Geosystems

Minor

The Department of Civil and Environmental Engineering offers a minor program in Geosystems. Geosystems is traditionally an interdisciplinary field, drawing on elements of geology, geophysics, and the mechanics of fluids and solids. This breadth can be obtained by combining an undergraduate major in physical and mathematical sciences with a minor in Geosystems. This minor is suitable for students interested in either professional practice or in graduate studies within the Department of Civil and Environmental Engineering at Berkeley, and elsewhere.

There is no major program in Geosystems.

Declaring the Minor

To be considered for admission to the minor, students should:

• Have earned an overall grade-point average (GPA) of 3.0.
• Have completed the lower division prerequisite courses with a GPA of 3.0 (for further information regarding the prerequisites, see the Minor Requirements tab on this page).
• Be able to complete the minor without delaying graduation.

Upon admission to the minor, students should:

• Complete a minimum of five courses, of which no more than one can be counted toward the requirements of the major(s).
• Earn a minimum grade-point average of 2.0 in the minor.

After completion of the prerequisite courses, students need to complete and submit to the Civil and Environmental Academic Affairs Office (750 Davis Hall) a Minor Program Application form.

Upon completion of the minor requirements, the student must complete and submit to the Civil and Environmental Engineering Department’s Office of Academic Affairs the Confirmation of Completion form during the first 2 weeks of the term in which the minor will be completed.

Other Majors and Minors Offered by the Department of Civil and Environmental Engineering

Civil Engineering (http://guide.berkeley.edu/undergraduate/degree-programs/civil-engineering) (Major only)
Environmental Engineering (http://guide.berkeley.edu/undergraduate/degree-programs/environmental-engineering) (Minor only)
Structural Engineering (http://guide.berkeley.edu/undergraduate/degree-programs/structural-engineering) (Minor only)

Minor programs are areas of concentration requiring fewer courses than an undergraduate major. These programs are optional, but can provide depth and breadth to a UC Berkeley education. The College of Engineering does not offer additional time to complete a minor, but it is usually possible to finish within the allotted time with careful course planning. Students are encouraged to meet with their ESS adviser to discuss the feasibility of completing a minor program.

All the engineering departments offer minors. Students may also consider pursuing a minor in another school or college.

General Guidelines

1. All minors must be declared no later than one semester before a student’s Expected Graduation Term (EGT). If the semester before EGT is fall or spring, the deadline is the last day of RRR week. If the semester before EGT is summer, the deadline is the final Friday of Summer Sessions. To declare a minor, contact the department advisor for information on requirements, and the declaration process.

2. All courses taken to fulfill the minor requirements must be taken for graded credit.

3. A minimum overall grade point average (GPA) of 3.0 and a minimum GPA of 3.0 in the prerequisite courses is required for acceptance into the minor program.

4. A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.

5. No more than one upper division course may be used to simultaneously fulfill requirements for a student’s major and minor programs.

6. Completion of the minor program cannot delay a student’s graduation.

Lower Division Prerequisites

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1A</td>
<td>Calculus</td>
<td>8</td>
</tr>
<tr>
<td>&amp; MATH 1B</td>
<td>Calculus</td>
<td>8</td>
</tr>
<tr>
<td>MATH 53</td>
<td>Multivariable Calculus</td>
<td>3</td>
</tr>
<tr>
<td>&amp; MATH 54</td>
<td>Linear Algebra and Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1A</td>
<td>General Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 4A</td>
<td>General Chemistry and Quantitative Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHYSICS 7A</td>
<td>Physics for Scientists and Engineers</td>
<td>4</td>
</tr>
<tr>
<td>CIV ENG C30</td>
<td>Introduction to Solid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>CIV ENG 70</td>
<td>Engineering Geology (or equivalent)</td>
<td>3</td>
</tr>
</tbody>
</table>

Upper Division Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIV ENG 100</td>
<td>Elementary Fluid Mechanics</td>
</tr>
<tr>
<td>CIV ENG 130N</td>
<td>Mechanics of Structures</td>
</tr>
<tr>
<td>CIV ENG 175</td>
<td>Geotechnical and Geoenvironmental Engineering</td>
</tr>
</tbody>
</table>

Select two courses from the following:

CIV ENG 171 | Rock Mechanics
CIV ENG 173 | Groundwater and Seepage
CIV ENG 176 | Environmental Geotechnics
CIV ENG 177 | Foundation Engineering Design
CIV ENG C178| Applied Geophysics

University of California Requirements

Entry Level Writing (https://www.ucop.edu/elwr)

All students who will enter the University of California as freshmen must demonstrate their command of the English language by fulfilling the Entry Level Writing Requirement. Satisfaction of this requirement is also a prerequisite to enrollment in all Reading and Composition courses at UC Berkeley.

American History and American Institutions (http://guide.berkeley.edu/undergraduate/education/#universityrequirements/text)
The American History and Institutions requirements are based on the principle that a U.S. resident graduated from an American university should have an understanding of the history and governmental institutions of the United States.

**Campus Requirement**

American Cultures (http://guide.berkeley.edu/undergraduate/education/#campusrequirementstext)

The American Cultures requirement is a Berkeley campus requirement, one that all undergraduate students at Berkeley need to pass in order to graduate. You satisfy the requirement by passing, with a grade not lower than C- or P, an American Cultures course. You may take an American Cultures course any time during your undergraduate career at Berkeley. The requirement was instituted in 1991 to introduce students to the diverse cultures of the United States through a comparative framework. Courses are offered in more than fifty departments in many different disciplines at both the lower and upper division level.

The American Cultures requirement and courses constitute an approach that responds directly to the problem encountered in numerous disciplines of how better to present the diversity of American experience to the diversity of American students whom we now educate.

Faculty members from many departments teach American Cultures courses, but all courses have a common framework. The courses focus on themes or issues in United States history, society, or culture; address theoretical or analytical issues relevant to understanding race, culture, and ethnicity in American society; take substantial account of groups drawn from at least three of the following: African Americans, indigenous peoples of the United States, Asian Americans, Chicano/Latino Americans, and European Americans; and are integrative and comparative in that students study each group in the larger context of American society, history, or culture.

This is not an ethnic studies requirement, nor a Third World cultures requirement, nor an adjusted Western civilization requirement. These courses focus upon how the diversity of America's constituent cultural traditions have shaped and continue to shape American identity and experience.

Visit the Class Schedule (http://classes.berkeley.edu) or the American Cultures website (http://americancultures.berkeley.edu) for the specific American Cultures courses offered each semester. For a complete list of approved American Cultures courses at UC Berkeley and California Community Colleges, please see the American Cultures Subcommittee's website (https://academic-senate.berkeley.edu/committees/amcult). See your academic adviser if you have questions about your responsibility to satisfy the American Cultures breadth requirement.

**CIV ENG 11 Engineered Systems and Sustainability 3 Units**

Terms offered: Spring 2019, Spring 2018, Spring 2017

An introduction to key engineered systems (e.g., energy, water supply, buildings, transportation) and their environmental impacts. Basic principles of environmental science needed to understand natural processes as they are influenced by human activities. Overview of concepts and methods of sustainability analysis. Critical evaluation of engineering approaches to address sustainability.

**Rules & Requirements**

**Prerequisites:** CHEM 1A and MATH 1A

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Summer: 8 weeks - 6 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Harley, Horvath, Nelson

Engineered Systems and Sustainability: Read Less [-]

**CIV ENG 24 Freshman Seminars 1 Unit**

Terms offered: Fall 2019, Spring 2019, Fall 2018

The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley seminars are offered in all campus departments, and topics vary from department to department and semester to semester.

**Rules & Requirements**

**Repeat rules:** Course may be repeated for credit when topic changes.

**Hours & Format**

Fall and/or spring: 15 weeks - 1 hour of seminar per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** The grading option will be decided by the instructor when the class is offered. Final Exam To be decided by the instructor when the class is offered.

Freshman Seminars: Read Less [-]
CIV ENG C30 Introduction to Solid Mechanics
3 Units
Terms offered: Fall 2019, Spring 2019, Fall 2018
Introduction to Solid Mechanics: Read More [+]

Rules & Requirements

Prerequisites: Mathematics 53 and 54 (may be taken concurrently); Physics 7A

Credit Restrictions: Students will receive no credit for Mechanical Engineering C85/Civil and Environmental Engineering C30 after completing Mechanical Engineering W85. A deficient grade in Mechanical Engineering W85 may be removed by taking Mechanical Engineering C85/Civil and Environmental Engineering C30.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer:
6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week
10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Armero, Papadopoulos, Zohdi, Johnson

Also listed as: MEC ENG C85

Introduction to Solid Mechanics: Read Less [-]

CIV ENG W30 Introduction to Solid Mechanics
3 Units
Terms offered: Summer 2019 8 Week Session, Summer 2018 8 Week Session, Summer 2016 10 Week Session
Introduction to Solid Mechanics: Read More [+]

Objectives & Outcomes

Course Objectives: To learn statics and mechanics of materials

Student Learning Outcomes: - Correctly draw free-body diagrams
- Apply the equations of equilibrium to two and three-dimensional solids
- Understand the concepts of stress and strain
- Ability to calculate deflections in engineered systems
- Solve simple boundary value problems in linear elastostatics (tension, torsion, beam bending)

Rules & Requirements

Prerequisites: Mathematics 53 and 54 (may be taken concurrently); Physics 7A

Credit Restrictions: Students will receive no credit for Mechanical Engineering W85/Civil and Environmental Engineering W30 after completing Mechanical Engineering C85/Civil and Environmental Engineering C30. A deficient grade in Mechanical Engineering C85/Civil and Environmental Engineering C30 may be removed by taking Mechanical Engineering W85/Civil and Environmental Engineering W30.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of web-based lecture and 1 hour of web-based discussion per week

Summer:
6 weeks - 7.5 hours of web-based lecture and 2.5 hours of web-based discussion per week
8 weeks - 6 hours of web-based lecture and 2 hours of web-based discussion per week
10 weeks - 4.5 hours of web-based lecture and 1.5 hours of web-based discussion per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Govindjee

Also listed as: MEC ENG W85

Introduction to Solid Mechanics: Read Less [-]
CIV ENG 60 Structure and Properties of Civil Engineering Materials 3 Units
Terms offered: Fall 2019, Spring 2019, Fall 2018
Introduction to structure and properties of civil engineering materials such as asphalt, cements, concrete, geological materials (e.g., soil and rocks), steel, polymers, and wood. The properties range from elastic, plastic and fracture properties to porosity and thermal and environmental responses. Laboratory tests include evaluation of behavior of these materials under a wide range of conditions.

Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Monteiro, Ostertag

Structure and Properties of Civil Engineering Materials: Read Less [-]

CIV ENG 88 Data Science for Smart Cities 2 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
Cities become more dependent on the data flows that connect infrastructures between themselves, and users to infrastructures. Design and operation of smart, efficient, and resilient cities nowadays require data science skills. This course provides an introduction to working with data generated within transportation systems, power grids, communication networks, as well as collected via crowd-sensing and remote sensing technologies, to build demand- and supply-side urban services based on data analytics.

Rules & Requirements
Prerequisites: Corequisite or Prerequisite: Foundations of Data Science (COMPSCI C8/INFO C8/STAT C8). This course is a Data Science connector course and is meant to be taken concurrent with or after COMPSCI C8/INFO C8/STAT C8. Students may take more than one Data Science connector course if they wish, concurrent with or after having taken the C8 course

Hours & Format
Fall and/or spring: 15 weeks - 0.5 hours of lecture, 0.5 hours of discussion, and 1 hour of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Pozdnukhov

Data Science for Smart Cities: Read Less [-]

CIV ENG 70 Engineering Geology 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
Principles of physical and structural geology; the influence of geological factors on engineering works and the environment. Field trip.

Rules & Requirements
Prerequisites: CHEM 1A (may be taken concurrently)

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
Summer: 8 weeks - 6 hours of lecture and 4 hours of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Glaser, Sitar

Engineering Geology: Read Less [-]
CIV ENG 88B Time Series Analysis: Sea Level Rise and Coastal Flooding 2 Units

Terms offered: Spring 2017

In this course, we will pursue analysis of long-term records of coastal water levels in the context of sea level rise. We will cover the collection, evaluation, visualization and analysis of time series data using long-term records of sea levels from coastal sites around the world. Specific topics will include extreme events and distributions, frequency-based descriptions, averaging, filtering, harmonic analysis, trend identification, extrapolations, and decision-making under uncertainty.

Time Series Analysis: Sea Level Rise and Coastal Flooding: Read More [+]

Rules & Requirements

Prerequisites: Concurrent or prior enrollment in Foundations of Data Science (COMPSCI C8 / INFO C8 / STAT C8) and MATH 1A

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Stacey

CIV ENG 92 Introduction to Civil and Environmental Engineering 1 Unit

Terms offered: Fall 2019, Fall 2018, Fall 2017

A course designed to familiarize the entering student with the nature and scope of civil and environmental engineering and its component specialty areas.

Introduction to Civil and Environmental Engineering: Read More [+]

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Instructor: Hansen, Rubin, Walker

CIV ENG 93 Engineering Data Analysis 3 Units

Terms offered: Fall 2019, Spring 2019, Fall 2018

Application of the concepts and methods of probability theory and statistical inference to CEE problems and data; graphical data analysis and sampling; elements of set theory; elements of probability theory; random variables and expectation; simulation; statistical inference. Use of computer programming languages for analysis of CEE-related data and problems. The course also introduces the student to various domains of uncertainty analysis in CEE.

Engineering Data Analysis: Read More [+]

Rules & Requirements

Prerequisites: ENGIN 7 or COMPSCI C8 / INFO C8 / STAT C8. Student should consult instructor prior to enrolling

Credit Restrictions: Students will receive no credit after taking Statistics 25.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Summer: 6 weeks - 5 hours of lecture and 7.5 hours of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Hansen, Rubin, Walker
CIV ENG 98 Supervised Group Study and Research 1 - 3 Units
Terms offered: Fall 2019, Spring 2019, Fall 2018
Supervised group study and research by lower division students.
Supervised Group Study and Research: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor
Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1-3 hours of directed group study per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Supervised Group Study and Research: Read Less [-]

CIV ENG 99 Supervised Independent Study and Research 1 - 4 Units
Terms offered: Fall 2019, Spring 2019, Fall 2018
Supervised independent study by lower division students.
Supervised Independent Study and Research: Read More [+]
Rules & Requirements
Prerequisites: Freshman or sophomore standing and consent of instructor. Minimum grade point average of 3.3 required
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of independent study per week
Summer: 8 weeks - 2-7.5 hours of independent study per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Supervised Independent Study and Research: Read Less [-]

CIV ENG 100 Elementary Fluid Mechanics 4 Units
Terms offered: Fall 2019, Fall 2018, Summer 2018 8 Week Session
Fluid statics and dynamics, including laboratory experiments with technical reports. Fundamentals: integral and differential formulations of the conservation laws are solved in special cases such as boundary layers and pipe flow. Flow visualization and computation techniques are introduced using Matlab. Empirical equations are used for turbulent flows, drag, pumps, and open channels. Principles of empirical equations are also discussed: dimensional analysis, regression, and uncertainty.
Elementary Fluid Mechanics: Read More [+]
Rules & Requirements
Prerequisites: PHYSICS 7A, MATH 53, and ENGIN 7 (may be taken concurrently); and CIV ENG C30 / MEC ENG C85 recommended
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of laboratory per week
Summer: 8 weeks - 6 hours of lecture and 3 hours of laboratory per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Chow, Stacey, Variano
Elementary Fluid Mechanics: Read Less [-]

CIV ENG 101 Fluid Mechanics of Rivers, Streams, and Wetlands 3 Units
Terms offered: Fall 2014, Spring 2013, Fall 2010
Analysis of steady and unsteady open-channel flow and application to rivers and streams. Examination of mixing and transport in rivers and streams. Effects of channel complexity. Floodplain dynamics and flow routing. Interaction of vegetation and fluid flows. Freshwater and tidal marshes. Sediment transport in rivers, streams, and wetlands. Implications for freshwater ecosystem function.
Fluid Mechanics of Rivers, Streams, and Wetlands: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG 100, MEC ENG 106, or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Variano
Fluid Mechanics of Rivers, Streams, and Wetlands: Read Less [-]
CIV ENG 103 Introduction to Hydrology 3 Units
Terms offered: Fall 2018, Fall 2017, Spring 2017
Course addresses principles and practical aspects of hydrology. Topics in introduction to hydrology include hydrologic cycle, precipitation, evaporation, infiltration, snow and snowmelt, and streamflow; introduction to geomorphology, GIS (Geographic Information Systems) applications, theory of unit hydrograph, frequency analysis, flood routing through reservoirs and rivers; introduction to rainfall-runoff analyses, watershed modeling, urban hydrology, and introduction to groundwater hydrology. Introduction to Hydrology: Read More [+]  
Rules & Requirements
Prerequisites: CIV ENG 93 and CIV ENG 100

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Thompson
Introduction to Hydrology: Read Less [-]

CIV ENG C103N Terrestrial Hydrology 4 Units
Terms offered: Spring 2019, Spring 2017, Spring 2015, Spring 2014, Fall 2005
A quantitative introduction to the hydrology of the terrestrial environment including lower atmosphere, watersheds, lakes, and streams. All aspects of the hydrologic cycle, including precipitation, infiltration, evapotranspiration, overland flow, streamflow, and groundwater flow. Chemistry and dating of groundwater and surface water. Development of quantitative insights through problem solving and use of simple models. This course requires one field experiment and several group computer lab assignments. Terms offered: Not yet offered
A quantitative introduction to the hydrology of the terrestrial environment including lower atmosphere, watersheds, lakes, and streams. All aspects of the hydrologic cycle, including precipitation, infiltration, evapotranspiration, overland flow, streamflow, and groundwater flow. Chemistry and dating of groundwater and surface water. Development of quantitative insights through problem solving and use of simple models. This course requires one field experiment and several group computer lab assignments.
Terrestrial Hydrology: Read More [+]  
Rules & Requirements
Prerequisites: CHEM 1A, MATH 1A, MATH 1B, and PHYSICS 7A; or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Larsen

Also listed as: ESPM C130/GEOG C136
Terrestrial Hydrology: Read Less [-]
CIV ENG C103N Terrestrial Hydrology 4 Units
Terms offered: Spring 2019, Spring 2017, Spring 2015, Spring 2014, Fall 2005
A quantitative introduction to the hydrology of the terrestrial environment including lower atmosphere, watersheds, lakes, and streams. All aspects of the hydrologic cycle, including precipitation, infiltration, evapotranspiration, overland flow, streamflow, and groundwater flow. Chemistry and dating of groundwater and surface water. Development of quantitative insights through problem solving and use of simple models. This course requires one field experiment and several group computer lab assignments.

Rules & Requirements

Prerequisites: CHEM 1A, MATH 1A, MATH 1B, and PHYSICS 7A; or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Larsen

Also listed as: ESPM C130/GEOG C136

Terrestrial Hydrology: Read More [+]

CIV ENG C103N Terrestrial Hydrology 4 Units
Terms offered: Spring 2019, Spring 2017, Spring 2015, Spring 2014, Fall 2005
A quantitative introduction to the hydrology of the terrestrial environment including lower atmosphere, watersheds, lakes, and streams. All aspects of the hydrologic cycle, including precipitation, infiltration, evapotranspiration, overland flow, streamflow, and groundwater flow. Chemistry and dating of groundwater and surface water. Development of quantitative insights through problem solving and use of simple models. This course requires one field experiment and several group computer lab assignments.

Rules & Requirements

Prerequisites: CHEM 1A, MATH 1A, MATH 1B, and PHYSICS 7A; or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Larsen

Also listed as: ESPM C130/GEOG C136

Terrestrial Hydrology: Read Less [-]
CIV ENG C103N Terrestrial Hydrology 4 Units
Terms offered: Spring 2019, Spring 2017, Spring 2015, Spring 2014, Fall 2005
A quantitative introduction to the hydrology of the terrestrial environment including lower atmosphere, watersheds, lakes, and streams. All aspects of the hydrologic cycle, including precipitation, infiltration, evapotranspiration, overland flow, streamflow, and groundwater flow. Chemistry and dating of groundwater and surface water. Development of quantitative insights through problem solving and use of simple models. This course requires one field experiment and several group computer lab assignments.

Rules & Requirements
Prerequisites: CHEM 1A, MATH 1A, MATH 1B, and PHYSICS 7A; or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Larsen
Also listed as: ESPM C130/GEOG C136
Terrestrial Hydrology: Read More [+]

CIV ENG 105 Water and Wind - Design for a Variable Environment 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2013
Hands-on design course in applied fluid mechanics, hydrology and water resources. Course goes beyond basic examples of fluid flow to develop environmental engineering solutions to real-world problems. A class team project is used to (1) explore the design process and project management; and (2) to integrate concepts from hydrology and fluid mechanics with structural, geotechnical and/or transportation engineering for a holistic design approach. Specific project topics vary with offering. Example topics include: engineering for air quality, design for sea-level rise mitigation, and development of alternative water supplies to address scarcity and post-disaster management.

Course Objectives: To develop and defend design criteria
To gain familiarity with the process of design and project management, from proposal writing to preliminary design delivery
To integrate fundamental engineering principles, subject to the needs and constraints of a specific design.

Rules & Requirements
Prerequisites: CIV ENG 100 and CIV ENG 103; or instructor's permission

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.
Instructors: Chow, Stacey, Variano

Water and Wind - Design for a Variable Environment: Read More [+]

Terrestrial Hydrology: Read Less [-]
CIV ENG C106 Air Pollution 3 Units
This course is an introduction to air pollution and the chemistry of earth's atmosphere. We will focus on the fundamental natural processes controlling trace gas and aerosol concentrations in the atmosphere, and how anthropogenic activity has affected those processes at the local, regional, and global scales. Specific topics include stratospheric ozone depletion, increasing concentrations of greenhouse gases, smog, and changes in the oxidation capacity of the troposphere.
Air Pollution: Read More [+]

Rules & Requirements
Prerequisites: Chemistry 1A-1B, Physics 8A or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Goldstein
Also listed as: EPS C180/ESPM C180
Air Pollution: Read Less [-]

CIV ENG 107 Climate Change Mitigation 3 Units
Terms offered: Spring 2019, Spring 2017, Spring 2016
Climate Change Mitigation: Read More [+]

Rules & Requirements
Prerequisites: Upper division or graduate standing in engineering or physical science, or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Nazaroff
Climate Change Mitigation: Read Less [-]

CIV ENG 110 Water Systems of the Future 3 Units
Terms offered: Spring 2019, Spring 2017, Fall 1999
This course will familiarize students with the complex infrastructure used to meet human water demands; competing uses and demands; water and wastewater infrastructure; technologies to enable recovery of water, energy, and other resources from wastewater; supply planning; trends and forecasting; costs, pricing and financing; environmental justice; methods to assess sustainability; regulatory, policy and institutional challenges; and water's contribution to other sectors (e.g., energy, food, buildings). Innovation, both barriers and opportunities, will be highlighted. California and the U.S. will be emphasized but global challenges will be discussed. Students will study, critique, and recommend improvements for a real-world system.
Water Systems of the Future: Read More [+]

Objectives & Outcomes
Course Objectives: Consider costs and tradeoffs in water supply planning under uncertainty for real-world water systems
Critically evaluate water planning and innovation potential for real-world utilities given future uncertainties and competing priorities.
Explore the innovation ecosystem in the water sector, its opportunities and challenges, and analyze case studies
Introduce the technologies that are currently in use for treating and managing water and wastewater, as well as innovations that have the potential to dramatically change water infrastructure.
Provide overview and examples of concepts and methods for analyzing the sustainability of water systems
Provide overview of the complex infrastructure systems that supply and manage water and wastewater.

Student Learning Outcomes: Ability to apply knowledge of mathematics, science, and engineering. MODERATE
Ability to communicate effectively. EXTENSIVE
Ability to design a system, component, or process to meet desired needs. MODERATE
Ability to function on multi-disciplinary teams. EXTENSIVE
Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. MODERATE
Knowledge of contemporary issues. EXTENSIVE
Recognition of the need for, and an ability to engage in life-long learning. EXTENSIVE
Understand the impact of engineering solutions in a global and societal context. EXTENSIVE
Understanding of professional and ethical responsibility. EXTENSIVE

Rules & Requirements
Prerequisites: Upper division status or consent of the instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Nelson
Water Systems of the Future: Read Less [-]
CIV ENG 111 Environmental Engineering 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
Quantitative overview of air and water contaminants and their engineering control. Elementary environmental chemistry and transport. Reactor models. Applications of fundamentals to selected current issues in water quality engineering, air quality engineering, air quality engineering, and hazardous waste management.
Environmental Engineering: Read More [+]
Rules & Requirements
Prerequisites: Upper division standing in engineering or physical sciences, or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Alvarez-Cohen, Nazaroff, Nelson, Sedlak

Environmental Engineering: Read Less [-]

CIV ENG 111L Water and Air Quality Laboratory 1 Unit
Terms offered: Fall 2019, Fall 2018, Fall 2017
This laboratory course is designed to accompany the lecture topics in Civil Engineering 111. Each laboratory activity will provide an opportunity to understand key concepts in water and air quality through hands-on experimentation. Laboratory topics include phase partitioning, acid/base reactions, redox reactions, biochemical oxygen demand, absorption, gas transfer, reactor hydraulics, particle destabilization, disinfection, and combustion emissions.
Water and Air Quality Laboratory: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG 111 (may be taken concurrently)

Hours & Format
Fall and/or spring: 15 weeks - 1 hour of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Alvarez-Cohen, Nelson, Sedlak

Water and Air Quality Laboratory: Read Less [-]

CIV ENG 112 Environmental Engineering Design 3 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
Engineering design and project management of environmental systems. Students will complete a design project focusing on pollution control in a selected environmental system. Lectures and project activities will address process design, economic optimization, legal and institutional constraints on design, and project management. Additional components of design (e.g., hydraulics, engineering sustainability, plant structures) will be included.
Environmental Engineering Design: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG 100 and CIV ENG 111

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.

Environmental Engineering Design: Read Less [-]
CIV ENG 113 Ecological Engineering for Water Quality Improvement 3 Units
Terms offered: Spring 2019, Spring 2017, Fall 2003
Ecological engineering approaches for treating contaminated water using natural processes to improve water quality. Emphasis on combining basic science and engineering approaches to understand the fundamental processes that govern the effectiveness of complex natural treatment systems. Applications include constructed wetlands, waste stabilization ponds, stormwater bioretention, decentralized wastewater management, ecological sanitation. Laboratory sessions will consist of design and monitoring of laboratory and full-scale natural treatment systems, including a range of water quality measurements.

Ecological Engineering for Water Quality Improvement: Read More [+]

Objectives & Outcomes

Course Objectives: Become familiar with common applications of natural treatment systems through lectures, reading materials, laboratory activities, and field trips
Develop a solid understanding of the fundamental processes in ecological engineering approaches to natural treatment systems that govern the removal or transformation of contaminants in water
Learn common design approaches for waste stabilization ponds and wetlands, as well as their necessary operation and maintenance activities
Measure key water quality parameters and evaluate the performance of mesocosm ponds and wetlands based on the data collected throughout the semester
Understand and appreciate the complexity of these systems compared to mechanical treatment systems

Student Learning Outcomes: Ability to apply knowledge of mathematics, science, and engineering. EXTENSIVE
Ability to communicate effectively. MODERATE
Ability to design a system, component, or process to meet desired needs. EXTENSIVE
Ability to design and conduct experiments, as well as to analyze and interpret data. EXTENSIVE
Ability to function on multi-disciplinary teams. MODERATE
Ability to identify, formulate and solve engineering problems. EXTENSIVE
Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. EXTENSIVE
Knowledge of contemporary issues. MODERATE
Recognition of the need for, and an ability to engage in life-long learning. MODERATE
Understand the impact of engineering solutions in a global and societal context. MODERATE
Understanding of professional and ethical responsibility. MODERATE

Rules & Requirements

Prerequisites: CIV ENG 111 or consent of instructor
Credit Restrictions: Civ Eng 113N

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Nelson

Formerly known as: Civil and Environmental Engineering 113N

CIV ENG 114 Environmental Microbiology 3 Units
Terms offered: Spring 2016, Spring 2015, Fall 2014
The scope of modern environmental engineering requires a fundamental knowledge of microbial processes with specific application to water, wastewater and the environmental fate of pollutants. This course will cover basic microbial physiology, biochemistry, metabolism, growth energetics and kinetics, ecology, pathogenicity, and genetics for application to both engineered and natural environmental systems.

Environmental Microbiology: Read More [+]

Rules & Requirements

Prerequisites: CHEM 1A and CHEM 1B

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Alvarez-Cohen

Environmental Microbiology: Read Less [-]

CIV ENG 115 Water Chemistry 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
The application of principles of inorganic, physical, and dilute solution equilibrium chemistry to aquatic systems, both in the aquatic environment and in water and wastewater treatment processes.

Water Chemistry: Read More [+]

Rules & Requirements

Prerequisites: Upper division or graduate standing in engineering or physical science, or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Sedlak

Water Chemistry: Read Less [-]
**CIV ENG C116 Chemistry of Soils 3 Units**


Chemical mechanisms of reactions controlling the fate and mobility of nutrients and pollutants in soils. Role of soil minerals and humus in geochemical pathways of nutrient bioavailability and pollutant detoxification. Chemical modeling of nutrient and pollutant soil chemistry. Applications to soil acidity and salinity.

Chemistry of Soils: Read More [+]  
**Rules & Requirements**

**Prerequisites:** Civil Engineering 111 or equivalent

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate  
**Grading/Final exam status:** Letter grade. Final exam required.  
**Instructor:** Sposito  
**Also listed as:** ESPM C128

Chemistry of Soils: Read Less [-]

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**CIV ENG 120 Structural Engineering 3 Units**

Terms offered: Spring 2019, Spring 2018, Spring 2017


Structural Engineering: Read More [+]  
**Rules & Requirements**

**Prerequisites:** CIV ENG C30 / MEC ENG C85 and CIV ENG 60 (may be taken concurrently)

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate  
**Grading/Final exam status:** Letter grade. Final exam required.  
**Instructor:** Moehle

Structural Engineering: Read Less [-]

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**CIV ENG 121 Structural Analysis 3 Units**

Terms offered: Fall 2018, Fall 2017, Fall 2016


Structural Analysis: Read More [+]  
**Objectives & Outcomes**

**Course Objectives:** Collapse load factor determination of simple structures by lower bound theorem of plastic analysis.  
Consistent process of writing equilibrium and compatibility relations for small and large structures permitting solution by hand and by matrix algebra software. Identification of degree of static indeterminacy. Force-deformation relations for truss and frame elements  
Modeling of structures. Nodes, elements, loading, organization of information for describing structural model, element properties and loading  
Solution of simple statically indeterminate structures by the force method of analysis. Understanding of structure flexibility and flexibility coefficients. Treatment of nodal loads and non-mechanical element deformations  
Solution of statically indeterminate structures of any size by the displacement method of analysis. Stiffness coefficients. Treatment of element and thermal loads. Computer implementation in the form of the direct stiffness approach  
Structural systems and their use in buildings and bridges. Parametric studies  
Work and energy principles. Principles of virtual work and complementary virtual work. Relation between virtual work principles and equilibrium/compatibility relations

**Student Learning Outcomes:** Analyze any type of truss and frame structure with the displacement method of analysis by hand and by computer. Determine internal forces, deformations, global displacements, support reactions. Error checking of computer analysis results (ABET Learning Goals: 1, 3, 5).

Determine the collapse load of simple perfectly-plastic truss and frame structures under equilibrium considerations (ABET Learning Goals: 1, 3, 5).

Identify the structural response contribution of individual elements and identify the effect of changes in element properties on the results (ABET Learning Goals: 1, 3, 11).

Perform analysis of statically determinate truss and frame structures under equilibrium and compatibility considerations. Perform equilibrium checks of given results under given loading. Perform compatibility checks for given deformations (ABET Learning Goals: 1, 3, 5).

Recognize force flow in beam, arch and cable structures and their derivatives, like suspension bridges, cable-stayed bridges, roofs and high-rise buildings (ABET Learning Goals: 3, 8, 10, 11).

Understand basic structural systems and their use throughout history and in modern times. (ABET Learning Goals: 3, 8, 10, 11)

Understand structural modeling. Be able to assess the complexity of a structural model and identify number of unknowns in the solution of the structural response to given loading. Be able to select the most appropriate solution method for hand calculations (ABET Learning Goals: 1, 3, 5).

**Rules & Requirements**

**Prerequisites:** CIV ENG 120 and CIV ENG 130

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
CIV ENG 122L Structural Steel Design Project 1 Unit
Terms offered: Spring 2019, Spring 2018, Spring 2017
Introduction to one or more comprehensive structural design problems. Design teams will conceive structural system; determine design loads; conduct preliminary and final design of structure and its foundation; prepare construction cost estimate; prepare final report containing project description, design criteria, cost estimate, structural drawings, and supporting calculations; and make "client" presentations as required. Structural Steel Design Project: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG 122N
Credit Restrictions: Students will receive no credit for Civil and Environmental Engineering 122L after taking Civil and Environmental Engineering 122 or 123L.

Hours & Format
Fall and/or spring: 15 weeks - 1.5 hours of lecture per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.
Instructor: Becker

CIV ENG 122N Design of Steel Structures 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
Introduction to materials and methods of steel construction; behavior and design of tension members, compression members, flexural members and beam-columns; design of welds, bolts, shear connections and moment connections; design of spread footings or other foundation elements; introduction to design of earthquake-resistant steel structures including concentrically braced frames and moment frames. Design of Steel Structures: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG 120

CIV ENG 123L Structural Concrete Design Project 1 Unit
Terms offered: Spring 2019, Spring 2018, Spring 2017
Introduction to one or more comprehensive structural design problems. Design teams will conceive structural system; determine design loads; conduct preliminary and final design of structure and its foundation; prepare construction cost estimate; prepare final report containing project description, design criteria, cost estimate, structural drawings, and supporting calculations; and make "client" presentations as required. Structural Concrete Design Project: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG 123N
Credit Restrictions: Students will receive no credit for Civil and Environmental Engineering 123L after taking Civil and Environmental Engineering 122L or 123.

Hours & Format
Fall and/or spring: 15 weeks - 1.5 hours of lecture per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.
Instructors: Moehle, Mosalam

CIV ENG 123N Design of Reinforced Concrete Structures 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
Introduction to materials and methods of reinforced concrete construction; behavior and design of reinforced concrete beams and one-way slabs considering deflections, flexure, shear, and anchorage; behavior and design of columns; design of spread footings or other foundation elements; design of earthquake-resistant structures; introduction to prestressed concrete. Design of Reinforced Concrete Structures: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG 120

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Moehle, Mosalam
Formerly known as: Civil and Environmental Engineering 122
Design of Reinforced Concrete Structures: Read Less [-]
CIV ENG 124 Structural Design in Timber 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
Characteristics and properties of wood as a structural material; design and detailing of structural elements and entire structures of wood. Topics include allowable stresses, design and detailing of solid sawn and glulam beams and columns, nailed and bolted connections, plywood diaphragms and shear walls. Case studies.
Structural Design in Timber: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG 120
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Filippou
Structural Design in Timber: Read Less [-]

CIV ENG 126 Engineering Dynamics and Vibrations 3 Units
Terms offered: Fall 2019
Engineering Dynamics and Vibrations: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG C30 / MEC ENG C85 and ENGIN 7; or consent of instructor
Credit Restrictions: Students will receive no credit for CIV ENG 126 after completing MEC ENG 104. A deficient grade in CIV ENG 126 may be removed by taking MEC ENG 104, or MEC ENG 104.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Filippou, Govindjee, Li
Engineering Dynamics and Vibrations: Read Less [-]

CIV ENG 130N Mechanics of Structures 3 Units
Terms offered: Spring 2019, Summer 2018 8 Week Session, Spring 2018
Elastic and plastic stress and deformation analysis of bars, shafts, beams, and columns; energy and variational methods; plastic analysis of structures; stability analysis of structures; computer-aided mathematical techniques for solution of engineering problems and modular computer programming methods.
Mechanics of Structures: Read More [+]
Rules & Requirements
Prerequisites: CIV ENG C30 / MEC ENG C85; and CIV ENG 60 or MAT SCI 45
Credit Restrictions: Students will receive no credit for 130N after taking 130.
Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week
Summer: 8 weeks - 4 hours of lecture and 6 hours of laboratory per week
Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Filippou, Konstantinidis, DeJong
Mechanics of Structures: Read Less [-]
CIV ENG 132 Applied Structural Mechanics 3 Units
Terms offered: Not yet offered
Concepts of theory of solid mechanics: three dimensional stress, strain, and material response; elastic and inelastic boundary value problems; fracture, fatigue, and geometric instability. Problems in advanced strength of materials; thin plate and axis-symmetric shell theory.

Rules & Requirements
Prerequisites: CIV ENG C30 / MEC ENG C85, MATH 53 and MATH 54
Credit Restrictions: Students will receive no credit for CivEng 132 after CivEng 130N.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Govindjee, Li, Konstantinidis

CIV ENG C133 Engineering Analysis Using the Finite Element Method 3 Units
Terms offered: Fall 2019, Spring 2019, Spring 2018
This is an introductory course on the finite element method and is intended for seniors in engineering and applied science disciplines. The course covers the basic topics of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems. Finite element formulations for several important field equations are introduced using both direct and integral approaches. Particular emphasis is placed on computer simulation and analysis of realistic engineering problems from solid and fluid mechanics, heat transfer, and electromagnetism. The course uses FEMLAB, a multiphysics MATLAB-based finite element program that possesses a wide array of modeling capabilities and is ideally suited for instruction. Assignments will involve both paper- and computer-based exercises. Computer-based assignments will emphasize the practical aspects of finite element model construction and analysis.

Rules & Requirements
Prerequisites: Engineering 7 or 77 or Computer Science 61A; Mathematics 53 and 54; senior status in engineering or applied science

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Also listed as: MEC ENG C180

Instructors: Govindjee, Li, Konstantinidis
Applied Structural Mechanics: Read More [+]
CIV ENG 140 Failure Mechanisms in Civil Engineering Materials 3 Units
Terms offered: Spring 2013, Spring 2010, Spring 2009
The failure mechanisms in civil engineering materials (cement-based materials, metallic- and polymer-based materials) are associated with processing, microstructure, stress states, and environmental changes. Fracture mechanics of brittle, quasi-brittle, and ductile materials; cracking processes in monolithic, particulate, and fiber reinforced materials; examples of ductile/brittle failure transitions in civil engineering structures; retrofitting of existing structures; non-destructive techniques for damage detection.

Failure Mechanisms in Civil Engineering Materials: Read More [+]

Rules & Requirements
Prerequisites: CIV ENG 60

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Ostertag

Failure Mechanisms in Civil Engineering Materials: Read Less [-]

CIV ENG 153 Transportation Facility Design 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
A capstone class with the objective to design transportation facilities based on operational capacity, site constraints, and environmental design considerations. Emphasis on airports, including landside and airside elements, and environmental assessment and mitigation techniques.

Transportation Facility Design: Read More [+]

Rules & Requirements
Prerequisites: CIV ENG 155

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Hansen

Transportation Facility Design: Read Less [-]

CIV ENG 140 Failure Mechanisms in Civil Engineering Materials 3 Units
Terms offered: Spring 2013, Spring 2010, Spring 2009
The failure mechanisms in civil engineering materials (cement-based materials, metallic- and polymer-based materials) are associated with processing, microstructure, stress states, and environmental changes. Fracture mechanics of brittle, quasi-brittle, and ductile materials; cracking processes in monolithic, particulate, and fiber reinforced materials; examples of ductile/brittle failure transitions in civil engineering structures; retrofitting of existing structures; non-destructive techniques for damage detection.

Failure Mechanisms in Civil Engineering Materials: Read More [+]

Rules & Requirements
Prerequisites: CIV ENG 60

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Ostertag

Failure Mechanisms in Civil Engineering Materials: Read Less [-]

CIV ENG 155 Transportation Systems Engineering 3 Units
Terms offered: Fall 2019, Spring 2019, Spring 2018

Transportation Systems Engineering: Read More [+]

Rules & Requirements
Prerequisites: Sophomore standing in engineering or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Cassidy, Daganzo, Hansen, Kanafani, Madanat

Transportation Systems Engineering: Read Less [-]

CIV ENG 156 Infrastructure Planning and Management 3 Units
Terms offered: Fall 2014, Spring 2014, Fall 2011
This course focuses on physical infrastructure systems that support society, including transportation, communications, power, water, and waste. These are complex, large-scale systems that must be planned and managed over a long-term horizon. Economics-based, analytical tools are covered, including topics of supply, demand, and evaluation. Problem sets, case studies, and a class project provide for hands-on experience with a range of infrastructure systems, issues, and methods of analysis.

Infrastructure Planning and Management: Read More [+]

Rules & Requirements
Prerequisites: MATH 1A, MATH 1B, and CIV ENG 93

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Civil and Environmental Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Walker

Infrastructure Planning and Management: Read Less [-]
CIV ENG 165 Concrete Materials, Construction, and Sustainability 3 Units
Terms offered: Spring 2019, Spring 2018, Fall 2016

CIV ENG 166 Construction Engineering 3 Units
Terms offered: Fall 2018, Spring 2016, Fall 2014
Introduction to construction engineering and field operations. The construction industry, construction methods and practice, productivity improvement, equipment selection, site layout formwork, erection of steel and concrete structures. Labs demonstrate the concepts covered. Field trips to local construction projects.

CIV ENG 167 Engineering Project Management 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
Principles of economics, decision making, and law applied to company and project management. Business ownership, liability and insurance, cash flow analysis, and financial management. Project life-cycle, design-construction interface, contracts, estimating, scheduling, cost control.

CIV ENG 171 Rock Mechanics 3 Units
Terms offered: Spring 2019, Spring 2017, Spring 2016
Geological and geophysical exploration for structures in rock; properties and behavior of rock masses; rock slope stability; geological engineering of underground openings; evaluation of rock foundations, including dams.
**CIV ENG 173 Groundwater and Seepage 3 Units**
Terms offered: Fall 2019, Fall 2018, Fall 2017
Introduction to principles of groundwater flow, including steady and transient flow through porous media, numerical analysis, pumping tests, groundwater geology, contaminant transport, and design of waste containment systems.

**Rules & Requirements**

**Prerequisites:** Senior standing in engineering or science; CIV ENG 100 recommended

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Rubin, Sitar

Groundwater and Seepage: Read Less [-]

**CIV ENG 174 Engineering Geomatics 3 Units**
Terms offered: Summer 2015 First 6 Week Session, Summer 2014 10 Week Session, Summer 2014 First 6 Week Session
Engineering Geomatics is a field that integrates collections, processing, and analysis of digital geospatial data. This new field is anchored in the established field of geodetics that describes the complex shape of the Earth, elements and usage of topographic data and maps. Basic and advanced GPS satellite mapping. Digital globe technology. Advanced laser-LIDAR mapping. Quantitative terrain modeling, change detection, and analysis. Hydrogeomatics-seafloor mapping.

**Engineering Geomatics:** Read More [+]

**Hours & Format**

Summer: 6 weeks - 6 hours of lecture and 5 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Bray, Sitar, Soga

Groundwater and Seepage: Read Less [-]

**CIV ENG 175 Geotechnical and Geoenvironmental Engineering 3 Units**
Terms offered: Spring 2019, Spring 2018, Fall 2017
Soil formation and identification. Engineering properties of soils. Fundamental aspects of soil characterization and response, including soil mineralogy, soil-water movement, effective stress, consolidation, soil strength, and soil compaction. Use of soils and geosynthetics in geotechnical and geoenvironmental applications. Introduction to site investigation techniques. Laboratory testing and evaluation of soil composition and properties.

**Rules & Requirements**

**Prerequisites:** CIV ENG C30 / MEC ENG C85 (may be taken concurrently); CIV ENG 100 recommended

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Bray, Sitar, Soga

Geotechnical and Geoenvironmental Engineering: Read Less [-]

**CIV ENG 176 Environmental Geotechnics 3 Units**
Terms offered: Spring 2016, Spring 2015, Spring 2014
Principles of environmental geotechnics applied to waste encapsulation and remediation of contaminated sites. Characterization of soils and wastes, engineering properties of soils and geosynthetics and their use in typical applications. Fate and transport of contaminants. Fundamental principles and practices in groundwater remediation. Application of environmental geotechnics in the design and construction of waste containment systems. Discussion of soil remediation and emerging technologies.

**Rules & Requirements**

**Prerequisites:** CIV ENG 175 or consent of instructor; CIV ENG 111 and CIV ENG 173 recommended

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Pestana, Sitar

Environmental Geotechnics: Read Less [-]
CIV ENG 177 Foundation Engineering Design
3 Units
Terms offered: Spring 2017, Spring 2016, Fall 2014
Principles of foundation engineering. Shear strength of soil and theories related to the analysis and design of shallow and deep foundations, and retaining structures. Structural design of foundation elements: piles, pile caps, and retaining structures. The course has a group project that incorporates both geotechnical and structural components of different foundation elements.

Foundation Engineering Design: Read More [+]

Rules & Requirements

Prerequisites: CIV ENG 175; CIV ENG 120 recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Bray

Foundation Engineering Design: Read Less [-]

CIV ENG C178 Applied Geophysics 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
The theory and practice of geophysical methods for determining the subsurface distribution of physical rock and soil properties. Measurements of gravity and magnetic fields, electrical and electromagnetic fields, and seismic velocity are interpreted to map the subsurface distribution of density, magnetic susceptibility, electrical conductivity, and mechanical properties.

Applied Geophysics: Read More [+]

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Rector

Also listed as: EPS C178

Applied Geophysics: Read Less [-]

CIV ENG 179 Geosystems Engineering Design 3 Units
Terms offered: Fall 2019, Fall 2018, Spring 2018
Geosystem engineering design principles and concepts. Fundamental aspects of the geomechanical and geoenvironmental responses of soil are applied to analyze and design civil systems, such as earth dams and levees, earth retention systems, building and bridge foundations, solid-waste fills, and tailings dams. Students form teams to design geotechnical aspects of a civil project and prepare/present a design document. Field trip to a project site.

Geosystems Engineering Design: Read More [+]

Rules & Requirements

Prerequisites: CIV ENG 175

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Bray, Sitar, Soga

Geosystems Engineering Design: Read Less [-]

CIV ENG 180 Life-Cycle Design and Construction 4 Units
Terms offered: Spring 2019, Spring 2018, Spring 2017
Course encompasses two design aspects of a civil and environmental engineering system: 1) Design of whole system, component, or life-cycle phase, subject to engineering standards and constraints, and 2) production system design (e.g., cost estimation and control, scheduling, commercial and legal terms, site layout design). Students form teams to address real-life projects and prepare project documentation and a final presentation.

Life-Cycle Design and Construction: Read More [+]

Rules & Requirements

Prerequisites: CIV ENG 167

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructor: Horvath

Life-Cycle Design and Construction: Read Less [-]
**CIV ENG 186 Design of Cyber-Physical Systems 3 Units**
Terms offered: Fall 2019, Fall 2018, Fall 2017
Design and prototype of large-scale technology intensive systems. Design project incorporating infrastructure systems and areas such as transportation and hydrology; for example, watershed sensor networks, robot networks for environmental management, mobile Internet monitoring, open societal scale systems, crowd-sources applications, traffic management. Design of sensing and control systems, prototyping systems, and measures of system performance. Modeling, software and hardware implementation.

**Rules & Requirements**

**Prerequisites:** CIV ENG 191

**Hours & Format**
Fall and/or spring: 15 weeks - 2 hours of lecture and 2 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam not required.

**Instructors:** Bayen, Glaser, Sengupta

**Design of Cyber-Physical Systems:** Read Less [-]

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**CIV ENG 190 Special Topics in Civil and Environmental Engineering 1 - 4 Units**
Terms offered: Spring 2016
This course covers current topics of interest in civil and environmental engineering. The course content may vary from semester to semester depending upon the instructor

**Rules & Requirements**

**Prerequisites:** 93, Engineering 7 or 77

**Hours & Format**
Fall and/or spring: 15 weeks - 1-4 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Alternative to final exam.

**Instructor:** Varian

**Special Topics in Civil and Environmental Engineering:** Read Less [-]

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**CIV ENG 191 Civil and Environmental Engineering Systems Analysis 3 Units**
Terms offered: Spring 2019, Spring 2018, Fall 2016
This course is organized around five real-world large-scale CEE systems problems. The problems provide the motivation for the study of quantitative tools that are used for planning or managing these systems. The problems include design of a public transportation system for an urban area, resource allocation for the maintenance of a water supply system, development of repair and replacement policies for reinforced concrete bridge decks, traffic signal control for an arterial street, scheduling in a large-scale construction project.

**Rules & Requirements**

**Prerequisites:** 93, Engineering 7 or 77

**Hours & Format**
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Bayen, Madanat, Sengupta

**Formerly known as:** 152

**Civil and Environmental Engineering Systems Analysis:** Read Less [-]

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**CIV ENG 192 The Art and Science of Civil and Environmental Engineering Practice 1 Unit**
Terms offered: Fall 2017, Fall 2016, Fall 2015
A series of lectures by distinguished professionals designed to provide an appreciation of the role of science, technology, and the needs of society in conceiving projects, balancing the interplay of conflicting demands, and utilizing a variety of disciplines to produce unified and efficient systems.

**Rules & Requirements**

**Prerequisites:** Senior standing in civil and environmental engineering

**Hours & Format**
Fall and/or spring: 15 weeks - 1 hour of lecture per week

**Additional Details**

**Subject/Course Level:** Civil and Environmental Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam not required.

**Instructor:** Varian

**The Art and Science of Civil and Environmental Engineering Practice:** Read Less [-]
CIV ENG 193 Engineering Risk Analysis 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
Applications of probability theory and statistics in planning, analysis, and design of civil engineering systems. Development of probabilistic models for risk and reliability evaluation. Occurrence models; extreme value distributions. Analysis of uncertainties. Introduction to Bayesian statistical decision theory and its application in engineering decision-making.
Rules & Requirements
Prerequisites: Upper division standing

CIV ENG H194 Honors Undergraduate Research 3 - 4 Units
Terms offered: Fall 2019, Spring 2019, Fall 2018
Supervised research. Students who have completed 3 or more upper division courses may pursue original research under the direction of one of the members of the staff. A final report or presentation is required. A maximum of 4 units of H194 may be used to fulfill the technical elective requirement.
Rules & Requirements
Prerequisites: Upper division technical GPA 3.3, consent of instructor and faculty advisor
Repeat rules: Course may be repeated for credit up to a total of 8 units.

CIV ENG 197 Field Studies in Civil Engineering 1 - 4 Units
Terms offered: Fall 2019, Summer 2019, Summer 2019 10 Week Session
Supervised experience in off-campus companies relevant to specific aspects and applications of civil engineering. Written report required at the end of the semester.
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 3-4 hours of independent study per week
Summer:
6 weeks - 2.5-10 hours of independent study per week
8 weeks - 1.5-7.5 hours of independent study per week
10 weeks - 1.5-6 hours of independent study per week

CIV ENG 198 Directed Group Study for Advanced Undergraduates 1 - 4 Units
Terms offered: Fall 2019, Spring 2019, Fall 2018
Group study of a selected topic or topics in civil engineering.
Rules & Requirements
Prerequisites: Senior standing in engineering
Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.
CIV ENG 199 Supervised Independent Study
1 - 4 Units
Terms offered: Fall 2019, Summer 2019 3 Week Session, Spring 2019
Supervised independent study.
Supervised Independent Study: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor and major adviser. Enrollment is restricted; see the Course Number Guide for details

Credit Restrictions: Course may be repeated for a maximum of four units per semester.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week
10 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/
Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Supervised Independent Study: Read Less [-]