ENST - ENVIRONMENTAL SCIENCE AND TECHNOLOGY

ENST100 International Crop Production-Issues and Challenges in the 21st Century (3 Credits)
Examines the role of crop production in elevating humans out of poverty in developing countries. It will introduce students to the basic principles of plant and soil science underlying the international production of food crops and world food security. The role of multinational agencies such as the World Bank in the promotion of sustainable crop production using environmentally-sound technologies will also be discussed.

ENST101 Ecological Discovery and Natural Solutions (1 Credit)
The UMD Environmental Science and Technology (ENST) Department seeks to develop and apply scientific tools and processes to advance solutions to some of society's greatest environmental challenges. This seminar provides a unique and exciting opportunity to learn directly from faculty and researchers in the Department about what they study, teach, and share with society. Students will learn about the wide variety of research being conducted in the Department and how it relates to potential solutions to current environmental challenges. The course will cover research in the following areas: urban green spaces, aquaponics, bioenergy, wildlife management, aquatic toxicology, urban green spaces, wetland restoration, water resources, ecosystem health, soil chemistry, and more. It is anticipated that the course will include short visits to ENST laboratories and facilities. The course will also include information about academic, internship, and career opportunities related to ENST.
Credit Only Granted for: ENST499K or ENST101.
Formerly: ENST499K.

ENST111 Field Exploration in Environmental Science and Technology (4 Credits)
Immerse yourself in the diverse aspects of the Environmental Science and Technology Department (ENST) with the Field Exploration in Environmental Science and Technology course. In this hands-on course, both the outdoors and the laboratory serve as your classroom. You will travel by foot, bus, and boat to a variety of ecosystems, from forests and wetlands to urban rivers and the open Bay. Along the way, you will explore many of the ecological challenges posed by human activities. Under expert guidance, you will learn and apply field methods and laboratory techniques, gaining a deeper understanding of how environmental scientists address humanity's grand challenges through scientific data collection and analysis. Each field experience, corresponding discussion, and laboratory analysis is designed to enhance your ecological literacy by engaging directly with the environment and the professionals working to understand and protect it.
Restriction: Must be in the Environmental Science and Technology program; or by permission of the Environmental Science and Technology department.

ENST115 Bats in Society: Human-Wildlife Relationships, Conflicts, & Solutions (3 Credits)
How might an understanding of human-wildlife conflicts shape our approach to disease, ecology, and conservation? Should we care that we are losing wildlife, like bats? Across the globe, human societies have significantly harmed bat populations both intentionally and unintentionally. This course will delve into different bat population crisis causes as well as current and potential solutions, while addressing complex human-wildlife conflicts that need to be considered while solving them. During the course, students will get hands-on experience using highly sophisticated bat acoustic technology to identify bats to species-level. Lecture and discussion sections will focus on bat ecology, management techniques, newest bat identification techniques, data interpretation, and scientific presentation skills.
Credit Only Granted for: ENST115 or ENST215.
Formerly: ENST215.
Additional Information: Students should expect to spend 1-3 hours across multiple nights deploying bat detectors (which will be provided by the instructor) at a location of their choosing. Safety protocols will be discussed and implemented.

ENST200 Fundamentals of Soil Science (4 Credits)
Study and management of soils as natural bodies, media for plant growth, and ecosystem components. Morphology, composition, formation, and conservation of soils. Chemical, biological, and physical properties are discussed in relation to the production of plants, the functioning of hydrologic and nutrient cycles, the protection of environmental quality, and engineering uses of soils.
Corequisite: CHEM131 and CHEM132; or permission of AGNR-Environmental Science & Technology department.
Credit Only Granted for: ENST200 or NRSC200.
Formerly: NRSC200.

ENST214 Introduction to Natural Resources Management (3 Credits)
An introductory course in natural resources management as it impacts society. Its focus is centered around lectures, discussions, and readings in social, biological, and human dimension issues facing natural resource managers in the United States. Coverage will include history and philosophical discussions of fishery, wildlife, and forestry sciences; conservation and management; principles of community, habitat, and animal ecology and management; and interrelations of wildlife, fish, and forestry.
Prerequisite: Must have completed or be concurrently enrolled in BSCI160.
Restriction: Must be in the ENST Natural Resources Management or ENSP Wildlife Ecology & Management programs; and must have completed less than 90 credits; or permission of instructor.

ENST220 Can Soil Be a Climate Solution? (3 Credits)
Can soil help mitigate climate change? The top 30 cm of soil stores twice as much carbon as the atmosphere and more than all of Earth's vegetation combined. Understanding how soil captures and retains carbon is essential to reversing global warming trends. This course explores the vital role soils play not only in food production but also in climate change mitigation. Through lectures, discussions, field trips, and literature-based research, students will examine the drivers of climate change, key soil properties, and sustainable soil management practices that can help reduce atmospheric carbon and prevent the worst impacts of climate change.
Credit Only Granted for: HNUH248W or ENST220.
Formerly: HNUH248W.

ENST231 Artificial Intelligence: Transforming Food, Agricultural, and Environmental Systems (3 Credits)
Artificial intelligence is fundamentally transforming agriculture, food, and environmental sciences, disciplines at the heart of the College of Agriculture and Natural Resources (AGNR). This course introduces students to the core concepts and practical realities of AI within these fields. Through a blend of theory, case studies, and expert seminars, students will examine how AI models (from Large Language Models to computer vision) function. Students will critically evaluate real-world applications, such as precision farming, environmental impact modeling, and veterinary diagnostics. The course will challenge the students to consider both the benefits and drawbacks of this rapidly expanding set of technological tools. By the end of the course, students will possess the foundational literacy to navigate the AI landscape and make informed decisions about integrating these tools into their education and future careers.
Cross-listed with: AGNR230.
Credit Only Granted for: AGNR230 or ENST231.

ENST233 Introduction to Environmental Health (4 Credits)
Examines how humans are affected by the quality of our air, water, soil and food supply as well as how human activities alter these survival necessities. Students will learn how the evolution and prosperity of human populations have resulted in degradation of our environment and the impact of environmental degradation on the health of people. The implications of individual and collective choices for sustainable food production, population management, and resource utilization will be explored.

ENST252 Wildlife Diseases (3 Credits)
Covers the identification and investigation of wildlife diseases, primarily in North America. The course will focus on mammalian, avian, amphibian, reptilian, and some aquatic wildlife, as well as the principles of disease investigation. Attention will be given to the following categories: etiology/causative agents, signs, animal hosts, geographic region, seasonality, means of transmission, pathology, human health/zoonotic risk, economic impacts, prevention, control, and effects of the disease on the population of the species involved. This course will present these topics in a manner appropriate for students from multiple disciplines. Occasionally, it will use experts in wildlife disease and management to provide students with opportunities to interact with veterinarians, biologists, and researchers in zoo and wildlife disease management.
Credit Only Granted for: ENST252 or ANSC252.

ENST281 Computer Aided Design in Ecology (2 Credits)
Basics of Computer Aided Drawing (CAD) applied to design of constructed ecosystems. Use of campus stormwater wetland as case study.

ENST282 Ecological Innovation and Entrepreneurship (3 Credits)
Ecotechnology innovation is taught with design thinking, which uses an iterative cycle of developing customer empathy, learning ecological technology, appreciating environmental stewardship, brainstorming, rapid prototyping, user experience, testing and redesign. Environment entrepreneurship is based on the Lean Startup process, which uses customer discovery, encourages quick product development, reduces start-up costs, tests ideas quickly, and employs designed experiments. A multidisciplinary academic setting embraces designing, building, testing and marketing novel technologies that enhance the environmental needs of humans. Students will learn in an active environment that requires working creatively, collaboratively, diligently, and precisely to create a business model and tangible prototype for a new commercial product.

ENST283 Artificial Intelligence for Environmental Good (3 Credits)
Explore the exciting world of generative AI to tackle real-world environmental challenges. This course blends science, ethics, and practical skills. You will learn the science and ethics of large language models, like ChatGPT, master cutting-edge AI skills, apply them to analyze a practical and complex environmental problem so you can develop a nature-based solution, all while working in a supportive, collaborative setting.
Credit Only Granted for: ENST499E or ENST283.
Formerly: ENST499E.

ENST301 Field Soil Morphology I (1 Credit)
This is a field-oriented course that introduces students to the techniques used to (1) describe soil morphology, and site and profile characteristics, (2) make land use interpretations based on soil characteristics, and (3) classify soils. This class is designed to prepare students for the Regional Collegiate Soil Judging Contest and for students to gain experience in the description and interpretation of soils in the field.
Restriction: Permission of AGNR-Environmental Science & Technology department.
Formerly: ENST308.

ENST302 Field Soil Morphology II (1 Credit)
This is the second field-oriented course in a three course sequence that provides intermediate training for students in the techniques used to (1) describe soil morphology, and site and profile characteristics, (2) make land use interpretations based on soil characteristics, and (3) classify soils. This class is designed to prepare students for the Regional Collegiate Soil Judging Contest and for students to gain experience in the description and interpretation of soils in the field.
Prerequisite: ENST301.
Restriction: Permission of AGNR-Environmental Science & Technology department.

ENST303 Field Soil Morphology III (1 Credit)
This is the third field-oriented course in a three course sequence that provides intermediate training for students in the techniques used to (1) describe soil morphology, and site and profile characteristics, (2) make land use interpretations based on soil characteristics, and (3) classify soils. This class is designed to prepare students for the Regional Collegiate Soil Judging Contest and for students to gain experience in the description and interpretation of soils in the field.
Prerequisite: ENST302.
Restriction: Permission of AGNR-Environmental Science & Technology department.

ENST309 Advanced Field Soil Morphology (1 Credit)
This is a field-oriented course that provides advanced training for students in the techniques used to (1) describe soil morphology, and site and profile characteristics, (2) make land use interpretations based on soil characteristics, and (3) classify soils. This class is designed to prepare students for the National Collegiate Soil Judging Contest and for students to gain experience in the description and interpretation of soils in the field. Students will be exposed to a variety of soil landscapes and geology from outside of the northeastern U.S.
Prerequisite: ENST301.
Restriction: Permission of AGNR-Environmental Science & Technology department.
Repeatable to: 3 credits if content differs.

ENST321 Statistics for Environmental Scientists (3 Credits)
Introduces students to statistical methods used in environmental science to analyze, interpret, and communicate data related to environmental science. The course emphasizes solving problems and independent learning and inquiry. Students will learn key concepts in descriptive and inferential statistics, probability distributions, hypothesis testing, regression modeling, and time series analysis. The course also covers advanced topics such as model selection and spatial data analysis. Hands-on exercises using real-world environmental datasets and statistical software (R) will provide students with practical skills in data visualization, analysis, and decision-making. By the end of the course, students will be equipped to critically evaluate environmental data and apply statistical tools to address pressing environmental challenges.
Prerequisite: MATH115.
Restriction: Must be in the Environmental Science and Technology program; or permission of the Environmental Science and Technology department.

ENST333 Ecosystem Health and Protection (3 Credits)
Discussion of the philosophies, principles, and practices for assessing ecosystem health with emphasis on an ecosystem perspective rather than a human health perspective. Degradation associated with human activities will be emphasized. Topics will range from local to regional to global issues, including a discussion on global warming and its possible impacts on ecosystems. Concepts will be clarified using case histories from the Chesapeake Bay watershed.
Prerequisite: ENST233 or permission of instructor.

ENST334 Environmental Toxicology (3 Credits)
Concepts and case histories in ecotoxicology. Emphasis on origin and variety of environmental pollutants, routes of biological exposure, modes of toxicological action and effects on individual organisms, populations and ecosystems. Ecotoxicological issues in the Chesapeake Bay will be used as examples.
Prerequisite: CHEM131 and CHEM132; or permission of AGNR-Environmental Science & Technology department.
Restriction: Permission of AGNR-Environmental Science Technology Department.

ENST344 Principles of Aquaponics: The Circular Food Production System (3 Credits)
In the last few years, aquaponics has attracted a lot of attention around the globe, especially in the context of urban farming. This course addresses the question: how does an aquaponics system work and what knowledge is needed to successfully run an aquaponic system? The different parts of this course will give the students an understanding of important topics in the field of aquaponics and develop a broad knowledge base: from water chemistry, fish and plant physiology, to engineering and microbiology and show them how to plan and design such a sustainable production system. Aquaponics is a technique that combines aquaculture (fish farming) and hydroponics (soil-less plant cultivation) in a circulatory system with the aim of recycling nutrients from fish farming wastewater. Also, aquaponics can serve as a learning model for inter-and transdisciplinary thinking and acting.
Prerequisite: BSCI160 or BSCI170; and CHEM131 or CHEM135.
Credit Only Granted for: ENST499O or ENST344.
Formerly: ENST499O.

ENST360 Ecosystem Ecology (4 Credits)
The study of ecology has a long and interesting history, from early society's efforts to understand and alter their environment as a matter of survival to the challenges the modern world is facing that are global in scale. Through the course text, distributed supplemental chapter readings and an understanding of the scientific literature, this course will cover the essential concepts and principles of ecosystem ecology as well as its history and past and present controversies. Several of the basic methods and tools of field research and the applied management of ecosystems will be discussed and demonstrated with several field excursions in the natural environs of the DC area. Central to this course will be the understanding that modern human society is an integral part of nature, with the power to impact and influence elements of the natural world at multiple scales. An analysis of policy implications for the biosphere will be discussed.
Prerequisite: BSCI160 and (BSCI180 or BSCI161).
Restriction: Must be in the Environmental Science and Technology major; or permission of instructor.

ENST361 Urban Environmental Science (3 Credits)
Urban Environmental Science is an interdisciplinary subject at the intersection of social, environmental, and economic systems. This course will examine ecology in the city (i.e. why do certain species live in certain greenspaces?), ecology of the city (i.e. how do urban ecological processes influence the health and safety of human residents?), and ecology for the city (i.e. how do we plan and restore greenspaces in a just way so that all residents have equitable access to nature?). This course will have a strong focus on natural systems within urban ecosystems. Each topic will focus on key urban ecological concepts and then explore how these topics apply to urban planning and design. The course will be a mix of traditional lectures, class discussions, and field trips to see urban environments in action in Washington, D.C.
Credit Only Granted for: ENST499A or ENST361.
Formerly: ENST499A.

ENST373 Natural History of the Chesapeake Bay (3 Credits)
Consideration of the major groups of organisms associated with the Chesapeake Bay and current issues that determine humans' present and future uses for the Chesapeake and its biota.
Cross-listed with: BSCI373.
Credit Only Granted for: BSCI373 or ENST373.

ENST379 Environmental Science and Technology Undergraduate Teaching Assistant (1-3 Credits)
A weekly teaching practicum and concurrent internship as an undergraduate teaching assistant in an Environmental Science and Technology course. By exploring the theories and best practices of teaching and learning in the various fields of environmental science, students will acquire foundational skills and knowledge for effective college teaching. Essential topics include teaching methods, classroom management, student engagement, and the basics of course design with emphasis placed on understanding diverse student needs, promoting inclusive teaching practices, and fostering critical thinking. Through interactive activities and peer & instructor feedback, students will gain hands-on experience in creating positive and impactful learning environments.
Restriction: Permission of the Environmental Science and Technology department; and permission of instructor; and must be in the Environmental Science and Technology program.
Repeatable to: 6 credits.
Additional Information: Students should have taken the course for which they will TA.

ENST388 Honors Thesis Research (3-6 Credits)
Undergraduate honors thesis research conducted under the direction of an AGNR faculty member in partial fulfillment of the requirements of the College of AGNR Honors Program. The thesis will be defended to a faculty committee.
Restriction: Permission of AGNR-Environmental Science & Technology department.
Repeatable to: 6 credits if content differs.

ENST389 Internship (3 Credits)
Credit will be granted for practical work carried out by students placed in work environment related to their stated career goals. Students must do an in-depth study in some portion of the work experience and produce a special project or report related to this study. A student work log is also recommended. An evaluation from the external supervisor of the project will be required. Credit arranged with supervising faculty member.
Restriction: Must be in Environmental Sci & Tech program.
Repeatable to: 6 credits if content differs.

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.
Recommended: ENST214, ENST314, ENST360, ENST410, and ENST460.
Jointly offered with: ENST604.
Restriction: Senior standing or higher.
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.
Jointly offered with: ENST605.
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.
Credit Only Granted for: ENST405, ENSP350, ENST605, or MEES698Z.

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; and PHYS121 must be completed or in progress; or permission of 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: CHEM131 and CHEM132; or permission of instructor.

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.

ENST431 Environmental Data Science (3 Credits)
Modern environmental science relies on data from many sources such as field observations, sensors, satellites, and models to understand how the planet is changing. This course introduces students to the core ideas and practices of environmental data science through theory and practice. Students will learn how to explore, visualize, and interpret environmental data. They will work with spatial datasets to map environmental patterns, build models to describe relationships among different environmental processes, and analyze time series. Emphasis is placed on developing algorithmic thinking, creativity in problem solving, and clear communication of results. By the end of the course, students will be able to work confidently with diverse datasets and models to solve real-world environmental problems. No prior programming experience is required, but familiarity with the R programming language is strongly recommended.
Recommended: ENST321 or other 300-level statistics course.

ENST432 Environmental Microbiology (3 Credits)
Microorganisms are everywhere and mediate many important processes. These organisms are the unseen catalysts for industrial processes and are critical to many emerging technologies. This course will explore how microorganisms benefit society through bioremediation, food safety and production, and biotechnology. Lectures, outside readings, and in-class discussions will help students gain an understanding of where microbiology fits into broader discussions of sustainability, green technology, and human and environmental health. This course is designed for undergraduates in a variety of environmental and life science majors who desire to understand how microorganisms can improve the lives of humans and the environment around us.
Prerequisite: BSCI160.

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).

ENST450 Wetland Ecology (3 Credits)
Plant and animal communities, biogeochemistry, and ecosystem properties of wetlands. Lectures are supplemented by field trips and in-class labs. Hands-on activities include identification of wetland plant species, wetland 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 equivalent courses in data analysis and ecology; or 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 (BSCI180 or BSCI161); or permission of instructor.

ENST453 Watershed Science: Water Balance, Open Channel Flow, and Near Surface Hydrology (3 Credits)
Definition and delineation of watersheds based on the stream orders. Discussion of the principle of conservation of mass in the context of life cycles (water cycle, carbon cycle, photosynthesis, aerobic cycle, anaerobic cycle, and nitrogen cycle) as it relates to our Biosystem. Conceptual study of hydrologic cycle components and their prediction using empirical and physical-based models is covered. Role of water as the dynamic force within the context of its interaction with landscapes of diverse geology and land cover will be discussed. Elements of watershed management is discussed.
Prerequisite: MATH120 or MATH140, ENST200, GEOG306 or BIOM301.
Recommended: PHYS121.
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.
Additional Information: Students will need to provide an 8GB (or larger) thumb drive for data storage.

ENST460 Principles of Wildlife Management (3 Credits)
In this course, we integrate animal behavior, population dynamics, and the social and political aspects of wildlife ecology within the context of wildlife management. We focus primarily on ecological aspects of population dynamics and responses of animal populations to disturbances and specific management actions.
Prerequisite: BSCI160 and BSCI170.

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: (BSCI160 and BSCI161) and (BSCI170 and BSCI171); and ENST460 must be completed or in progress; or permission of instructor.
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, managament, 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)
This advanced course explores green technologies, waste treatment, and ecological solutions. It covers principles of ecological design, biologically-based waste treatment systems, water quality parameters, and the implementation of green technologies. Key topics include ecology, ecological engineering, nutrient cycling, wastewater treatment, wetland treatment, leach fields, anaerobic digestion, composting, stream restoration, LEED certification, green walls, green roofs, living machines, rain gardens, bioswales, and algal turf scrubbers.
Prerequisite: MATH120 or MATH140; BSCI160; and must have completed or be concurrently enrolled in CHEM121 and PHYS131.
Jointly offered with: MEES681.
Credit Only Granted for: ENST481, ENST681, or MEES681.

ENST485 Water Management in Urban Environment (3 Credits)
In this course we explore relevant processes in pathways and fluxes of water in urban areas; urban water balance and consequences of urbanization on surface and groundwater regimes; effects of climate and hydrology; quantity and quality of urban runoff, sources of pollution and behavior of contaminants; and ecological quality and processes associated with urban water. We study design and planning for water quality and quantity management in urban water systems; and engineered and ecologically engineered alternatives for stormwater management. Additionally, we look at the climate impacts on the urban water cycle.
Prerequisite: MATH120, 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.
Additional Information: The course has two types of activities: lecture and experiential learning. Students are expected to work on their professional-level experience for 90 hours and participate in a 2-hour lecture every other week, during the semester to develop their Senior Integrative Experience (SIE) project. Each student's research question, proposal methodology, analysis, paper, and presentation will follow learning outcomes of all ENST SIE course options.

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.