CIVIL & ENVIRONMENTAL ENGINEERING (CEE)

CEE 1130 - Sustainable Engineering of Energy, Water, Soil, and Air Resources (3 Credits)
Crosslisted with ENGRI 1130
Course introduces concepts and tools required for the sustainable management of energy, water, soil, and air resources in our modern society. Semester is organized into four modules, each concentrating on one resource area and including a case study of local or regional significance. Students work in teams to address sustainability problems that arise in the case studies. Each module also includes presentations of technical approaches used in environmental engineering analyses. Project teams will be expected to apply those methods in their case study evaluations and management proposals. Technical approaches include life cycle analysis, mass balance computations, and mathematical modeling of pollutant dynamics in the environment.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Students will be able to describe key scientific, economic, and social issues associated with sustainable management of energy, water, soil, and air resources.
- Students will be able to explain how infrastructure and regulatory systems influence sustainable resource use.
- Students will be able to identify appropriate technical engineering approaches to address management questions, and to apply basic versions of these techniques to specific problems.

Schedule of Classes (https://classes.cornell.edu/)

CEE 1160 - Modern Structures (3 Credits)
Crosslisted with ENGRI 1160
A hands-on introduction to structural engineering, combining classroom demonstrations and presentations with laboratory experience. Students predict hurricane wind forces and design key elements in a high-rise building to resist those forces. Students design a residential wood-deck based on laboratory tests to stretch, compress, shear, split, and bend wooden specimens. Students build brick walls and fail them under simulated hurricane and tornado wind pressures, weld steel bars and pull them apart, and forensically examine the failures. Students use software to analyze and design steel truss bridges, and become proficient at using spreadsheets to perform routine structural calculations and graph the results. Students become familiar with structural concrete by designing, building and testing small-scale reinforced-concrete frames to resist large dynamic forces.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Apply mechanics principles, learn analysis/design process.
- Design, build, test model structures.
- Gain experience with working in teams.

Schedule of Classes (https://classes.cornell.edu/)

CEE 1165 - Climate Change and You, the Engineer (3 Credits)
Crosslisted with ENGRI 1165
Our current students are the first generation that will feel the impacts of climate change, and the last generation that can do anything about it. The dual objectives of this course are to inform young pre-professional engineers of the factual science in the nexus of climate change/fossil fuels/renewable energy, and to inspire them to dive into that nexus now, and to begin to do something about untangling it as engineers in practice. In this nexus are key issues for civil engineers: water quality/quantity, emissions, renewable energy supply and structures, civil infrastructure systems engineering, energy economics, sustainability in megacities.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 2550 - AguaClara: Sustainable Water Supply Project (1-3 Credits)
Last Four Terms Offered: Spring 2022, Fall 2021, Spring 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 3040 - Uncertainty Analysis in Engineering (4 Credits)
Introduction to statistics and data analysis for engineers. Covers probability theory, discrete and continuous random variables, parametric probability distributions commonly used in engineering practice and research, point estimation, sampling distributions, confidence intervals, hypothesis testing, simple linear regression, and nonparametric statistics. Empirical examples from engineering problems are highlighted. Textbook: Applied Statistics and Probability of Engineers. Montgomery and Runger, 7th Edition, Wiley. Access to WileyPLUS will be required.
Prerequisites: MATH 1910 and MATH 1920, or equivalents.
Distribution Requirements: (MQL-AG, OPHLS-AG)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Introduce students to the basic framework provided by probability theory for analyzing problems exhibiting variability and uncertainty.
- Introduce students to the basic methods and concepts employed in statistics to estimate the parameters of models, make decisions, and to describe uncertainty.
- Prepare students to be able to use statistical methods with confidence during their professional careers (perhaps after further study).

Schedule of Classes (https://classes.cornell.edu/)

CEE 3080 - Introduction to CADD (1 Credit)
Last Four Terms Offered: Spring 2022, Fall 2021, Spring 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 3090 - Special Topics in Civil and Environmental Engineering (1-6 Credits)
Supervised study by individuals or groups of upper-division students on an undergraduate project or on specialized topics not covered in regular courses.
Exploratory Studies: (CU-CEL, CU-SBY, CU-UG)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 3101 - Introduction to Python for Engineering (1 Credit)
Crosslisted with ENMGT 3101
Python is one the most popular programming languages for machine learning and data science in various engineering fields. This course rapidly introduces students to programming in Python, focusing on practical tools for data analysis, visualization, and scientific computing. We will learn to work with data, create visualizations, and write simple functions and scripts. We will install and use libraries such as NumPy, Matplotlib, and Pandas, and create and manage virtual environments. Basic computer science and software engineering concepts will be introduced, however, the focus of this short course is on learning to use Python as a computational tool for engineering and data analysis problems, and creating a foundation for continued learning.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Install and set up Python and additional computational libraries.
- Be fluent in the use of expressions, variables, functions, conditional statements, and loops.
- Use Python to load, analyze, and visualize data.
- Set up and use virtual environments such as Anaconda to install and manage packages and other tools, for project portability and collaboration.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3102 - Basics of Programming in Python (1 Credit)
Crosslisted with ENMGT 3102
The goal of this course is to provide students with a quick introduction to programming that will allow them to use Python as a problem solving tool for work, research, or study, and present a basis for continued learning of Python and other programming tools.The course focuses on practical tools, including basic programming concepts and methods, introduction to data analysis, visualization, and scientific computing using Python, as well as setting up and managing project environments, libraries, and dependencies. We will work with libraries designed for scientific programming such as NumPy, Matplotlib, and Pandas.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Define a problem and design a program to solve the problem by creating executable codes.
- Be fluent in the use of expressions, variables and functions, conditional statements, loops, sequences, and recursion.
- Understand the concept of object-oriented programming used in Python.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3200 - Engineering Computation (4 Credits)
Crosslisted with ENGRD 3200
Introduction to numerical methods, computational mathematics, and probability and statistics. Development of programming and graphics proficiency with MATLAB and spreadsheets. Topics include Taylor-series approximations, numerical errors, condition numbers, operation counts, convergence, and stability, probability distributions, hypothesis testing. Included are numerical methods for solving engineering problems that entail roots of functions, simultaneous linear equations, statistics, regression, interpolation, numerical differentiation and integration, and solution of ordinary and partial differential equations, including an introduction to finite difference methods. Applications are drawn from different areas of engineering. A group project uses these methods on a realistic engineering problem.
Prerequisites: CS 1110 or CS 1112, and MATH 2930. Prerequisite or corequisite: MATH 2940.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Be familiar with standard numerical methods and statistical procedures for engineering computation and learn to synthesize from different methods in a specific engineering application.
- Learn how to compute, estimate and track errors associated with numerical computations.
- Have a working knowledge of higher-level programming languages widely used in engineering for numerical methods and graphics, in particular, MATLAB.
- Gain experience in teams.
- Learn how to develop sanity tests for one's computational results and how to report them in a clear and objective manner.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3230 - Engineering Economics and Management (3 Credits)
Crosslisted with ENGRG 3230
Introduction to engineering and business economics investment alternatives and to project management. Intended to give students a working knowledge of money management and how to make economic comparisons of alternatives involving future benefits and cost. The impact of inflation, taxation, depreciation, financial planning, economic optimization, project scheduling, and legal and regulatory issues are introduced and applied to economic investment and planning and project-management problems.
Prerequisites: Prerequisite or corequisite: CEE 3040 or ENGRD 2700 or ILRST 2100 or BTRY 3010 or AEM 2100 or by permission of the instructor.
Course Fee: Course Fee, TBA. Students enrolling in this course are required to purchase access to software to have the capacity to turn in assignments during the semester.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Gain a working knowledge of money management and how to make economic comparisons of alternative engineering designs or projects.
- Understand the impact of inflation, taxation, depreciation. Financial planning, economic basis for replacement, project scheduling, and legal and regulatory issues are introduced and applied to economic investment and project-management problems.
- Appreciation of ethical and other non-economic issues related to professional and personal financial and economic decisions.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3310 - Fluid Mechanics (4 Credits)
Covers hydrostatics, the basic equations of incompressible fluid flow, potential flow and dynamic pressure forces, viscous flow and shear forces, steady pipe flow, turbulence, dimensional analysis, laminar and turbulence boundary layer, flows around obstacles, and open-channel flow. Includes small-group laboratory assignments.
Prerequisites: MATH 2930, or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Develop an analytic foundation and physical/experiential sense in fluid statics and fluid dynamics.
- Develop general skills in dimensional analysis.
- Expand on students' abilities to identify and analytically state and solve engineering problems.
- Expand on students' abilities to use engineering judgment to assess the correctness of a solution approach and solutions.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3410 - Introduction to Geotechnical Engineering (4 Credits)
This course covers the fundamentals of geotechnical engineering and deals with soil as an engineering material in civil and environmental applications. Topics include origins and descriptions of soil and rock, principles of effective stresses, stress distribution and ground settlements from surface loads, steady-state and time-dependent subsurface fluid flow, soil strength and failure criteria, earthwork construction and quality control, introduction to lateral earth pressures, and geotechnical exploration.
Prerequisites: ENGRD 2020 or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Develop a practical overview of soil mechanics and geotechnical engineering, and the application of important principles to civil infrastructure.
- Develop analytical skills in dealing with soil as a medium for water flow, structural support, and a primary building material.
- Gain direct experience with soil properties via laboratory testing and case studies to make justify decisions about the engineering significance of these properties.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3510 - Environmental Quality Engineering (3 Credits)
Introduction to engineering aspects of environmental quality control. Quality parameters, criteria, and standards for water and wastewater. Elementary analysis pertaining to the modeling of pollutant reactions in natural systems, and introduction to design of unit processes for wastewater treatment.
Prerequisites: MATH 2930 and ENGRD 2510.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Students learn how the kinetics and equilibria of chemical and biologically mediated reactions coupled with an understanding of physical transport processes relate to the formulation of models that predict contaminant fate in aquatic systems as well as the effect of contaminants on those systems.
- Students also learn how the kinetics and equilibria of chemical and biologically mediated reactions coupled with an understanding of physical transport processes result in the formulation of models that allow rational design of wastewater treatment systems.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3610 - Introduction to Transportation Engineering (3 Credits)
Introduces technological, economic, and social aspects of transportation. Emphasizes design and functioning of transportation systems and their components. Covers supply-demand interactions; system planning, design, and management; traffic flow, intersection control and network analysis; institutional and energy issues; and environmental impacts.
Prerequisites: MATH 1920.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Develop understanding of analytical models used for traffic flow, intersection delay, transit line operations, and urban transportation planning.
- Develop understanding of how engineering and economic criteria interact to guide decisions regarding system design and operation.
- Increase awareness of transportation's role with respect to energy usage, environmental quality, and the economy.
- Develop understanding of how transportation systems are financed, the role of public policy, and potential alternative financing methods.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3710 - Structural Modeling and Behavior (4 Credits)
Introduction to the structural engineering enterprise including aspects of design, loads, behavior, form, modeling, mechanics, materials, analysis, and construction/ manufacturing. Case studies involve different scales and various materials. Topics include analytical and finite-element computational modeling of structural systems, including cables, arches, trusses, beams, frames, and 2-D continua; deflections, strains, and stresses of structural members, systems, and 2-D continua by analytical and work/energy methods, with a focus on linear elastic behavior; the foundations of matrix structural analysis; and the application of finite-element software.
Prerequisites: ENGRD 2020 with a grade of C or higher. Corequisite: MATH 2940.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Understand the structural engineering enterprise, the structural modeling process, and the elements of structural behavior.
- Calculate displacements and stresses of structures by analytical and work/energy methods.
- Perform analysis of statically indeterminate structures by the stiffness and flexibility methods.
- Apply the stiffness method of analysis to statically indeterminate truss and beam/column structures via finite element computer programs.

Schedule of Classes (https://classes.cornell.edu/)

CEE 3790 - Introduction to Building Information Modeling (BIM) using Revit (2 Credits)
The purpose of this course is to provide a general knowledge of the use of Revit to document and model all of the major architectural elements of a commercial project. You will learn the design and detailing aspects of commercial buildings including floor plans, interior and exterior elevations, wall and building sections, schedules, and construction drawing set. Lab assignments will be created utilizing Revit (latest version).
Enrollment Information: Priority given to: CEE structual mechanics M.Eng students.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022
Learning Outcomes:

- Students will have a basic knowledge of considerations involved in the preliminary design of small commercial buildings.
- Students will be able to use the college's architectural BIM system to create a three-dimensional building model.
- Students will be able to use the college's architectural BIM system to create construction drawings for a commercial building, including architectural floor plans, reflected ceiling plans, sections, and elevations. Graduate students will be able to use the college's architectural BIM system to create structural framing plans.
- Students will be able to develop an architectural design and create a set of construction documents for a small commercial building, included in the set are architectural floor plans, reflected ceiling plans, sections, and elevations. Graduate students will be required to create foundation and structural framing plans.
- Students will be able to present the proposed design to the class, with oral explanations.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4000 - Senior Honors Thesis (1-4 Credits)
Supervised research, study, and/or project work resulting in a written report or honors thesis.
Enrollment Information: Enrollment limited to: students admitted to CEE Honors Program.
Exploratory Studies: (CU-UG)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 4010 - Undergraduate Engineering Teaching in CEE (1-3 Credits)
Methods of instruction developed through discussions with faculty and by assisting with the instruction of undergraduates under the supervision of faculty.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 4089 - Special Projects for Summer Research (1-6 Credits)
Last Four Terms Offered: Summer 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 4090 - CEE Undergraduate Research (1-4 Credits)
Research in any area of civil or environmental engineering on problems under investigation by the department or of special interest to the student, provided that adequate facilities can be obtained. The student must review pertinent literature, prepare a project outline, carry out an approved plan, and submit a formal final report.
Prerequisites: adequate training for work proposed.
Enrollment Information: Enrollment limited to: juniors and seniors.
Exploratory Studies: (CU-UG)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 4200 - Managing Water Resources in a Changing World (3 Credits)
The field of water resources management is an exciting showcase of the many challenges that await civil and environmental engineers. On one hand, increasing water demand from the urban, energy, and agricultural sectors are aggravating multi-sector conflicts. On the other hand, several drivers of change, such as global warming or socio-economic development, make future water demand and availability deeply uncertain. How can we reconcile these challenges? How can we plan and manage water resources systems in an integrated, sustainable, and just way? Building on the legacy of research in water resources systems, this course is designed to equip the new generation of professionals with the forma mentis and mathematical modelling tools that are needed to discover and negotiate the highly uncertain tradeoffs we face in balancing the water resources demands of the future.
Prerequisites: CS 1110 or CS 1112 and CEE 3040 or ENGRD 2700.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024
Learning Outcomes:

- Identify the actors and decision-makers of a water management problem.
- Describe the main components of a water system through mathematical models.
- Develop and evaluate optimization-based models for the planning and management of river basins.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4210 - Renewable Energy Systems (3 Credits)
The goal of this course is to survey renewable energy technologies and systems, primarily focusing on solar and wind as physically the largest renewable energy sources available to society, and considering hydropower, biomass, and geothermal energy as well. The course explains calculations to support capacity, efficiency, and productivity of renewable energy. Cost and economics of renewables are explored as well, along with the connection to U.S. and global climate and energy policy. Homework assignments completed during the semester culminate in a renewable energy system design project.
Prerequisites: BEE 3310, CEE 3310, CHEME 3230, or by permission of the instructor.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 4215 - Stochastic Modeling of Complex Systems (3 Credits)
The theory of stochastic processes is introduced through examples of complex systems from the natural and applied sciences, with an emphasis on applications rather than mathematical abstraction. Students will learn how to model dynamical systems with intrinsic and extrinsic noise sources, simulate their dynamics, and explore how the interplay between stochasticity and nonlinear dynamics can impact their behavior. Topics covered include generating processes for heavy-tailed distributions, diffusion processes (gaussian white noise), jump processes (white shot noise, birth/death processes, dichotomous Markov noise), stochastic hybrid systems, stochastic differential equations, first passage times, and noise-induced transitions. Analytical tools developed in the class include stochastic differential equations, the differential Chapman-Kolmogorov equation and its derivatives (Fokker-Planck and master equation), the use of transforms to solve master and Fokker-Planck equations, and the system size expansion to approximate solutions to master equations with nonlinear transition rates. Applications include examples from biophysics, climate, environmental sciences, and various areas of biology including systems, synthetic, molecular, and cellular biology.
Prerequisites: MATH 2930 or MATH 3230.
Last Four Terms Offered: Fall 2024, Fall 2022
Learning Outcomes:

- Identify the sources of stochasticity in a variety of processes in the applied and natural sciences.
- Model complex stochastic processes using different types of stochastic processes including random walks, Levy flights and hybrid stochastic processes.
- Determine and analyze the equation(s) describing the temporal evolution of probabilities and probability densities in continuous-state and discrete-state stochastic processes.
- Analyze the stationary probability distribution of a stochastic process (if it exists) and the temporal evolution of moments and cumulants.
- Understand the relationship between the Langevin and Fokker-Planck equations, and how to derive approximations to the solution of master equations with nonlinear transition rates via the system size expansion.
- Identify the fundamental processes that lead to noise-induced transitions and heavy-tailed distributions.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4330 - Physical Hydrology in the Built and Natural Environments (3 Credits)
Understanding of the physical processes of the movement of water on Earth is essential to water resource management, natural hazard assessment and mitigation. This course covers the fundamental principles governing the pathway of water in the global hydrologic cycle and emphasizes the applications of physical hydrology in both the natural and built systems. Topics include but not limited to: fluid mechanics of the lower atmosphere, free surface and subsurface flows, and groundwater outflows. These concepts will be applied to both the natural environment and systems that are responding to human modification of the water cycle due to urbanization, climate change, the construction of reservoirs, and groundwater extraction. Grades are based on individual and group assignments and a final project.
Prerequisites: ENGRD 3200 and CEE 3310.
Last Four Terms Offered: Spring 2024, Spring 2023, Spring 2022, Spring 2021
Learning Outcomes:

- Gain an understanding of the key physical processes involved in the hydrologic cycle.
- Apply the fundamental understanding to solve problems in the context of both natural and built systems.
- Provide opportunities for students to revisit and apply relevant analytical and numerical methods to solve problems pertaining to physical hydrology.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4350 - Coastal Engineering (3 Credits)
Covers the following topics: review of hydrodynamics, small-amplitude wave theory, wave statistics, wave-structure interactions, and coastal processes.
Prerequisites: CEE 3310.
Last Four Terms Offered: Spring 2025, Fall 2022, Spring 2018, Spring 2014
Learning Outcomes:

- Understand fundamental issues in coastal engineering.
- Gain laboratory experience.
- Gain experience in team design project.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4370 - Experimental Methods in Fluid Dynamics (4 Credits)
Introduction to experimental techniques, data collection, and data analysis, in particular as they pertain to fluid flows. Introduces theory and use of analog transducers, acoustic Doppler velocimetry (ADV), full-field (2-D) quantitative imaging techniques such as particle image velocimetry (PIV) and laser induced fluorescence (LIF). Additional topics include computer-based experimental control, analog and digital data acquisition, discrete sampling theory, digital signal processing, and uncertainty analysis. The canonical flows of the turbulent flat plate boundary layer and the neutrally buoyant turbulent round jet are introduced theoretically and the subject of three major laboratory experiments using ADV, PIV and LIF. In CEE 6370/MAE6270 There is a final group project on a flow of the students choosing.
Prerequisites: Prerequisite or corequisite: CEE 3310 or BEE 3310, CEE 3040 or ENGRD 2700, and ENGRD 3200.
Last Four Terms Offered: Spring 2024, Fall 2021, Spring 2020, Spring 2017
Schedule of Classes (https://classes.cornell.edu/)

CEE 4510 - Microbiology for Environmental Engineering (3 Credits)
Introduction to the fundamental aspects of microbiology and biochemistry that are pertinent to environmental engineering and science. Provides an overview of the characteristics of Bacteria, Archaea, unicellular Eukaryotes (protozoa, algae, fungi), and viruses. Includes discussions of cell structure, bioenergetics and metabolism, and microbial genetics. Focus is then applied to topics pertinent to environmental engineering: pathogens; disease and immunity; environmental influences on microorganisms; roles of microbes in the carbon, nitrogen, and sulfur cycles; enzymes; bioremediation, bioenergy, molecular microbiology; and microbial ecology.
Prerequisites: CHEM 2090 and CHEM 1570, or permission of instructor.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Recognize, name and predict important properties of key classes of organic compounds pertinent to both environmental contamination and biomolecules.
- Comprehend the organization and behavior of different types of microbial cells.
- Understand the diversity of microbial physiological and biochemical reactions.
- Describe key features of the informational macromolecules (DNA,RNA, and protein) and modern techniques for analyzing them in environmentally-relevant contexts.
- Make quantitative estimates of the impact of microbes on natural and engineered processes.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4520 - Sustainable Recovery of Critical Metals and Advanced Material Conversions (3 Credits)
The course is motivated by the need to educate students in the fundamental science and emerging technologies for recovering critical metals and in advanced material conversions for a sustainable climate, energy, and environmental future. The course will introduce fundamental chemical pathways for recovering energy critical metals from various substrates including natural and urban ores. The ubiquity of metals in daily products motivate the development of sustainable approaches to recover metals via urban mining, which will be discussed in this course. The course will also introduce advanced material conversions for the energy transition including emerging electrochemical and photochemical pathways to upcycle low value emissions into high value products.
Prerequisites: CEE 3510 or equivalent and CEE 4210.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2023
Learning Outcomes:

- Analyze sustainable pathways to recover critical metals and convert low value emissions into higher value resources.
- Evaluate energy- and material-efficient pathways for upcycling materials.
- Co-create natural and urban mining solutions and advanced material conversions in teams.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4530 - Laboratory Research in Environmental Engineering (3 Credits)
Laboratory investigations of reactor flow characteristics; acid rain/lake chemistry; contaminated soil-site assessment and remediation; and wastewater treatment.
Prerequisites: CEE 3510.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Explore current environmental issues through laboratory experiments and computational simulations that provide a hands-on context for teaching fundamental theories and analytical techniques.
- Develop problem-solving and laboratory skills using modern instrumentation and computational simulation models.
- Become familiar with the limitations of real-world laboratory data.
- Develop ability to work effectively in teams.
- Effectively deliver results in written reports.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4535 - Water Chemistry for Environmental Engineering (3 Credits)
This course covers chemical principles relevant to the understanding, design, and control of chemical processes in natural and engineered systems. Topics include chemical thermodynamics, acid-base equilibria, mineral precipitation/dissolution, trace element speciation, redox reactions, and reactions at the solid-solution interface. This course focuses on the mathematical description of chemical equilibria and the development of numerical, graphical, and computational solutions to these problems. Students will learn to use chemical equilibrium modeling software to describe and predict chemical speciation in complex waters. Applications of aquatic chemical principles to topics including lead in drinking water systems, arsenic mobility in agricultural soils, and geologic CO_2 sequestration are discussed.
Prerequisites: CHEM 2090 or equivalent for undergraduates.
Last Four Terms Offered: Fall 2024, Fall 2023
Learning Outcomes:

- Formulate systems of equations to describe aquatic chemical systems using engineering and chemistry principles including mass balance and chemical equilibrium concepts.
- Quantify chemical parameters in aquatic systems using numerical, graphical, and computational solution methods.
- Implement chemical equilibrium modeling of complex aquatic systems using Visual Minteq software.
- Communicate applications of chemical equilibrium modeling techniques to real-world aquatic systems in writing and through graphical representations.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4560 - Physical and Chemical Process (3 Credits)
This course focuses on the theoretical and engineering aspects of physical and chemical phenomena and processes applicable to the removal of impurities from water, wastewater, and industrial wastes. The first unit covers general chemical engineering principles relevant in environmental processes including mass balances, reactor models, and reaction kinetics. The second unit covers chemical processes involving dissolved species including gas transfer, adsorption, and oxidation-reduction processes. The third unit covers particle processes and the conventional theories behind particle destabilization, particle flocculation, and particle removal processes. Each topic area has a corresponding problem set that provides students with opportunities to apply the fundamentals discussed in class. The fundamental theory is coupled with a number of real-world examples that provide context for the more abstract principles that are introduced
Prerequisites: CEE 3510.
Last Four Terms Offered: Fall 2024, Fall 2023
Learning Outcomes:

- Recognize critical water quality regulations.
- Recognize the advantages/disadvantages of conventional and advanced options for removal of dissolved and particulate contaminants.
- Formulate a qualitative understanding of the fundamental theory upon which individual treatment process design is based.
- Master the quantitative skills necessary to model and design individual processes and integrated wastewater and drinking water treatment systems.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4565 - Waste Water Processes and Resources Recovery (3 Credits)
Given the current state of the energy crisis and climate changes impacts, innovative approaches are needed in order to remediate, reduce and recover the energy and nutrient resources through various waste streams and to provide creative energy solutions that lead to self-sustaining wastewater treatment facilities. This course will cover fundamental theory of each unit operation process and design principles of major water and wastewater treatment processes. The topics will cover wastewater characteristics and evaluation methods, design flow and loads statistical analysis, process selection rationale, primary treatment processes, secondary treatment processes and tertiary and advanced treatment processes, and effluent and solids processing and disposal. In addition to the fundamentals of conventional wastewater processes, the course will also include the discussions on the emerging issues in water sustainability and advances in fundamental science and technology in integrating scientific principles, engineered processes, and systems analyses to address diverse challenges related to society's growing water needs and their nexus with energy and the environment. The course is designed to stimulate multi-disciplinary thinking and research among traditional areas of civil and environmental engineering, biology, chemistry, modeling, data science and others. Special projects will be designed to have students working in multi-disciplinary teams to develop sustainable solutions to meet the present and future water and resources needs of the society.
Prerequisites: CEE 3510.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Fall 2022, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 4570 - Environmental Biological Processes (3 Credits)
Principles and application of microbiology and biotechnology with emphasis on biological processes in environmental engineering applications. Theoretical and engineering aspects of biological phenomena and processes applicable to the removal of impurities from water, wastewater, and industrial wastes and to their transformation in the environment. Microbiology fundamentals, bioenergetics analysis, stoichiometry, biokinetics, and design of biological treatment processes for pollutants removal, bioremediation and resources recovery. Topics include cell metabolism, cell nutrition and growth, energy transfer and utilization, aerobic and anaerobic microbial metabolism, biological wastewater process theory and modeling, biological nutrients removal, bioremediation and resources recovery.
Prerequisites: CEE 3510 or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023
Learning Outcomes:

- Apply the biochemical and microbial principles for CEE-relevant environmental biological processes design.
- Analyze stoichiometry, bioenergetics involved in environmental biological processes.
- Design complex biological processes for targeted outcome and goals.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4590 - Sustainable Environmental Technology for Remediation and Resources Recovery (3 Credits)
Course considers sustainable technologies for environmental remediation, treatment, and resources and energy recovery. It will include municipal water treatment methods that are also applicable to remediation of municipal water, groundwater, storm water, industrial and agricultural wastewater and other water sources, as well as green technologies for storm water management and reuse, sustainable and low carbon energy and resource conversions, and other technologies relevant to environmental processes. Student teams create a design for a selected technology that solves a problem and meets the regulatory requirements for a client. The capstone design projects are provided by the instructor or by industrial partners and may vary depending on the instructor. Design teams are advised by a faculty member and engineering practitioners. Integrates project design with further development of student communications skills; students present the design to practicing engineers and interested parties such as community groups.
Prerequisites: Prerequisite or corequisite: for Environmental Engineering students, CEE 4565.
Last Four Terms Offered: Spring 2023, Spring 2020
Learning Outcomes:

- Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- Ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- Ability to communicate effectively with a range of audiences.
- Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- Ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4620 - Analysis and Control of Transportation Systems and Networks (3 Credits)
This course will cover the development and application of mathematical models and optimization techniques for the analysis and control of transportation systems and networks, with a focus on urban mobility. We will cover topics related to network routing, dynamic traffic models, static and dynamic traffic assignment, traffic control mechanisms and mobility-on-demand systems (including their connections to mass transit). Students will be expected to implement the algorithms covered in class during homework assignments and complete a final project.
Prerequisites: MATH 2940, CS 1110 or CS 1112, and CEE 4665 or ORIE 3300.
Last Four Terms Offered: Spring 2025, Fall 2022, Fall 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 4640 - Sustainable Transportation Systems Design (3 Credits)
Senior-level design course in transportation, with a focus on design of sustainable transportation systems. The perspective in the course is one of system design, i.e., understanding the process of creating objectives, developing alternative designs and having models capable of representing the interactions among major elements of the overall system. We will also adopt a sustainable development or triple bottom line perspective, taking into account ecological and social as well as economic dimensions of transportation systems design. From this perspective, efficient transportation function achieves the economic objective, while quantifying and minimizing negative impacts addresses ecological and social goals. The interactions among the major system elements (vehicles, infrastructure, people, freight) occurs on networks, and we need to focus on how networks function. We will also study how resources are allocated and how capacity is maintained in networks. Systems design is examined from both a public sector perspective and from a private sector perspective.
Prerequisites: CEE 3040 or ENGRD 2700, and CEE 3610, or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Develop the student's ability to apply knowledge of mathematics, science and basic transportation engineering in a design context.
- Design transportation systems to meet desired objectives.
- Develop the students' ability to see their solutions in a social context.
- Understand current issues related to design of effective transportation systems.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4665 - Modeling and Optimization for Smart Infrastructure Systems (3 Credits)
Course provide students with a set of quantitative tools for systematic decision making in the context of civil infrastructure systems. The goal is to enable students to develop models and solution strategies based on a systems perspective, which is necessary for intelligent planning and management of largescale infrastructure systems. A major focus of the course will be to motivate the study of quantitative tools that are used for planning and managing these systems via application oriented programming assignments.
Prerequisites: MATH 2940 or equivalent, ability to program in Matlab or Python.
Last Four Terms Offered: Fall 2024, Spring 2023, Spring 2022, Spring 2019
Schedule of Classes (https://classes.cornell.edu/)

CEE 4725 - Intermediate Solid Mechanics (4 Credits)
This course introduces students to the mathematical framework that describes the deformation of solids and structures due to the action of mechanical and thermal loads. The course is intended to provide a foundation for better understanding and utilizing popular and novel engineering analysis tools associated with predicting mechanical behavior, e.g. finite element analysis. Focusing on linear elasticity, yield criteria, and basic fracture mechanics, this course emphasizes the development of a mechanical intuition that will enable students to better solve problems and innovate across a broad range of domains, e.g. civil, aerospace, nuclear, biomedical, and mechanical engineering, as well as the physical, geological, and materials sciences.
Prerequisites: MATH 2940, ENGRD 2020 and ENGRD 3200.
Last Four Terms Offered: Fall 2022, Fall 2021, Summer 2020, Fall 2019
Learning Outcomes:

- Demonstrate the ability to utilize common constitutive laws to relate stress to mechanical and thermal strains in three dimensions (and vice versa).
- Demonstrate a fundamental understanding of the mechanical boundary value problem as related to the stress and strain fields that arise in a three dimensional solid.
- Demonstrate the ability to utilize basic continuum mechanics and computing resources to analyze real-world problems in mechanics.
- Demonstrate the ability to utilize common yield surfaces (and fracture criteria) to qualitatively assess mechanical response in three dimensions.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4730 - Design of Concrete Structures (4 Credits)
Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019
Schedule of Classes (https://classes.cornell.edu/)

CEE 4740 - Introduction to the Behavior of Metal Structures (4 Credits)
Introductory course focused on the use of solid and structural mechanics to quantify elementary behavior of metal structures in order to enable design. The course is project focused; with the students preparing a complete and detailed design deliverable. The course considers applications from civil structures, naval architecture, and aerospace engineering.
Prerequisites: CEE 3710.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Understanding of steel as a material; its limitations, strengths, and applications.
- Understanding of the variability of environmental loading and uncertainty in strength prediction.
- Understanding the use and origin of standard building codes and specifications.
- Understand the notion of instability and recognize its unique importance to metal structures.
- Execute a real world design within the context of a semester long design project.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4745 - Sustainability and Automation: The Future of Construction Industry (3 Credits)
The construction industry is currently facing many challenges with respect to shortage of skilled workers, greenhouse gas emissions, and use of non-sustainable construction materials with high embodied carbon. Robotic construction enables efficient use of materials, reduction of waste generated and the ability to fabricate complex, multi-scale structures. In this course students will learn the principles of designing new structural elements with reduced embodied carbon. The course will introduce sustainable construction materials and the challenges associated with material variability and quality on building design. Students will learn the differences between standard construction techniques and advances enabled through automation. Students will reimagine and design complex, yet efficient member shapes and connections. They will evaluate the performance of these newly designed members using structural modeling and laboratory techniques.
Enrollment Information: Recommended prerequisite: CEE 3710.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022
Learning Outcomes:

- Analyze 3D printed structural elements using modeling software and evaluate their performance in the lab.
- Identify sources of embodied carbon in structures and introduce ways to reduce them.
- Learn to control a robot and use the robot to perform tasks.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4750 - Concrete Materials and Construction (3 Credits)
Last Four Terms Offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 4760 - Behavior and Design of Concrete and Masonry Structures (4 Credits)
This introductory course will discuss concrete and masonry as materials of construction and their incorporation into structural components and systems. The course will focus on fundamental behavior of reinforced concrete and masonry members and systems and explore how they are analyzed and designed. The course will cover their behavior under in-plane and out plane loading, their performance under environmental conditions, and other topics. The course is project focused with the students preparing a complete and detailed design deliverable.
Prerequisites: CEE 3710 or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023
Learning Outcomes:

- Recognize concrete and masonry as structural materials; their limitations, strengths, and applications.
- Apply engineering principles to the behavior and analysis of concrete and masonry.
- Recognize the variability of environmental loading and uncertainty in strength prediction.
- Recognize the limit states of concrete and masonry and their impact on performance of structures in service conditions.
- Demonstrate the application of structural engineering design within the context of a semester long design project.
- Explore concrete masonry and their applications on Cornell's Ithaca campus.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4770 - Natural Hazards, Reliability, and Insurance (3 Credits)
Last Four Terms Offered: Fall 2023, Fall 2022, Fall 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 4780 - Structural Dynamics and Earthquake Engineering (3 Credits)
Covers modal analysis, numerical methods, and frequency-domain analysis. Introduction to earthquake-resistant design.
Prerequisites: Prerequisite or corequisite: MATH 2940.
Enrollment Information: Enrollment limited to: juniors or seniors.
Last Four Terms Offered: Spring 2024, Spring 2023, Spring 2021, Spring 2020
Learning Outcomes:

- Understand the behavior of structures subjected to dynamic loads.
- Know how to calculate displacement time histories.
- Capable of calculating seismic response of multi degree-of-freedom structures subjected to earthquakes.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4795 - Sensors for the Built and Natural Environments (3 Credits)
Sensors are the link between the physical world and engineering decision making. This course introduces students to a wide variety of sensors with a specific focus on civil and environmental engineering applications such as material testing, structural health monitoring, traffic engineering, air and water quality monitoring, structural testing, watershed engineering, and geotechnical and subsurface energy applications. This course is intended to teach students how to implement sensors to measure physical quantities, conduct experiments, and develop monitoring tools for the natural environment and our engineered systems. Course topics include general introduction to different classes of sensors, data acquisition, signals, noise, system calibration, and uncertainty.
Prerequisites: CEE 3200.
Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2022, Spring 2021
Learning Outcomes:

- Use information theory to design an optimal data acquisition procedure.
- Calibrate or characterize the sensor/acquisition process with respect to underlying physical quantities, and quantify uncertainty associated with those measurements.
- Design and assemble a sensing system for a specific measuring/monitoring application

Schedule of Classes (https://classes.cornell.edu/)

CEE 4800 - Engineering Smart Cities (3 Credits)
This course prepares students to tackle the technical challenges to designing and operating smart and dynamic infrastructure systems. In particular, students will learn to combine data and models to control overall system performance in the face of uncertainty. The class will focus on smart city infrastructure systems that are self-aware, with continual surveillance of the built and natural environment and an autonomous capacity to control resource allocation. This course will build upon fundamental engineering principles (for systems such as transportation, energy, and water resources) and teach students to employ emerging sensor technologies, accompanying data analytics, resource demand forecasting, and model predictive control theory. Students will learn to couple engineering models of infrastructure with data-driven probabilistic models of resource demand and the approaches to control these integrated hybrid systems for optimal and equitable resource allocation with improved resilience to exogenous disturbances. Finally, the class will explore cases studies in urban flooding, energy supply, transportation and air quality, and water supply.
Prerequisites: MATH 2940.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Apply data-driven models to forecast resource demand for infrastructure applications.
- Apply model predictive control principles to smart infrastructure systems.
- Critically evaluate the security, overall performance, and equity of resource allocation for smart infrastructure systems.

Schedule of Classes (https://classes.cornell.edu/)

CEE 4880 - Applied Modeling and Simulation for Renewable Energy Systems (3 Credits)
Crosslisted with BEE 4880
This course will provide an applied introduction to modeling, simulation and optimization techniques for various renewable energy systems. The course will be modular in nature. Each module will focus on a particular renewable energy application and relevant modeling/simulation tools. Some modules are independent and some will build on previous modules. The instructional format of the course will include lectures, scientific paper reviews, and some AMPL programming. Students will have an opportunity to apply new techniques to a relevant modeling project. The course will culminate with a modeling project relevant to renewable energy. Undergraduates will work in teams of 2-3 students to complete the term project.
Enrollment Information: Enrollment limited to: seniors in Engineering, or permission of instructor.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 4930 - Data Analytics (4 Credits)
Big data is transforming organizations enabling vast improvements in operating efficiency, market identification and segmentation, and many other domains. This course focuses on data collection at all scales, the transformation of that data into knowledge using a variety of data analytic techniques, and the integration of that knowledge into system models for decision-making to better manage organizations. Expertise in R will be developed throughout this course.
Prerequisites: CEE 3230 and CEE 3040, or equivalent.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Develop an ability to manage, analyze, and interpret data.
- Improve the students' ability to identify, formulate, and solve engineering management problems.
- Develop the skills and techniques necessary to become an effective problem solver.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5022 - Project in Environmental and Water Resources Systems (3 Credits)
Project-based course in the area of environmental and water resources under the guidance of a faculty member.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5025 - Civil and Environmental Engineering Seminar for First-Year Research Students (1 Credit)
We will invite our CEE faculty to host presentations related to topics they feel open to discussing. Examples may include: how to have a successful PhD and pitfalls to avoid, the academic and industry job markets, academic writing and presenting, how to select research topics, topics currently popular in research and who certain key players / universities / companies are, grants fellowships and scholarships, postdocs, effective teaching, the differences between being an academic in different types of schools and departments, work-life balance, etc. The seminar will be very interactive, with students asking questions, internal discussions between student and faculty/non-student seminar participants, the students giving presentations, and other student-driven activities that will be interactively defined as the semester evolves.
Enrollment Information: Enrollment limited to: PhD students.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Learning Outcomes:

- Introduce research graduate students to campus resources that will serve them throughout their degree program, the culture of their home-department, and the greater University.
- Contextualize of research concentrations and faculty affiliations with the field of Civil and Environmental Engineering.
- Demonstrate competence in proactive leadership communication skills.
- Provide tools and support to students that will help conduct sustainable research progress within the PhD program. These tools will hopefully be application to care.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5031 - Project in Environmental Fluid Mechanics and Hydrology (3 Credits)
Project-based course in the area of environmental fluid mechanics and hydrology under the guidance of a faculty member.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 5032 - Project in Environmental Fluid Mechanics and Hydrology (3 Credits)
Project-based course in the area of environmental fluid mechanics and hydrology under the guidance of a faculty member.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5041 - Project in Geotechnical Engineering (3 Credits)
Design of major geotechnical engineering project. Planning and preliminary design during fall semester; final design completed in January intersession.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 5042 - Project in Geotechnical Engineering (3 Credits)
Design of major geotechnical engineering project. Planning and preliminary design during fall semester; final design completed in January intersession.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5050 - Interdisciplinary Master of Engineering Project (1-6 Credits)
Crosslisted with ENMGT 5050
Students will participate in a community-engaged, interdisciplinary Master of Engineering (M.Eng.) project to tackle pressing technological and societal challenges surrounding infrastructure, with a specific focus on energy and environmental systems. For example, in 2018/19, projects were focused on Puerto Rico post Hurricane Maria. As part of this course, you will work closely with local stakeholders to hear their perspective on prior challenges and future needs. Each subsequent year will then build upon the prior year's activity to tackle large, complex issues over multiple years. During the course, you will contribute to developing a library of monitoring tools and algorithms which will persist over time and then be applied to solve new challenges with each course iteration.
Enrollment Information: Enrollment limited to: M.Eng. students.
Exploratory Studies: (CU-CEL)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 5051 - Project in Environmental Engineering (3 Credits)
Design project related to Environmental Engineering.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 5052 - Project in Environmental Engineering (3 Credits)
Continuation of design project related to Environmental Engineering.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5061 - Project in Transportation Engineering (3 Credits)
Systems analysis of a substantial transportation service.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 5062 - Project in Transportation Engineering (3 Credits)
Systems analysis of a substantial transportation service.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5071 - Professional Experience in Structural Engineering (3 Credits)
A comprehensive professional experience, involving: a real-world problem, an industry adviser, integrating technical course work, and resulting in a final written report. Representative themes for the practice experience include: forensic engineering studies and failure investigations; design of signature buildings or bridges; structural condition assessment and prognosis studies; etc.
Enrollment Information: Enrollment limited to: Structural Engineering M.Eng. students in good academic standing.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5072 - Professional Experience in Structural Engineering (3 Credits)
A project-centered course focusing on the design of experiments within structural mechanics and materials contexts.
Last Four Terms Offered: Fall 2023, Fall 2022, Fall 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 5101 - Introduction to Python for Engineering (1 Credit)
Crosslisted with ENMGT 5101
Python is one the most popular programming languages for machine learning and data science in various engineering fields. This course rapidly introduces students to programming in Python, focusing on practical tools for data analysis, visualization, and scientific computing. We will learn to work with data, create visualizations, and write simple functions and scripts. We will install and use libraries such as NumPy, Matplotlib, and Pandas, and create and manage virtual environments. Basic computer science and software engineering concepts will be introduced, however, the focus of this short course is on learning to use Python as a computational tool for engineering and data analysis problems, and creating a foundation for continued learning.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Install and set up Python and additional computational libraries.
- Be fluent in the use of expressions, variables, functions, conditional statements, and loops.
- Use Python to load, analyze, and visualize data.
- Set up and use virtual environments such as Anaconda to install and manage packages and other tools, for project portability and collaboration.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5102 - Basics of Programming in Python (1 Credit)
Crosslisted with ENMGT 5102
The goal of this course is to provide students with a quick introduction to programming that will allow them to use Python as a problem solving tool for work, research, or study, and present a basis for continued learning of Python and other programming tools.The course focuses on practical tools, including basic programming concepts and methods, introduction to data analysis, visualization, and scientific computing using Python, as well as setting up and managing project environments, libraries, and dependencies. We will work with libraries designed for scientific programming such as NumPy, Matplotlib, and Pandas.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Define a problem and design a program to solve the problem by creating executable codes.
- Be fluent in the use of expressions, variables and functions, conditional statements, loops, sequences, and recursion.
- Understand the concept of object-oriented programming used in Python.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5200 - Economics of the Energy Transition (3 Credits)
Crosslisted with ENMGT 5200, SYSEN 5210
In response to the risks posed by global climate change, many states and countries have set emissions reductions goals necessitating a rapid transition toward zero-carbon energy resources. Achieving these goals entails unprecedented investment in civil infrastructure systems combined with large-scale consumer and industry adoption of clean energy solutions. This course will explore the economic challenges and opportunities associated with this transition, with an emphasis on the electric power sector. The course is broken into two halves. The first focuses on the economic viability of individual projects. The second develops system level models and considers interactions between competing energy sources.
Prerequisites: CEE 3040 or ENGRD 2700, CEE 3230 or ENMGT 5940.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 5240 - Model Based Systems Engineering (4 Credits)
Crosslisted with SYSEN 5100, ECE 5120, ORIE 5140, MAE 5910
Fundamental ideas of systems engineering, and their application to design and development of various types of engineered systems. Defining system requirements, creating effective project teams, mathematical tools for system analysis and control, testing and evaluation, economic considerations, and the system life cycle.Content utilizes model-based systems engineering, which is the integration of systems modeling tools, such as SysML, with tools for systems analysis, such as Matlab and Modelica. The vision for this integration is the ability to create and analyze complete parametric representations of complex products and systems. These systems make it possible to investigate the impact of changing one aspect of a design on all other aspects of design and performance. This course will familiarize students with these modeling languages. Off-campus students must provide their own Windows 7, internet-connected, computer with administrator access in order to install the commercial software used in this course.
Prerequisites: Prerequisite or corequisite: enrollment in group-based project with strong system design component approved by course instructor.
Enrollment Information: Enrollment limited to: seniors or graduate students in an engineering field.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 5252 - Systems Analysis Behavior and Optimization (3 Credits)
Crosslisted with SYSEN 5200, MAE 5920, ORIE 5142, ECE 5130
This is an advanced course in the application of analytical methodologies and tools to the analysis and optimization of complex systems. On completion of this course, students should be able to use probability and statistics as a modeling and analysis tool for systems exhibiting uncertainty; be able to use algorithms and dynamic programming to model and optimize systems with a recursive structure; be able to use optimization tools to optimize complex systems and tune parameters.
Prerequisites: ENGRD 2700, calculus skills, and familiarity with basic programming in a language such as python, C++, java, matlab, etc.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5420 - Energy Technologies and Subsurface Resources (3 Credits)
This course will discuss the scientific basis for advancing sustainable energy systems including clean fossil and renewable energy resources. Specifically, the course will draw on the fundamentals of thermodynamics, chemical kinetics and transport behavior of fluids at solid interfaces. Students will evaluate the impacts of existing and emerging energy technologies on the environment. In a given week, we will discuss the energy resource of interest and the underlying scientific principles.
Prerequisites: differential equations, inorganic chemistry, environmental fluid dynamics at the undergraduate level.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5510 - Microbiology for Environmental Engineering (3 Credits)
Introduction to the fundamental aspects of microbiology and biochemistry that are pertinent to environmental engineering and science. Provides an overview of the characteristics of Bacteria, Archaea, unicellular Eukaryotes (protozoa, algae, fungi), and viruses. Includes discussions of cell structure, bioenergetics and metabolism, and microbial genetics. Focus is then applied to topics pertinent to environmental engineering: pathogens; disease and immunity; environmental influences on microorganisms; roles of microbes in the carbon, nitrogen, and sulfur cycles; enzymes; bioremediation, bioenergy, molecular microbiology; and microbial ecology.
Prerequisites: CHEM 2090 and CHEM 1570, or permission of instructor.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Recognize, name and predict important properties of key classes of organic compounds pertinent to both environmental contamination and biomolecules.
- Comprehend the organization and behavior of different types of microbial cells.
- Understand the diversity of microbial physiological and biochemical reactions.
- Describe key features of the informational macromolecules (DNA,RNA, and protein) and modern techniques for analyzing them in environmentally-relevant contexts.
- Make quantitative estimates of the impact of microbes on natural and engineered processes.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5610 - Introduction to Transportation Engineering (3 Credits)
Introduces technological, economic, and social aspects of transportation. Emphasizes design and functioning of transportation systems and their components. Covers supply-demand interactions; system planning, design, and management; traffic flow, intersection control and network analysis; institutional and energy issues; and environmental impacts.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Develop understanding of analytical models used for traffic flow, intersection delay, transit line operations, and urban transportation planning.
- Develop understanding of how engineering and economic criteria interact to guide decisions regarding system design and operation.
- Increase awareness of transportation's role with respect to energy usage, environmental quality, and the economy.
- Develop understanding of how transportation systems are financed, the role of public policy, and potential alternative financing methods.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5665 - Modeling and Optimization for Smart Infrastructure Systems (3 Credits)
Course provide students with a set of quantitative tools for systematic decision making in the context of civil infrastructure systems. The goal is to enable students to develop models and solution strategies based on a systems perspective, which is necessary for intelligent planning and management of largescale infrastructure systems. A major focus of the course will be to motivate the study of quantitative tools that are used for planning and managing these systems via application oriented programming assignments.
Prerequisites: MATH 2940 or equivalent, ability to program in Matlab or Python.
Last Four Terms Offered: Fall 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 5700 - Masonry Behavior and Design (3 Credits)
This introductory course in masonry design will discuss the materials of masonry construction and their incorporation into building components and structural systems. The course will focus on behavior and explore how masonry structures are analyzed and designed. The course will cover reinforced and unreinforced masonry, wall behavior under in-plane and out-of-plane lateral loading, masonry performance under environmental conditions, and other topics.
Prerequisites: CEE 3710 or permission of instructor.
Last Four Terms Offered: Fall 2022
Learning Outcomes:

- Understand masonry as a material; its limitations, strengths, and applications.
- Apply engineering principles to understand the behavior and analysis of masonry.
- Understand the limit states and their impact on performance of masonry in service conditions.
- Describe the behavior of material assemblies with respect to differential movement, water permeability, thermal properties, acoustical properties, fire resistance.
- Explore masonry and its application on Cornell's Ithaca campus.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5710 - Timber Behavior and Design (3 Credits)
This introductory course in timber behavior and design will discuss the materials of timber construction and their incorporation into building components and structural systems.
Prerequisites: CEE 3710 or by permission of the instructor.
Enrollment Information: Enrollment limited to: graduate students and CEE seniors, or permission of instructor.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023
Learning Outcomes:

- Understand timber as a material; its limitations, strengths, and applications.
- Apply engineering principles to understand the behavior and analysis of timber structures.
- Understand the limit states and their impact on performance of timber in service conditions.
- Describe the behavior of timber assemblies with respect to its environmental conditions including moisture, differential movement, fire, and varying durations of applied load.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5735 - Mathematical Modeling of Natural and Engineered Systems (3 Credits)
This course builds from previously studied fundamental concepts to uncover strategies for using math to describe natural and engineered systems that impact the human experience (e.g. infrastructure systems, subsurface structures and networks, bacterial colonies, traffic networks, reservoir systems, etc.) Specifically, selected approaches for mechanistic descriptions (clear box models), data-driven descriptions (black box models), and hybrids of these (grey box models) will be covered: both through an introduction to foundational theory and also in computational implementation. In gaining experience in formulating their own mathematical models for real world phenomena, students will be better able to describe, study, and control the performance of natural and engineered systems in their professional lives.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 5740 - Intermediate Behavior of Metal Structures (3 Credits)
Building off the introductory course in the topic which focused on the fundamental behavior of structural members, this class will explore the behavior, interaction, and design of more complex structural systems in metal structures. Analyzing, designing, and detailing the transfer of load through the structures and its components will be the focus. The course will cover composite floor systems and columns, bolted and welded connections, built-up members, trusses, bracing for stability, vibration, and other advanced topics.
Prerequisites: CEE 4740 or permission of instructor.
Last Four Terms Offered: Fall 2022, Fall 2021
Learning Outcomes:

- Understand principles and behaviors of structural systems in metal structures and apply them in design.
- Analyze how loads are transferred through the structural system and identify the most critical components.
- Identify key considerations of constructible, resilient and serviceable structures, and formulate appropriate solutions to address these considerations.
- Demonstrate the application of structural engineering design within the context of a semester long design project.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5745 - Inverse Problems: Theory and Applications (3 Credits)
The course covers foundational theory underpinning the inverse problems that naturally arise when developing technology for society. Through a treatment of theory and application, the course aims to equip students to answer questions such as: what source/forcing/action has caused the system response I am currently observing?; what model parameters best instantiate a predictive model explaining certain noisy/incomplete observations of the subject system?; and how certain am I about any of the foregoing results?
Prerequisites: MATH 2940.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Identify an inverse problem.
- Analyze it from a theoretical point of view.
- Employ deterministic and stochastic methods to solve it.
- Apply solution methods in real-world contexts.
- Critically analyze their resulting solutions.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5746 - Sustainability and Automation: The Future of Construction Industry (3 Credits)
The construction industry is currently facing many challenges with respect to shortage of skilled workers, greenhouse gas emissions, and use of non-sustainable construction materials with high embodied carbon. Robotic construction enables efficient use of materials, reduction of waste generated and the ability to fabricate complex, multi-scale structures. In this course students will learn the principles of designing new structural elements with reduced embodied carbon. The course will introduce sustainable construction materials and the challenges associated with material variability and quality on building design. Students will learn the differences between standard construction techniques and advances enabled through automation. Students will reimagine and design complex, yet efficient member shapes and connections. They will evaluate the performance of these newly designed members using structural modeling and laboratory techniques.
Prerequisites: CEE 3710 and CEE 3080 or graduate standing.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022
Learning Outcomes:

- Analyze 3D printed structural elements using modeling software and evaluate their performance in the lab.
- Identify sources of embodied carbon in structures and introduce ways to reduce them.
- Learn to control a robot and use the robot to perform tasks.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5760 - Behavior and Design of Concrete and Masonry Structures (4 Credits)
This introductory course will discuss concrete and masonry as materials of construction and their incorporation into structural components and systems. The course will focus on fundamental behavior of reinforced concrete and masonry members and systems and explore how they are analyzed and designed. The course will cover their behavior under in-plane and out plane loading, their performance under environmental conditions, and other topics. The course is project focused with the students preparing a complete and detailed design deliverable.
Prerequisites: CEE 3710 or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 5770 - Intermediate Behavior of Concrete and Metal Structures (3 Credits)
Building off the introductory courses in these topics which focused on the fundamental behavior of structural members, this class will explore the behavior, interaction, and limit states of more complex metal and concrete structures. The behavior of concrete and steel structures as systems will be the focus, covering frame behavior, composite floor systems, trusses, stability, vibration, and other advanced topics. The course will conclude with analyzing, designing, and detailing the transfer of load through the structures and its components.
Prerequisites: CEE 4740 or CEE 4760, or permission of instructor.
Last Four Terms Offered: Fall 2024
Learning Outcomes:

- Understand principles of structural system behavior in concrete & metal structures and apply them in analysis & design.
- Analyze how loads are transferred through the structural system and identify the most critical components.
- Identify key considerations of constructible, resilient and serviceable structures, and formulate appropriate solutions to address these considerations.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5790 - Introduction to Building Information Modeling (BIM) using Revit (2 Credits)
The purpose of this course is to provide a general knowledge of the use of Revit to document and model all of the major architectural elements of a commercial project. You will learn the design and detailing aspects of commercial buildings including floor plans, interior and exterior elevations, wall and building sections, schedules, and construction drawing set. Lab assignments will be created utilizing Revit (latest version).
Enrollment Information: Priority given to: CEE structural mechanics M.Eng students.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022
Learning Outcomes:

- Students will have a basic knowledge of considerations involved in the preliminary design of small commercial buildings.
- Students will be able to use the college's architectural BIM system to create a three-dimensional building model.
- Students will be able to use the college's architectural BIM system to create construction drawings for a commercial building, including architectural floor plans, reflected ceiling plans, sections, and elevations. Graduate students will be able to use the college's architectural BIM system to create structural framing plans.
- Students will be able to develop an architectural design and create a set of construction documents for a small commercial building, included in the set are architectural floor plans, reflected ceiling plans, sections, and elevations. Graduate students will be required to create foundation and structural framing plans.
- Students will be able to present the proposed design to the class, with oral explanations.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5795 - Sensors for the Built and Natural Environments (3 Credits)
Sensors are the link between the physical world and engineering decision making. This course introduces students to a wide variety of sensors with a specific focus on civil and environmental engineering applications such as material testing, structural health monitoring, traffic engineering, air and water quality monitoring, structural testing, watershed engineering, and geotechnical and subsurface energy applications. This course is intended to teach students how to implement sensors to measure physical quantities, conduct experiments, and develop monitoring tools for the natural environment and our engineered systems. Course topics include general introduction to different classes of sensors, data acquisition, signals, noise, system calibration, and uncertainty.
Prerequisites: CEE 3040, CEE 3200.
Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2022, Spring 2021
Learning Outcomes:

- Use information theory to design an optimal data acquisition procedure.
- Calibrate or characterize the sensor/acquisition process with respect to underlying physical quantities, and quantify uncertainty associated with those measurements.
- Design and assemble a sensing system for a specific measuring/monitoring application.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5820 - Global Food, Energy, and Water Nexus – Engage the US, China, and India for Sustainable Future (3-4 Credits)
Crosslisted with ANSC 6880, FDSC 6880, AEM 6880, CHEME 6780, GDEV 6880
This course is offered by six Departments at Cornell, in collaboration with five Universities in China and one India. Video conferencing will be used to connect classrooms in the three countries in real time. Important issues related to the food, energy, and water nexus and its implications for nutrition security, one health, environmental sustainability, climate change, and economic development in the US and these two countries will be described. Challenges associated with these issues will be evaluated and strategies to address them will be proposed. Engagement of these countries with each other and the rest of the world will be explored. The course serves as a platform for students from Cornell, China, and India to learn from and interact with each other in the same class, and to share their thinking, creativity, and perspectives on these issues.
Enrollment Information: Enrollment limited to: graduate student status, or permission of the instructors.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Identify and compare the major food, nutrition and health, energy, water, and economic challenges facing the US, China, and India.
- Describe barriers to food and nutrition security for all people in each of the three countries and globally and propose solutions for overcoming these barriers.
- Identify and quantify the requirements of energy and water for producing, processing, transporting, and/or preparing food.
- Evaluate various predictions of regional and global impacts of climate change on agricultural production and human health in the 21st century.
- Collaborate as members of interdisciplinary teams composed of students from the US, China, and India to analyze and solve problems that affect food, water, and energy security.
- Effectively and respectfully debate, with people of opposing views, issues related to food, water, and energy nexus.
- Prepare and deliver focused, clear, impactful, and culturally sensitive presentations to an international audience of peers.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5900 - Project Management (4 Credits)
Crosslisted with ENMGT 5900
Core graduate course in project management for people who will manage technical or engineering projects. Focuses both on the technical tools of project management (e.g., methods for planning, scheduling, and control) and the human side (e.g., forming a project team, managing performance, resolving conflicts), with somewhat greater emphasis on the latter.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 5910 - Engineering Management Project (4 Credits)
Crosslisted with ENMGT 5910
As Engineering Managers, you need to embrace both technical and business skills to tackle complex, sociotechnical challenges, while staying on top of the current pace of technological change. In this Engineering Management project course, we are bridging from your coursework to your role as an engineering manager. To get there, you will practice the tools, themes, and techniques learned in your Engineering Management coursework through the scaffolding of a large project.
In CEE 5910, you will work in teams to lead and execute a project in collaboration with an industry partner. You will perform an intensive evaluation of some mixture of the technological and management aspects of a major engineering project or system, conducted with a team of students.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 5930 - Data Analytics (4 Credits)
Crosslisted with ENMGT 5930
Big data is transforming organizations enabling vast improvements in operating efficiency, market identification and segmentation, and many other domains. This course focuses on data collection at all scales, the transformation of that data into knowledge using a variety of data analytic techniques, and the integration of that knowledge into system models for decision-making to better manage organizations. Expertise in R will be developed throughout this course.
Prerequisites: CEE 3040 or equivalent.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Develop an ability to manage, analyze, and interpret data.
- Improve the students' ability to identify, formulate, and solve engineering management problems.
- Develop the skills and techniques necessary to become an effective problem solver.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5950 - Construction Planning and Operations (3 Credits)
Crosslisted with ENMGT 5950, REAL 5950
Prepares students for responsibilities in overseeing the engineering and management of construction; on time-on budget. Emphasis is placed on the management processes for organizing, planning, and controlling the activities of complex development and construction programs. Students study the contracts for engineering, architecture, and construction; focusing on cost estimation and schedule control, responsibilities and risks, and the relationships among owners, designers, contractors, and suppliers. The potential for project disruption is discussed with special emphasis on dispute resolution methods.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Evaluate the client's conceptual design providing broad, yet accurate cost appraisals.
- Have a thorough understanding of the interactions and relationships among the participants within the construction process.
- Prepare a comprehensive construction cost estimate for a complex building, including general construction, and specialty contractors. Develop an understanding of how this estimate is developed and carried forward into the bidding and cost control processes.
- Develop a project schedule from this cost estimate to determine the overall project duration and critical path.
- Confidentially advise a project owner of project delivery options in an ethical and effective manner.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5970 - Risk Analysis and Management (3 Credits)
Crosslisted with ENMGT 5970
Develops a working knowledge of risk terminology and reliability engineering, analytic tools and models used to analyze safety, environmental and technological risks, and social and psychological risk issues. Discussions address life risks in the United States historical accidents, natural hazards, threat assessment, transportation risks, industrial accidents, waste incineration, air pollution modeling, public health, regulatory policy, risk communication, and risk management.
Prerequisites: CEE 3040 or ENGRD 2700 or ILRST 2100 or BTRY 3010 or AEM 2100, MATH 1910, MATH 1920, or by permission of instructor.
Enrollment Information: Enrollment limited to: seniors or graduate students.
Last Four Terms Offered: Fall 2020, Spring 2020, Spring 2019, Spring 2018
Learning Outcomes:

- Students should gain an ability to apply knowledge of mathematics, science, and engineering.
- Students should gain an ability to identify, formulate, and solve engineering problems.
- Students should gain an understanding of professional and ethical responsibility.
- Students should gain the broad education necessary to understand the impact of engineering solutions in a global and societal context.
- Students should gain a knowledge of contemporary issues.

Schedule of Classes (https://classes.cornell.edu/)

CEE 5980 - Decision Framing and Analytics (3 Credits)
Crosslisted with ENMGT 5980
Framework to structure the way we think about decision situations that are complicated by uncertainty, complexity, and competing objectives. Specific decision analysis concepts and tools, such as decision trees, sensitivity analysis, value of information, and utility theory. Applications to all areas of engineering and life. Includes a group project to analyze a real-world decision.
Prerequisites: at least one of the following courses: CEE 3040, ENGRD 2700, ILRST 2100, BTRY 3010, AEM 2100, or equivalent.
Enrollment Information: Enrollment limited to: seniors and graduate students, or permission of instructor.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6000 - Numerical Methods for Engineers (3 Credits)
Last Four Terms Offered: Fall 2022, Fall 2018, Fall 2016, Fall 2013
Schedule of Classes (https://classes.cornell.edu/)

CEE 6015 - Special Topics: Remote Sensing (1-6 Credits)
Students may elect to undertake a project in remote sensing. The work is supervised by a professor in this subject area.
Last Four Terms Offered: Fall 2024, Spring 2024, Fall 2023, Spring 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 6020 - Seminar - Water Resources and Environmental Engineering (1 Credit)
Graduate students and faculty members give informal lectures on various topics related to ongoing research in environmental engineering or water resources.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6021 - Seminar: Environmental Engineering and Water Resources (1 Credit)
Graduate students and faculty members give informal lectures on various topics related to ongoing research in environmental engineering or water resources.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 6025 - Special Topics in Environmental and Water Resources Systems Analysis (1-6 Credits)
Supervised study, by individuals or small groups, of one or more specialized topics not covered in regular courses.
Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2020, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 6035 - Special Topics in Hydraulics (1-6 Credits)
Special topics in fluid mechanics, hydraulic engineering, or hydrology.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6045 - Special Topics in Geotechnical Engineering (1-6 Credits)
Supervised study of special topics not covered in the formal courses.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6055 - Special Topics in Environmental Engineering (1-6 Credits)
Supervised study in special topics not covered in formal courses.
Last Four Terms Offered: Spring 2025, Fall 2024, Fall 2023, Fall 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 6065 - Special Topics in Transportation (1-6 Credits)
Advanced subject matter not covered in depth in other regular courses.
Last Four Terms Offered: Fall 2024, Fall 2023, Spring 2023, Fall 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 6070 - Seminar - Civil Infrastructure (0.5 Credits)
Presents topics of current interest.
Last Four Terms Offered: Fall 2024, Fall 2023, Spring 2023, Fall 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 6075 - Special Topics in Structural Engineering (1-6 Credits)
Study of topics in structural engineering that are more specialized or different from other courses. Special topics depend on faculty and student interests.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 6080 - Seminar: Engineering Systems and Management (1 Credit)
Last Four Terms Offered: Spring 2025
Schedule of Classes (https://classes.cornell.edu/)

CEE 6091 - Seminar: Project Management (1 Credit)
Crosslisted with ENMGT 6091
Weekly seminar aimed at M.Eng students, in particular in the engineering management program. Weekly speaker will come from different engineering applications and discuss insights into project management. Seminar is non-participatory.
Exploratory Studies: (CU-CEL)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 6095 - Special Topics in Engineering Management (1-6 Credits)
Individually supervised study of one or more specialized topics not covered in regular courses.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 6200 - Managing Water Resources in a Changing World (3 Credits)
The field of water resources management is an exciting showcase of the many challenges that await civil and environmental engineers. On one hand, increasing water demand from the urban, energy, and agricultural sectors are aggravating multi-sector conflicts. On the other hand, several drivers of change, such as global warming or socio-economic development, make future water demand and availability deeply uncertain. How can we reconcile these challenges? How can we plan and manage water resources systems in an integrated, sustainable, and just way? Building on the legacy of research in water resources systems, this course is designed to equip the new generation of professionals with the forma mentis and mathematical modelling tools that are needed to discover and negotiate the highly uncertain tradeoffs we face in balancing the water resources demands of the future.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 6210 - Renewable Energy Systems (3 Credits)
The goal of this course is to survey renewable energy technologies and systems, primarily focusing on solar and wind as physically the largest renewable energy sources available to society, and considering hydropower, biomass, and geothermal energy as well. The course explains calculations to support capacity, efficiency, and productivity of renewable energy. Cost and economics of renewables are explored as well, along with the connection to U.S. and global climate and energy policy. Homework assignments completed during the semester culminate in an individual renewable energy research project in line with the student's interests.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Identify and evaluate different types of renewable energy resources available in nature.
- Analyze renewable energy conversion devices for technical, economic, and ecological performance.
- Demonstrate an understanding of the connection between ecological/social policy objectives and the deployment of renewable energy to meet human needs and improve quality of life.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6215 - Stochastic Modeling of Complex Systems (3 Credits)
The theory of stochastic processes is introduced through examples of complex systems from the natural and applied sciences, with an emphasis on applications rather than mathematical abstraction. Students will learn how to model dynamical systems with intrinsic and extrinsic noise sources, simulate their dynamics, and explore how the interplay between stochasticity and nonlinear dynamics can impact their behavior. Topics covered include generating processes for heavy-tailed distributions, diffusion processes (gaussian white noise), jump processes (white shot noise, birth/death processes, dichotomous Markov noise), stochastic hybrid systems, stochastic differential equations, first passage times, and noise-induced transitions. Analytical tools developed in the class include stochastic differential equations, the differential Chapman-Kolmogorov equation and its derivatives (Fokker-Planck and master equation), the use of transforms to solve master and Fokker-Planck equations, and the system size expansion to approximate solutions to master equations with nonlinear transition rates. Applications include examples from biophysics, climate, environmental sciences, and various areas of biology including systems, synthetic, molecular, and cellular biology.
Prerequisites: MATH 2930 or MATH 3230.
Last Four Terms Offered: Fall 2024, Fall 2022
Learning Outcomes:

- Identify the sources of stochasticity in a variety of processes in the applied and natural sciences.
- Model complex stochastic processes using different types of stochastic processes including random walks, Levy flights and hybrid stochastic processes.
- Determine and analyze the equation(s) describing the temporal evolution of probabilities and probability densities in continuous-state and discrete-state stochastic processes
- Analyze the stationary probability distribution of a stochastic process (if it exists) and the temporal evolution of moments and cumulants.
- Understand the relationship between the Langevin and Fokker-Planck equations, and how to derive approximations to the solution of master equations with nonlinear transition rates via the system size expansion.
- Identify the fundamental processes that lead to noise-induced transitions and heavy-tailed distributions.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6300 - Spectral Methods for Incompressible Fluid Flows (4 Credits)
An introduction to the fundamental building blocks of flow solvers for the simulation of incompressible flow processes in the natural environment. High-order accuracy element-based spatial discretization methods (spectral element and discontinuous Galerkin) are covered along with high-accuracy time-advancement methods. Initially applied to fundamental linear problems, these methods are then implemented in the context of the Burgers equation with a focus on aliasing effects and spectral filtering. The course concludes with a presentation of the fundamentals of non-hydrostatic environmental flow modeling.
Last Four Terms Offered: Fall 2024, Fall 2018, Fall 2014, Fall 2011
Schedule of Classes (https://classes.cornell.edu/)

CEE 6330 - Physical Hydrology in the Built and Natural Environments (3 Credits)
Understanding of the physical processes of the movement of water on Earth is essential to water resource management, natural hazard assessment and mitigation. This course covers the fundamental principles governing the pathway of water in the global hydrologic cycle and emphasizes the applications of physical hydrology in both the natural and built systems. Topics include but not limited to: fluid mechanics of the lower atmosphere, free surface and subsurface flows, and groundwater outflows. These concepts will be applied to both the natural environment and systems that are responding to human modification of the water cycle due to urbanization, climate change, the construction of reservoirs, and groundwater extraction. Grades are based on individual and group assignments and a final project.
Prerequisites: ENGRD 3200 or equivalent, CEE 3310 or equivalent, or permission of instructor.
Last Four Terms Offered: Spring 2024, Spring 2023, Spring 2022, Spring 2021
Learning Outcomes:

- Gain an understanding of the key physical processes involved in the hydrologic cycle.
- Apply the fundamental understanding to solve problems in the context of both natural and built systems.
- Provide opportunities for students to revisit and apply relevant analytical and numerical methods to solve problems pertaining to physical hydrology.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6350 - Coastal Engineering (3 Credits)
Last Four Terms Offered: Spring 2025, Fall 2022, Spring 2012
Schedule of Classes (https://classes.cornell.edu/)

CEE 6364 - Hydrokinetic and Aerodynamic Energy Module (1 Credit)
Crosslisted with CHEME 6664
Energy technology module of CHEME 6660. An overview of water and wind energy resources and technology both on and off shore. Emphasis will be placed on water power from conventional impoundment dams and run of river resources to pumped hydro, wave energy, and tidal basin systems. Covering water resource assessment, basic fundamentals of hydrokinetic energy capture, hydro turbine technology, designs and performance, wave power energy recovery systems, siting issues and environmental impacts, and cost estimates and projections.
Enrollment Information: Permission of instructor required.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2023, Spring 2023, Spring 2020, Spring 2018
Schedule of Classes (https://classes.cornell.edu/)

CEE 6370 - Experimental Methods in Fluid Dynamics (4 Credits)
Crosslisted with MAE 6270
Introduction to experimental techniques, data collection, and data analysis, in particular as they pertain to fluid flows. Introduces theory and use of analog transducers, acoustic Doppler velocimetry (ADV), full-field (2-D) quantitative imaging techniques such as particle image velocimetry (PIV) and laser induced fluorescence (LIF). Additional topics include computer-based experimental control, analog and digital data acquisition, discrete sampling theory, digital signal processing, and uncertainty analysis. The canonical flows of the turbulent flat plate boundary layer and the neutrally buoyant turbulent round jet are introduced theoretically and the subject of three major laboratory experiments using ADV, PIV and LIF. There is a final group project on a flow of the students choosing.
Prerequisites: Prerequisite or corequisite: CEE 3310 and CEE 3040, or equivalents and ENGRD 3200.
Last Four Terms Offered: Spring 2024, Fall 2021, Spring 2020, Spring 2017
Schedule of Classes (https://classes.cornell.edu/)

CEE 6400 - Artificial Intelligence for Control of Environmental Systems (3 Credits)
The course has the dual objective of introducing students to the control problems characterizing modern environmental and water infrastructures while exposing them to real-world examples of how modelling and control analytics are used. Specific topics include: (1) dynamic programming and its main extensions (stochastic and approximate DP), (2) policy search for single- and multi-objective problems, (3) deterministic and stochastic model predictive control, (4) model-order reduction and its application to large-scale control problems. Emphasis will be given not only to the theoretical aspects underpinning the control problems, but also to their practical use. Examples will be drawn from several domains, including reservoir operations, urban water supply, drainage networks, and groundwater management. Emphasis will be also placed on the role that data analysis plays in the formulation of these control problems. Class periods will be a mixture of in-person lectures, group discussions, and hands-on activities.
Last Four Terms Offered: Spring 2025
Learning Outcomes:

- Identify the modelling and control analytics that are best suited for a given environmental system.
- Formulate and solve an optimal control problem with the aid of modern programming languages.
- Analyze conflicting settings through the resolution of multi-objective control problems.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6520 - Sustainable Recovery of Critical Metals and Advanced Material Conversions (3 Credits)
The course is motivated by the need to educate students in the fundamental science and emerging technologies for recovering critical metals and in advanced material conversions for a sustainable climate, energy, and environmental future. The course will introduce fundamental chemical pathways for recovering energy critical metals from various substrates including natural and urban ores. The ubiquity of metals in daily products motivate the development of sustainable approaches to recover metals via urban mining, which will be discussed in this course. The course will also introduce advanced material conversions for the energy transition including emerging electrochemical and photochemical pathways to upcycle low value emissions into high value products.
Prerequisites: CEE 3510 or equivalent and CEE 4210.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 6530 - Water Chemistry for Environmental Engineering (3 Credits)
Covers principles of chemistry applicable to the understanding, design, and control of water and wastewater treatment processes and to reactions in receiving waters. Topics include chemical thermodynamics, reaction kinetics, acid-base equilibria, mineral precipitation/dissolution, and electrochemistry. Focuses on the mathematical description of chemical reactions relevant to engineered processes and natural systems, and the numerical or graphical solution of these problems.
Prerequisites: undergraduates need one semester of college chemistry or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6550 - Transport, Mixing, and Transformation in the Environment (3 Credits)
Application of fluid mechanics to problems of transport, mixing, and transformation in the water environment. Introduction to advective, diffuse, and dispersive processes in the environment. Boundary interactions: air-water and sediment-water processes. Introduction to chemical and biochemical transformation processes. Applications to transport, mixing, and transformation in rivers, lakes, and coastal waters.
Prerequisites: CEE 3310.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

CEE 6560 - Physical and Chemical Process (3 Credits)
This course focuses on the theoretical and engineering aspects of physical and chemical phenomena and processes applicable to the removal of impurities from water, wastewater, and industrial wastes. The first unit covers general chemical engineering principles relevant in environmental processes including mass balances, reactor models, and reaction kinetics. The second unit covers chemical processes involving dissolved species including gas transfer, adsorption, and oxidation-reduction processes. The third unit covers particle processes and the conventional theories behind particle destabilization, particle flocculation, and particle removal processes. Each topic area has a corresponding problem set that provides students with opportunities to apply the fundamentals discussed in class. The fundamental theory is coupled with a number of real-world examples that provide context for the more abstract principles that are introduced.
Prerequisites: CEE 3510 for undergraduates or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Recognize critical water quality regulations.
- Recognize the advantages/disadvantages of conventional and advanced options for removal of dissolved and particulate contaminants.
- Formulate a qualitative understanding of the fundamental theory upon which individual treatment process design is based.
- Master the quantitative skills necessary to model and design individual processes and integrated wastewater and drinking water treatment systems.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6565 - Waste Water Processes and Resources Recovery (3 Credits)
Given the current state of the energy crisis and climate changes impacts, innovative approaches are needed in order to remediate, reduce and recover the energy and nutrient resources through various waste streams and to provide creative energy solutions that lead to self-sustaining wastewater treatment facilities. This course will cover fundamental theory of each unit operation process and design principles of major water and wastewater treatment processes. The topics will cover wastewater characteristics and evaluation methods, design flow and loads statistical analysis, process selection rationale, primary treatment processes, secondary treatment processes and tertiary and advanced treatment processes, and effluent and solids processing and disposal. In addition to the fundamentals of conventional wastewater processes, the course will also include the discussions on the emerging issues in water sustainability and advances in fundamental science and technology in integrating scientific principles, engineered processes, and systems analyses to address diverse challenges related to society's growing water needs and their nexus with energy and the environment. The course is designed to stimulate multi-disciplinary thinking and research among traditional areas of civil and environmental engineering, biology, chemistry, modeling, data science and others. Special projects will be designed to have students working in multi-disciplinary teams to develop sustainable solutions to meet the present and future water and resources needs of the society.
Enrollment Information: Enrollment limited to: graduate students.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Fall 2022, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 6570 - Environmental Biological Processes (3 Credits)
Principles and application of microbiology and biotechnology with emphasis on biological processes in environmental engineering applications. Theoretical and engineering aspects of biological phenomena and processes applicable to the removal of impurities from water, wastewater, and industrial wastes and to their transformation in the environment. Microbiology fundamentals, bioenergetics analysis, stoichiometry, biokinetics, and design of biological treatment processes for pollutants removal, bioremediation and resources recovery. Topics include cell metabolism, cell nutrition and growth, energy transfer and utilization, aerobic and anaerobic microbial metabolism, biological wastewater process theory and modeling, biological nutrients removal, bioremediation and resources recovery.
Prerequisites: CEE 3510 or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Spring 2021, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 6590 - Partitioning and Transformation of Organic Contaminants in Environmental Systems (3 Credits)
This course examines the major physical and chemical processes affecting the transport, fate, and treatment of organic chemicals in aquatic systems, including volatilization, sorption/attachment, diffusion, and transformation reactions. The emphasis is on anthropogenic legacy chemicals and chemicals of emerging concern such pharmaceuticals and personal care products. The course examines the relationships between chemical structure, properties, and environmental behavior. Equilibrium and kinetic models based on these principles are used to predict the fate and transport of organic contaminants in the environment.
Prerequisites: CHEM 2090 and CHEM 1570, or permission of instructor.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2022, Spring 2019, Spring 2017
Schedule of Classes (https://classes.cornell.edu/)

CEE 6620 - Analysis and Control of Transportation Systems and Networks (3 Credits)
This course will cover the development and application of mathematical models and optimization techniques for the analysis and control of transportation systems and networks, with a focus on urban mobility. We will cover topics related to network routing, dynamic traffic models, static and dynamic traffic assignment, traffic control mechanisms and mobility-on-demand systems (including their connections to mass transit). Students will be expected to implement the algorithms covered in class during homework assignments and complete a final project. Students in 6620 will also be required to review and critique research publication in the area of their project.
Prerequisites: MATH 2940, CS 1110 or equivalent, CEE 4665 or ORIE 3300 or equivalent, or permission of instructor.
Last Four Terms Offered: Spring 2025, Fall 2022, Fall 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 6640 - Microeconometrics of Discrete Choice (3 Credits)
Understanding individual choice behavior is critical for several disciplines that need to account for demand dynamics. Discrete choice models represent the cognitive process of economic decisions and are widely used in transportation analysis, applied economics, marketing, and urban planning. Discrete choice analysis is used to forecast demand under differing pricing and marketing strategies and to determine how much consumers are willing to pay for qualitative improvements. In transportation engineering, these models allow researchers, firms, and policy-makers to predict demand for new alternatives and infrastructure (e.g. a light rail or a new highway), to analyze the market impact of firm decisions (e.g. merger of two airline companies), to set pricing strategies (e.g. road pricing, toll definition, revenue management), to prioritize research and development decisions (e.g. ultra low emission vehicles) as well as to perform cost-benefit analyses of transportation projects (e.g. building a new bridge).
Prerequisites: CEE 3040, MATH 2940.
Last Four Terms Offered: Spring 2024, Spring 2023, Spring 2022, Spring 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6648 - Sustainable Transportation Systems Design (3 Credits)
Graduate-level design course in transportation, with a focus on design of sustainable transportation systems. The perspective in the course is one of system design, i.e., understanding the process of creating objectives, developing alternative designs and having models capable of representing the interactions among major elements of the overall system. We will also adopt a sustainable development or triple bottom line perspective, taking into account ecological and social as well as economic dimensions of transportation systems design. From this perspective, efficient transportation function achieves the economic objective, while quantifying and minimizing negative impacts addresses ecological and social goals. The interactions among the major system elements (vehicles, infrastructure, people, freight) occurs on networks, and we need to focus on how networks function. We will also study how resources are allocated and how capacity is maintained in networks. Systems design is examined from both a public sector perspective and from a private sector perspective.
Enrollment Information: Enrollment limited to: graduate students or by permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6660 - Multiobjective Systems Engineering Under Uncertainty (3 Credits)
Crosslisted with SYSEN 6410
Exploration of engineering design frameworks that effectively exploit simulation, optimization, and uncertainty assessments when balancing large numbers of conflicting performance objectives. Students will learn and advance software frameworks that combine evolutionary multiobjective optimization, high performance computing, uncertainty modeling techniques, and visual design analytics. The primary focus will be improving multi-stakeholder design of complex engineered systems. Course concepts will be demonstrated using case studies and projects drawn from the disciplines of the students enrolled.
Prerequisites: programming experience, CS 4210 or ENGRD 3200, ORIE 3310, CEE 5970 or equivalents.
Enrollment Information: Enrollment limited to: graduate students.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Fall 2020, Spring 2019
Learning Outcomes:

- Incorporate conflicting objectives, account for system uncertainties, and exploit careful design diagnostics to guide problem formulation and capture key design dependencies.
- Use and advance software frameworks that combine evolutionary multiobjective optimization, high performance computing, uncertainty modeling techniques, and visual design analytics.
- Facilitate improved decision making in multi-stakeholder systems engineering design processes.
- Effectively communicate design analysis results visually and in writing.

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CEE 6667 - Transportation Energy Systems Module (1 Credit)
Crosslisted with CHEME 6667
Energy technology module of CHEME 6660 covering transportation energy systems. Focuses on understanding the link between transportation demand and energy consumption and on how to build a path for a conversion to sustainable energy sources. Covers engineering systems tools for analyzing the interactions among the transportation, economic, energy, and environmental systems. Analytical tools from transportation economics and engineering will be covered to assess the energy consumption and environmental effects of long-term projects over complex, large-scale transportation systems.
Enrollment Information: Permission of instructor required.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2023, Fall 2021, Fall 2019, Fall 2018
Schedule of Classes (https://classes.cornell.edu/)

CEE 6680 - Optimal Control and Decision Theory (3 Credits)
Crosslisted with SYSEN 5680, SYSEN 6680
Covers the basic models and solution approaches for individual and team decision-making problems under uncertainty and provide a unified mathematical treatment of the subject, suitable for a broad engineering audience. The material will consider optimal decision-making of systems over a finite- and an infinite-time horizon. Topics include: (1) Stochastic optimization: finite- and infinite-horizon problems with complete or partial state information, separation principle, dual control; (2) Team Theory: mathematical framework of cooperating members in which all members have the same objective yet different information; (3) Reinforcement learning: approximate dynamic programming, forward references to the approximate dynamic programming formalism, learning policies.
Enrollment Information: Primarily for: graduate students.
Last Four Terms Offered: Spring 2025, Spring 2024
Schedule of Classes (https://classes.cornell.edu/)

CEE 6690 - Information Design for Strategic Decision-Making (3 Credits)
Crosslisted with SYSEN 5690
The course covers the basic models and solution approaches in problems that involve interactions among strategic agents distilling the key results in mechanism design theory. Over the last seventy years, the theory of mechanism design was developed as an approach to efficiently align the individuals' and system's interests in problems where individuals have private preferences. It can be viewed as the art of designing information and protocols to achieve a desired outcome. Mechanism design has broad applications spanning many fields, including transportation routing, smart grid, communication networks, social media, online advertising, and resource allocation problems. The objective of this course is to gain a sound understanding of the science behind the use of mechanism design in solving modern problems that involve strategic interactions among agents. The course will provide a unified treatment of the subject, suitable for a broad engineering audience.
Last Four Terms Offered: Fall 2024
Learning Outcomes:

- Formulate a mechanism design problem, identify the set of outcomes, and define the social choice function.
- Identify whether a direct or indirect mechanism is appropriate to use for a given problem.
- Implement a social choice function using different solution concepts, e.g., dominant strategy implementation, Bayesian Nash implementation, etc.
- Solve resource allocation problems using mechanism design.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6726 - Intermediate Solid Mechanics (4 Credits)
This course introduces students to the mathematical framework that describes the deformation of solids and structures due to the action of mechanical and thermal loads. The course is intended to provide a foundation for better understanding and utilizing popular and novel engineering analysis tools associated with predicting mechanical behavior, e.g. finite element analysis. Focusing on linear elasticity, yield criteria, and basic fracture mechanics, this course emphasizes the development of a mechanical intuition that will enable students to better solve problems and innovate across a broad range of domains, e.g. civil, aerospace, nuclear, biomedical, and mechanical engineering, as well as the physical, geological, and materials sciences.
Prerequisites: MATH 2940, ENGRD 2020 and ENGRD 3200.
Last Four Terms Offered: Fall 2022, Fall 2021
Learning Outcomes:

- Demonstrate the ability to utilize common constitutive laws to relate stress to mechanical and thermal strains in three dimensions (and vice versa).
- Demonstrate a fundamental understanding of the mechanical boundary value problem as related to the stress and strain fields that arise in a three dimensional solid.
- Demonstrate the ability to utilize basic continuum mechanics and computing resources to analyze real-world problems in mechanics.
- Demonstrate the ability to utilize common yield surfaces (and fracture criteria) to qualitatively assess mechanical response in three dimensions.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6730 - Design of Concrete Structures (4 Credits)
Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019
Schedule of Classes (https://classes.cornell.edu/)

CEE 6736 - Mathematical Modeling of Natural and Engineered Systems (3 Credits)
This course builds from previously studied fundamental concepts to uncover strategies for using math to describe natural and engineered systems that impact the human experience (e.g. infrastructure systems, subsurface structures and networks, bacterial colonies, traffic networks, reservoir systems, etc.) Specifically, selected approaches for mechanistic descriptions (clear box models), data-driven descriptions (black box models), and hybrids of these (grey box models) will be covered: both through an introduction to foundational theory and also in computational implementation. In gaining experience in formulating their own mathematical models for real world phenomena, students will be better able to describe, study, and control the performance of natural and engineered systems in their professional lives.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6745 - Inverse Problems: Theory and Applications (3 Credits)
The course covers foundational theory underpinning the inverse problems that naturally arise when developing technology for society. Through a treatment of theory and application, the course aims to equip students to answer questions such as: what source/forcing/action has caused the system response I am currently observing?; what model parameters best instantiate a predictive model explaining certain noisy/incomplete observations of the subject system?; and how certain am I about any of the foregoing results?
Prerequisites: MATH 2940.
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Identify an inverse problem.
- Analyze it from a theoretical point of view.
- Employ deterministic and stochastic methods to solve it.
- Apply solution methods in real-world contexts.
- Critically analyze their resulting solutions.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6750 - Concrete Materials and Construction (3 Credits)
Covers the materials science, structural engineering, and construction technology involved in the materials aspects of the use of concrete. Topics include cement chemistry and physics, mix design, admixtures, engineering properties, testing of fresh and hardened concrete, and the effects of construction techniques on material behavior.
Last Four Terms Offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 6755 - Finite Element Method: Theory and Applications in Mechanics and Multiphysics (3 Credits)
Crosslisted with MAE 6755, EAS 6755
This class is an intermediate-level course on the linear Finite Element Method (FEM) for graduate engineering students. The students will learn to: set up the strong formulation of mechanical, hydraulic, thermal, and coupled problems, write the variational formulation, discretize the weak form in space and time, choose a resolution algorithm, write an input file for a FEM software, and interpret numerical results. Applications will focus on climate change and energy. First, one-dimensional problems will be solved for one dependent variable, e.g., elongation, fluid flow, heat transfer. Second, hydro-mechanical equations for two-phase porous media will be introduced and applied to consolidation problems. Next, 2D space discretization and numerical integration will be explained and applied through simulation and analysis of problems of plane elasticity and seepage. The course will conclude with the modeling unsaturated porous media with applications to geological storage, evapo-transpiration, and subsidence.
Last Four Terms Offered: Spring 2025
Learning Outcomes:

- Approximate the solution of partial differential equations by using a variational method.
- Design Finite Element models for time-dependent hydro-mechanical problems.
- Analyze Finite Element results, numerical errors, and convergence issues.

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CEE 6770 - Natural Hazards, Reliability, and Insurance (3 Credits)
Essentials of probability theory, random functions, and statistics are introduced via simple examples. These concepts are applied to (1) construct probability models for natural hazards, e.g., earthquakes, wind speeds, hurricanes, and floods, (2) calibrate these models to observations, and (3) develop Monte Carlo algorithms for generating samples of natural hazards. The focus is on applications rather than theoretical arguments. Approximate methods are used to characterize probabilistically system responses to natural hazards. System responses and properties are used to assess performance by reliability metrics and estimate insurance premiums for damages caused by natural hazards. Grades are based on individual and group assignments, a midterm, and a final project. The final projects for CEE 6770 will be significantly more demanding than those for CEE 4770.
Prerequisites: undergraduate level course in probability and statistics, basic computer programming skills (preferable MATLAB).
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2023, Fall 2022, Fall 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 6780 - Structural Dynamics and Earthquake Engineering (3 Credits)
Covers modal analysis, numerical methods, and frequency-domain analysis. Introduces earthquake-resistant design. Students are also required to complete an individual or group project assigned by theinstructor.
Last Four Terms Offered: Spring 2024, Spring 2023, Spring 2021, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 6790 - Time Series Data Analysis for Civil, Mechanical and Geophysical Applications (3 Credits)
Data acquired as time series are increasingly common in age of GPS, smart phones, and wireless data transfer. This course will cover data processing tools and techniques that allow us to efficiently manipulate and better understand the data and the physical world that they sample. Course topics include Fourier transforms, convolution, filtering, data acquisition, noise, linear systems, and AutoRegressive Moving Average (ARMA) models. Topics are covered both from theoretical (continuous, analog signals) and practical (discrete-time digital signals) viewpoints. More advanced topics will emphasize the analysis of transient and non-stationary time series such as earthquake ground motions, structural or environmental response to extreme events, and other signals related to engineering and earth science disciplines.
Prerequisites: MATH 2940 or equivalent.
Enrollment Information: Enrollment limited to: graduate students or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6800 - Engineering Smart Cities (3 Credits)
This course prepares students to tackle the technical challenges to designing and operating smart and dynamic infrastructure systems. In particular, students will learn to combine data and models to control overall system performance in the face of uncertainty. The class will focus on smart city infrastructure systems that are self-aware, with continual surveillance of the built and natural environment and an autonomous capacity to control resource allocation. This course will build upon fundamental engineering principles (for systems such as transportation, energy, and water resources) and teach students to employ emerging sensor technologies, accompanying data analytics, resource demand forecasting, and model predictive control theory. Students will learn to couple engineering models of infrastructure with data-driven probabilistic models of resource demand and the approaches to control these integrated hybrid systems for optimal and equitable resource allocation with improved resilience to exogenous disturbances. Finally, the class will explore cases studies in urban flooding, energy supply, transportation and air quality, and water supply.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Apply data-driven models to forecast resource demand for infrastructure applications.
- Apply model predictive control principles to smart infrastructure systems.
- Critically evaluate the security, overall performance, and equity of resource allocation for smart infrastructure systems.
- Identify open research and development needs in the engineering of smart cities.
- Propose promising approaches to closing the existing R&D gaps.

Schedule of Classes (https://classes.cornell.edu/)

CEE 6880 - Applied Modeling and Simulation for Renewable Energy Systems (3 Credits)
Crosslisted with BEE 6880
This course will provide an applied introduction to modeling, simulation and optimization techniques for various renewable energy systems. The course will be modular in nature. Each module will focus on a particular renewable energy application and relevant modeling/simulation tools. Some modules are independent and some will build on previous modules. The instructional format of the course will include lectures, scientific paper reviews, and some AMPL programming. Students will have an opportunity to apply new techniques to a relevant modeling project. The course will culminate with a modeling project relevant to renewable energy. Graduate students will be required to complete the term project on an individual basis.
Enrollment Information: Enrollment limited to: graduate students, or permission of instructor.
Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 6910 - Project Management (4 Credits)
Core graduate course in project management for people who will manage technical or engineering projects. Focuses both on the technical tools of project management (e.g., methods for planning, scheduling, and control) and the human side (e.g., forming a project team, managing performance, resolving conflicts), with somewhat greater emphasis on the latter.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 6930 - Public Systems Modeling (3 Credits)
Crosslisted with PUBPOL 5325
This course serves as an introduction to the art of model building, especially related to public sector planning and management issues. The course also introduces the quantitative approach for identifying, evaluating and estimating the physical, economic, environmental, and social impacts of alternative decisions planners and managers are asked to make.
Last Four Terms Offered: Spring 2024, Spring 2023, Fall 2021, Fall 2020
Learning Outcomes:

- Students will demonstrate proficiency with quantitative modeling techniques, including simulation, optimization, and linear/dynamic programming.
- Students will identify, evaluate, and estimate the physical, economic, environmental, and social aspects of alternative decisions planners and managers are asked to make.
- Students will integrate concepts learned in class through a team project.

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CEE 6940 - Research in Engineering Management (1-6 Credits)
The student may select an area of investigation in engineering management. Results should be submitted to the instructor in charge in the form of a research report.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 7010 - Research - Remote Sensing (1-6 Credits)
For students who want to study one particular area in depth. The work may take the form of laboratory investigation, field study, theoretical analysis, or development of design procedures.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 7020 - Environmental and Water Resources Systems Analysis Research (1-6 Credits)
Investigations of particular environmental or water resources systems problems.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 7030 - Research in Environmental Fluid Mechanics and Hydrology (1-6 Credits)
The student may select an area of investigation in fluid mechanics, hydraulic engineering, or hydrology. The work may be either experimental or theoretical in nature. Results should be submitted to the instructor in charge in the form of a research report.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 7040 - Research in Geotechnical Engineering (1-6 Credits)
For students who want to pursue a particular geotechnical topic in considerable depth.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 7050 - Research in Environmental Engineering (1-6 Credits)
For students who want to study a particular area in depth. The work may take the form of laboratory investigation, field study, theoretical analysis, or development of design and analysis procedures.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

CEE 7070 - Research in Structural Engineering (1-6 Credits)
Pursues a branch of structural engineering beyond what is covered in regular courses. Theoretical or experimental investigation of suitable problems.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 7073 - Civil and Environmental Engineering Materials Project (1-3 Credits)
Individual projects or reading and study assignments involving engineering materials.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 7360 - Turbulence and Turbulent Mixing in Environmental Stratified Flows (3 Credits)
Fundamentals of stably stratified flows, stratified homogeneous turbulence (spectra, lengthscales, and timescales), kinematics of diapycnal mixing, basic turbulent flow processes in homogeneous and stratified fluids (shear layers, wakes, boundary layers, etc.), energy budget analysis, and parameterizations of geophysical turbulence. Additional topics may include fossil turbulence theory and vortex-internal wave decomposition in strongly stratified turbulence.
Prerequisites: CEE 6550 or second course in fluid mechanics or permission of instructor.
Last Four Terms Offered: Fall 2021, Fall 2015, Spring 2012
Schedule of Classes (https://classes.cornell.edu/)

CEE 7740 - Advanced Structural Concrete (3 Credits)
Course is an extension of CEE 6730 covering design of reinforced and post-tensioned slabs, doubly-reinforced beams, slender columns, deflections, shear walls, deep beams, two-way slab systems, punching shear, and other advanced topics.
Last Four Terms Offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

CEE 7750 - Introductory Nonlinear Finite Element Analysis for Solids (3 Credits)
Crosslisted with MAE 7750
The focus of this course is the development of the fundamentals of nonlinear finite element analysis for continuum solids, spanning topics from finite element formulations, functional analysis, numerical solution techniques to aspects of practical implementation. Most natural phenomena are nonlinear, so the main aim of this course is the development of an adequate framework to model nonlinear phenomena in solids and obtain approximate solutions. We will focus on several problems for solid mechanics, including material nonlinearities, geometric nonlinearities, contact mechanics, and multiphysics problems. All assignments will include coding.
Prerequisites: MAE 5700 or equivalent.
Last Four Terms Offered: Spring 2023, Spring 2021, Spring 2015, Spring 2013
Learning Outcomes:

- Students will be able to develop nonlinear finite element formulations for problems in solid mechanics.
- Students will be able to learn about nonlinear solution techniques.
- Students will be able to learn practical finite element implementation details for nonlinear problems in solid mechanics.

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CEE 7780 - Continuum Mechanics and Thermodynamics (3 Credits)
Crosslisted with MAE 7880
Continuum mechanics is the basis for a vast array of problems in modern and classical engineering. The focus of this course is the development of the fundamentals of continuum mechanics and thermodynamics which will allow for description of complex phenomena in solids, fluids, and mixtures (solid-fluid) and quickly take us to modern and exciting topics of coupled problems in multiphysics problems in solids as well mechanics of soft and biological materials. Most natural phenomena are nonlinear, so the main aim of this course is the development of an adequate framework to model nonlinear phenomena in solids. The models that will be developed to capture physcial phenomena, can be solved analytically or numerically; towards the latter, a connection of the proposed modeling with the Finite Element Method in the context of multiphysical modeling will be covered.
Prerequisites: MAE 6810, MAE 6110 and MAE 6120 or equivalents.
Last Four Terms Offered: Spring 2024, Spring 2022, Spring 2019, Spring 2017
Schedule of Classes (https://classes.cornell.edu/)

CEE 8100 - Thesis - Remote Sensing (1-12 Credits)
The student selects a thesis research topic with the advice of the faculty member in charge and pursues it either independently or in conjunction with others working on the same topic.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 8200 - Thesis - Environmental and Water Resource Systems (1-12 Credits)
The student selects a thesis research topic with the advice of the faculty member in charge and pursues it either independently or in conjunction with others working on the same topic.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
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CEE 8300 - Thesis - Environmental Fluid Mechanics and Hydrology (1-12 Credits)
The student selects a thesis research topic with the advice of the faculty member in charge and pursues it either independently or in conjunction with others working on the same topic.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 8400 - Thesis - Geotechnical Engineering (1-12 Credits)
The student selects a thesis research topic with the advice of the faculty member in charge and pursues it either independently or in conjunction with others working on the same topic.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 8500 - Thesis - Environmental Engineering (1-12 Credits)
The student selects a thesis research topic with the advice of the faculty member in charge and pursues it either independently or in conjunction with others working on the same topic.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 8600 - Thesis - Transportation Systems Engineering (1-12 Credits)
The student selects a thesis research topic with the advice of the faculty member in charge and pursues it either independently or in conjunction with others working on the same topic.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 8700 - Thesis - Structural Engineering (1-12 Credits)
The student selects a thesis research topic with the advice of the faculty member in charge and pursues it either independently or in conjunction with others working on the same topic.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

CEE 8800 - Thesis - Civil Infrastructure Systems (1-12 Credits)
The student selects a thesis research topic with the advice of the faculty member in charge and pursues it either independently or in conjunction with others working on the same topic.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)