ENVIRONMENTAL SYSTEMS ENGINEERING UNDERGRADUATE MAJOR

See the "Department of Civil and Environmental Engineering (http://exploreddegrees.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://exploreddegrees.stanford.edu/soe-ug-majors/civilengineering) and a minor in Civil Engineering (http://exploreddegrees.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 to take on the complex challenges of the twenty-first century study, which includes a capstone experience, aims to equip engineering students with the fundamental tools/skills must include:

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 31X Chemical Principles Accelerated (or PHYSICS 43 Electricity and Magnetism, 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, CEE 133H Drawing in the Urban Environment, ME 101 Visual Thinking, ME 110 Design Sketching, ARTSTUDI 160 Intro to Digital / Physical Design, or OSPPARIS 44 EAP Analytical Drawing and Graphic Art;
   3. at least one oral/written communication class from ENGR 103 Public Speaking, ENGR 102W Technical and Professional Communication, ENGR 202W Technical Communication, CEE 151 Negotiation, CEE 175P Persuasive Communication for Environmental Scientists, Practitioners, and Entrepreneurs, EARTHSYS 191 Concepts in Environmental Communication or EARTHYS 200 Environmental Communication in Action: The SAGE Project;
   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 120A Building Information Modeling Workshop (or CEE 120S Building Information Modeling Special Study), CEE 146S Engineering Economics and Sustainability, CEE 155 Introduction to Sensing Networks for CEE, CEE 226 Life Cycle Assessment for Complex Systems, CEE 228 Methods in Urban Systems, CEE 211 Software Development for Scientists and Engineers, CS 102 Big Data - Tools and Techniques, EARTHSYS 142 Sustainable Energy for 9 Billion People, EARTHSYS 144 Fundamentals of Geographic Information Science (GIS), ENGR 150 Data Challenge Lab, EARTS 214 Introduction to geostatistics and modeling of spatial uncertainty, or OSPCPPWN 13 Technological Risks (Win 18-19 only)

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>
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</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>3-4</td>
</tr>
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</table>

Electives (at least two of the 4 areas below must be included)

Building Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 102</td>
<td>Legal and Ethical Principles in Design, Construction, and Project Delivery</td>
<td>3</td>
</tr>
<tr>
<td>CEE 120B</td>
<td>Building Information Modeling Workshop</td>
<td>2-4</td>
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<tr>
<td>CEE 130</td>
<td>Architectural Design: 3-D Modeling, Methodology, and Process</td>
<td>5</td>
</tr>
<tr>
<td>CEE 156</td>
<td>Building Systems</td>
<td>4</td>
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</tbody>
</table>

Energy Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>CEE 107A</td>
<td>Understanding Energy</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>CEE 173S</td>
<td>Electricity Economics</td>
<td>3</td>
</tr>
</tbody>
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Water Systems

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 165C</td>
<td>Water Resources Management</td>
<td>3</td>
</tr>
<tr>
<td>OSPSANTG 76</td>
<td>Urban Water (Spr 18-19 only)</td>
<td>4</td>
</tr>
</tbody>
</table>
Environmental Systems Engineering Undergraduate Major

Coastal Environments Focus Area (37 units)

Required

CEE 70 Environmental Science and Technology 3
CEE 101B Mechanics of Fluids 4
CEE 162F Coastal Processes 3
CEE 175A California Coast: Science, Policy, and Law 3-4
or CEE 162I Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3

Electives

CEE 162I Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3
CEE 166A Watersheds and Wetlands 4
CEE 166B Floods and Dams and Aqueducts 4
CEE 230 Urban Development and Governance 3
or EARTHSYS 238 Land Use Law 3
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
CEE 230 Urban Development and Governance 3
CEE 265E Adaptation to Sea Level Rise and Extreme Weather Events 3
CEE 272 Coastal Contaminants 3-4

Capstone (1 class required)

CEE 141A Infrastructure Project Development 3
CEE 179C Environmental Engineering Design 5
CEE 224X Sustainable Urban Systems Fundamentals 1-5
CEE 224Y Sustainable Urban Systems Project 3-5
CEE 224Z Sustainable Urban Systems Project 3-5
CEE 235 5
CEE 199 Undergraduate Research in Civil and Environmental Engineering 3-4

Freshwater Environments Focus Area (37 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
or CEE 174A Providing Safe Water for the Developing and Developed World 3

Electives

CEE 162E Rivers, Streams, and Canals 3
CEE 165C Water Resources Management 3
Environmental Systems Engineering Undergraduate Major

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).

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.

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. 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 and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).