

Earth and Environmental Science (EES)

Course information contained within the Bulletin is accurate at the time of publication in June 2025 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

EES 5011. Remote Sensing and GIS. 4 Credit Hours.

The focus of this class is on remote sensing technologies and geographic information systems. Remote sensing is a dynamic field; new, high-resolution satellites are coming on line almost daily, and there has been an exponential growth in applications of remote sensing data during the past decade, including: mineral exploration, precision agriculture, watershed management, land use classification, military intelligence, and climate monitoring. By the end of the semester you will have a fundamental understanding of the uses and limitations of remote sensing data for environmental applications, and a thorough familiarity with geographic information systems.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

EES 5015. Drone Short Course. 1 Credit Hour.

Drones are everywhere. This course offers a short introduction to use of drones, otherwise known as unmanned aerial vehicles (UAVs). Students will be taught use of drones in research and other societal applications, basics of flight and operation of drones, and regulations applicable to drone usage. This course does not provide certification to become a professional drone pilot, but the steps to certification will be reviewed, and the exam for recreational flying can be completed. Flying experience will be provided through indoor labs. Graduate students will complete a project involving photogrammetry. This course is typically offered in even-numbered years in the Spring.

Repeatability: This course may not be repeated for additional credits.

EES 5042. Coastal Processes. 4 Credit Hours.

The course will apply a process geomorphological approach to understanding coastal behavior, including global distribution of coasts, wave and tidal hydrodynamics, nearshore and aeolian sediment transport, and morphological signatures of extreme events.

Course Attributes: SI

Repeatability: This course may not be repeated for additional credits.

EES 5050. Special Topics in Field Investigations. 1 to 3 Credit Hour.

This is a field seminar designed to help graduate students develop critical field skills needed for a successful career in environmental science, geoscience, or sustainability. Students must submit a final written document at the conclusion of the field study. Must be taken with permission of the program director of graduate program.

Course Attributes: SF

Repeatability: This course may be repeated for additional credit.

EES 5051. Natural Hazards. 4 Credit Hours.

This course is typically offered in Spring.

This 4-credit lab course focuses on the physical processes that control natural disasters, why they may pose a risk to people or infrastructure, how to assess risk, and potential mitigation strategies. Labs are used to develop and analyze data characterizing these physical processes and defining risk; this work focuses on defining what can be measured, monitored, and predicted as the basis of the assessment. The first third of the course is devoted to solid earth hazards under the unifying paradigm of plate tectonics including earthquakes and volcanoes. The middle third of the course is devoted to weather hazards including storms/coastal hazards, floods, and landslides. The final third of the course is devoted to climate change, focusing on how hazards may change including extreme weather, heat waves/droughts, wildfire and feedbacks among hazards such as fire, erosion, and landslides. A critical aspect of the course is use of geoscience data tools to identify and analyze risk from topographic, remote sensing, hydrologic, and other data streams combined with hazard products developed by states, NOAA, FEMA, USGS, and other agencies.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

EES 5052. Fundamentals of Sustainability Science and Environmental Justice. 3 Credit Hours.

How can we apply science to promote intergenerational equity in the face of global environmental change? This graduate-level course provides a transdisciplinary introduction to sustainability science, exploring the complex interactions between human and environmental systems. Students will become acquainted with the key concepts, issues, and debates of this integrative field to apply a systems-thinking approach to solve real-world sustainability problems.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

EES 5101. Structural Geology (Graduate). 4 Credit Hours.

The purpose of this course is to train students in the concepts and techniques of structural geology. Students will learn how to collect, analyze, and interpret geologic data drawn from a variety of disciplines pertinent to structural geology and present a cohesive analysis and interpretation of these results. Results are presented as maps, reports, and computer models. A hypothesis driven term project will be conducted by the graduate student on a topic in structural geology. NOTE: This course differs from the undergraduate version EES 4101 through graduate specific laboratory and exam questions, readings, and the term project.

Repeatability: This course may not be repeated for additional credits.

EES 5234. Energy and Environment. 3 Credit Hours.

This course examines the scientific principles governing energy technologies and use, and the implications of energy development on our natural resources and environmental quality. The first part of the course will provide an introduction to the basic physical principles behind energy production, existing and emerging energy technologies, and energy use. The second part of the course will provide an understanding of the impacts associated with energy development on land, water and the atmosphere; impact assessment techniques; and interactions among energy, food and water resources. This course will provide an opportunity to familiarize with the future grand challenges in energy development in the context of changing climate and policy scenarios.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

EES 5343. Environmental Sensors. 1 Credit Hour.

Environmental monitoring using sensors is critical to improve our understanding of earth processes and climate, assessing the quality of the environment, developing and calibrating models to predict climate variability and hazards, designing and evaluating sustainable or "green" solutions, and guiding evidence-based environmental policy decisions. This course provides hands-on experience with implementing field-sensor systems to monitor the environment for research and citizen science projects. The students will familiarize with the fundamental operation principles of a variety of passive and active sensors used widely for long-term field measurements of meteorological and hydrological variables, field installation and maintenance, automation of data collection with data loggers and IoTs, telemetry, and best practices for acquiring and securing data.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

EES 5401. Analytical Methods in Mineralogy. 4 Credit Hours.

An introduction to the theory and application of X-ray diffraction and spectroscopic techniques for analysis of mineralogical samples. Students will learn the theory underpinning these methods, acquire skills in instrument operation, and apply these skills to research-relevant problems such as phase identification, site occupancy, chemical analysis, and planetary surface studies. Techniques discussed include powder X-ray diffraction, visible, Raman, and infrared spectroscopy, and synchrotron-based X-ray spectroscopic and scattering techniques.

Repeatability: This course may not be repeated for additional credits.

EES 5402. X-ray Crystallography. 4 Credit Hours.

Generation and use of x-rays for diffraction analysis; Analysis of clays and related minerals by x-ray diffraction; Crystal structure patterns and biogeochemical groups.

Repeatability: This course may not be repeated for additional credits.

EES 5406. Nanoscience and the Environment. 4 Credit Hours.

Nanotechnology has developed rapidly in the past decade, yet our knowledge of its environmental impact, particularly regarding the fate and behavior of nanomaterials in the environment, lags far behind. This course will cover a range of topics concerning nanomaterials in the environment, ranging from the unique size-dependent properties of nanomaterials to their applications in environmental remediation. The lab component of this course will include nanomaterial synthesis and characterization; nanomaterial transport, aggregation, deposition, transformation, and persistence in natural settings; environmental applications of nanomaterials; and nanomaterial characterization techniques, particularly electron microscopy.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

EES 5434. Ecohydrology. 3 Credit Hours.

Hydrological and ecological processes are tightly interrelated, with vegetation affecting the hydrological cycle, and hydrologic partitioning of the water budget affecting vegetation dynamics. This course builds on perspectives from ecology, hydrology, and soil science to focus on the emerging, interdisciplinary area of ecohydrology - the science that studies mutual interaction between the hydrological cycle and ecosystems. The first part of the course will deal with fundamental processes controlling the flow of water in the biosphere (in land, atmosphere, soil and plants) and the interactions with ecological processes and human dimensions at different scales. The second part will deal with the implications of ecohydrological feedbacks, covering a broad range of issues including global environmental change, land use change, global desertification/land degradation, urbanization, soil erosion, and the food-energy-water nexus. The concepts and principles discussed in the class will have broad applications ranging from finding innovative solutions to ecosystem degradation and food security, and designing global change responses.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

EES 5454. Introduction to Geophysics. 4 Credit Hours.

An introduction to gravity, magnetic, electromagnetic, and seismic exploration methods. Applications include environmental characterization, oil and mineral exploration, geotechnical engineering, and archeology.

Repeatability: This course may not be repeated for additional credits.

EES 5461. Low-Temperature Geochemistry. 4 Credit Hours.

Principles of aqueous geochemistry discussed within the framework of geologic processes. One or two field trips.

Repeatability: This course may not be repeated for additional credits.

EES 5462. Advanced Low-Temperature Geochemistry. 3 Credit Hours.

Study and discussion of topics in aqueous and sedimentary geochemistry.

Course Attributes: SI

Repeatability: This course may not be repeated for additional credits.

EES 5502. Ice and Global Climate. 4 Credit Hours.

We live in a time of rapid global warming and are faced with adverse effects on human society. Ice, in its various forms from snow to ice sheets, play an important role in the global climate system by, for example, modulating the solar-energy flux and global sea level. Ice also provides a unique archive of past climate history that contributed to our understanding of global warming today. This course will provide an overview of different forms of ice and their role in Earth's climate system, and foundations in physical understanding of how ice behaves at and near Earth's surface. In addition, contemporary techniques in observations of different forms of ice will be explored with examples in processing and interpretation of publicly available datasets. Prior to Fall 2023, the course title was "Glaciology."

Course Attributes: SE, SF

Repeatability: This course may not be repeated for additional credits.

EES 5506. Observing and Modeling Climate Change. 3 Credit Hours.

There is no scientific doubt that human activity has been influencing the climate system since the industrial era due to emissions of greenhouse gases and causing a rise in global mean temperature (i.e., global warming). While Earth's climate and temperature has fluctuated naturally in the past, the rate of current warming in response to human activity is unprecedented and is having a large impact on the climate system and living organisms on our planet. We are experiencing the effects of climate change today in the form of melting of sea ice, glaciers, and ice sheets, sea level rise, increases in the intensity of heat waves, change in frequency and intensity of droughts, extreme rainfall events, and wildfires. The results of climate model simulations suggest that the effects of climate change will worsen throughout the 21st century and beyond if we continue to emit greenhouse gases. In this course we will gain a foundational understanding of anthropogenic climate change and explore the evidence directly through hands-on analysis and visualization of real-world observational datasets. After investigating observational evidence, we will build an understanding of climate models, the experiments performed including climate projections, and how to access, analyze, and visualize publicly available model output. Along the way, students will gain experience in the tools that scientists use to analyze and visualize observational datasets and climate model output. While no prior computational knowledge is assumed, students will be introduced to aspects of the Python programming language, the command line interface, and GitHub. Course content and assignments will be centered around the use of Jupyter Notebooks. This course will be hands-on and assignment and project oriented, with in-class periods geared toward learning to analyze and visualize climate datasets.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

EES 5601. Vertebrate Paleontology and Taphonomy. 3 Credit Hours.

This course examines vertebrate fossils and their importance for interpreting and reconstructing terrestrial ecosystems. Students will learn the basics of vertebrate skeletal anatomy, interpret transport and depositional histories of skeletal elements and assemblages, and combine this information with geologic data to reconstruct paleoenvironmental settings and paleocommunity associations. Several class sessions will meet off-campus at local museums; one weekend field trip is required.

Repeatability: This course may not be repeated for additional credits.

EES 5625. Electron Optical Techniques. 4 Credit Hours.

This course will introduce the microanalytical and imaging methods of electron optical instruments such as the Electron Probe Microanalyzer (EPMA) and the Scanning Electron Microscope (SEM). The theory and operation of the instruments will be covered as will the interpretation of images and analytical results.

Repeatability: This course may not be repeated for additional credits.

EES 5702. Sedimentary Petrology. 4 Credit Hours.

This course explores the basic composition and texture of sedimentary rocks in order to understand depositional environment and provenance. This course focuses on sedimentation mechanics, petrography, and diagenesis. Includes a lab.

Repeatability: This course may not be repeated for additional credits.

EES 5725. Soils and Paleosols. 4 Credit Hours.

The course is divided into two parts: modern soils and paleosols. The goals of this course are to teach students the fundamentals of modern soil genesis and classification in order to interpret ancient soils preserved in the rock record (paleosols), and to incorporate models of soil genesis into the traditional geology paradigm. Students will be exposed to a combination of laboratory methods and field work.

Repeatability: This course may not be repeated for additional credits.

EES 5801. Quantitative Structural Geo. 4 Credit Hours.

Repeatability: This course may not be repeated for additional credits.

EES 5802. Tectonics. 3 Credit Hours.

Plate tectonic theory. Structure and geometry of lithospheric plates; mechanisms of divergent, transform and convergent boundaries; subduction; obduction; mantle plumes; large igneous provinces; large sedimentary basins and Phanerozoic orogenic belts.

Repeatability: This course may not be repeated for additional credits.

EES 5811. Planetary Geology. 4 Credit Hours.

This course explores the modern and ancient geologic processes on other planets and discusses how studies of other planets can aid us in a better understanding of our Earth. The course will also cover topics such as planetary exploration and astrobiology. Includes a lab.

Repeatability: This course may not be repeated for additional credits.

EES 8000. Geology Seminar. 1 Credit Hour.

Required of M.A. students. Visiting specialists in a wide variety of geologic fields will lecture and discuss their research.

Repeatability: This course may be repeated for additional credit.

EES 8082. Independent Study Program. 1 to 3 Credit Hour.

Limited to Geology graduate students with permission from the department.

Repeatability: This course may be repeated for additional credit.

EES 8200. Graduate Geology Seminar. 3 to 6 Credit Hours.

Advanced seminar course; subject matter varies from semester to semester. The educational objectives of the course are to focus on current issues at the interfaces of geological processes through advanced technological methods of analysis.

Repeatability: This course may be repeated for additional credit.

EES 8411. Advanced Hydrogeology. 3 to 4 Credit Hours.

This course is typically offered in Spring.

This course covers water resources with an emphasis on groundwater. Topics include quantifying groundwater flow, groundwater-surface water interactions, contaminant transport, and a brief introduction to modeling. Problem sets and labs are used to develop specific skills, including field techniques.

Repeatability: This course may not be repeated for additional credits.

EES 8421. Groundwater Modeling. 3 Credit Hours.

This course offers students a chance to construct models using well known codes such as MODFLOW and other practical tools. The goals of this course are: learn tools for groundwater flow modeling, be able to recognize how to judge models and compare them with reality, and gain computer skills that can be used with a wide variety tools.

Course Attributes: SI

Repeatability: This course may not be repeated for additional credits.

EES 8701. High Temperature Reactions. 4 Credit Hours.

Thermodynamic laws and theory are used to discuss igneous and metamorphic processes. Exact field relationships are combined with thermodynamics to solve applied petrologic problems.

Repeatability: This course may not be repeated for additional credits.

EES 8706. Regional Geology. 3 Credit Hours.

Discussion of the geologic history and tectonics of selected regions.

Repeatability: This course may not be repeated for additional credits.

EES 8711. Economics of Geo Ore Deposits. 3 Credit Hours.

Study of the geology, origin, distribution, economics and extraction methods of major classes of ore deposits.

Repeatability: This course may not be repeated for additional credits.

EES 8911. Teaching of Geology. 0 to 1 Credit Hours.

Required of all teaching assistants in their first semester of teaching. Instruction and evaluation of teaching laboratory, or discussion sections.

Repeatability: This course may be repeated for additional credit.

EES 9991. Master's Research Projects. 1 to 6 Credit Hour.

Short-term, limited research project or laboratory project in the field. This course is not the capstone project course, nor can it be used for thesis based research. The course is for master's students only, including PSM, MA or MS. This class will not confer full-time program status unless nine credits are taken.

Repeatability: This course may be repeated for additional credit.

EES 9993. Comprehensive Examination Prep. 1 Credit Hour.

This 1-credit seminar is designed to prepare students for the MS Comprehensive Exam given at the end of this course, ensuring a fundamental grounding in Earth Science. Students will study material covered in the exam including hydrogeology, geophysics, sedimentology/stratigraphy, earth history, geomorphology, structural geology, GIS, geochemistry, mineralogy and petrology. MS students will take this course in the Spring semester of their first year.

Repeatability: This course may not be repeated for additional credits.

EES 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.

This course is required for students who are preparing for the preliminary or candidacy examination. Students should enroll after coursework is completed or when preparing for the candidacy exam until the time that the preliminary or candidacy examination is completed. This course will confer full-time status at the minimum credit hour registration limit of one credit. All students must complete a minimum of one credit of this course. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Repeatability: This course may be repeated for additional credit.

EES 9995. Capstone Project. 1 to 6 Credit Hour.

Capstone project for master's students including students in PSM, MA or MS. This class will provide full-time status. Students in PSM programs need to register for at least one credit of this course to fulfill program requirements. Additional credits may be required for specific programs. This course will confer full-time status at the minimum credit hour registration limit of one credit.

Repeatability: This course may be repeated for additional credit.

EES 9996. Master's Thesis Research. 1 to 6 Credit Hour.

Course for master's thesis research. Only intended for students in thesis bearing master's programs. A minimum of one credit is required. This course will confer full-time status at the minimum credit hour registration limit of one credit.

Repeatability: This course may be repeated for additional credit.

EES 9998. Pre-Dissertation Research / Elevation to Candidacy. 1 to 6 Credit Hour.

This course is intended for students who are performing research prior to candidacy. Students can register for this course after required courses are completed. This course will confer full-time status at the minimum credit hour registration limit of one credit. Students must be registered for this course during the semester that they are to be elevated to candidacy examination. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Repeatability: This course may be repeated for additional credit.

EES 9999. Dissertation Research. 1 to 6 Credit Hour.

The course is for Ph.D. students who have been elevated to candidacy. During the course of their candidacy students must complete a minimum of two credits of dissertation research. This course will confer full-time status at the minimum credit hour registration limit of one credit. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Repeatability: This course may be repeated for additional credit.