ENVIRONMENTAL SYSTEMS ENGINEERING UNDERGRADUATE MAJOR

See the "Department of Civil and Environmental Engineering (http://exploredegrees.stanford.edu/schoolofengineering/civilandenvironmentalengineering)" section of this bulletin for additional information on the department, and its programs and faculty.

The department offers a B.S. as well as a minor in Environmental Systems Engineering (see following), as well as a B.S. in Civil Engineering (http://exploredegrees.stanford.edu/soe-ug-majors/civilengineering) and a minor in Civil Engineering (http://exploredegrees.stanford.edu/schoolofengineering/civilandenvironmentalengineering/#minortext).

Environmental Systems Engineering (EnvSE)

Completion of the undergraduate program in Environmental Systems Engineering leads to the conferment of the Bachelor of Science in Environmental Systems Engineering.

Mission of the Undergraduate Program in Environmental Systems Engineering

The mission of the undergraduate program in Environmental Systems Engineering is to prepare students for incorporating environmentally sustainable design, strategies and practices into natural and built systems and infrastructure involving buildings, water supply, and coastal regions. Courses in the program are multidisciplinary in nature, combining math/science/engineering fundamentals, and tools and skills considered essential for an engineer, along with a choice of one of three focus areas for more in-depth study: coastal environments, freshwater environments, or urban environments. This major offers the opportunity for a more focused curriculum than the Environmental and Water Studies concentration in the Civil Engineering degree program. The program of study, which includes a capstone experience, aims to equip engineering students to take on the complex challenges of the twenty-first century involving natural and built environments, in consulting and industry as well as in graduate school.

Requirements

Mathematics and Science

See Basic Requirement 1 and 2

Technology in Society (TIS)

One 3-5 unit course required, course chosen must be on the SoE Approved Courses list at <ughb.stanford.edu> the year taken; see Basic Requirement 4

Engineering Fundamentals

Two courses minimum (see Basic Requirement 3), including:

CS 106A Programming Methodology

or (CS 106X)

ENGR 14 Intro to Solid Mechanics

Fundamental Tools/Skills

in visual, oral/written communication, and modeling/analysis

Specialty Courses, in either

Coastal environments (see below)

or freshwater environments (see below)

or urban environments (see below)

Total Units

96-98

1 Math must include CME 100 Vector Calculus for Engineers (or MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications), and either a Probability/Statistics course or CME 102 Ordinary Differential Equations for Engineers (or MATH 53 Ordinary Differential Equations with Linear Algebra). Science must include PHYSICS 41 Mechanics; and either CHEM 31B Chemical Principles II or CHEM 31M Chemical Principles. For urban focus area only.

2 Fundamental tools/skills must include:

1. CEE 1 Introduction to Environmental Systems Engineering;

2. at least one visual communication class from CEE 31 Accessing Architecture Through Drawing / CEE 31Q Accessing Architecture Through Drawing, DESINST 270 Visual Design Fundamentals, ME 101 Visual Thinking, ME 110 Design Sketching, ARTSTUDI 160 Intro to Digital / Physical Design, or DSPPARIS 44 EAP Analytical Drawing and Graphic Art;

3. at least one oral/written communication class from ENGR 103 Public Speaking, CEE 102W Technical and Professional Communication, ENGR 202W Technical Communication, CEE 151 Negotiation, EARTH SYS 191 Concepts in Environmental Communication or ORALCOMM 117 The Art of Effective Speaking;

4. at least one modeling/analysis class from CEE 101D Computations in Civil and Environmental Engineering (or CEE 101S) if not counted as Math; CEE 120 (online only). CEE 146S Engineering Economics and Sustainability (online only), CEE 124X Shaping the Future of the Bay Area, CEE 155 Introduction to Sensing Networks for CEE, CEE 226 Life Cycle Assessment for Complex Systems, CME 211 Software Development for Scientists and Engineers, CS 102 Working with Data - Tools and Techniques, EARTH SYS 140 Data science for geoscience, EARTH SYS 142 Remote Sensing of Land, EARTH SYS 144 Fundamentals of Geographic Information Science (GIS), or ESS 227 Decision Science for Environmental Threats.

3 A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.

Urban Environments Focus Area (37 units)

Required

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 100</td>
<td>Managing Sustainable Building Projects</td>
<td>4</td>
</tr>
<tr>
<td>CEE 101B</td>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>CEE 146S</td>
<td>Engineering Economics and Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>CEE 176A</td>
<td>Energy Efficient Buildings</td>
<td>3</td>
</tr>
<tr>
<td>Electives (at least two of the 4 areas below must be included with at least 3 units from 2nd area)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Building Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 102A</td>
<td>Legal and Ethical Principles in Design, Construction, and Project Delivery</td>
<td>3</td>
</tr>
<tr>
<td>CEE 120B</td>
<td>Advanced Building Modeling Workshop</td>
<td>2-4</td>
</tr>
<tr>
<td>CEE 130</td>
<td>Architectural Design: 3-D Modeling, Methodology, and Process</td>
<td>5</td>
</tr>
<tr>
<td>or CEE 131C</td>
<td>How Buildings are Made − Materiality and Construction Methods</td>
<td>4</td>
</tr>
<tr>
<td>CEE 156</td>
<td>Building Systems</td>
<td>4</td>
</tr>
</tbody>
</table>
| Energy Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 107A</td>
<td>Understanding Energy (or CEE 107S, S or Sum, 3-4 units)</td>
<td>4-5</td>
</tr>
<tr>
<td>CEE 176B</td>
<td>100% Clean, Renewable Energy and Storage for Everything</td>
<td>3-4</td>
</tr>
<tr>
<td>ENERGY 104</td>
<td>Sustainable Energy for 9 Billion</td>
<td>3</td>
</tr>
<tr>
<td>or ENERGY 171</td>
<td>Energy Infrastructure, Technology and Economics</td>
<td>3</td>
</tr>
<tr>
<td>CEE 173S</td>
<td>Electricity Economics</td>
<td>3</td>
</tr>
</tbody>
</table>
ENERGY 191 Optimization of Energy Systems 3-4

Water Systems
CEE 165C Water Resources Management 3
CEE 166A Watersheds and Wetlands 4
CEE 166B Floods and Droughts, Dams and Aqueducts 4
CEE 174A Providing Safe Water for the Developing and Developed World 3
CEE 174B Wastewater Treatment: From Disposal to Resource Recovery 3

Urban Planning, Design, Analysis
CEE 6 Physics of Cities 3
CEE 136 Urban Development and Governance 3
CEE 162F Urban Development and Governance 3
CEE 162E Urban Development and Governance 3
CEE 275D Environmental Policy Analysis 4
CEE 273B The Business of Water 2
CEE 174A Providing Safe Water for the Developing and Developed World (prereq: CHEM 31B) (if not counted as a Req'd course) 3
CEE 174B Wastewater Treatment: From Disposal to Resource Recovery (prereq: CEE 174A) 3
CEE 179A Water Chemistry Laboratory (CEE 177 recommended) (not offered AY 19-20)) 3
CEE 174A or CEE 166A

Capstone (one class required)
CEE 131D Urban Design Studio 5
CEE 141A Infrastructure Project Development (recom. pre-req. CEE 136 or CEE 171P) 3
CEE 141B Infrastructure Project Delivery 3
CEE 226E Advanced Topics in Integrated, Energy-Efficient Building Design 2-3
CEE 224Y 3-5
CEE 224Z 1-5
CEE 243 Intro to Urban Sys Engr 3
CEE 265F Environmental Governance and Climate Resilience 3
CEE 325 CapaCity Design Studio 5
CEE 199 Undergraduate Research in Civil and Environmental Engineering 3-4

Freshwater Environments Focus Area (40 units)
Required
CEE 70 Environmental Science and Technology 3
CEE 101B Mechanics of Fluids 4
CEE 177 Aquatic Chemistry and Biology 4
CEE 166A Watersheds and Wetlands 4
CEE 174A Providing Safe Water for the Developing and Developed World 3

Electives
CEE 162E Rivers, Streams, and Canals 3
CEE 162F Coastal Processes 3
CEE 165C Water Resources Management 3
CEE 166A Watersheds and Wetlands (if not counted as a req’d course) 4
CEE 166B Floods and Droughts, Dams and Aqueducts 4
CEE 136 Urban Development and Governance 3
CEE 275D Environmental Policy Analysis 4
CEE 273B The Business of Water 2
CEE 174A Providing Safe Water for the Developing and Developed World (prereq: CHEM 31B) (if not counted as a Req'd course) 3
CEE 174B Wastewater Treatment: From Disposal to Resource Recovery (prereq: CEE 174A) 3
CEE 179A Water Chemistry Laboratory (CEE 177 recommended) (not offered AY 19-20)) 3
CEE 166A

Coastal Environments Focus Area (40 units)
Required
CEE 70 Environmental Science and Technology 3
CEE 101B Mechanics of Fluids 4
CEE 162F Coastal Processes 3
CEE 162D Introduction to Physical Oceanography 4
CEE 175A California Coast: Science, Policy, and Law 3-4

Electives
CEE 162D Introduction to Physical Oceanography 4
CEE 162I Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3
CEE 166A Watersheds and Wetlands 4
CEE 136 Urban Development and Governance 3
CEE 275D Environmental Policy Analysis 4
CEE 273B The Business of Water 2
CEE 174A Providing Safe Water for the Developing and Developed World 3
CEE 174B Wastewater Treatment: From Disposal to Resource Recovery 3
CEE 175A California Coast: Science, Policy, and Law 3-4
CEE 177 Aquatic Chemistry and Biology 4
The program involves an in-depth research study in an area proposed to encourage qualified students to undertake a more intensive study of civil and environmental engineering than is required for the normal majors through a substantial, independent research project.

At the time of application, the student must have an overall grade point average (GPA) of at least 3.3 for course work at Stanford; this GPA must be maintained to graduation. The thesis is supervised by a CEE faculty adviser and must involve input from the School of Engineering writing program by means of ENGR 202S Directed Writing Projects or ENGR 199W Writing of Original Research for Engineers. The written thesis must be approved by the thesis adviser. Students are encouraged to present their results in a seminar for faculty and students. Up to 10 units of CEE 199H Undergraduate Honors Thesis, may be taken to support the research and writing (not to duplicate ENGR 202S or ENGR 199W). These units are beyond the normal Civil Engineering or Environmental Systems Engineering major program requirements.

For additional information on the major, minor, honors, and sample programs see the Handbook for Undergraduate Engineering Programs (UHGB) (http://ughb.stanford.edu).

**Honors Program**

This program leads to a B.S. with honors for undergraduates majoring in Civil Engineering or in Environmental Systems Engineering. It is designed to encourage qualified students to undertake a more intensive study of civil and environmental engineering than is required for the normal majors through a substantial, independent research project.

The program involves an in-depth research study in an area proposed to and agreed to by a Department of Civil and Environmental Engineering faculty adviser and completion of a thesis of high quality. A written proposal for the research to be undertaken must be submitted and approved by the faculty advisor in the fourth quarter prior to graduation. The program is designed (UGHB) programs see the Handbook for Undergraduate Engineering Programs (http://web.stanford.edu/group/ughb/cgi-bin/handbook/index.php/Handbooks).

Environmental Systems Engineering (EnvSE) Minor

The Environmental Systems Engineering minor is intended to give students a focused introduction to one or more areas of Environmental Systems Engineering. Departmental expertise and undergraduate course offerings are available in the areas of environmental engineering and science, environmental fluid mechanics and hydrology, and atmosphere/energy. The minimum prerequisite for an Environmental Systems Engineering minor is MATH 19 Calculus (or MATH 20 Calculus or MATH 21 Calculus); additionally, many courses of interest require PHYSICS 41 Mechanics and/or MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications as prerequisites. Students should recognize that a minor in Environmental Systems Engineering is not an ABET-accredited degree program.

Since undergraduates having widely varying backgrounds may be interested in obtaining an Environmental Systems Engineering minor, no single set of course requirements is appropriate for all students. Instead, interested students are encouraged to propose their own set of courses within the guidelines listed below. Additional information on preparing a minor program is available in the Undergraduate Engineering Handbook (http://web.stanford.edu/group/ughb/cgi-bin/handbook/index.php/Handbooks).

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 265E</td>
<td>Adaptation to Sea Level Rise and Extreme Weather Events</td>
<td>3</td>
</tr>
<tr>
<td>CEE 272</td>
<td>Coastal Contaminants</td>
<td>3.5-4</td>
</tr>
<tr>
<td>BIOHOPK 150H</td>
<td>Ecological Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>BIOHOPK 163H</td>
<td>Oceanic Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIO 30</td>
<td>Ecology for Everyone</td>
<td>4</td>
</tr>
<tr>
<td>or</td>
<td>BIO 81 Introduction to Ecology</td>
<td>4</td>
</tr>
<tr>
<td>or</td>
<td>BIOHOPK 81 Introduction to Ecology</td>
<td>4</td>
</tr>
<tr>
<td>or</td>
<td>EARTHSYS 116 Ecology of the Hawaiian Islands</td>
<td>4</td>
</tr>
<tr>
<td>or</td>
<td>OSPAUSTL 32 Coastal Ecosystems</td>
<td>3</td>
</tr>
<tr>
<td>or</td>
<td>OSPGEN 53 Corals of Palau: Ecology, the Physical Environment, and Reefs at Risk</td>
<td>2</td>
</tr>
<tr>
<td>or</td>
<td>OSPSANTG 85 Marine Ecology of Chile and the South Pacific</td>
<td>5</td>
</tr>
<tr>
<td>DESINST 250</td>
<td>OCEANS BY DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>ESS 8</td>
<td>The Oceans: An Introduction to the Marine Environment</td>
<td>4</td>
</tr>
<tr>
<td>or</td>
<td>ESS 240 Advanced Oceanography</td>
<td>3</td>
</tr>
<tr>
<td>or</td>
<td>BIOHOPK 182H Stanford at Sea (Oceanography portion)</td>
<td>4 (only 3 units allowed to count)</td>
</tr>
<tr>
<td>EARTHSYS 141</td>
<td>Remote Sensing of the Oceans</td>
<td>3-4</td>
</tr>
<tr>
<td>EARTHSYS 151</td>
<td>Biological Oceanography</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>to be taken concurrently with</td>
<td></td>
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<tr>
<td>EARTHSYS 152</td>
<td>Marine Chemistry</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td><strong>Capstone (1 class required)</strong></td>
<td></td>
</tr>
<tr>
<td>CEE 141A</td>
<td>Infrastructure Project Development</td>
<td>3</td>
</tr>
<tr>
<td>CEE 179C</td>
<td>Environmental Engineering Design</td>
<td>5</td>
</tr>
<tr>
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<td>or</td>
<td>CEE 224Z</td>
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<td>CapaCity Design Studio</td>
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Environmental Systems Engineering Undergraduate Major

General guidelines are—

- An Environmental Systems Engineering minor must contain at least 24 units of course work not taken for the major and must consist of at least six classes of at least 3 units each of letter-graded work, except where letter grades are not offered.
- The list of courses must represent a coherent body of knowledge in a focused area, and should include classes that build upon one another. Example programs are available on the CEE web site (https://cee.stanford.edu/academics/undergraduate-programs/minor).

Professor Nicholas Ouellette ( nto@stanford.edu ) is the CEE undergraduate minor adviser in Environmental Systems Engineering. Students must consult with Professor Ouellette (https://cee.stanford.edu/people/nicholas-t-ouellette) in developing their minor program, and obtain approval of the finalized study list from him.