Tufts Institute of the ENVIRONMENT

Graduate Environmental Course Guide 2013—2014

This course guide is compiled by the Tufts Institute of the Environment (TIE). The Tufts Institute of the Environment (TIE) is an interdisciplinary university-wide institute that initiates, facilitates, and promotes environmental education, research, and outreach toward a sustainable future.

TIE is located on the Medford Campus and its physical space is used by many students to study, work, and meet other students and faculty members. TIE holds and supports events for the environmental community throughout the year, offers fellowships and travel grants, and hosts guest researchers. We also support the Office of Sustainability in its efforts to improve campus sustainability.

INTRODUCTION

Over the last few decades, Tufts has won the reputation of being one of the top "green" schools in the nation. Tufts offered environmental classes in the curriculum as early as 1962, long before most other universities saw the need for such programs. We are thus extremely well prepared to meet the current demand for environmental education. In this time of great momentum and change in the global community concerning environmental and human issues, environmental literacy is becoming incorporated in even more courses, departments, and programs across the various schools of Tufts, and we hope this course guide will prove a valuable tool to navigate the wealth of these offerings.

The main purpose of this guide is to give students a broad overview of the various options of environmentally related courses offered at Tufts University. The booklet provides a comprehensive listing of courses offered at Graduate Schools of the University (with the exception of the Dental and Veterinary Schools), and is meant for all students interested in broadening their particular concentration to include a higher level of environmental literacy, not just those interested in earning an environmental degree.

This year's course guide includes thematic labeling. Below each course name is a category based on topic or purpose: Food, Environmental Justice, Environmental Leadership and Activism, Sustainable Solutions, Environmental Health, Energy and Climate, and Water. We hope this breakdown will allow students to more easily identify classes that they are interested in taking. Some courses may be listed under multiple categories.

- **Food:** includes classes about U.S. agriculture, food systems, and food policy.
- **Environmental Justice:** includes classes about populations vulnerable to climate change, conflict over natural resources, and environmental imperialism.
- **Environmental Leadership and Activism:** includes classes about environmental preservation and improvement, and sustainability. Many of the courses have an active learning component.
- **Sustainable Solutions:** includes courses that focus on ways of conserving natural resources or limiting ecological damage. Many of the courses in this section cover government actions/policies regarding the environment, or the basic science underlying environmental processes.
- **Environmental Health:** includes classes about health hazards such as air pollution and hazardous waste. Also includes classes that focus on identifying environmental health, such as environmental economics or risk assessment.
- **Energy and Climate:** topics related to energy (gas, oil, clean energy) and climate change.
- **Water:** includes classes about the mechanics and politics of water.

If you would like information regarding environmental degrees or programs, we urge you to look at the previous Environmental Course Guides, available on our website.

Questions, comments, and concerns may be directed to:

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Course information may change after the printing of this guide. The most updated version can be found on the Tufts Institute of the Environment website.

FRIEDMAN SCHOOL OF NUTRITION

NUTR 215/UEP 223 Fundamentals of U.S. Agriculture
Fall, Prerequisites: No
Theme: **Food**
This course covers the major social, institutional, and human aspects of the American agricultural system, both as it exists today as well as its historical development. After consideration of agricultural systems in general and of the values that underlie different concepts of agriculture, it covers some of the key historical forces that have made American agriculture what it is today, and the major role of the federal government, both past and present. The next part of the course deals with the economics of American agriculture as a whole and its large-scale structure, followed by an analysis of farming on the microlevel, emphasizing types of farms and farm-scale production economics. This course was formerly listed as NUTR 223.

NUTR 221 The Global Food Business
Spring, Prerequisites: Graduate standing or consent of instructor
Theme: **Food**
The purpose of this course is to introduce the student to the field of international food and agribusiness. Today, international trade in agricultural commodities and foods is a major segment of the world's business. This business continues to grow yearly, motivated by new and potential international trade agreements (GATT, NAFTA), expansion by both established and new multinational companies, and export policies by countries seeking new markets for their growing food and agricultural production. The focus of this course will be to develop in each student a conceptual knowledge of the analytical skills in administration, marketing, business strategy, research, governmental policies and technology that international food business requires today. The course also attempts to analyze the global food business from a transnational perspective, rather than any single nationalistic viewpoint of food and agribusiness.

NUTR 233 Agriculture Science and Politics I
Spring, Prerequisites: No
Themes: **Food, Sustainable Solutions**
First part of a two-semester sequence required of AFE students. This course covers the major biological, chemical and physical components of agricultural systems. Each is discussed from the viewpoints of both the underlying natural processes and principles, and their significance for major agricultural, food safety, and environmental policy issues in the US today. In the first semester, the topics covered are soils, water, nutrients, and genetic resources.

NUTR 241/BIO 185/CIS 201 Food For All: Ecology, Biotechnology and Sustainability
Spring, Prerequisites: Introductory Biology, Introductory Chemistry or equivalent
Themes: **Food, Sustainable Solutions**
In this interdisciplinary seminar , we will examine the pros and cons of two divergent

approaches to meeting this food demand: organic farming and genetic engineering. Using contrasting crops grown in developing and industrialized countries as case studies, we will evaluate: (1) how ecological knowledge makes food production more sustainable; (2) what existing and emerging approaches can, in the face of climate change, contribute to a reliable supply of nutritious food; and (3) the political and economic drivers that shape who has access to these technologies. We will also explore stakeholder specific perspectives (growers, advocacy groups, industry, governmental agencies), as well as develop important communication skills for negotiating these different perspectives.

NUTR 303 Determinants of U.S. Food Policy
Fall, Prerequisites: Yes
Themes: **Food, Sustainable Solutions**
Focuses on government food-related programs from an economic and political perspective. Reviews the evolution of a range of policies and programs, analyzing their effects on the U.S. economy and on household consumption and the farm economy, as well as on food consumption at the national, household, and individual level. Existing policies and programs are related to the political and economic environment and to changing food consumption patterns in American society. Food assistance programs (e.g., Food Stamps), nutrition programs, food supply and agricultural price policies, and consumer protection and information are considered.

NUTR 304 Nutrition, Food Security, and Development
Fall, Prerequisites: NUTR 203 and NUTR 238 or consent of instructor
Themes: **Food, Sustainable Solutions**
The aim of this course is to introduce current policy and development issues and debate, and to encourage critical analysis of conventional wisdom and generalizations. Focusing on complex interactions among local and global systems, the course seeks to prepare students for employment in the field of international development, be it as practitioners, analysts, teachers or writers. Alternative concepts, data and viewpoints will be explored on key problems in real contexts. Case studies will be drawn on experiences in countries as diverse as Ethiopia, Niger, Thailand, Vietnam, China and Peru.

NUTR 327 Food Systems
Fall, Prerequisites: Graduate standing or instructor consent
Theme: **Food**
Food Systems represents a form of capstone course with a discussion format. Students will provide input into selection of topics that they will focus and present on. The course primarily addresses food system structures and components, with an emphasis on sustainability – spanning agriculture, environment, power and economics, values and ethics, food security, food sovereignty, and food choices. Topics of concentration may cover contemporary issues and can include food miles and 'foodprints'; climate change; greening vs. greenwashing; ethics of eating meat and using bottled water; and eating sustainably. We will also examine the global political economy of the food system, and approaches to understanding

and influencing food system change. Common terminology used in food systems and sustainability discourses are clarified. Classes will emphasize student presentations on components of the food system; student-led discussions of readings; and group exercises/debates. Assignments will include research-based projects focusing on food system change. This class is suitable for second year students, or for first year students with grounding in food systems literature and/or relevant experience (to be approved by the instructor).

NUTR 333 Agriculture Science and Politics II
Fall, Prerequisites: Yes
Themes: **Food, Sustainable Solutions**
Second part of a two-semester sequence required of AFE students. This course covers the major biological, chemical and physical components of agricultural systems. Each is discussed from the viewpoints of both the underlying natural processes and principles, and their significance for major agricultural, food safety, and environmental policy issues in the US today. In this second semester, the topics are best management practices, livestock systems, food systems, climate change and bio-energy. Major policy issues associated with these areas include protecting groundwater from nitrogen contamination; regulating and monitoring pesticide use; regulating agricultural biotechnology; and regulating "factory" animal production.

NUTR 341 Economics of Agriculture and the Environment
Fall, Prerequisites: Yes
Themes: **Food, Environmental Health**
This course is highly recommended for AFE students and any Friedman student with an interest in economic aspects of the food/environment interface. In this class we will be studying a broad range of environmental and natural resource problems through the tools and concepts of microeconomics - the social science that deals with balancing our (seemingly unlimited) wants and needs within the limitations of our personal, social, and natural environments. It therefore provides useful frameworks for considering issues such as how we protect and use our land, forests, and oceans; the impact of climate change on food production; societal investment in land, water, and soil quality; and how private and social incentives can help overcome market failures. Economic aspects of environmental and agricultural policies will be a major focus.

FLETCHER SCHOOL OF LAW AND DIPLOMACY

ILO L223 Seminar on International Environmental Law
Fall, Prerequisites: No
Theme: **Environmental Leadership**
This course will address the nature, content and structure of international environmental law. The course will begin with an introduction and overview designed to familiarize students with international environmental problems and basic principles of international law and environmental regulation. The course will then take up various specific topics, such as global warming, stratospheric ozone depletion, and exports of hazardous substances. Other topics likely to be addressed are marine pollution, trans-boundary pollution, trade and environment, and development and environment. Throughout, the course will explore the role of international and non-governmental organizations in the development of international environmental law and policy; the interrelationship between international legal process and domestic law; and the difficulties of negotiating, concluding, and implementing international environmental agreements.

DHP P250 Elements of International Environmental Policy
Fall, Prerequisites: No
Themes: **Environmental Leadership**
This course is designed to provide an introduction to international environmental policy development beginning with the scientific identification of the problem, the assessment of its economic and social impact, and the political forces that shape international agreements. It is recommended that students intending to concentrate in the environment and resource field take this course unless they have a solid environmental background. Following a short introduction to some of the basic scientific and economic factors that characterize most environmental problems, the course examines five case studies that illustrate the range of international problems facing diplomats and corporations. Bilateral, multilateral and commons issues are studied using examples of air, climate, hazardous waste, fisheries, and biological diversity. The emphasis is on the development of effective policy solutions based on sound scientific and economic information that meet the often-divergent political positions of nations.

DHP P253 Sustainable Development Diplomacy
Fall, Prerequisites: No
Theme: **Sustainable Solutions**
This course is designed to provide an introduction to international environmental policy development beginning with the scientific identification of the problem, the assessment of its economic and social impact, and the political forces that shape international agreements. Following a short introduction to some of the basic scientific and economic factors that characterize most environmental problems, the course examines five case studies that illustrate the range of international

problems facing diplomats and corporations. Bilateral, multilateral and commons issues are studied using examples of air, climate, water, fisheries, and forests/ biological diversity.

DHP P254 Climate Change Policy
Fall, Prerequisites: No
Theme: **Sustainable Solutions**
This course examines how governments can and might respond to the challenges and opportunities posed by the complex problem of global climate change. We begin with a study of the latest scientific understanding of the problem. Then, the technological options, the economic dimensions, the role of the private sector, and the domestic and international politics related to addressing climate change are explored. The policies of the major emitting countries are analyzed and compared. The international climate negotiations are analyzed. Policy tools are assessed against different criteria. The course will introduce and strengthen multidisciplinary policy analysis skills.

DHP P255 International Energy Policy
Spring, Prerequisites: No
Theme: **Energy and Climate**
Energy affects every dimension of human society including basic living conditions, mobility, and economic prosperity. Energy is at the heart of some of the most intractable environmental problems, national security challenges, and economic development strategies. Energy is also central to addressing each of these challenges. This course maps how issues differ among countries, exploring basic differences between industrialized and developing countries. The policies of major energy consumers and producers are compared. International energy policy topics such as the geopolitics of oil and gas, energy markets, climate change, public health, and international energy-technology cooperation and competition are covered.

DHP P256 Innovation for Sustainable Prosperity
Spring, Prerequisites: None
Theme: **Sustainable Solutions**
This seminar explores the nature of technology, theories and "stylized facts" about innovation processes, and how to think about innovation systems. A major focus is policy for innovation. Topics include national innovation systems, management of risks, global change, actors and institutions, social innovation, private vs. public, education, cross-country comparisons, competitiveness, technology transfer and diffusion, learning and "catch-up", IPR's, and leapfrogging. Case studies are used to understand each topic. Spring semester.

DHP P257/CEE 265/UEP 265 Corporate Management of Environmental Issues
Fall, Prerequisites: No
Theme: **Environmental Leadership and Activism**
This objective of this course is to examine environmental issues from the point of view of large corporations. Corporations are critical players affecting the environment because they control vast resources, and changes in their mode of doing business can have significant impacts on air, water, waste production, and raw material use. Public policy makers concerned with environmental issues seek to change

corporate behavior with respect to the environment, but often have an inadequate understanding of how companies work. As a consequence, policies may be ineffective or unnecessarily contentious. Topics include: strategy and organization; staffing for environment; health and safety; accountability for environmental performance; ethics; corporate environmental policies; pollution prevention; management tools; accident response; companies and non-governmental organizations; response to laws and regulations; international issues; environmental accounting; corporate social responsibility; and voluntary codes of conduct.

DHP P258 Clean Energy Technology and Policy Issues
Spring, Prerequisites: No
Theme: **Energy and Climate**
This course identifies the major environmental, security and economic issues associated with the continued use of traditional energy sources such as fossil fuels. It then explores alternative technologies that are capable of providing essential energy services in both developed and developing countries. Woven into the assessment of each technology is a determination of the present policies and factors that lock-in current technology and lock-out new alternatives. Types of regulatory, market, contractual and voluntary policies and practices are identified that can facilitate the introduction of new, clean energy technologies. The major emphasis is on electricity production, transportation and building energy conservation. Examples of technologies include solar, wind, biomass and high efficiency end use appliances, hybrid and fuel cell vehicles, transport fuels from biomass, efficiency gains in conventional vehicles, and integrated building and campus design.

EIB E246 Environmental Economics
Fall, Prerequisites: No
Theme: **Environmental Health**
This course will introduce students to the underlying concepts and major debates in contemporary environmental economics. Building on basic concepts from microeconomics, this course emphasizes how environmental degradation takes place in market economies and how incentives can be designed to protect the environment. Topics covered will include resource consumption, innovation, international trade and the environment, global climate change, and environmental regulation. Special attention will be paid to how such issues play out in Mexico and Latin America. Students will engage in empirical data analysis to test relevant environmental economics hypotheses. Background in basic statistics and working knowledge of excel is encouraged.

SCHOOL OF MEDICINE

MPH 204/CE 158/ENV 158 Environmental and Occupational Health
Fall, Prerequisites: No
Theme: **Environmental Health**
An examination of current topics in the area of occupational and environmental health, with particular emphasis on the types of materials that produce human health effects. Both clinical and epidemiologic data will be used to assess the public health importance of environmental pollutants and to evaluate the effectiveness of control strategies.

GRADUATE SCHOOL OF ARTS AND SCIENCES

BIO 185/CIS 201/NUTR 241 Food For All: Ecology, Biotechnology and Sustainability
Spring, Prerequisites: Introductory Biology, Introductory Chemistry or equivalent
Themes: **Food, Sustainable Solutions**
In this interdisciplinary seminar, we will examine the pros and cons of two divergent approaches to meeting this food demand: organic farming and genetic engineering. Using contrasting crops grown in developing and industrialized countries as case studies, we will evaluate: (1) how ecological knowledge makes food production more sustainable; (2) what existing and emerging approaches can, in the face of climate change, contribute to a reliable supply of nutritious food; and (3) the political and economic drivers that shape who has access to these technologies. We will also explore stakeholder specific perspectives (growers, advocacy groups, industry, governmental agencies), as well as develop important communication skills for negotiating these different perspectives.

CEE 112/ENV 112 Hydrology and Water Resource Engineering
Fall, Prerequisites: No
Theme: **Water**
An introduction to the science of hydrology and to the design of water resource systems. Basic hydrologic processes such as precipitation, infiltration, groundwater flow, evaporation, and streamflow are discussed. Applications of hydrology to water supply, flood control and watershed modeling are emphasized. Students develop their own hydrologic models using computer software.

CEE 113/ENV 113 Groundwater Hydrology
Fall, Prerequisites: Geo 2 and Calculus or Permission of instruction
Theme: **Water**
The geology and hydrology of groundwater. Topics include: hydraulic properties of soils, sediments, and rocks; physics of groundwater flow; flow nets, modeling groundwater systems; geology of regional flow; aquifer exploration and water well construction methods; well hydraulics and aquifer testing; applications in the geosciences and in civil/geotechnical/environmental engineering.

CEE 131 River Hydraulics and Restoration
Spring, Prerequisites: MATH 51 (formerly MATH 38) and CEE 12
Themes: **Water, Environmental Health**
The physical and mathematical basis for steady and unsteady flow processes in hydraulic engineering, with emphasis on fluvial systems. Numerical procedures for gradually varied steady flow and rapidly varied unsteady flow will be covered with applications to floodplain delineations, flood routing, dam safety, and river restoration. Other applications may include the design of hydraulic structures such as culverts, stilling basins, spillways, levees, weirs, fish ladders, and retention/detention ponds. With laboratory.

CEE 132 Environmental Engineering Practices
Spring, Prerequisites: CEE 30 and CEE 32, or consent of instructor
Theme: **Sustainable Solutions**
Study of the chemical, physical, and biological basis for unit processes commonly used in environmental engineering. Processes representing applications in all environmental media are examined. Emphasis is on rational design of unit processes, with attention to fundamental principles and experimental methods. With laboratory.

CEE 133 Wastewater Plant Design
Spring, Prerequisites: CEE 32 or consent of instruction
Theme: **Water**
Design of facilities for municipal drinking water and wastewater treatment. Synthesis of unit processes and operations into integrated treatment plant. Emphasis on conventional treatment processes. Additional topics include liquid and solids streams, hydraulics, chemical feed and control systems, costs, and performance requirements. Design projects and field trips.

CEE 136/CHBE 136 Air Pollution Control
Fall, Prerequisites: Junior Standing
Theme: **Environmental Health**
A study of health and environmental effects from air pollution, dispersion modeling, air pollution laws and regulations, fate and transport of air pollution, and design of pollution control equipment and processes. Prerequisites: differential equations, physics, chemistry, fluid/thermal sciences; or advanced undergraduate standing.

CEE 147 Soil Dynamics and Earthquake Engineering
Spring, Prerequisites: CEE 42
Theme: **Sustainable Solutions**
Review of seismicity, fault-rupture mechanisms, and vibration and wave propagation theory. Deterministic and probabilistic seismic hazard analysis including ground motion prediction relations. Dynamic behavior of soils, including soil amplification concepts, liquefaction, and ground response analysis. Application of soil dynamics in terms of design codes and design ground motions.

CEE 149 Earth Support Systems
Fall, Prerequisites CEE 42
Theme: **Sustainable Solutions**
Examination of earth pressure theories and design problems related to earth-retaining structures and tunnels. Analysis and design of braced and unbraced excavations; code requirements; strut-waler systems; tie backs; ground movement control; reinforced earth and slurry wall methods. Slope stability analysis related to excavations and retaining structures.

CEE 172 Fate and Transport of Environmental Contaminants
Spring, Prerequisites: Chem 2 or consent of instructor
Theme: **Environmental Health**
Key processes and reactions governing the movement and distribution of contaminants in surface water, ground water, soil, and air. Fate and transport mechanisms; Development and use of quantitative tools to predict contaminant fate and transport in water, air, soil, and biota.

CEE 194 Field Methods for Global Health
Fall, Prerequisites: Junior standing
Theme: **Sustainable Solutions**
In this course, students will select a real-world development program, and then work throughout the term to develop a protocol for program evaluation. The course is ideal for students working with, or interested in, international development programs, and its main goal will be to teach students the research skills to rigorously evaluate such programs. Topics covered will include ethics approval, sample size calculation, survey development & implementation, focus groups & key informant interviews, spatial analysis, data entry and analysis, water and air quality testing, anthropometrics, field work examples, and interpretation & dissemination of results.

CEE 194A/ENV 196R Introduction to Remote Sensing
Spring, Prerequisites: No
Theme: **Sustainable Solutions**
This introductory course with no prerequisites deals with remote sensing sensors and their applications, the basics of image acquisition, processing and data analysis used in the field of geomatics, as well as conceptual issues involved with collecting data in the electromagnetic spectrum, storing, processing and analyzing remotely sensed datasets and images. The class focuses on learning fundamentals and designing a workflow in remote sensing to solve an environmentally based problem with real-world applications. The course is especially suitable for students exposed to Geographic Information Systems (GIS) who wish to explore collection of environmental data and imagery from remote platforms and explore the basics of visual interpretation, digital analysis and application of remote sensing in industry and academia.

CEE 194C Environmental Informatics Course
Fall, Prerequisites: No
Theme: **Sustainable Solutions**
This new course will introduce students to environmental informatics (EI), an emerging field of information sciences applied to environmental studies. EI aims to develop, standardize, and disseminate methodologies for information processing in application to environmental data utilizing computational intelligence, communication infrastructure and knowledge integration. With unprecedented growth of information, EI encapsulate the research and system development to effectively collect, store, process, integrate, display and disseminate data and information as it pertains to the environmental sciences. This course will enable students to assemble datasets and formulate research questions for data analysis using large environmental data repositories and own research data. Students will learn the fundamentals of the data visualization and processing, and will develop skills in using techniques and modern analytical tools essential in Climate, Environment and Health applications.

CEE 194H Global Environmental Datasets
Fall, Prerequisites: No
Theme: **Sustainable Solutions**
This new introductory-level course focuses on geospatial data concepts, methods and tools used for the study of global environmental change. Growing concern about human impact on the environment has led to the development of new observation and analysis tools to tackle and monitor types, magnitudes and rates of environmental changes. Timely observations by Earth Observation (EO) satellite systems and improved mapping and analysis tools are enabling a better understanding of the ecological interactions that underlie our Earth systems which is critical for developing sustainable solutions. This course will enable students to search and use satellite imagery (higher level products) in the context of a number of disciplines including climatology, ecology, geology, hydrology, and public health. Students will learn the fundamentals of the EO systems and the tools (geo-portals, web based tools, open source software) to observe, monitor and assess the changes occurring on or near the Earth surface.

CH 188 Health Equality and Built Environment
Fall, Prerequisites: Senior standing or consent of instructor
Themes: **Environmental Health**
When it comes to community health "place matters." As such, the impact of the built environment on health has expanded from a narrow focus on sanitation to a greater socio-political conceptualization of the influence of man-made systems and structures on the health and wellbeing of communities. Resting at the intersection of urban planning and public health, our understanding of the built environment has shifted with the parallel development of these two disciplines. Public health concerns over the built environment often fall within the broader context of environmental health, and as such have historically been concerned primarily with preventing exposure to toxins and pollutants, often through zoning ordinances and regulation. However, as both fields have matured, the domain of environmental health has grown to encompass the broader health effects of the built environment. This course will explore the role of the built environment in modifying, exacerbating, or protecting against health inequity.

CH 188-11 Water, Sanitation and Hygiene in Global Health
Fall, Prerequisites: No
Theme: **Water**
This course covers the basics of water, sanitation, and hygiene (WASH) infrastructure in the context of tropical public health. In the first third of the course, we will cover drinking water quality and quantity, appropriate water sources, and water treatment options. In the second third, we will cover sanitation technologies (various types of latrines, sewers, and septic systems), including construction and use. In the last third of the course, we will cover hygiene in a tropical context. This includes essential hygiene practices in rural, urban, and peri-urban settings and under conditions of both water abundance and water stress. Additional topics to be addressed throughout the course include demand creation, assessment of current practices, and behavior change techniques. The course will emphasize appropriate use of the peer-reviewed literature and critical-thinking skills.

EOS 287 Subsurface Fluid Dynamics
Fall, Prerequisites: MATH 51 (formerly MATH 38) and ES 8, or equivalents
Theme: **Water**
Advanced theory in groundwater hydrology. Topics include: hydrodynamics of groundwater flow; Darcy's Law in porous sediments and fractured rocks; fluid potential; flow nets and hodographs; vorticity of inhomogeneous fluids; physics of the unsaturated zone; two-phase flow in petroleum reservoirs and carbon sequestration; flow in deforming media; aqueous mass transport in reactive formations; fluid and heat transport in geothermal reservoirs.

EOS 288 Groundwater Modeling
Fall, Prerequisites: No
Theme: **Water, Sustainable Solutions**
Numerical analysis of groundwater flow, with applications. Topics include: numerical formulation of the governing equations using finite difference, finite element, integrated finite difference, particle tracking, boundary element, and discrete element techniques; matrix and iterative solutions; algorithms for 1-D, 2-D, and 3-D flow; stability and accuracy; applications using popular USGS software in the public domain. Students will be expected to apply existing Fortran programs for 1-D, 2-D, and 3-D solutions as part of computational laboratory modeling assignments.

EOS 289 Geofluids
Fall, Prerequisites: No
Theme: **Sustainable Solutions**
Study of groundwater flow in geologic processes. Topics include: theory and equations governing coupled fluid flow with heat and mass transport in deep geologic systems; continental-scale groundwater flow; hydrogeologic applications in studies of weathering, sediment diagenesis, petroleum migration, hydrothermal ore formation, metamorphism, deformation and earthquake mechanics. This advanced course will introduce students to current literature and software for theoretical analysis of reactive hydrothermal flows in the Earth's crust.

ENV 196R/CEE 194A Introduction to Remote Sensing
Spring, Prerequisites: No
Theme: **Sustainable Solutions**
This introductory course with no prerequisites deals with remote sensing sensors and their applications, the basics of image acquisition, processing and data analysis used in the field of geomatics, as well as conceptual issues involved with collecting data in the electromagnetic spectrum, storing, processing and analyzing remotely sensed datasets and images. The class focuses on learning fundamentals and designing a workflow in remote sensing to solve an environmentally based problem with real-world applications. The course is especially suitable for students exposed to Geographic Information Systems (GIS) who wish to explore collection of environmental data and imagery from remote platforms and explore the basics of visual interpretation, digital analysis and application of remote sensing in industry and academia.

UEP 223 Fundamentals of U.S. Agriculture
Fall, Prerequisites: Graduate standing or consent of instructor
Theme: **Food**
This course covers the major social, institutional and human aspects of the American

agricultural system, both as it exists today as well as its historical development. After consideration of agricultural systems in general and of the values that underlie different concepts of agriculture, it covers some of the key historical forces that have made American agriculture what it is today, and the major role of the federal government, both past and present. The next part of the course deals with the economics of American agriculture as a whole and its large-scale structure, followed by an analysis of farming on the microlevel, emphasizing types of farms and farm-scale production economics. This course is cross-listed as NUTR 223.

UEP 207/CE 207/ENV 207 Environmental Law
Fall, Prerequisites: Senior or graduate standing and consent of instructor
Theme: **Environmental Solutions**
Role of the courts in shaping environmental policy and ways that the regulatory system connects policy objectives to legal directives. Role of science and economics in environmental law. Provides students with a solid introduction to the American legal system and the basic structure of many of the major environmental statutes. Students work with the Mystic River Watershed Association on high-priority issues that blend law and policy.

UEP 278 Environmental Justice, Security and Sustainability
Fall, Prerequisites: Graduate standing or consent of instructor
Theme: **Environmental Justice**
Examines the concept of social and environmental justice; the history and development of the U.S. environmental justice movement; racism, resource colonization, and the destruction of indigenous and First People's cultures; the shape of environmental justice in different parts of the world; the specter of environmental insecurity; and the role of a 'just sustainability' in shaping new sustainability discourses, ethics, policies, and plans for the twenty-first century.

UEP 294-04 Special Topics: Green Urban Design
Spring, Prerequisites: Graduate standing or consent of instructor
Theme: **Sustainable Solutions**
Applies design principles to selected sites, with the objective of creating meaningful and sustainable places. Students will be given three design problems over the semester: the first to be done individually and the other two in groups. The scale ranges from a small site (less than 5 acres) to medium and large neighborhoods (up to 50 acres). Topics include housing, office, retail, civic uses, parking, circulation, open spaces, and streetscape elements; and how to assemble them into low-impact mixed-use development. Sustainable development and green building practices will be explored by applying the LEED for Neighborhood Development certification process (currently under development as a pilot program) to the second and third design projects.

UEP 294-08 Special Topics: Planning for Low Impact Development
Spring, Prerequisites: Graduate Standing or consent of instructor
Theme: **Sustainable Solutions**
Designed for students in the field of planning, engineering, and environmental policy. Provides a land use planning approach and specific site planning skills. Low impact development (LID) is a land use planning and a site planning approach that integrates conservation design principles and specific best management practices to minimize or eliminate the environmental impacts associated with development. Course will present planning approaches using actual case studies. A field trip to visit LID projects will be scheduled.

REFERENCE GUIDE

Graduate Environmental Courses by Department:

FRIEDMAN SCHOOL OF NUTRITION

NUTR 215/ UEP 223	Fundamentals of U.S. Agriculture	Fall 2013	Prerequisites: Graduate standing or consent of instructor
NUTR 221	The Global Food Business	Spring 2014	Prerequisites: Graduate standing or consent of instructor
NUTR 233	Agriculture Science and Politics I	Spring 2014	Prerequisites: NUTR 215
NUTR 241/BIO 185/CIS 201	Food For All: Ecology, Biotechnology, and Sustainability	Spring 2014	Prerequisites: Introductory Biology, Introductory Chemistry, or equivalent
NUTR 303	Determinants of U.S. Food Policy	Fall 2013	Prerequisites: NUTR 238 or consent of instructor
NUTR 304	Nutrition, Food Security, and Development	Fall 2013	Prerequisites: NUTR 203 and NUTR 238, or consent of instructor
NUTR 327	Food Systems	Spring 2014	Prerequisites: Graduate standing or consent of instructor
NUTR 333	Agriculture Science and Politics II	Fall 2013	Prerequisites: NUTR 215 and NUTR 233
NUTR 341	Economics of Agriculture and the Environment	Fall 2013	Prerequisites: YES

FLETCHER SCHOOL OF LAW AND DIPLOMACY

ILO L223	Seminar on International Environmental Law	Fall 2013	Prerequisites: NO
DHP P250	Elements of International Environmental Policy	Fall 2013	Prerequisites: NO
DHP P253	Sustainable Development Diplomacy	Fall 2013	Prerequisites: NO
DHP P254	Climate Change Policy	Fall 2013	Prerequisites: NO
DHP P255	International Energy Policy	Spring 2014	Prerequisites: NO
DHP P256	Innovation for Sustainable Prosperity	Spring 2014	Prerequisites: NO
DHP P257/CEE 265/UEP 265	Corporate Management of Environmental Issues	Fall 2013	Prerequisites: NO
DHP P258	Clean EnergyTechnology and Policy Issues	Spring 2014	Prerequisites: NO
EIB E246m	Environmental Economics (0.5 credit)	Fall 2013	Prerequisites: NO

SCHOOL OF MEDICINE

MPH 204/ CEE 158	Environmental and Occupational Health	Fall 2013	Prerequisites: NO

GRADUATE SCHOOL OF ARTS AND SCIENCES

BIO 185/CIS 201/NUTR 241	Food For All: Ecology, Biotechnology, and Sustainability	Spring 2014	Prerequisites: Introductory Biology, Introductory Chemistry, or equivalent
CEE 112/ENV 112	Hydrology and Water Resource Engineering	Fall 2013	Prerequisites: NO
CEE 113/ENV 113	Groundwater Hydrology	Fall 2013	Prerequisites: GEO 2 and Calculus, or consent of instructor
CEE 131	River Hydraulics and Restoration	Spring 2014	Prerequisites: MATH 51 (formerly MATH 38) and CEE 12
CEE 132	Environmental Engineering Practices	Spring 2014	Prerequisites: CEE 30 and CEE 32, or consent of instructor
CEE 133	Wastewater Plant Design	Spring 2014	Prerequisites: CEE 32 or consent of instructor
CEE 136/ CHBE 136	Air Pollution Control	Fall 2013	Prerequisites: Junior standing
CEE 147	Soil Dynamics and Earthquake Engineering	Spring 2014	Prerequisites: CEE 42
CEE 149	Earth Support Systems	Fall 2013	Prerequisites: CEE 42
CEE 172	Fate and Transport of Environmental Contaminants	Spring 2014	Prerequisites: CHEM 2 or consent of instructor
CEE 194	Field Methods for Global Health	Fall 2013	Prerequisites: Junior standing
CEE 194A/ ENV 196R	Introduction to Remote Sensing	Spring 2014	Prerequisites: NO
CEE 194C	Environmental Informatics Course	Fall 2013	Prerequisites: NO
CEE 194H	Global Environmental Datasets	Fall 2013	Prerequisites: NO
CH 188-09	Health Equality and Built Environment	Fall 2013	Prerequisites: Senior standing or consent of instructor
CH 188-11	Water, Sanitation, and Hygiene in Global Health	Fall 2013	Prerequisites: NO
EOS 287	Subsurface Fluid Dynamics	Fall 2013	Prerequisites: MATH 51 (formerly MATH 38) and ES 8, or equivalents

EOS 288	Groundwater Modeling	Spring 2014	Prerequisites: NO
EOS 289	Geofluids	Fall 2013	Prerequisites: NO
ENV 196R/ CEE 194A	Introduction to Remote Sensing	Spring 2014	Prerequisites: NO
UEP 223/ NUTR 215	Fundamentals of U.S. Agriculture	Fall 2013	Prerequisites: Graduate standing or consent of instructor
UEP 207/ CE 207/ENV 207	Environmental Law	Fall 2013	Prerequisites: Senior or graduate standing and consent of instructor
UEP 278	Environmental Justice, Security, and Sustainability	Fall 2013	Prerequisites: Graduate standing or consent of instructor
UEP 294-04	Special Topics: Green Urban Design	Spring 2014	Prerequisites: Graduate standing or consent of instructor
UEP 294-08	Special Topics: Planning for Low Impact Development	Spring 2014	Prerequisites: Graduate standing or consent of instructor