SOIL SCIENCE (SOILS)

SOILS 502: Soils Properties and Functions

3 Credits

Introduction to soil science for graduate students including fundamentals of and applications to plant production and environmental sustainability. SOILS 502 Soils Properties and Functions (3)This course provides an introduction to soil science, emphasizing the three areas of biological, chemical and physical properties of soils. It is intended as an introductory course in soil science for graduate students whose work would benefit from background knowledge of soil science but who have not previously been exposed to the science of soils as an undergraduate. As a graduate course, the pace of learning will be rapid, and the material covered will be quite comprehensive. The breadth of material is comparable to that covered in an undergraduate introduction to soil science, but with greater depth. The class will incorporate a substantial level of experiential components, including chemical analysis lab practice overview, some labs for gaining insight into physical properties, and field trips to help students gain an appreciation of how soils are influenced by, and also influence, the landscape in which they exist. Landscape visits with guided discussions, research proposal development and analysis, and selected soil management problem analysis provide students opportunities to synthesize classroom and textbook based material. Students will be evaluated based on quizzes, exams and written assignments.

SOILS 504: Unsaturated Zone Hydrology and Chemical Transport

3 Credits

Recommended Preparations: At least one undergraduate course in Mathematics and in Chemistry. GEOSC 452 This course provides the theoretical basis for and mathematical description of the transport of water and chemicals through the unsaturated zone between the soil surface and the regional water table. This zone is frequently referred to as the vadose zone. In particular, the course investigates the solutions to problems involving the transport of water and chemicals through the vadose zone, such as might be the case when attempting to predict direction and rate of a contaminant spill, or to determine the length of time required for contaminant remediation, or to protect buried waste from infiltrating water. Students will recognize parameters required in order to develop solutions to identified problems, will identify means to obtain values of the needed parameters, and will develop model solutions in order to gain insight into expected outcomes of proposed solutions.

SOILS 507: Soil Physics

3-4 Credits/Maximum of 4

Soil physical properties emphasizing water, heat, gas, and ion movement in unsaturated soils. Laboratory included with 4 credits.

Prerequisite: 6 credits each of calculus, physics, and soils

SOILS 510: Geographic Information System Applications

3 Credits

Soil data bases, image processing, and geographic information systems will be used to model and understand land and water resources.

Prerequisite: GEOG 457

SOILS 512: Environmental Soil Microbiology

3 Credits

Biology and ecology of microorganisms in terrestrial environments; microbiological and molecular analysis methods; microbial processes in carbon and nitrogen cycling. SOILS 512 Environmental Soil Microbiology (3) Environmental Soil Microbiology (SOILS 512) examines the major groups of microorganisms and their processes and interactions in terrestrial systems, with an emphasis on carbon and nitrogen cycling. Students will obtain an overview of the biology, ecology, and functions of bacteria, archaea, and fungi in soils, rhizospheres, sediments, and organic wastes. This course is intended for students interested in spatial and temporal distribution and activities of microorganisms in the environment, as well as in appropriate methods for analyzing microbes in environmental samples. Course format will consist of two weekly lectures, each followed by a 25 -min discussion period. Class discussions will include exercises and reviews of recent literature on classical and molecular soil/environmental microbiology. Grading will be based on participation in class discussions (20%), two midterm exams (20 % each), one final take-home exam (20%), and a 10-page research proposal to be presented to the class in late April (20%). SOILS 512 will support interdisciplinary training of graduate students in Soil Science as well as in other disciplines of the College of Agricultural Sciences, especially Plant Pathology, Horticulture, Entomology, and Agricultural and Biological Engineering. Graduate students in the Intercollege Graduate Degree Program in Ecology (IGDPE), College of Earth and Mineral Sciences, Eberly College of Science, and College of Engineering also will find this course useful when undertaking research on systems involving microorganisms (e.g., biogeochemistry, plant or animal systems, or environmental engineering). Course will be offered every other spring semester with an anticipated enrollment of 20 students per class.

Prerequisite: two years of chemistry and B M B401 , A B E308 , or equivalent

SOILS 513: Soil Environmental Chemistry

3 Credits

Chemical constituents and processes occurring in soils. Discussion of soil components, reactions at the solid-solution interface, and soil chemical processes.

Prerequisite: CHEM 450

SOILS 516: Soil Genesis

1-4 Credits/Maximum of 4

Field trip to study the genesis, classification, and geomorphology of the major soils of the northeastern United States.

Prerequisite: SOILS416 or 6 credits in geology or physical geography

SOILS 519: Nature of Soil Minerals

3 Credits

Constituent minerals of soils: modern methods for identification; relations to soil formation and agricultural practices.

SOILS 536: Topics in Biogeochemistry

2 Credits/Maximum of 999

This seminar addresses chemical interactions between the biosphere and the physical environment over Earth's history and as impacted by humans. This course will provide a broad survey of biogeochemical principles, and offer a community-building experience for students with biogeochemical interests from diverse departments. Students will complete the course with a synthetic knowledge of the key topics in the field of biogeochemistry. Each week we will focus on a topic within the broad field of biogeochemistry such as: origins of the elements, reactions in the atmosphere, soil development, the distribution of redox reactions and microbial metabolic pathways, and the global cycles of carbon, water, nitrogen, phosphorus, sulfur, mercury, and perhaps other elements. For each topic, we will focus on the questions: What is known or can be observed? How is this information used to understand biogeochemical phenomena and process? How are these processes scaled over time and space? What are emerging and important questions in the subspecialties of biogeochemistry?

Cross-listed with: CE 536, GEOSC 536

SOILS 571: Ecosystem Nutrient Cycles

3 Credits

Ecological theory and applications related to water, carbon, nitrogen, phosphorus, and cation cycling in managed and unmanaged terrestrial ecosystems. SOILS 571 Ecosystem Nutrient Cycles (3)This course is designed to benefit basic and applied environmental scientists that want to understand how nutrients cycle in terrestrial ecosystems. Students will develop knowledge of the biologically important nutrient cycles in terrestrial ecosystems, including linkages between nutrient cycling and energy (carbon) and water flow. The material covers the major theoretical advances in ecosystem ecology and applications of ecosystem theory to environmental management and problem solving. The water, carbon, nitrogen, phosphorus, and nutrient cation cycles will be covered. For each nutrient, inputs, outputs and internal cycling in plants and soils are discussed. Class time will include a mixture of lectures, discussions of primary literature and case studies, and group projects. Each student will write a paper on a topic related to their research that will be reviewed by student peers. Field and laboratory experiences will expose students to methods used by ecosystem ecologists. Students will complete the class with an understanding of: (1) classic and contemporary theories of nutrient cycling at the ecosystem scale, 2) variability in nutrient cycling among the major unmanaged and managed ecosystem types, 3) ecosystem responses to natural disturbance and human management, and 4) common and cutting-edge methods of ecosystem analysis.

SOILS 589: Critical Zone Science Seminar

1-3 Credits/Maximum of 3

This course will explore the foundations, discoveries, and applications linked to the Critical Zone concept through primary literature, class discussions, and original student projects. We will start by spending one week each on the four foundational science domains that are woven together to make Critical Zone science: hydrology, geoscience, soil science, and ecology. Then we will spend several weeks highlighting key discoveries that arise from the interdisciplinary Critical Zone perspective. The end of the class explores whether the Critical Zone science perspective might have useful applications for land and water management. Throughout the class, students take a co-leadership role with the instructors in terms of selecting readings, lecturing, and designing active learning allied with key concepts.

Cross-listed with: CE 589, GEOSC 589

SOILS 590: Colloquium

1-3 Credits/Maximum of 3

Continuing seminars which consist of a series of individual lectures by faculty, students, or outside speakers.

Cross-listed with: FOR 590, WFS 590

SOILS 596: Individual Studies

1-9 Credits/Maximum of 9

Creative projects, including nonthesis research, that are supervised on an individual basis and which fall outside the scope of formal courses.

SOILS 597: Special Topics

1-9 Credits/Maximum of 9

Formal courses given on a topical or special interest subject which may be offered infrequently.

SOILS 600: Thesis Research

1-15 Credits/Maximum of 999

NO DESCRIPTION.

SOILS 601: Ph.D. Dissertation Full-Time

0 Credits/Maximum of 999

NO DESCRIPTION.

SOILS 602: Supervised Experience In College Teaching

1-3 Credits/Maximum of 6

GRADUATE STUDENT INVOLVEMENT IN PREPARATION, PRESENTATION, AND EVALUATION OF COURSE MATERIALS FOR UNDERGRADUATE FORMAL COURSES.

SOILS 610: Thesis Research Off-Campus

1-15 Credits/Maximum of 999

No description.

SOILS 611: Ph.D. Dissertation Part-Time

0 Credits/Maximum of 999

NO DESCRIPTION.

SOILS 804: Soil Ecosystem Analytical Techniques

3 Credits

SOILS 804 is a three-credit quantitative laboratory instrumentation course that is designed to give students a deeper understanding and application of modern laboratory instrumental techniques for the isolation, identification, detection, and quantitation of soil ecosystem chemical substances. Upon completion of the course, students should be well versed in appropriate techniques used to collect and process a sample and measure the chemical constituents and assess the condition of soil ecosystems: soil gases; soil inorganic and organic solids, and soil solutions/digests/extracts. Instrumental techniques covered in the course include spectroscopic, chromatographic, spectrometric, electrochemical, and thermal methods for soil ecosystem measurements. As such, the course has laboratory and lecture components. In the lectures, students learn good laboratory practices, sampling and sample processing and preparation methods, selection of analytical instruments and the chemical and/or physical principles exploited during the measurement, how the instrument performs the measurement and some of the techniques used to increase accuracy, precision, sensitivity, selectivity, and measurability. In the laboratory, students will put the theory and principles into practice by performing various analytical experiments designed to provide examples of the usefulness of selected instruments or techniques in a way that will enable the student to understand and operate a wide range of other related instruments for soil ecosystem analyses. Thus, while the laboratory experiments and demonstrations will illustrate some of the applications of the instruments, students will be expected to develop a deep understanding of the advantages and disadvantages of different instrument analytical techniques in terms of their usability, sensitivity, cost, and other parameters with emphasis on the applicability and complementarity of different techniques to soil ecosystem chemical measurements.

SOILS 896: Individual Studies

1-9 Credits/Maximum of 9

Creative projects with a professional orientation, including nonthesis research, that are supervised on an individual basis and which fall outside the scope of formal courses.

SOILS 897: Special Topics

1-9 Credits/Maximum of 9

Formal courses given on a topical or special interest subject with a professional orientation that may be offered infrequently; several different topics may be taught in one year or semester.