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:
ENGR 70A Programming Methodology
(or ENGR 70X)
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

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 EARTHSYS 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, CME 211 Software Development for Scientists and Engineers, CS 102 Big Data - Tools and Techniques, EARTHSYS 142 Remote Sensing of Land, EARTHSYS 144 Fundamentals of Geographic Information Science (GIS), ENGR 150 Data Challenge Lab, RSS 214 Introduction to geostatistics and modeling of spatial uncertainty, or OSPCPNTWN 13 Technological Risks (Win 18-19 only)

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
CEE 100 Managing Sustainable Building Projects
CEE 101B Mechanics of Fluids
CEE 146S Engineering Economics and Sustainability
CEE 176A Energy Efficient Buildings

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

Building Systems
CEE 102 Legal and Ethical Principles in Design, Construction, and Project Delivery
CEE 120B Building Information Modeling Workshop
CEE 130 Architectural Design: 3-D Modeling, Methodology, and Process
CEE 156 Building Systems

Energy Systems
CEE 107A Understanding Energy
CEE 176B 100% Clean, Renewable Energy and Storage for Everything
ENERGY 104 Sustainable Energy for 9 Billion
CEE 173S Electricity Economics
or
ENERGY 171 Energy Infrastructure, Technology, and Economics

Water Systems
CEE 165C Water Resources Management
or
OSPSANTG 76 Urban Water (Spr 18-19 only)
### Freshwater Environments Focus Area (37 units)

**Required**

- **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

**Electives**

- **CEE 162E** Rivers, Streams, and Canals 3
- **CEE 165C** Water Resources Management 3

### Coastal Environments Focus Area (37 units)

**Required**

- **CEE 174A** Coastal Processes 3
- **CEE 175A** California Coast: Science, Policy, and Law 3
- **CEE 179A** Water Chemistry Laboratory 3
- **CEE 166D** Sustainable Water Resources Development (offered occasionally) 3
- **CEE 265A** Water and Sanitation in Developing Countries 3

**Electives**

- **CEE 162I** Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3
- **CEE 166A** Watersheds and Wetlands 4
- **CEE 166B** Floods and Droughts, Dams and Aqueducts 4
- **CEE 230** Urban Development and Governance 3

**Capstone (1 class required)**

- **CEE 112A** Industry Applications of Virtual Design & Construction 3
- **CEE 122A** Computer Integrated Architecture/Engineering/Construction 2
- **CEE 122B** Computer Integrated A/E/C 2
- **CEE 131D** Urban Design Studio 5
- **CEE 141A** Infrastructure Project Development 3
- **CEE 141B** Infrastructure Project Delivery 3
- **CEE 224X** Sustainable Urban Systems Fundamentals 3
- **CEE 224Y** Sustainable Urban Systems Project 3
- **CEE 224Z** Sustainable Urban Systems Project 3
- **CEE 226E** Advanced Topics in Integrated, Energy-Efficient Building Design 3
- **CEE 235** CapaCity Design Studio 5
- **CEE 199** Undergraduate Research in Civil and Environmental Engineering 3

### Urban Planning, Design, Analysis

**Required**

- **CEE 174A** Providing Safe Water for the Developing and Developed World 3
- **CEE 174B** Wastewater Treatment: From Disposal to Resource Recovery 3

**Capstone (1 class required)**

- **CEE 112A** Industry Applications of Virtual Design & Construction 3
- **CEE 122A** Computer Integrated Architecture/Engineering/Construction 2
- **CEE 122B** Computer Integrated A/E/C 2
- **CEE 131D** Urban Design Studio 5
- **CEE 141A** Infrastructure Project Development 3
- **CEE 141B** Infrastructure Project Delivery 3
- **CEE 224X** Sustainable Urban Systems Fundamentals 3
- **CEE 224Y** Sustainable Urban Systems Project 3
- **CEE 224Z** Sustainable Urban Systems Project 3
- **CEE 226E** Advanced Topics in Integrated, Energy-Efficient Building Design 3
- **CEE 235** CapaCity Design Studio 5
- **CEE 199** Undergraduate Research in Civil and Environmental Engineering 3

**Electives**

- **CEE 162I** Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3
- **CEE 166A** Watersheds and Wetlands 4
- **CEE 166B** Floods and Droughts, Dams and Aqueducts 4
- **CEE 230** Urban Development and Governance 3

**Capstone (1 class required)**

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

**Freshwater Environments Focus Area (37 units)**

**Required**

- **CEE 165C** Water Resources Management 3

**Electives**

- **CEE 162E** Rivers, Streams, and Canals 3
- **CEE 165C** Water Resources Management 3

**Capstone (1 class required)**

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

**Coastal Environments Focus Area (37 units)**

**Required**

- **CEE 174A** Coastal Processes 3
- **CEE 174B** Wastewater Treatment: From Disposal to Resource Recovery 3
- **CEE 175A** California Coast: Science, Policy, and Law 3
- **CEE 166D** Sustainable Water Resources Development (offered occasionally) 3
- **CEE 265A** Water and Sanitation in Developing Countries 3
- **CEE 265D** Water and Sanitation in Developing Countries 3
- **URENST 213** Environmental Science and Technology 3
- **URENST 215** Environmental Engineering 3
- **URENST 217** Environmental Engineering Design 3
- **URENST 219** Sustainability and the Built Environment 3
- **URENST 221** Sustainable Urban Systems Fundamentals 3
- **URENST 223** Sustainable Urban Systems Project 3
- **URENST 225** Sustainable Urban Systems Project 3
- **URENST 227** CapaCity Design Studio 5
- **URENST 229** Undergraduate Research in Civil and Environmental Engineering 3

**Electives**

- **CEE 162I** Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3
- **CEE 166A** Watersheds and Wetlands 4
- **CEE 166B** Floods and Droughts, Dams and Aqueducts 4
- **CEE 230** Urban Development and Governance 3

**Capstone (1 class required)**

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

**Coastal Environments Focus Area (37 units)**

**Required**

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- **CEE 174B** Wastewater Treatment: From Disposal to Resource Recovery 3
- **CEE 175A** California Coast: Science, Policy, and Law 3

**Electives**

- **CEE 162I** Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3
- **CEE 166A** Watersheds and Wetlands 4
- **CEE 166B** Floods and Droughts, Dams and Aqueducts 4
- **CEE 230** Urban Development and Governance 3

**Capstone (1 class required)**

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

**Coastal Environments Focus Area (37 units)**

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- **CEE 174B** Wastewater Treatment: From Disposal to Resource Recovery 3
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**Electives**

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- **CEE 166A** Watersheds and Wetlands 4
- **CEE 166B** Floods and Droughts, Dams and Aqueducts 4
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**Capstone (1 class required)**

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

**Coastal Environments Focus Area (37 units)**

**Required**

- **CEE 174A** Coastal Processes 3
- **CEE 174B** Wastewater Treatment: From Disposal to Resource Recovery 3
- **CEE 175A** California Coast: Science, Policy, and Law 3

**Electives**

- **CEE 162I** Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3
- **CEE 166A** Watersheds and Wetlands 4
- **CEE 166B** Floods and Droughts, Dams and Aqueducts 4
- **CEE 230** Urban Development and Governance 3

**Capstone (1 class required)**

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

### Capstone (1 class required)

- **CEE 126** International Urbanization Seminar: Cross-Cultural Collaboration for Sustainable Urban Development 4-5
- **CEE 141A** Infrastructure Project Development 3
- **CEE 179C** Environmental Engineering Design 5
- **CEE 224X** Sustainable Urban Systems Fundamentals 3-5
- **CEE 224Y** Sustainable Urban Systems Project 3-5
- **CEE 224Z** Sustainable Urban Systems Project 3-5
- **CEE 235** CapaCity Design Studio 5
- **CEE 199** Undergraduate Research in Civil and Environmental Engineering 3-4

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