

# ENST - ENVIRONMENTAL SCIENCE AND TECHNOLOGY

## ENST403 Invasive Species Ecology (3 Credits)

We will examine ecological, evolutionary, and anthropogenic processes facilitating or resisting biological invasions, and consider their environmental, economic, and human health impacts. We will consider various management strategies to mitigate invasions and identify areas of future research. Field trips and detailed discussion of recent findings and controversies in the literature will help illustrate fundamental concepts of invasions among various ecosystems.

**Credit Only Granted for:** ENST403, ENST603, or ENST689R.

## ENST404 Ecological and Natural Resources Ethics (3 Credits)

Bridges science and management with ethical theory and concepts to help scientists, regulators, and managers understand how to deal with potential ethical dilemmas that arise in natural resource and environmental management implementation and policy development.

**Prerequisite:** ENST214 and ENST360.

**Recommended:** ENST314, ENST410, and ENST460.

**Restriction:** Senior standing or higher. Jointly offered with ENST604.

**Credit Only Granted for:** ENST604 or ENST404.

## ENST405 Energy and Environment (3 Credits)

Introduction to the role of energy in environmental and human-dominated systems. Discussion of the historical and modern production and consumption of energy. Introduction to energy systems computer simulation and energy auditing.

**Prerequisite:** MATH140 or MATH120; or must have completed MATH220.

**Restriction:** Junior standing or higher. And must be in Environmental Sci & Tech program; or must be in Environmental Sci & Tech: Ecological Tech Design program; or must be in Environmental Sci & Tech: Environmental Health program; or must be in Environmental Sci & Tech: Soil & Watershed Science program; or must be in Environmental Sci & Tech: Natural Resources Mgmt program. Jointly offered with ENST605.

**Credit Only Granted for:** ENST405, ENSP350, ENST605, or MEES698Z.

## ENST406 Applied Forestry Practices (3 Credits)

Focuses on the applied dynamics of a set of forest practices such as management, silviculture, measurement and inventory, preparation of a management plan, etc, within the urban/rural interface. Several field trips are included to gain hands-on experience.

**Prerequisite:** ENST200. And ENST360; or PLSC471. Cross-listed with PLSC475.

**Credit Only Granted for:** ENST406 or PLSC475.

## ENST410 Ecosystem Services: An Integrated Analysis (3 Credits)

The importance of our ecosystems and the services they provide will be discussed. Basic principles used to analyze ecosystem services will be discussed and applied using case studies & field exercises. Forestland, wetlands and our marine resources are increasingly recognized for their ecosystem services provided to society, to include clean air and water, wildlife habitat, biodiversity, carbon storage and pollination services. This course will prepare students to deal with the complex issues involved in understanding those and other ecosystem services and their importance to society and environmental sustainability. Slowly, new markets are emerging for these services. Students will analyze the ecological, policy and financial dimensions of enhancing, restoring, and sustaining ecosystem services. New and on-going government programs and private business ventures will be discussed.

**Prerequisite:** ENST360 or BSCI361; or permission of instructor.

**Restriction:** Must be in one of the following programs (Environmental Sci & Tech: Ecological Tech Design; Environmental Sci & Tech; Environmental Sci & Tech: Natural Resources Mgmt; Environmental Sci & Tech: Soil & Watershed Science; Environmental Sci & Tech: Environmental Health).

## ENST411 Principles of Soil Fertility (3 Credits)

Soil factors affecting plant growth and quality with emphasis on the bio-availability of mineral nutrients. The management of soil systems to enhance plant growth by means of crop rotations, microbial activities, and use of organic and inorganic amendments.

**Prerequisite:** ENST200; or students who have taken courses with comparable content may contact the department. Jointly offered with ENS T611.

**Credit Only Granted for:** ENST411 or NRSC411.

**Formerly:** NRS C411.

## ENST414 Soil Morphology, Genesis and Classification (4 Credits)

Processes and factors of soil genesis. Taxonomy of soils of the world by U.S. System. Soil morphological characteristics, composition, classification, survey and field trips to examine and describe soils.

**Prerequisite:** Must have completed or be concurrently enrolled in ENST200.

## ENST415 Renewable Energy (3 Credits)

An overview of renewable energy technologies and their current applications. Emphasis will be placed on technological readiness, efficiency and sustainability of renewable energy alternatives. Technologies include solar thermal, photovoltaics, biodiesel, ethanol, anaerobic digestion, wind, hydroelectric, and microbial fuel cells.

**Prerequisite:** CHEM131, PHYS121, and MATH113; or permission of AGNR-Environmental Science & Technology department.

**Restriction:** Must be in a major within AGNR-Environmental Science & Technology department.

## ENST417 Soil Hydrology and Physics (3 Credits)

A study of soil water interactions: the hydrologic cycle; the unique properties of water and soil; the soil components and their interactions; the field water cycle; transport processes involving water, heat and solutes; human effects on soil and groundwater; as well as the measurement, prediction, and control of the physical processes taking place in and through the soil.

**Prerequisite:** ENST200; and (MATH113 or MATH115).

## ENST421 Soil Chemistry (4 Credits)

The chemistry and composition of mineral and organic colloids in soils, including ion exchange, oxidation-reduction, acidity, surface charge, and solution chemistry. Lectures and readings pertain to plant nutrition, waste disposal, and groundwater quality.

**Prerequisite:** ENST200.

**ENST422 Soil Microbial Ecology (3 Credits)**

The interdisciplinary study of soil microorganisms and their interactions with the mineral matrix; resulting in processes such as nutrient cycling, decontamination, and natural product production. We will focus on the diversity of soil communities, their survival strategies, and the new strategies used to study these communities.

**Prerequisite:** ENST200; or 1 course in BCHM; or must have completed a course in microbiology; or students who have taken courses with comparable content may contact the department. Jointly offered with: ENST622.

**ENST423 Soil-Water Pollution (3 Credits)**

Reaction and fate of pesticides, agricultural fertilizers, industrial and animal wastes in soil and water with emphasis on their relation to the environment.

**Prerequisite:** ENST200.

**ENST430 Wetland Soils (3 Credits)**

The soils of wetlands including hydrology, chemistry, and genesis are discussed. Federal and regional guidelines for wetland soils are covered with an emphasis on validating interpretations through field observations.

**Prerequisite:** ENST200.

**Credit Only Granted for:** ENST430 or ENST630.

**ENST432 Environmental Microbiology (3 Credits)**

Microorganisms are everywhere and mediate many of the processes that we observe everyday. These organisms are the unseen catalysts for numerous industrial processes and are critical to many emerging technologies and novel products. Environmental microbiologists ask: How do microorganisms in the environment benefit society? This course will answer this question by examining microbes in bioremediation, food safety, climate change, and biotechnology.

**Prerequisite:** CHEM131 and CHEM132.

**ENST434 Toxic Contaminants: Sources, Fate, and Effects (3 Credits)**

Study of the release to the environment, transport through natural compartments, persistence and ultimate fate of various classes of contaminants produced as a result of human activities. Topics will culminate in discussions of impacts to wildlife and human health. Students should emerge with a practical appreciation of the actual risks from exposure to a variety of environmental contaminants and an understanding of the environmental and human health implications of continuing the contaminating activities.

**Prerequisite:** ENST333 and ENST334.

**ENST436 Emerging Environmental Threats (3 Credits)**

Examine new and potential environmental concerns in the air, water, soil, space, and the built environment. Emphasis on studying the intrinsic links between ecosystem and human health. Topics will include climate change, resource consumption, biodiversity change, infectious disease, non-traditional pollutants, and other complex and significant environmental concerns.

**Prerequisite:** ENST233; or permission of AGNR-Environmental Science & Technology department.

**ENST441 Sustainable Agriculture (3 Credits)**

Environmental, social and economic needs for alternatives to the conventional, high-input farming systems which currently predominate in industrial countries. Strategies and practices that minimize the use of non-renewable resources.

**ENST445 Ecological Risk Assessment (3 Credits)**

Assessment of ecological impacts of perturbations on natural systems. Course will describe methods for estimating environmental impacts including extrapolating from laboratory and field data. The role of regulatory agencies and implications of scientific uncertainty on risk management will be covered.

**Prerequisite:** ENST360 or BSCI361; and (BIOM301 and ENST334). Or permission of AGNR-Environmental Science & Technology department.

**ENST450 Wetland Ecology (3 Credits)**

Plant and animal communities, biogeochemistry, and ecosystem properties of wetlands. Lectures are supplemented by field trips (normally 2 days total during the semester) and in-class labs. Hands-on activities and exercises include identification of wetland plant species, wetland mapping and delineation, and collection and analysis of field data on wetland vegetation, soil, and hydrology. Wading boots (at least hip length) are strongly recommended.

**Prerequisite:** BIOM301 and ENST360; or permission of AGNR-Environmental Science & Technology department.

**Restriction:** Permission of AGNR-Environmental Science & Technology department. Jointly offered with: ENST650.

**Credit Only Granted for:** ENST450, ENST650, or MEES650.

**ENST452 Wetland Restoration (3 Credits)**

Design, construction, and evaluation of wetlands restored or created to provide ecosystem services or to mitigate losses due to development. Topics include fundamental properties of wetlands, ecological restoration theory, site selection and goal-setting, design plans, practices for establishing wetland hydrology, substrate, and vegetation, and restored ecosystem monitoring.

**Prerequisite:** (BSCI160 and BSCI161; or BSCI106); and (BSCI362, ENST450, ENST360, or BSCI361).

**ENST453 Watershed Science: Water Balance, Open Channel Flow, and Near Surface Hydrology (3 Credits)**

Concepts of surface water balance, surface radiative flux, precipitation and evaporation measurements.

**Credit Only Granted for:** ENST453 or ENST653.

**ENST456 Spatial Analysis and Ecological Sampling (3 Credits)**

Teaches ENST students ecological sampling methods and applied spatial analysis skills. Students will work in small groups on research projects they develop and test during the semester. Students will develop a research hypothesis, test their hypothesis, display it visually in QGIS, and analyze it with appropriate statistical methods in QGIS and R Studio culminating in a final presentation.

**Recommended:** GEOG306 and GEOG373.

**Restriction:** Senior standing or higher; and permission of instructor.

**ENST460 Principles of Wildlife Management (3 Credits)**

Ecological principles and requirements of wildlife as basis for management, and introduction to the scientific literature. Conflicts in wildlife management, government administration of wildlife resources, legislation, and history of the wildlife management profession.

**Prerequisite:** Must have completed two semesters of biology laboratory; and (ENST360; or BSCI361). Or permission of AGNR-Environmental Science & Technology department.

**ENST461 Urban Wildlife Management (3 Credits)**

Ecology and management of wildlife in urban areas. For students in biological sciences, geography, landscape design, natural resources management, recreation and urban studies. Planning, design, and wildlife conservation in landscape ecology. Public attitudes, preferences, and values, review of private conservation organizations.

**ENST462 Field Techniques in Wildlife Management (3 Credits)**

Hands-on experience with field techniques in wildlife management focusing on various methods of conducting indices, estimates, and censuses of wildlife populations. Includes capture and handling of amphibians, reptiles, birds, and mammals by use of drift fences, cover boards, mist nets, box traps, and dart guns.

**Prerequisite:** ENST460. And BSCI160 and BSCI161; or BSCI106. And BSCI170 and BSCI171; or BSCI105.

**Recommended:** ENST461.

**Restriction:** Permission of AGNR-College of Agriculture & Natural Resources.

**ENST470 Ideas into Impact (3 Credits)**

This will be a capstone-type course based around developing proposals for projects emphasizing research, monitoring, design, restoration, management, entrepreneurship, or other approaches to ecological or environmental questions, issues, or problems.

**Restriction:** Junior or Senior standing only; Permission of AGNR-Environmental Science & Technology department.

**ENST472 Capstone (3 Credits)**

This capstone course focuses on professional project preparation, presentation, and critical evaluation on environmental science research. Students will develop and present original projects and critique projects presented by others.

**Restriction:** Must be in a major within AGNR-Environmental Science & Technology department; and permission of AGNR-Environmental Science & Technology department.

**Additional Information:** This is the pinnacle course for students majoring in ENST and is therefore recommended in one of the students' final semesters.

**ENST481 Ecological Design (4 Credits)**

An advanced survey course on the field of ecological design. Principles of design are illustrated with case studies from biologically-based waste treatment systems, ecosystem management and sustainable development. Concepts covered include ecology, ecological engineering, nutrient cycling, energy, lifecycle analysis, and design process. Technologies include treatment wetlands, living machines, anaerobic digestion, rain gardens, bioswales, bioremediation, algal turf scrubbers, and green building design.

**Prerequisite:** (MATH120 or MATH140; or must have completed MATH220); and (PHYS121 and CHEM131); and (BSCI361; or students who have taken courses with comparable content may contact the department). Or permission of instructor.

**Restriction:** Permission of AGNR-Environmental Science & Technology department. Jointly offered with: MEES681.

**Credit Only Granted for:** ENST481, ENST681, or MEES681.

**ENST485 Water Management in Urban Environment (3 Credits)**

Historically, with the exception of certain locations, water has been available in sufficient quantities, and providing supporting infrastructure has been relatively straightforward. In urban areas, the concentration of people and the drastic changes in land use, have altered the fluxes of water, sediments, chemicals, and microorganisms. As the population increases and the number of large urban areas keeps growing (both in U.S. and internationally), managing water in urban areas is becoming more challenging. Water must be supplied for domestic, commercial, and industrial use, as well as irrigation and maintaining and enhancing local environments (e.g., urban streams). In addition, stormwater must be managed to prevent flooding and environmental damage, and used water, which contains organic matter, nutrients, and other constituents that can be extracted and reused, must be collected and managed. In this course we take a systems approach to urban water hydrology, engineering, planning and management. We will explore urban water cycle, urban runoff and drainage characteristics, urban water supply and demand, stormwater collection and treatment and designing best management practices. Additionally, we look at the climate impacts on the urban water cycle.

**Prerequisite:** MATH120, MATH130, MATH136, or MATH140.

**ENST486 Senior Professional Experience (3 Credits)**

Students will arrange an off-campus professional-level work experience related to Environmental Science and Technology (ENST) to develop expertise in a specific area of their ENST concentration curriculum. Classroom sessions will frame student experiences within the broader discipline of Environmental Science and Technology. This course will tie together current practices in the ENST career industry, proposal writing, critical analysis, and culminate in a final paper and presentation.

**Prerequisite:** ENST389.

**Restriction:** Must be in the Environmental Science and Technology program; and permission of AGNR-Environmental Science & Technology department.

**ENST487 Environmental Conflicts and Decision Making (2 Credits)**

Study major cases which focus on environmental science with concentration on the role and techniques of negotiation, collaborative decision making, and adaptive resource management as an environmental conflict resolution process.

**Restriction:** Senior standing. And must be in one of the following programs (Environmental Sci & Tech: Natural Resources Mgmt; Environmental Sci&Pol-Wildlife Ecology & Mgmt); or permission of AGNR-Environmental Science & Technology department.

**ENST489 Research Experience (3 Credits)**

An advanced research-based course in the field of environmental science and technology.

**Restriction:** Permission of AGNR-Environmental Science & Technology department.

**Repeatable to:** 6 credits.

**ENST499 Special Topics in Environmental Science and Technology (1-4 Credits)**

An independent study, and/or lecture, and/or laboratory series organized to study a selected phase of Environmental Science and Technology not covered by existing courses. Credit arranged with supervising faculty member.

**Restriction:** Permission of AGNR-Environmental Science & Technology department.

**ENST602 Research Principles and Methodology in Environmental Science and Technology (3 Credits)**

Fundamental research strategies and methods of investigation in Environmental Science and Technology including field and laboratory procedures.

**Restriction:** Must be in Environmental Sci & Tech program.

**ENST603 Advanced Invasive Species Ecology (3 Credits)**

We will examine ecological, evolutionary, and anthropogenic processes facilitating or resisting biological invasions, and consider their environmental, economic, and human health impacts. We will consider various management strategies to mitigate invasions and identify areas of future research. Field trips and detailed discussion of recent findings and controversies in the literature will help illustrate fundamental concepts of invasions among various ecosystems. Jointly offered with ENST403.

**Credit Only Granted for:** ENST403, ENST603, or ENST689R.

**Formerly:** ENST689R.

**Additional Information:** Two field trips are planned for this class.

**ENST604 Advanced Ecological and Natural Resource Ethics (3 Credits)**

Bridges science and management with ethical theory and concepts to help scientists, regulators, and managers understand how to deal with potential ethical dilemmas that arise in natural resource and environmental management implementation and policy development.

**Prerequisite:** ENST214 and ENST360.

**Recommended:** ENST314, ENST410, and ENST460.

**Credit Only Granted for:** ENST404 or ENST604.

**ENST605 Energy and Environment (3 Credits)**

Role of energy in environmental and human-dominated systems and their linkage. Discussion of the historical and modern production and consumption of energy. Energy systems simulation modeling, energy analysis and energy auditing. Review of national energy policies and proposed alternatives.

**Prerequisite:** MATH120; or must have completed MATH220; or students who have taken courses with comparable content may contact the department. Jointly offered with ENST405.

**Credit Only Granted for:** ENST405, ENST605, or MEES698Z.

**Formerly:** MEES698Z.

**ENST606 Advanced Ecosystem Health and Natural Resource Management (3 Credits)**

Explore some of the most important and current global environmental and health challenges. Investigate fundamental and new concepts from the fields of ecology, eco-epidemiology, social anthropology, and environmental and health policy, as well as interdisciplinary cross-sectorial approaches such as One Health, Eco-Health, and Planetary Health.

**Restriction:** Permission of AGNR-Environmental Science & Technology department.

**Credit Only Granted for:** ENST606 or ENST689E.

**Formerly:** ENST689E.

**Additional Information:** Priority in enrollment will be given to students in ENST program.

**ENST607 Adaptation and Resilience in Cities (3 Credits)**

Knowledge about the relations between urbanization and global and local challenges, such as climate change, biodiversity loss, resource deficiency, poverty, justice and health, is of key importance to move towards sustainable development and resilient systems. This course takes a trans-disciplinary approach to understanding urban questions. Urban possibilities and challenges are analyzed by using a systems approach where ecological, social, and economic aspects are integrated through a social-ecological perspective to analyze resilience and sustainability. Linkages between and perspectives from science, social-sciences, and practice are emphasized throughout the course.

**Prerequisite:** ENST360.

**Restriction:** Must be a graduate student; or permission of AGNR-Environmental Science & Technology department.

**Credit Only Granted for:** ENST607 or ENST689C.

**Formerly:** ENST689C.

**ENST608 Research Methods (1-4 Credits)**

Development of research viewpoint by detailed study and report on crop and soil research of the Maryland Agriculture Experiment Station or review and discussion of literature on specific agricultural problems or new research techniques.

**Restriction:** Permission of AGNR-Environmental Science & Technology department.

**Repeatable to:** 4 credits if content differs.

**Credit Only Granted for:** ENST608 or NRSC608.

**Formerly:** NRSC608.

**ENST611 Advanced Principles of Soil Fertility (3 Credits)**

Soil factors affecting plant growth and quality with emphasis on the bio-availability of mineral nutrients. The management of soil systems to enhance plant growth by means of crop rotations, microbial activities, and use of organic and inorganic amendments.

**Prerequisite:** ENST200; or students who have taken courses with comparable content may contact the department. Jointly offered with: ENST411.

**Credit Only Granted for:** ENST411 or ENST611.

**ENST622 Advanced Soil Microbial Ecology (3 Credits)**

The interdisciplinary study of soil microorganisms and their interactions with the mineral matrix; resulting in processes such as nutrient cycling, decontamination, and natural product production. We will focus on the diversity of soil communities, their survival strategies, and the new strategies used to study these communities. The course will include an examination of current literature in this field.

**Prerequisite:** ENST200; or 1 course in BCHM; or must have completed one course in microbiology; or students who have taken courses with comparable content may contact the department. Jointly offered with ENST422.

**Credit Only Granted for:** ENST422 or ENST622.

**ENST630 Advanced Wetland Soils (3 Credits)**

The soils of wetlands including hydrology, biogeochemistry, and pedogenesis, including a focused discussion of current literature. Federal and regional guidelines for wetland soils are covered with an emphasis on validating interpretations through field observations.

**Prerequisite:** ENST200.

**Credit Only Granted for:** ENST630, ENST430, or NRSC461.



**ENST640 Advanced Crops, Soils, and Civilization (3 Credits)**

Explore the rise, cycling, resilience, and decline of civilizations and apply learning to modern issues in the fields of sustainability, environmental ethics, natural resource management, and agriculture. Role and importance of crop and soil resources in the development of human civilization. History of crop and soil use and management as they relate to the persistence of ancient and modern cultures. Jointly offered with ENST440.

**Credit Only Granted for:** ENST440 or ENST640.

**ENST643 Advanced Industrial Ecology (3 Credits)**

Problems of waste management and recycling in human societies are covered. The industrial ecology approach to design is contrasted with analogous patterns and processes from natural ecosystems.

**Prerequisite:** BSCI361; and permission of AGNR-Environmental Science & Technology department. Jointly offered with: ENST443.

**Credit Only Granted for:** ENST443 or ENST643.

**ENST650 Advanced Wetland Ecology (3 Credits)**

Plant and animal communities, biogeochemistry, and ecosystem properties of wetlands. Lectures are supplemented by field trips (normally 2 days total during the semester) and in-class labs. Hands-on activities and exercises include identification of wetland plant species, wetland mapping and delineation, and collection and analysis of field data on wetland vegetation, soil, and hydrology. Wading boots (at least hip length) are strongly recommended.

**Prerequisite:** BIOM301; and ENST360 or other ecology equivalent; or permission of AGNR-Environmental Science and Technology department; or permission of CMNS-Marine & Estuarine-Environmental Science Program). Cross-listed with: MEES650. Jointly offered with: ENST450, MEES650.

**Credit Only Granted for:** ENST450, ENST650, or MEES650.

**Additional Information:** Wading boots (at least hip length) are strongly recommended.

**ENST681 Advanced Ecological Design (3 Credits)**

An advanced survey course on the field of ecological design. Principles of design are illustrated with case studies from biologically-based waste treatment systems, ecosystem management and sustainable development.

**Prerequisite:** Must have completed one semester of calculus; and (CHEM131 and PHYS121). Or permission of instructor. Cross-listed with MEES681.

**Credit Only Granted for:** ENST481, ENST681, or MEES681.

**ENST689 Special Topics (1-3 Credits)**

Credit according to time scheduled and organization of the course.

Organized as a lecture series on a specialized advanced topic.

**Repeatable to:** 6 credits if content differs.

**Credit Only Granted for:** ENST689 or NRSC689.

**Formerly:** NRSC689.

**ENST702 Environmental Science and Technology: Communication and Professional Development (2 Credits)**

Training in communication and professional development to prepare students to succeed in careers within the fields of environmental science and technology. Topics will include manuscript and technical writing, job search, communication with academic and non-academic audiences, multi-disciplinary collaboration, management (project, personnel, time), professionalism, leadership, ethics, and career opportunities. Course emphasizes practical training through facilitated discussions and critique practicums.

**Prerequisite:** ENST602.

**Restriction:** Must be in Environmental Science and Technology (Master's) program; or must be in Environmental Science and Technology (Doctoral) program; or permission of instructor.

**ENST722 Advanced Soil Chemistry (3 Credits)**

A continuation of AGRO 421 with emphasis on soil chemistry of minor elements necessary for plant growth.

**Restriction:** Permission of instructor; and permission of AGNR-Environmental Science & Technology department.

**Credit Only Granted for:** ENST722 or NRSC722.

**Formerly:** NRSC722.

**ENST761 Methods in Pedological Investigations (4 Credits)**

This is designed to equip students with analytical tools for soil microfabric and mineralogical analysis in order to understand soil properties and processes. A number of techniques will be discussed, but emphasis will be placed on micromorphology and x-ray diffractometry. Both theoretical and applied considerations will be covered, and students will gain substantial hands on experience in collecting and interpreting data germane to their research interests.

**Prerequisite:** ENST414; or permission of AGNR-Environmental Science & Technology department.

**ENST789 Advances in Research (1-4 Credits)**

A study of recent advances in agronomy research.

**Repeatable to:** 4 credits if content differs.

**Credit Only Granted for:** ENST789 or NRSC789.

**Formerly:** NRSC789.

**ENST798 Graduate Seminar (1 Credit)**

Designed to provide a venue for interactive discussion between ENST graduate students and other members of the ENST community regarding thesis/dissertation research planned or conducted as part of the students graduate program.

**Restriction:** Must be in one of the following programs (Environmental Science and Technology (Doctoral); Environmental Science and Technology (Master's)) ; or permission of AGNR-Environmental Science & Technology department.

**Repeatable to:** 6 credits.

**Credit Only Granted for:** ENST798 or NRSC798.

**ENST799 Master's Thesis Research (1-6 Credits)****ENST821 Advanced Methods of Soil Investigation (3 Credits)**

First semester, alternate years. An advanced study of the theory of the chemical methods of soil investigation with emphasis on problems involving application of physical chemistry.

**Credit Only Granted for:** ENST821 or NRSC821.

**Formerly:** NRSC821.

**ENST831 Soil Mineralogy (4 Credits)**

Soil minerals, with emphasis on clay minerals, are studied from the viewpoint of soil genesis and physical chemistry. Mineralogical analyses by x-ray and chemical techniques.

**ENST832 Advanced Soil Physics (3 Credits)**

An advanced study of physical properties of soils.

**Restriction:** Permission of instructor; and permission of AGNR-Environmental Science & Technology department.

**Credit Only Granted for:** ENST832 or NRSC832.

**Formerly:** NRSC832.

**ENST898 Pre-Candidacy Research (1-8 Credits)**

**ENST899 Doctoral Dissertation Research (1-8 Credits)**