

# Geotechnical Engineering

## Minor

The Department of Civil and Environmental Engineering offers a minor program in Geotechnical Engineering. Geotechnical Engineering 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 Geotechnical Engineering. 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 Geotechnical Engineering.

## 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 upper division courses used for 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 (<https://guide.berkeley.edu/undergraduate/degree-programs/civil-engineering/>) (Major only)

Environmental Engineering (<https://guide.berkeley.edu/undergraduate/degree-programs/environmental-engineering/>) (Minor only)

Structural Engineering (<https://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

Complete one Math sequence

MATH 1A & MATH 1B	Course Not Available and Course Not Available	8
MATH 16A & MATH 16B	Analytic Geometry and Calculus and Analytic Geometry and Calculus	6

Complete one Physics course:

PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 8A	Introductory Physics	4
Complete:		
CHEM 1A	General Chemistry	3
CIV ENG C30	Introduction to Solid Mechanics	3

## Upper Division Requirements

CIV ENG 175	Geotechnical and Geoenvironmental Engineering	3
Select three courses from the following:		
CIV ENG 100	Elementary Fluid Mechanics	4
CIV ENG 132	Applied Structural Mechanics	3
CIV ENG 170A	Infrastructure Sensing and Modeling	3
CIV ENG 171	Rock Mechanics	3
CIV ENG 173	Groundwater and Seepage	3
CIV ENG 174	Engineering Geomatics	3
CIV ENG 176	Environmental Geotechnics	3
CIV ENG C178	Applied Geophysics	3
CIV ENG 179	Geosystems Engineering Design	3

## University of California Requirements

### Entry Level Writing (<https://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

All students who will enter the University of California as freshmen must demonstrate their command of the English language by satisfying the Entry Level Writing Requirement (ELWR). The UC Entry Level Writing Requirement website (<https://admission.universityofcalifornia.edu/elwr/>) provides information on how to satisfy the requirement.

### American History and American Institutions (<https://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

The American History and Institutions (AH&I) requirements are based on the principle that a US resident graduated from an American university should have an understanding of the history and governmental institutions of the United States.

## Campus Requirement

### American Cultures (<https://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

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.

## Geosystems

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

Terms offered: Spring 2025, Fall 2024, Spring 2024

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 51

#### 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

## CIV ENG 24 Freshman Seminars 1 Unit

Terms offered: Spring 2020, Fall 2019, Spring 2019

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.

## CIV ENG C30 Introduction to Solid Mechanics 3 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

A review of equilibrium for particles and rigid bodies. Application to truss structures. The concepts of deformation, strain, and stress. Equilibrium equations for a continuum. Elements of the theory of linear elasticity. The states of plane stress and plane strain. Solution of elementary elasticity problems (beam bending, torsion of circular bars). Euler buckling in elastic beams.

#### 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

## CIV ENG W30 Introduction to Solid Mechanics 3 Units

Terms offered: Summer 2021 8 Week Session, Summer 2020 8 Week Session, Summer 2019 8 Week Session

A review of equilibrium for particles and rigid bodies. Application to truss structures. The concepts of deformation, strain, and stress. Equilibrium equations for a continuum. Elements of the theory of linear elasticity. The states of plane stress and plane strain. Solution of elementary elasticity problems (beam bending, torsion of circular bars). Euler buckling in elastic beams.

### Objectives & Outcomes

**Course Objectives:** To learn statics and mechanics of materials

### Student Learning Outcomes: -

Correctly draw free-body

-

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:** MATH 53 and MATH 54 (may be taken concurrently); PHYSICS 7A

**Credit Restrictions:** Students will receive no credit for MEC ENG W85 after completing MEC ENG C85. A deficient grade in MEC ENG W85 may be removed by taking MEC ENG C85.

### 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

## CIV ENG 60 Structure and Properties of Civil Engineering Materials 3 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

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

## CIV ENG 70 Engineering Geology 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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

## 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.

### Rules & Requirements

**Prerequisites:** MATH 51; and COMPSCI C8 / INFO C8 / STAT C8 (may be enrolled concurrently)

### 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 C88 Data Science for Smart Cities 2 Units

Terms offered: Spring 2024, Spring 2023, Spring 2022

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.

### Objectives & Outcomes

**Course Objectives:** Become familiar with urban big data and sensor data collection techniques.

Develop intuition in various machine learning classification algorithms, as well as regression modelling.

Develop intuition in various machine learning classification algorithms, as well as regression modelling.

Foster critical thinking about real-world actionability from analytics.

Learn how to use data science techniques in urban decision-making and scenario generation.

**Student Learning Outcomes:** Develop capabilities in a range of data science techniques.

Gain the ability to solve problems in smart city research and practice.  
Think critically about how to assess analytics for cities.  
Use data analytics in the smart city domain.

### Rules & Requirements

**Prerequisites:** This course is a Data Science connector course and is meant to be taken concurrent with or after Foundations of Data Science COMPSCI C8/INFO C8/STAT C8. Students may take more than one Data Science connector course if they wish, concurrently or after taking the C8 course

### 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. Alternative to final exam.

**Instructor:** Gonzalez

**Formerly known as:** Civil and Environmental Engineering 88

**Also listed as:** CY PLAN C88

## 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.

### 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.

## CIV ENG 92A Design for Future Infrastructure Systems 2 Units

Terms offered: Spring 2022, Fall 2020

Hands-on engineering design experience for creating future infrastructure systems. Intelligent infrastructure systems leverage data and computational to enhance sustainability and resilience for smart cities of the future. Student teams identify a challenge with current transportation, energy, water, waste, and/or the built infrastructure. Student teams design and prototype an innovation that solves this problem using maker resources, e.g. 3D printing, laser cutters, and open-source electronics. The project will be executing via the "Design Sprint" process, which is popular in agile development and Silicon Valley. Students present projects to guest judges from industry. Course is an introductory design experience for first-year students.

### Hours & Format

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

### Additional Details

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

**Grading/Final exam status:** Offered for pass/not pass grade only. Alternative to final exam.

**Instructor:** Moura

## CIV ENG 92B Cornerstone Structural Design 2 Units

Terms offered: Fall 2024, Fall 2023, Spring 2023

This course introduces students to conceptual structural design, fabrication, and testing. The course aims to provide a hands-on structural engineering design experience and to inspire creativity. Students will learn the design process as well as fundamental principles of structural analysis. Student teams will be given a design challenge with performance objectives and practical constraints that emphasize sustainable design practices. Student teams will use maker space resources (e.g. 3D printing, laser cutting, CNC router, woodshop) to fabricate their structures, which will be tested to failure in the Structural Engineering Lab in Davis Hall.

### Objectives & Outcomes

#### Student Learning Outcomes: -

Explain basic concepts of statics and equilibrium.

### 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. Alternative to final exam.

**Instructor:** DeJong

## CIV ENG 93 Engineering Data Analysis 3 Units

Terms offered: Summer 2025 First 6 Week Session, Spring 2025, Fall 2024

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.

### 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 - 3 hours of lecture and 2 hours of laboratory per week

**Summer:** 6 weeks - 7.5 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:** Hansen, Rubin, Walker

## CIV ENG 98 Supervised Group Study and Research 1 - 3 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

Supervised group study and research by lower division students.

### 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.

## CIV ENG 99 Supervised Independent Study and Research 1 - 4 Units

Terms offered: Spring 2024, Spring 2023, Fall 2022

Supervised independent study by lower division students.

### 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.

## CIV ENG 100 Elementary Fluid Mechanics 4 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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.

### 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

## CIV ENG C103N Terrestrial Hydrology 4 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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

## CIV ENG 104 Planetary Boundaries and the Anthropocene 1 Unit

Terms offered: Fall 2022, Fall 2021, Spring 1998

This course aims to introduce students to the debates and discussions about the impact of increasing human resource consumption, increasing population, and increasing human prosperity on the planet's environmental systems that support human societies.

### Objectives & Outcomes

**Course Objectives:** Explain the major arguments on the sides of "planetary boundaries" and "cornucopia"  
Understand the basic system dynamics view of planetary systems  
Understand the main features of several of planetary boundaries that have scientific consensus

### Rules & Requirements

**Prerequisites:** Upper division undergraduate standing

**Credit Restrictions:** Students will receive no credit for CIV ENG 104 after completing CIV ENG 104. A deficient grade in CIV ENG 104 may be removed by taking CIV ENG 104.

### 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:** Letter grade. Alternative to final exam.

**Instructors:** Chow , Gadgil

## CIV ENG 105 Design for Global Transformation 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2022

Student teams will design strategies to address critical global challenges, such as climate change, biodiversity loss, pollution, and related issues, with the potential for transformational change. Project topics will vary. Students will explore global to local scales using principles and practices from design science, systems thinking, regenerative design, circular economy, environmental justice, science communication, data visualization, and numerical modeling, among other disciplines.

### Objectives & Outcomes

**Course Objectives:** Create a multi-media exhibit to clearly communicate your findings and strategy

Iteratively design a comprehensive strategy to address your team's global challenge

To gain familiarity with relevant design and engineering tools, including data visualization and simulation and modeling

Work strategically and collaboratively with fellow students in a design team

### Rules & Requirements

**Prerequisites:** At least one of the following courses: CIV ENG C103N / ESPM C130 / GEOG C136, CIV ENG 111, CIV ENG 120, CIV ENG 155, CIV ENG 175, or CIV ENG 191; 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.

**Instructor:** Chow

## CIV ENG C106 Air Pollution 3 Units

Terms offered: Spring 2024, Spring 2023, Spring 2022

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 green house gasses, smog, and changes in the oxidation capacity of the troposphere.

### Rules & Requirements

**Prerequisites:** CHEM 1A, CHEM 1B, and 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

## CIV ENG 107 Climate Change Mitigation 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Assessment of technological options for responding to climate change. Overview of climate-change science; sources, sinks, and atmospheric dynamics of greenhouse gases. Current systems for energy supply and use. Renewable energy resources, transport, storage, and transformation technologies. Technological opportunities for improving end-use energy efficiency. Recovery, sequestration, and disposal of greenhouse gases. Societal context for implementing engineered responses.

### 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.

## CIV ENG 108 Climate Change Adaptation 3 Units

Terms offered: Fall 2024, Fall 2023, Spring 2022

In this course, we will examine the local manifestation of global climate change and consider interventions and responses that anticipate long-term change in communities. The course will integrate environmental sciences, civil and environmental engineering, and the social sciences to both understand the impacts of global change and to quantitatively evaluate possible adaptation interventions. Upon completing the course, you will have a holistic perspective on the challenges associated with climate change adaptation, an understanding of the wide range of potential solutions and interventions that may be possible, and an awareness of the strengths and weaknesses of those solutions.

### Rules & Requirements

**Prerequisites:** CIV ENG 11 or introductory climate science course, 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. Alternative to final exam.

**Instructor:** Stacey



## CIV ENG 110 Water Systems of the Future 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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.

### 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 identify, formulate and solve engineering problems. MODERATE  
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

## CIV ENG 111 Environmental Engineering 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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.

### 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, Nelson, Sedlak

## CIV ENG 111L Water and Air Quality Laboratory 1 Unit

Terms offered: Fall 2024, Fall 2023, Fall 2022

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.

### 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

## CIV ENG 112 Water & Wastewater Systems Design and Operation 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

Water and wastewater systems serving communities are complex, large, and were built and expanded over many decades. The infrastructure includes a network of reservoirs, pipelines, pump stations, treatment plants, and other facilities that are connected to natural systems such as watersheds, rivers, groundwater basins, and bay and ocean environments. The planning, design, operation, and maintenance of urban water and wastewater systems require balancing many factors including aging infrastructure, changing regulations, climate change, costs, and community impacts.

One of the greatest challenges facing civil engineers in the 21st century is the stewardship of the infrastructure to protect public health and the environment. Existing systems r

### Rules & Requirements

**Prerequisites:** Upper division standing in engineering or physical sciences, 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. Alternative to final exam.

**Instructor:** Soga

## CIV ENG 113 Ecological Engineering for Water Quality Improvement 3 Units

Terms offered: Spring 2021, Spring 2019, Spring 2017

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.

### 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.

## 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.

### 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

## CIV ENG 115 Water Chemistry 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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.

### 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

## CIV ENG C116 Chemistry of Soils 3 Units

Terms offered: Fall 2021, Fall 2020, Spring 2018

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.

### Rules & Requirements

**Prerequisites:** CIV ENG 111

### 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.

**Also listed as:** ESPM C128

## CIV ENG 119 Data and Equity in Environmental Engineering 3 Units

Terms offered: Not yet offered

Python analysis of datasets that are relevant to today's grand challenges in environmental engineering. Topics include, but are not limited to, human exposures, water resources, solid waste, water quality, energy equity, and coastline resilience. Discussion of datasets through the lens of socioeconomic equity and historical unintended consequences of environmental engineering decisions.

### Rules & Requirements

**Prerequisites:** ENGIN 7 and DATA C8 and CIV ENG 111; or consent of instructor

**Credit Restrictions:** Students will receive no credit for CIV ENG 119 after completing CIV ENG 119. A deficient grade in CIV ENG 119 may be removed by taking CIV ENG 119.

### Hours & Format

**Fall and/or spring:** 15 weeks - 3 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. Alternative to final exam.

**Instructor:** Ivey

## CIV ENG 120 Structural Engineering 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Introduction to design and analysis of structural systems. Loads and load placement. Proportioning of structural members in steel, reinforced concrete, and timber. Structural analysis theory. Hand and computer analysis methods, validation of results from computer analysis. Applications, including bridges, building frames, and long-span cable structures.

### 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

## CIV ENG 122 Design of Steel Structures 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

A first course in steel design focusing on basic principles. 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. Includes laboratory sessions to illustrate member behavior. By the end of the course students should be able to design simple steel structures subjected to static gravity and lateral loads. Design teams will conceive, determine design loads, and conduct a preliminary and final design of a structural system and its foundation. Teams will prepare a report containing project description, design criteria, structural drawings, and supporting calculations.

### Rules & Requirements

**Prerequisites:** CIV ENG 120

**Credit Restrictions:** Students will receive no credit for CIV ENG 122 after completing CIV ENG 122N, or CIV ENG 122. A deficient grade in CIV ENG 122 may be removed by taking CIV ENG 122N, or CIV ENG 122.

### 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:** Becker

## CIV ENG 123 Design of Reinforced Concrete Structures 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Introduction to materials and methods of reinforced concrete design and construction; behavior and design of reinforced concrete beams and one-way slabs considering deflections, moment, shear, and reinforcement development requirements; behavior and design of columns; design of spread footings; design of earthquake-resistant structures; laboratory sessions to illustrate member behavior, to solve problem sets, and to develop and present the preliminary designs for a design project.

### Rules & Requirements

**Prerequisites:** CIV ENG 120

**Credit Restrictions:** Students will receive no credit for CIV ENG 123 after completing CIV ENG 123N, or CIV ENG 123. A deficient grade in CIV ENG 123 may be removed by taking CIV ENG 123N, or CIV ENG 123.

### 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:** Moehle

## CIV ENG 124 Structural Design in Timber 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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.

### 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.

## CIV ENG 126 Engineering Dynamics and Vibrations 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

Introduction to the dynamics of particles, rigid bodies, and deformable solids in civil engineering. Newtonian and Lagrangian formulations.

Vibration of particles and rigid body systems: natural frequencies and mode shapes, free and forced vibration. Vibration of continuous systems: bars, strings, beams. Modeling and numerical simulation methods..

### 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:** Konstantinidis, DeJong

## CIV ENG 132 Applied Structural Mechanics 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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: Spring 2025, Spring 2024, Spring 2023

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

## CIV ENG C138 Flight Vehicle Structures and Aeroelasticity 3 Units

Terms offered: Spring 2025

This course introduces engineering students to the analysis and design of load-bearing components of flight structures, ranging from subsonic aircraft to rockets. Emphasis is placed on the quasi-static and dynamic analysis of structural components which are prevalent in aerospace engineering. Attention is also devoted to a comprehensive design roadmap of flight vehicle structures from the full system- to the individual component-level

### Objectives & Outcomes

**Course Objectives:** 1. Familiarize students with the different load-bearing components and loads encountered in flight vehicles.

2. Sharpen the students' skills in the statics and dynamics of thin-walled structures.

3. Enhance the students' aerospace engineering design skills by leveraging the use of the finite element method as a tool for both global and local analysis.

**Student Learning Outcomes:** Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

(g) A knowledge of contemporary issues.

Ability to apply knowledge of mathematics, science, and engineering.

Ability to design and conduct experiments, as well as to analyze and interpret data

Ability to identify, formulate, and solve engineering problems.

Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Understanding of professional and ethical responsibility.

### Rules & Requirements

**Prerequisites:** CIV ENG C30 / MEC ENG C85, and MEC ENG 104 or CIV ENG 126

### Hours & Format

**Fall and/or spring:** 15 weeks - 3 hours 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. Final exam required.

**Instructor:** Papadopoulos

## 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.

### 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

## CIV ENG 153 Transportation Facility Design 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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.

### 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

## CIV ENG 155 Transportation Systems Engineering 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

Operation, management, control, design, and evaluation of passenger and freight transportation systems. Their economic role. Demand analysis. Overall logistical structure. Performance models and modeling techniques: time-space diagrams, queuing theory, network analysis, and simulation. Design of control strategies for simple systems. Feedback effects. Paradoxes. Transportation impact modeling; noise; air pollution. Multi-criteria evaluation and decision making. Financing and politics.

### 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

## CIV ENG 157 Sustainable Aviation and Infrastructure 3 Units

Terms offered: Spring 2025

The course overviews principles of “green” and “sustainable” aviation and provides analysis methods for evaluating aviation sustainability metrics and measurements. Aircraft operations and airport systems are studied in the context of global warming, aviation noise, local air quality, global emissions, third-party risk, environmental economics and resilience. Models of carbon reduction, and technology and operations alternatives are studied. Future sustainable aviation concepts, such as urban and regional air mobility are introduced and analyzed. Case studies.

### Objectives & Outcomes

**Course Objectives:** To become aware of sustainable aviation development, and its global and local societal importance.

To learn about major concepts of carbon reduction in aviation, including new technologies and operations alternatives.

To be able to think critically about the role of sustainable aviation and infrastructure in society.

To learn how to critically study action plans and policies related to aviation environmental issues, developed by the UN, ICAO, FAA, EPA, IPCC, and local and regional policy-makers.

To develop skills for planning and assessment of the green and sustainable aviation sector's future in the context of real-world developments and practice, equity and justice. To develop analytical skills for quantifying the benefits and disadvantages of electric aircraft and their use.

To learn about sustainable aviation by evaluating case studies and the relationship among aircraft, airspace, airport/vertiport/spaceport facilities and policy.

### Rules & Requirements

**Prerequisites:** ENGIN 7 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.

## CIV ENG 160D Data Science in Aviation 3 Units

Terms offered: Spring 2023

The course will be centered around analyses of a set of aviation data sets and will enable the students to become familiar with data science applications to aviation. Aviation topics to be covered include fundamentals of air traffic control, models of aviation operations, aircraft trajectory prediction and optimization, data sources in aviation, overview of data science methods, role of data science in solving problems in aviation operations such as conflict detection and resolution, traffic flow management, arrivals management and surface operations, airline operations, fuel efficiency, global aviation.

### Rules & Requirements

**Prerequisites:** DATA C8 and CIV ENG 93

### 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.

## CIV ENG 165 Concrete Materials, Construction, and Sustainability 3 Units

Terms offered: Spring 2023, Spring 2021, Spring 2020

Concrete materials: cements, supplementary cementitious materials, water, and admixtures. Sustainability analysis of concrete materials and mixtures. Development of special concretes: self-leveling concrete, high-performance concrete, and mass concrete. Consideration of sustainability of concrete construction methods used for buildings, highways, airfields, bridges, dams and other hydraulic structures. Non-destructive methods. Discussion of long-term durability. Comprehensive group projects.

### 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:** Monteiro

## CIV ENG 166 Construction Engineering 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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.

### Rules & Requirements

**Prerequisites:** Upper division standing; CIV ENG 167 recommended

### 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:** Horvath

## CIV ENG 167 Engineering Project Management 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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.

### Rules & Requirements

**Prerequisites:** CIV ENG 93 (can be taken concurrently)

### 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:** Ibbs, Tommelein



## CIV ENG 170A Infrastructure Sensing and Modeling 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

Introduction to sensing and modeling of infrastructure system; Imagery analysis (point clouds, lidar, structure for motion, satellite); Geophysics (Synthetic-aperture radar analysis, time histories analyses); Sensor systems (distributed fiber optics, wireless sensor network, MEMS, conventional); Structural health monitoring and analysis; Infrastructure network analysis (graph theory, GIS, simulations); entrepreneurship in infrastructure and smart cities industry.

### Rules & Requirements

**Prerequisites:** ENGIN 7, CIV ENG C30, and CIV ENG 93 or equivalents

### 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.

**Instructors:** Soga , Zekkos, Kayen

## CIV ENG 171 Rock Mechanics 3 Units

Terms offered: Spring 2024, Spring 2022, Spring 2020

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.

### Rules & Requirements

**Prerequisites:** CIV ENG 70 or an introductory course in physical geology; and upper division standing in engineering

### 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:** Glaser

## CIV ENG C172 Remote Sensing of the Environment 4 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020

The course will introduce junior/senior undergraduate students to the basic physical concepts of remote sensing as they relate to different earth surface processes. It will introduce students to a variety of recently developed ground, airborne, and satellite instruments and their applications to monitor and analyze environmental processes. These include active (e.g., Lidar), and passive (radiometers) sensors, optical (e.g., Landsat, MODIS), microwave (e.g., SMAP), and gravitational (e.g., GRACE) satellites.

### Rules & Requirements

**Credit Restrictions:** Students will receive no credit for ESPM C172 after completing CIV ENG 172, or ESPM 172. A deficient grade in ESPM C172 may be removed by taking CIV ENG 172, or ESPM 172.

### 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:** Girotto

**Also listed as:** ESPM C172

## CIV ENG 173 Groundwater and Seepage 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

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

### **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.

#### **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.

### **CIV ENG 175 Geotechnical and Geoenvironmental Engineering 3 Units**

Terms offered: Spring 2025, Spring 2024, Spring 2023

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 geosynthetic materials 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

### **CIV ENG 176 Environmental Geotechnics 3 Units**

Terms offered: Spring 2021, Spring 2016, Spring 2015

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.

**Instructor:** Sitar

### **CIV ENG C178 Applied Geophysics 3 Units**

Terms offered: Fall 2024, Fall 2022, Fall 2021

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.

#### **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

## CIV ENG 179 Geosystems Engineering Design 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020

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.

### 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

## CIV ENG 180 Life-Cycle Design and Construction 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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.

### 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.

## CIV ENG 186 Design of Internet-of-Things for Smart Cities 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2022

Hands-on engineering design experience for creating cyber-physical systems, or more colloquially, "internet-of-things (IoT) systems" for smart cities. Projects overlay a software layer onto physical infrastructure to produce one integrated system. Student teams will identify a challenge with current urban systems, e.g. mobility, energy & environment, water, waste, health, security, and the built environment. Student teams design and prototype an innovation that addresses this challenge using maker resources, e.g. 3D printing, laser cutters, and open-source electronics. The project will be executing via the "Design Sprint" process, which is popular in agile development and Silicon Valley. Students present projects to industry judges.

### 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. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).

**Instructors:** Moura, Sengupta

## CIV ENG 187 Emerging Technologies for Public Health 3 Units

Terms offered: Not yet offered

In this course, students will learn how to leverage and harness technology for better and more equitable public health outcomes. This entails learning and understanding the business and policy models that can put technology into practice, overcome community-specific barriers to technology uptake, and create outcomes. The course has a case study format with each case covering an important technology advancing public health. The technologies span medical devices, environmental health infrastructure, lifestyle wellness devices, AI, and mental health. Students will become capable of advancing the health of the public by innovating with technology.

### Rules & Requirements

**Prerequisites:** DATA C8 or equivalent; CIV ENG 93 or equivalent; or consent of instructor

**Credit Restrictions:** Students will receive no credit for CIV ENG 187 after completing CIV ENG 190S, or CIV ENG 187. A deficient grade in CIV ENG 187 may be removed by taking CIV ENG 190S, or CIV ENG 187.

### 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 required.

## CIV ENG 188 Carbon Capture and Storage 3 Units

Terms offered: Spring 2025, Spring 2024

Carbon capture and storage and its role in reducing carbon emissions, Fossil fuels and concentrated emissions sources. Chemistry, physics, and engineering principles of pre and post combustion carbon capture technologies. Principles of underground sequestration. Geology of storage zones, physical and chemical properties of pore fluids. Principles of subsurface CO<sub>2</sub> flow. Drilling, wellbore construction, and characterization of deep injection boreholes. Injection and monitoring. Political and socio-economic drivers and constraints for carbon capture and storage.

### Rules & Requirements

**Prerequisites:** Upper division standing or consent of instructor

**Credit Restrictions:** Students will receive no credit for CIV ENG 188 after completing CIV ENG 188. A deficient grade in CIV ENG 188 may be removed by taking CIV ENG 188.

### 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:** Rector

## CIV ENG 190 Special Topics in Civil and Environmental Engineering 1 - 4 Units

Terms offered: Fall 2024, Spring 2024, Fall 2023

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

**Repeat rules:** Course may be repeated for credit without restriction. Students may enroll in multiple sections of this course within the same semester.

### 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:** Variano

## CIV ENG 190S Special Topics in Civil and Environmental Engineering 3 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

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:** CIV ENG 93 (or equivalent) and DATA 8 (or equivalent)

**Repeat rules:** Course may be repeated for credit with instructor consent.

### 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 required.

**Instructor:** Sengupta

## CIV ENG 191 Civil and Environmental Engineering Systems Analysis 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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:** CIV ENG 93 and ENGIN 7

### 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

## 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 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.

## CIV ENG 193 Engineering Risk Analysis 3 Units

Terms offered: Fall 2024, Fall 2023, Spring 2023

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

### 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:** Li

## CIV ENG H194 Honors Undergraduate Research 3 - 4 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

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.

### Hours & Format

**Fall and/or spring:** 15 weeks - 3-4 hours of independent study per week

### Summer:

6 weeks - 7.5-10 hours of independent study per week

8 weeks - 6-7.5 hours of independent study per week

### Additional Details

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

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

## CIV ENG 197 Field Studies in Civil Engineering 1 - 4 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

Supervised experience in off-campus companies or tutoring/mentoring relevant to specific aspects and applications of civil engineering on or off campus. 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 - 1-4 hours of fieldwork per week

### Summer:

6 weeks - 2.5-10 hours of fieldwork per week

8 weeks - 1.5-7.5 hours of fieldwork per week

10 weeks - 1.5-6 hours of fieldwork 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.

## CIV ENG 198 Directed Group Study for Advanced Undergraduates 1 - 4 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

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.

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

### Hours & Format

**Fall and/or spring:** 15 weeks - 1-4 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.

## CIV ENG 199 Supervised Independent Study 1 - 4 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

Supervised independent study.

### 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.