

NATURAL RESOURCES AND THE ENVIRONMENT (NRE)

NRE 5115. Field Methods in Hydrogeology. (3 Credits)

Field methods associated with ground water and contamination assessments.

Enrollment Requirements: Not open to students who have passed EARTH 5790.

NRE 5150. Ecosystem Science and Management. (3 Credits)

Ecosystem biogeochemical processes, the organism-environment interactions that regulate them, and natural resources management strategies that explicitly consider ecosystem structure and function.

Enrollment Requirements: This course and NRE 4150 may not both be taken for credit.

NRE 5175. Regional Climate Modeling. (3 Credits)

How physical processes in climate and environmental systems - such as atmospheric motion, hydrological processes and transport of atmospheric constituents - are represented in numerical models. Topics include classification of numerical models, steps in climate and environmental (mathematical) modeling, conservation theories of mass and energy, mass balance equations, numerical techniques, and initial and boundary conditions.

Enrollment Requirements: Recommended preparation: Undergraduate calculus I and II.

NRE 5180. Climate Change Adaptation Science. (3 Credits)

An overview of climate change adaptation science including knowledge, principles, and applications of adaptation practices, technologies, tools, and strategies. Topics include the scientific evidence of anthropogenic climate change, climate change impacts on our lives and society, two-way relationships between climate change and humans, and multiple approaches applied in adaptation across diverse sectors (agriculture, forestry, fisheries, etc.) from local to regional and global scales. Emphasis on the fundamental concepts of climate change adaptation science, different disciplinary perspectives and interconnections, and its effectiveness, limitations, and future needs.

NRE 5200. Sustainable Natural Resources Management. (3 Credits)

Explores social-ecological systems, including relationships between ecosystem services and human well-being and livelihoods; introduces systems theory for understanding disturbance, feedbacks, thresholds, directional change, adaptation and resilience in social-ecological systems; includes applied case studies in sustainable agriculture, fisheries, forestry, freshwater, marine, and wildlife.

NRE 5205. Decision Methods in Natural Resources. (3 Credits)

Aspects and methods of decision making for individuals, organizations, and institutions, including structured decision making, adaptive resource management, and organizational learning; concepts and techniques for managing risk and uncertainty, model-based and experience-based approaches to link alternative actions and consequences, tradeoff and optimization approaches, and monitoring and evaluation of resulting outcomes.

NRE 5210. Communications for Environmental Decision Makers. (3 Credits)

Methods and techniques for effective communication with diverse audiences using written, spoken, and digital media; includes conflict resolution, crisis situations, persuasion, negotiation, marketing and advocacy.

NRE 5215. Introduction to Geospatial Analysis with Remote Sensing. (3 Credits)

Introduction to collecting, managing, displaying, and analyzing geospatial data. Topics include coordinate systems, finding and using existing sources of geospatial data, analysis of vector and raster data, creating geospatial data with remote sensing, concepts of Global Positioning System (GPS), topographic and landscape analyses, and spatial interpolation.

NRE 5220. Environmental Planning for Sustainable Communities and Regions. (3 Credits)

Principles of environmental planning with application to human health, natural areas, working landscapes, and built environments; basis and context for planning, including laws, regulations, zoning, compliance, uncertainty, and risk management.

NRE 5225. Sustainable Use of Ocean Resources. (3 Credits)

Introduction to the marine environment and associated environmental, social, and economic issues. Topics include marine ecology and ecosystem services, human drivers of change and trends related to the ocean, ocean-based industries and activities, coastal and marine pollution, ocean policy and law, sustainable use of living marine resources, and ecosystem management strategies to aid conservation efforts.

Enrollment Requirements: Department consent.

NRE 5230. Sustainability Leadership in Organizations. (3 Credits)

Organizational leadership strategies for adopting sustainability practices to develop a culture of sustainability and a commitment to advancing environmental, social, and economic benefits for multiple stakeholders, (e.g., employees, partners, society, and the environment). Viewed through an interdisciplinary lens, students will examine challenges and opportunities that organizations face in various sectors, covering topics such as pollution prevention, circular economy, "triple bottom line," "greening" the supply chain, UN SDGs, key performance indicators (e.g., customer satisfaction, return on investment), and assessment of progress toward achieving sustainability goals, among other topics. Case studies and practical applications will be emphasized.

NRE 5235. Water, Society, and Sustainability. (3 Credits)

Introduction to the science and practice of sustainable water management in the context of global environmental changes. Topics include water demand and budgets; water quality challenges (PFAS, road salt, nutrients, invasive species); management of surface water and groundwater for drinking water, wastewater, irrigation, hydropower, and recreation; inland wetlands; legal and economic dimensions; flood-risk analysis; and freshwater-marine linkages.

NRE 5255. Water Quality Management. (3 Credits)

An introduction to all aspects of water quality problems relating to the many beneficial uses of water, including the physical, chemical, and biological properties. Taught with NRE 4255.

Enrollment Requirements: Recommended preparation: NRE 3125. Not open for credit to students who have passed NRE 4255.

NRE 5325. Wildlife Management. (1-6 Credits)

The application of ecological principles as practiced by natural resource agencies throughout North America.

NRE 5335. Advanced Stream Ecology. (3 Credits)

A broad overview of stream ecology will be presented. Topics covered will include stream habitats and the diversity of organisms which inhabit them, adaptations to life in running water, and energy flow and nutrient cycling in stream ecosystems. Efforts targeted at the conservation of streams will be integrated throughout the semester. One or more field trips required. Instructor consent required. Taught with NRE 4205.

Enrollment Requirements: Instructor consent. Not open for credit to students who have passed NRE 4205.

NRE 5340. Ecotoxicology. (3 Credits)

Introduction to the current state of environmental toxicology knowledge and research. Relevant concepts in ecosystem science, toxicology, and public health are taught within the framing of historic and current case studies of environmental contamination problems. Term paper and presentation are required.

Enrollment Requirements: Recommended preparation: prior coursework in ecology or environmental biology, and environmental chemistry.

NRE 5370. Population Dynamics. (3 Credits)

How population dynamics models are used in science and in the management of fish and wildlife populations, factors influencing population dynamics. Design, evaluation, and use of a population model. Students will complete activities in the R scripting language. Taught concurrently with NRE 4370.

Enrollment Requirements: Recommended preparation: STAT 1100Q, MATH 1060Q or higher, and NRE 3345.

NRE 5390. Advanced Wetland Ecology. (3 Credits)

The current state of wetlands research and field methods used to quantify wetland vegetation, hydrology, and soils. Discussions of the primary literature will be complemented by field trips to a variety of wetlands to implement field techniques and explore wetland natural history, classification, biogeochemistry, and responses to anthropogenic stressors.

Enrollment Requirements: Instructor consent required. Recommended preparation: prior coursework in ecology and wetland science.

NRE 5461. Landscape Ecology. (3 Credits)

Interdisciplinary focus on the effect of landscape pattern on environmental processes and conditions and the influence of disturbance and underlying geomorphology on landscape pattern. Consideration of landscape ecology principles in planning and management of pattern and processes in which conservation and production land uses are intermingled.

NRE 5525. Remote Sensing of the Environment. (3 Credits)

Introduction to remote sensing theory and practice. Includes electromagnetic radiation, spectral reflectance, earth observation platforms and sensors, image processing methods, and multidisciplinary applications.

Enrollment Requirements: Instructor consent.

NRE 5535. Remote Sensing Image Processing. (3 Credits)

A variety of related topics that include the physical processes involved in remote sensing and various image processing methods. The labs will be primarily focused on how to use image processing software (e.g., ENVI) to analyze satellite imagery.

Enrollment Requirements: A course in remote sensing of the environment.

NRE 5545. Quantitative Remote Sensing Methods. (3 Credits)

Quantitative remote sensing methods for solving real-world problems, and methods for quantitative analysis of remotely sensed imagery plus various remote sensing applications.

Enrollment Requirements: A course in remote sensing image processing.

NRE 5560. High Resolution Remote Sensing: Applications of UAS and LiDAR. (3 Credits)

Introduction to high-resolution remote sensing data and collection platforms. The first half of the course focuses on unmanned aerial systems (UAS) including operations, data collection, and post-processing of acquired data. Topics include laws, safety, and ethical considerations; mission planning, sensor selection, and photogrammetric processing of the collected data in commercial software. The second half of the course focuses on the fundamentals of light detection and ranging (LiDAR) and applications of LiDAR in mapping and environmental analysis. Topics include LiDAR point-cloud visualization and interpretation, creation of digital elevation and surface models, and feature extraction using ArcGIS and LAS Tools.

NRE 5585. Python Scripting for Geospatial Analysis. (3 Credits)

GIS scripting techniques in Python for geospatial analyses, enabling students to pursue integrated research in earth resources data geoprocessing applications.

Enrollment Requirements: Instructor consent. Recommended preparation: NRE 5215 or equivalent.

NRE 5605. Environmental Data Analysis. (3 Credits)

Develop proficiency in fundamental data analytic techniques in the R scripting language commonly used in environmental science and engineering with applications spanning practice and research. Topics include: trend detection, numerical approaches to model fitting, cluster analysis, and introductory machine learning methods.

Enrollment Requirements: Recommended preparation: a course in introductory linear algebra and introductory statistics. May be repeated for a total of 3 credits

NRE 5615. EnviroAI: Artificial Intelligence Applications in Environmental Management. (3 Credits)

Introduces students to the application of artificial intelligence (AI) and machine learning (ML) techniques from the rapidly growing field of AI to address environmental challenges. Through case studies on topics such as earth observation, forest ecosystems, water resources, wildlife and fisheries, and climate resilience, students will gain experience applying AI techniques to real-world environmental data. The course is designed to balance breadth and practice - providing an overview of applications across environmental domains while also offering manageable hands-on experiences that build practical skills without requiring in-depth technical expertise. Students will work with open-source datasets and AI tools, while critically examining the promises and limits of AI in advancing sustainability. Emphasizes both technical literacy and policy relevance, and prepares students to evaluate, design, and responsibly apply AI in environmental management contexts.

NRE 5665. Ecosystem Modeling. (3 Credits)

Overview of ecosystem modeling science including knowledge, principles, and applications as a tool for sustainable resource management, conservation, and global environmental change. Topics include ecosystem concept, hydrologic and biogeochemical pathways, changes through space and time, global ecosystem dynamics, the status and role of modeling in ecosystem sciences, the modeling process, and applications of ecosystem models. Emphasis on the conceptual terrestrial-ecosystem model development to be used as a basis for studying specific research questions in the context of global changes, and its effectiveness, limitations, and future needs.

Enrollment Requirements: Recommended preparation: Basic knowledge of ecosystem ecology science.

NRE 5695. Special Topics in Natural Resources. (1-4 Credits)

Advanced topics in the field of natural resources. Topics and credits to be published prior to the registration period preceding the semester offerings.

Enrollment Requirements: Instructor consent.

May be repeated for a total of 6 credits

NRE 5698. Natural Resources Colloquium. (1-6 Credits)

Study and discussion of readings (journal articles, books, current research) on a selected topic in natural resources.

May be repeated for a total of 6 credits

NRE 5699. Independent Study. (1-3 Credits)

May be repeated for a total of 18 credits

NRE 5800. Graduate Seminar. (1 Credit)

Weekly meetings focused on recent advances in Natural Resources and Environmental Sciences, including departmental seminars and/or discussions of scientific literature.

May be repeated for a total of 4 credits

NRE 5830. Internship in Energy and Environmental Management. (3 Credits)

Integrate core concepts of the Energy and Environmental Management program with planned and supervised experience in the public or private sector. Students complete an internship or research project that applies knowledge and skills, gains professional experience, and builds networks with prospective employers.

Enrollment Requirements: NRE 5200, 5220, or LAW 7812; open to majors or non-degree students in the Master of Energy and Environmental Management program, instructor consent required.

NRE 5850. Practicum in Energy and Environmental Management. (3 Credits)

Application and synthesis of core concepts of the Energy and Environmental Management program with project-based work in student's area of emphasis.

Enrollment Requirements: NRE 5200, 5220 and LAW 7812; instructor consent required.

NRE 6000. Research Methods in Natural Resources. (3 Credits)

General research techniques, writing scientific articles and grant proposals, problem solving approaches, experimental design and modeling concepts, and research ethics.

NRE 6135. Small Watershed Modeling. (3 Credits)

Students will develop proficiency in fundamental modeling principles used to describe watershed hydrology and various associated ecosystem functions. Topics include ecohydrology focusing on catchment water and energy balances, hydrologic modeling (potential evapotranspiration, snow accumulation and melt, soil moisture, plant growth, surface runoff), forest-water modeling, introduction to model sensitivity and calibration techniques, application of tracers in ecohydrology, issues in parameterized hydrologic model climate-transferability, and basic R scripting.

Enrollment Requirements: Recommended preparation: A general familiarity with R scripting.

NRE 6450. Teaching Practicum. (3 Credits)

Doctoral students in the Natural Resources: Land, Water, and Air program take primary teaching responsibility for a course under the supervision of a faculty liaison.

May be repeated for a total of 6 credits

NRE 6500. Grant Proposal Writing. (2 Credits)

Designed for Ph.D. students in natural resource and associated environmental fields. Provides students with experience in individual and collaborative grant and funded-project proposal writing. Students will gain an overview of federal, state, and private funding organizations, and familiarity with the proposal review process. By the end of the course, students will have developed a draft grant or funded-project proposal targeted to a current request for research proposal (RFP/RFA) or other ongoing funding program relevant to their disciplinary expertise.

Enrollment Requirements: Recommended preparation: NRE 6000.