2
21-259	Calculus in Three Dimensions	9
or 21-254	Linear Algebra and Vector Calculus for Engineers	
15-110	Principles of Computing	10
xx-xxx	General Education Course	9
39-210	Experiential Learning I	0
		48

Spring		Units
12-231	Solid Mechanics	9
12-234	Sensing and Data Acquisition for Engineering Systems	4
12-271	Computation and Data Science for Civil & Environmental Engineering	9
21-260	Differential Equations	9
09-111	Chemical Building Blocks or 09-105 Modern Chemistry I	9
xx-xxx	General Education Course	9
39-220	Experiential Learning II	0
		49

Junior Year

Fall		Units
12-301	CEE Projects: Integrating the Built, Natural and Information Environments	9
12-351	Environmental Engineering	9
12-355	Fluid Mechanics	9
12-356	Fluid Mechanics Lab	2
36-220	Engineering Statistics and Quality Control	9

xx-xxx	Elective 1	9
39-310	Experiential Learning III	0
		47

Spring		Units
12-333	Experimental & Sensing Systems Design and Computation for Infrastructure Systems	4
12-335	Soil Mechanics	9
12-371	Advanced Computing and Problem Solving in Civil and Environmental Engineering	9
27-357	Introduction to Materials Selection	6
xx-xxx	Elective 2	9
xx-xxx	General Education Course	9
		46

Senior Year

Fall		Units
12-401	CEE Design	12
12-411	Project Management for Engineering and Construction	9
xx-xxx	Elective 3	9
xx-xxx	Elective 4	9
xx-xxx	General Education Course	9
		48

Spring		Units
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
xx-xxx	Elective 5	9
xx-xxx	Elective 6	9
xx-xxx	Elective 7	9
xx-xxx	Elective 8	9
		54

Notes on Electives

1. One elective must be in the basic sciences, from the following list:

03-121	Modern Biology	9
12-201	Geology	9
12-353	Environmental Biology and Ecology	9

   Substitutions may be made only with the approval of the Department Head.
2. One elective course is restricted to a 600-level or 700-level Civil Engineering course of at least 9 units, except 12-648 and 12-690. The combination of 12-644 and 12-645 may also be used, but no other combination is allowed.
3. **Students are encouraged to take multiple 12-6xx and 12-7xx courses to provide them with specific civil engineering domain depth in their field(s) of interest.**

Elective Courses

Students may select a set of civil engineering and other electives in the junior and senior years. Some examples for grouping electives are indicated below. Students can create other groupings to meet their academic and career interests; discussion with a faculty mentor is encouraged.

Structural Engineering

		Units
12-201	Geology	9
12-631	Structural Design	12
12-635	Structural Analysis	12
12-636	Geotechnical Engineering	9
21-241	Matrices and Linear Transformations	11
24-311	Numerical Methods	10
24-351	Dynamics	10

Computing in Civil Engineering

		Units
12-600	AutoCAD	3
12-623	Molecular Simulation of Materials	12
12-645	Smart Cities: Growth and Intelligent Transportation Systems	6
12-659	Special Topics: Matlab	6
24-451	Feedback Control Systems	12
24-650	Applied Finite Element Analysis	12
24-658	Image-Based Computational Modeling and Analysis	12

Engineering and Society

		Units
12-645	Smart Cities: Growth and Intelligent Transportation Systems	6
12-657	Water Resource Systems Engineering	9
24-291	Environmental Systems on a Changing Planet	9
48-371	City & Suburb: American House and Housing Since 1850	9
79-303	Pittsburgh and the Transformation of Modern Urban America	9
79-315	The Politics of Water in Global Perspective	9

Construction Management

		Units
12-600	AutoCAD	3
12-631	Structural Design	12
12-635	Structural Analysis	12
12-636	Geotechnical Engineering	9
48-380	Constructing Value(s): Economies of Design	6
70-311	Organizational Behavior	9
70-321	Negotiation and Conflict Resolution	9

Next-Generation Building and Construction

		Units
12-631	Structural Design	12
39-245	Rapid Prototype Design	9
48-530	Human-Machine Virtuosity	12
48-555	Introduction to Architectural Robotics	9

Smart Cities

		Units
12-600	AutoCAD	3
12-612	Intro to Sustainable Engineering	9
12-631	Structural Design	12
12-635	Structural Analysis	12
12-636	Geotechnical Engineering	9
12-644	Intro to Transportation Systems Analysis	6
12-645	Smart Cities: Growth and Intelligent Transportation Systems	6
24-643	Energy Storage Materials and Systems	12

Smart Buildings

		Units
12-600	AutoCAD	3
12-631	Structural Design	12
12-635	Structural Analysis	12
48-116	Introduction to Building Performance	3
48-315	Environmental Systems: Climate & Energy in Buildings	9
48-432	Environment II: Design Integration of Active Building Systems	9

Materials

		Units
12-623	Molecular Simulation of Materials	12
24-643	Energy Storage Materials and Systems	12
27-201	Structure of Materials	9
27-202	Defects in Materials	9
27-215	Thermodynamics of Materials	12
27-301	Microstructure and Properties	9

27-406	Sustainable Materials	9
27-503	Additive Manufacturing and Materials	9