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 1

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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 106A</td>
<td>Programming Methodology</td>
</tr>
<tr>
<td>ENGR 14</td>
<td>Intro to Solid Mechanics</td>
</tr>
</tbody>
</table>

Fundamental Tools/Skills 2

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

Specialty Courses, in either

<table>
<thead>
<tr>
<th>Environment</th>
<th>Required Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal environments</td>
<td>CEE 176A, CEE 176B</td>
</tr>
<tr>
<td>Freshwater environments</td>
<td>CEE 176A, CEE 176B</td>
</tr>
<tr>
<td>Urban environments</td>
<td>CEE 176A, CEE 176B</td>
</tr>
</tbody>
</table>

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 I or CHEM 31M Chemical Principles II.

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 OSPPARIS 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, EARTHSYS 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 120S Building Information Modeling Special Study (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, CSE 102 Working with Data - Tools and Techniques, EARTHSYS 140 Data science for geoscience, EARTHSYS 142 Remote Sensing of Land, EARTHSYS 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 Code</th>
<th>Course 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>
</tbody>
</table>

Electives (at least two of the 4 areas below must be included with at least 3 units from 2nd area)

<table>
<thead>
<tr>
<th>Course Code</th>
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<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</td>
<td>CEE 131C</td>
<td>How Buildings are Made – Materiality and Construction Methods</td>
</tr>
<tr>
<td>or</td>
<td>CEE 156</td>
<td>Building Systems Design &amp; Analysis</td>
</tr>
</tbody>
</table>

Energy Systems

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 107A</td>
<td>Understanding Energy (or CEE 107S, 8 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>CEE 173S</td>
<td>Electricity Economics</td>
<td>3</td>
</tr>
<tr>
<td>or</td>
<td>ENERGY 171</td>
<td>Energy Infrastructure, Technology and Economics</td>
</tr>
</tbody>
</table>
ENERGY 191  Optimization of Energy Systems  3-4

**Water Systems**
- CEE 165C  Water Resources Management  3
- CEE 166A  Watershed 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
  or
- CEE 275D  Environmental Policy Analysis  3-4
  or
- CEE 273B  The Business of Water  2
- CEE 177L  Smart Cities & Communities  3
- URBANST 113  Introduction to Urban Design: Contemporary Urban Design in Theory and Practice  5
  or
- URBANST 164  Sustainable Cities  4-5
  or
- URBANST 165  Sustainable Urban and Regional Transportation Planning (alt. years)  4-5
- ME 267  Ethics and Equity in Transportation Systems  3

**Capstone (one class required)**
- CEE 131D  Urban Design Studio  5
- CEE 141A  Infrastructure Project Development  3
- CEE 141B  Infrastructure Project Delivery  3
- CEE 218Y  Shaping the Future of the Bay Area  1-5
  or
- CEE 218Z  Shaping the Future of the Bay Area  1-5
- CEE 243  Intro to Urban Sys Engrg  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
  or
- 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
  or
- CEE 275D  Environmental Policy Analysis  3-4
  or
- 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
  or
- EARTSYS 124  Measurements in Earth Systems  3-4
- CEE 260D  Remote Sensing of Hydrology (prereq: CS 106A)  3
- CEE 265A  Sustainable Water Resources Development (offered occasionally)  3
- CEE 265D  Water and Sanitation in Developing Countries  3
- BIOHOPK 150H  Ecological Mechanics ((alt. years))  3

**Coastal Environments Focus Area (40 units)**

**Required**
- CEE 141A  Infrastructure Project Development (recom. pre-req. CEE 136 or CEE 171P)  3
- CEE 179C  Environmental Engineering Design (prereq: CEE 174A or CEE 166A)  5
- CEE 218Y  Shaping the Future of the Bay Area  1-5
- CEE 218Z  Shaping the Future of the Bay Area  1-5
- CEE 325  CapaCity Design Studio  5
- CEE 199  Undergraduate Research in Civil and Environmental Engineering (must petition CEE UG Committee for approval, prior to enrollment; must have completed greater than or equal to 6 focus area classes; excluding Breadth)  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
  or
- CEE 275D  Environmental Policy Analysis  3-4
  or
- 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

Stanford Bulletin 2019-20
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).

Environmental Systems Engineering (EnvSE) Minor

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 adviser 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.

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.

This 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 adviser 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.
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.