ENGINEERING INTRODUCTION (ENGRI)

ENGRI 1100 - Lasers and Photonics (3 Credits)
Crosslisted with AEP 1100
Lasers have had an enormous impact on communications, medicine, remote sensing, and material processing. This course reviews the properties of light that are essential to understanding the underlying principles of lasers and these photonic technologies. There also is a strong, hands-on laboratory component in which the students build and operate a nitrogen laser and participate in several demonstration experiments such as holography, laser processing of materials, optical tweezers, and fiber optics.
Distribution Requirements: (SCT-IL)
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

ENGRI 1101 - Engineering Operations: Data Science and Decision Making (3 Credits)
Introduction to the problems and methods of operations research and information engineering focusing on problem areas (including inventory, network design, and resource allocation), the situations in which these problems arise, and several standard solution techniques. In the computational laboratory, students encounter problem simulations and use some standard commercial software packages.
Enrollment Information: Enrollment limited to: first-years and sophomores.
Last Four Terms Offered: Summer 2025, Spring 2025, Fall 2024, Summer 2024
Learning Outcomes:

- Understand the breadth of quantitative decision situations that arise in engineering, industry, and society.
- Develop the skills needed for mathematical modeling of real-world decision situations.
- Learn fundamental algorithms used to solve such models and the basic mathematical techniques of validating the accuracy and efficiency of these solution methods.
- Build familiarity with current software used in the computational analysis of these models.

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

ENGRI 1120 - Feast! Chemical and Biomolecular Processes and Products through Food (3 Credits)
Chemical and biomolecular engineering (ChemE) is central to how we produce, store, and consume food. Learn the principles and practices of chemical engineering through a tasty, hands-on approach to process and product design. This course introduces key concepts and tools in ChemE including process flow diagrams, unit operations, materials and energy balances, phase equilibria, and scale-up. These concepts will be applied in design projects that leverage the use of quantitative methods to support design decisions and balance considerations of product quality, economics, safety, and environmental issues in food products. The course will also explore career pathways in ChemE to understand the wide range of what chemical engineers do in practice.
Enrollment Information: Enrollment limited to: first-year students.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Identity, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- Apply engineering design for process and products that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.
- Understand current challenges and opportunities for careers in the chemical and biomolecular engineering field.
- Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- Communicate effectively with a range of audiences.

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

ENGRI 1130 - Sustainable Engineering of Energy, Water, Soil, and Air Resources (3 Credits)
Crosslisted with CEE 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/)

ENGRI 1140 - Materials: The Future of Energy (3 Credits)
Crosslisted with MSE 1140
New technologies are urgently needed to fulfill projected global energy requirements. Materials properties typically limit the performance that can be achieved in generation, transport, and utilization of energy. This course will explore how new materials can increase our energy supply, facilitate transportation of energy, and decrease consumption. Materials issues in photovoltaic, fuel cell, battery, transportation, lighting, and building technologies will be studied.
Prerequisites: knowledge of Calculus, Physics, and Chemistry at the high school level.
Exploratory Studies: (CU-SBY)

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

ENGRI 1160 - Modern Structures (3 Credits)
Crosslisted with CEE 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/)

ENGRI 1165 - Climate Change and You, the Engineer (3 Credits)
Crosslisted with CEE 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/)

ENGRI 1170 - Introduction to Mechanical Engineering (3 Credits)
Crosslisted with MAE 1170
Introduction to fundamentals of mechanical and aerospace engineering. Students learn and understand topics such as stress and strain, fluid mechanics, heat transfer, automotive engineering, and engineering design and product development. Emphasis is placed on critically examining problem solutions to begin developing engineering intuition. Key components of the class include in-class discussions, homework, laboratory experiments, and a group design project.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Students will be able to gain a basic understanding of four major areas of the mechanical engineering curriculum: statics, mechanics of materials, fluid mechanics, and thermal sciences.
- Students will be able to identify a system and its interactions with surroundings; they will use this approach to solve problems in both mechanical and thermal/fluids systems.
- Students will gain experience with unit conversion, estimation, approximations, and critical thinking.
- Students will be able to design and build a device (e.g. a small battery-powered car), and perform and document laboratory experiments.
- Students will be able to become aware of current problems, issues, successes, entrepreneurship opportunities, design trade-offs, and failures in the mechanical and aerospace field.

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

ENGRI 1180 - How to Build a Habitable Planet (3 Credits)
Crosslisted with EAS 1180
Our first human ancestors appeared only six million years ago--4.55 billion years into Earth's history. How did our planet develop the critical ingredients for human life-what are the characteristics that make our Pale Blue Dot suited to host complex life? Should we expect to find life elsewhere on other planets? How has human activity altered the story of the Earth, and what global challenges will Homo sapiens encounter in the coming years to decades? Can we devise and implement solutions to present and future environmental crises? In this course, we will investigate these questions through study of the formation and evolution of our universe, investigate the mechanisms that have led to intelligent life on Earth and quantify the impact of both natural and anthropogenic processes on Earth's changing surface. Students in this course will learn how to analyze and interpret scientific data and apply concepts like mass balance and convection to evaluate Earth as series of complex chemical and physical systems interacting over a breadth of scales.
Distribution Requirements: (OPHLS-AG, PSC-AG, SCH-AG), (PHS-AS)
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Learning Outcomes:

- Describe how the elements formed in stars and the evolution of our solar system.
- Characterize Earth's internal structure and how it has changed over time.
- Quantify the relationship between plate tectonics and hazards like earthquakes and volcanoes.
- Discriminate between long-term, short-term, natural and/or anthropogenic drivers of Earth's climate.
- Place the appearance of life and the role of humanity within the context of Earth's geologic history.

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

ENGRI 1190 - Biomaterials for the Skeletal System (3 Credits)
Crosslisted with MSE 1190
Biomaterials exist at the intersection of biology and engineering. This course explores natural structural materials in the human body, their properties and microstructure, and their synthetic and semi-synthetic replacements. Bones, joints, teeth, tendons, and ligaments are used as examples, with their metal, plastic, and ceramic replacements. Topics covered include mechanical properties, corrosion, toxicity, and biocompatibility. Case studies of design lead to consideration of regulatory approval requirements and legal liability issues.
Exploratory Studies: (CU-CEL)

Last Four Terms Offered: Fall 2024, Fall 2023, Spring 2022, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

ENGRI 1200 - Introduction to Nanoscience and Nanoengineering (3 Credits)
Crosslisted with AEP 1200
Lecture/laboratory course designed to introduce first-year students to some of the ideas and concepts of nanoscience and nanotechnology with stronger emphasis on nanobiotechnology in the spring semester. Topics include nanoscience and nanotechnology-what they are and why they are of interest; atoms and molecules; the solid state; surfaces; behavior of light and material particles when confined to nanoscale dimensions; scanning tunneling microscopy (STM), atomic force microscopy (AFM), scanning electron microscopy (SEM); microelectromechanical systems (MEMS) design; basic micromachining and chemical synthesis methods, i.e., top-down and bottom-up approaches to nanofabrication; how to manipulate structures on the nanoscale; physical laws and limits they place on the nanoworld; some far-out ideas. In the laboratory, students construct a simple STM to record atomic resolution images; learn through hands on experience the basic workings of an SEM; use a MEMS computer-aided design software package to model the entire manufacturing sequence of a simple MEMS device, examine the simulated behavior of the device and compare it with real behavior; investigate the optical properties of quantum dots and the unexpected properties of fluids that flow through narrow channels.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- An introductory understanding of quantum mechanics and optics as applied to nanoscience and nanotechnology.
- Acquired a basic understanding of the tools and fabrication techniques used in nanoscience and nanotechnology.

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

ENGRI 1210 - The Computing Technology Inside Your Smartphone (3 Credits)
Crosslisted with ECE 1210
The organization of the computer system found within devices used in everyday living, such as smartphones and tablets. Computer systems are presented in a bottom up fashion, from bits to digital logic, computer organization, instruction sets, assembly language, and the connection to high-level languages. Discussion of the computing engines found in smart phones, tablets, and wearables.
Last Four Terms Offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

ENGRI 1220 - Natural Hazards (3 Credits)
Crosslisted with EAS 1220
Explores the science of natural hazards, their societal impacts, and means of mitigation. The focus is on earthquakes, volcanoes, and tsunami, but hurricanes, severe weather, climate change, landslides, wildfires, and the threat of extinction from a future impact by an extraterrestrial body are also considered.
Distribution Requirements: (OPHLS-AG, PSC-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Learning Outcomes:

- Understand the impact of natural hazards on society and its infrastructure.
- Be able to analyze and interpret geological and geophysical datasets in the context of their role in hazard assessment.

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

ENGRI 1270 - Introduction to Entrepreneurship for Engineers (3 Credits)
Crosslisted with MAE 1270
This course is intended for first-year students. A solid introduction to the entrepreneurial process to students in engineering. The main objective is to identify and to begin to develop skills in the engineering work that occurs in high-growth, high-tech ventures. Basic engineering management issues, including the entrepreneurial perspective, opportunity recognition and evaluation, and gathering and managing resources are covered. The fundamentals of supply and demand and other basic microeconomic terms are covered. Technical topics such as the engineering design process, product realization, and technology forecasting are discussed.
Last Four Terms Offered: Fall 2023, Fall 2022, Fall 2021, Fall 2020
Learning Outcomes:

- Students will be able to explore a multi-disciplinary look at high-technology entrepreneurial businesses.
- Students will define terms and be familiar with the general attributes of various funding sources.
- Students will calculate simple financial numbers, such as gross margin, net income, and cost of goods sold.
- Students will demonstrate familiarity with the basics of intellectual property terminology and laws in the USA.
- Students will be familiar with the basics of microeconomics, such as supply and demand, externalities, and competition.

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

ENGRI 1310 - Introduction to Biomedical Engineering (3 Credits)
Crosslisted with BME 1310
An introduction to the field of biomedical engineering with emphasis on application. Specific applications include biomechanics, bioimaging, bioinstrumentation, biotechnology/nanofabrication, artificial organs, cancer therapy and vaccines.
Enrollment Information: Enrollment limited to: first-year or sophomore Engineering students, or permission of instructor.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- To understand the underlying molecular, cellular, physiological and engineering that govern the field of biomedical engineering.

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

ENGRI 1337 - Innovating with Biological Engineering (3 Credits)
This course introduces the discipline that integrates biology with engineering. Students will explore how biological principles can be mimicked, harnessed, and interfaced to solve important societal problems at various scales. Topics include bioprocessing, wastewater, food production and processing, renewable energy, novel tools for improved health, and general biotechnology. Examples from bioprocessing applications, genetic engineering, and synthetic biology will be discussed, highlighting how biology can address societal and technological challenges.
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Learning Outcomes:

- Students will demonstrate improved ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as relevant global, cultural, social, environmental, and economic factors (ABET 2).
- Students will demonstrate the ability to acquire and apply new knowledge as needed, using appropriate learning strategies (ABET 7).

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

ENGRI 1510 - Modeling and Simulation of Real-World Scientific Problems (3 Credits)
Crosslisted with MAE 1510, CHEM 1350, CHEME 1510
Last Four Terms Offered: Spring 2022, Spring 2020, Spring 2019, Spring 2018
Schedule of Classes (https://classes.cornell.edu/)

ENGRI 1610 - Computing in the Arts (3 Credits)
Crosslisted with CS 1610, PSYCH 1650, MUSIC 1465
Over the centuries, artists in a wide variety of media have employed many approaches to the creative process, ranging from the philosophical to the mechanical to the virtual. This course unravels some of the mysteries going on inside software used for art and music. It looks at ways of breaking things apart and sampling and ways of putting things together and resynthesizing, and explores ideas for creation. This course does not teach software packages for creating art and music. The course complements ART 2701 and MUSIC 1421.
Distribution Requirements: (SMR-AS)
Last Four Terms Offered: Summer 2025, Summer 2024, Summer 2023, Summer 2022
Learning Outcomes:

- Understand, manipulate, and design algorithms and other processes for creating music and other art forms. Specific techniques may draw from stochastic, iterative, algebraic and geometric methods, amongst others.
- Have a degree of understanding of the design process -idea, formulation, specification, implementation, testing to refinement - and the development of effective interfaces.
- Have a basic understanding of the basics of probability, group theory, basic programming, feedback systems, sampling, and synthesis with emphasis on building applications via assisted process control (principles of simple programming).

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

ENGRI 1620 - Visual Imaging in the Electronic Age (4 Credits)
Crosslisted with ARCH 3702, ART 2907, CS 1620
Interdisciplinary survey course designed to introduce students in the creative arts, science, and engineering to the concepts of 2D and 3D digital pictorial representation and display. It is a concept course that concentrates on why rather than how. Topics include perspective representations, display technology, how television works, bandwidth concepts, digital photography, computer graphics modeling and rendering, color perception, 3D data acquisition, volumetric imaging, and historical precedents, primarily from the art world.
Distribution Requirements: (MQR-AAP)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)