GEOSCIENCES (GEOSC)

GEOSC 500: Issues in Geosciences

3 Credits

Introduction of first year graduate students to issues in geosciences. GEOSC 500

Prerequisite: admission to the Geosciences Graduate Program

GEOSC 501: Words to Live by: Professional Communication in the Geosciences

3 Credits

This course develops writing skills for graduate students seeking careers in the geosciences. It emphasizes expression of research questions, methods, and findings with engaging text, compelling arguments and narratives, and impactful figures. The course covers scientific editing and publishing, professional correspondence, and broader science communication using news and social media

Prerequisites: GEOSC 500 Recommended Preparations: The student should be engaged in graduate-level research and preparing for a professional career in the geosciences.

GEOSC 502: Evolution of the Biosphere

3 Credits

The geologic history of the co-evolution of life and the surface environment is examined from an Earth systems perspective. The course will examine significant events in Earth history through a combination of lectures, discussions, papers, and presentations. In particular, the class will use selected events in Earth history to highlight the various and varied geochemical and molecular records or proxies related to life on Earth. Assessment will include an examination, required discussions, research proposals, and peer evaluation of research proposals.

Recommended Preparation: Undergraduate-level coursework in biology and geology or consent of instructor.

GEOSC 508: Mechanics of Earthquakes and Faulting

3 Credits

An in-depth treatment of fundamental concepts in brittle faulting and earthquake mechanics with emphasis on physical processes. GEOSC 508

Prerequisite: GEOSC465, GEOSC489, MATH 251

GEOSC 511B: Transmission Electron Microscopy

1 Credits

Principles and practice of transmission electron microscope operation. Students undertake individual projects.

Cross-listed with: MATSE 511B

GEOSC 514: Data Inversion in the Earth Sciences

3 Credits

This course focuses on how one finds theoretical parameters to explain observed data using discrete inverse theory.

Prerequisite: MATH 220

GEOSC 518A: Isotope Geochemistry Fundamentals

2 Credits

This course covers the fundamental knowledge and quantitative approaches used in the application of isotopes and their relative abundances within the natural and applied sciences. Students will gain understanding of the theory and guiding principles of isotope systems, including isotope fractionation, radioactive decay, mass balance, isotope notation, and quantitative treatment of isotopic data. The course will cover methods of isotope analyses and the quantitative treatment of isotope data. After successfully completing the course, students will be able to apply theory and methods in isotope systems to diverse disciplines spanning Earth, material, biological, and environmental sciences.

GEOSC 518B: Isotope Biogeochemistry

2 Credits

This course explores knowledge and quantitative approaches used in the application of isotopes within the biogeochemical sciences. Students will gain advanced understanding of isotopic data relevant to the cycling of life-sustaining elements and substrates, including carbon assimilation, metabolic processes and products, and energy metabolism. The course will focus on isotopes of the major elements (C,H,N,O,S) and include examples involving minor elements or metals relevant to biogeochemistry. Each course module will cover a core concept (or concepts) that provides a theoretical framework for understanding isotopic distributions in a certain type of system, and then apply this concept to a range of real-world topics. After successfully completing this course, students will be able to apply methods in isotope biogeochemical systems in fields relevant to the biological, ecological, environmental, soil, and earth sciences.

GEOSC 518C: Isotopes in Oceans and Climate

2 Credits

Students in this course will explore the isotopes that build the major molecules involved in Earth's oceans and atmospheres. In particular, the course investigates how isotopes within Earth materials can record and reconstruct: climate from an anthropogenic and deep-time perspective, hydroclimate, climate states in Earth's past, atmospheric chemistry, ocean chemistry, and the carbon cycle.

GEOSC 518D: Isotopic Analysis in the Geosciences

2 Credits

This course covers the principles and practice of analyzing the isotopic composition of natural geological and biological materials. In particular, the course investigates the physical and chemical principles underlying: the conversion of matter into atomic and molecular ions, the separation of charged particles by mass, and the detection of ion beam intensities for the purpose of precise, accurate, reproducible determination of isotopic ratios in geoscientific applications. The course delves into

the principles behind, and practical considerations of, the equipment that enables contemporary mass analysis techniques, such as power supplies, vacuum systems and monitoring, signal detecting and processing, data handling, and standardization. Students will gain advanced understanding of how isotopic ratios are measured, an appreciation of how analytical developments guide (and have guided) research questions in isotope geochemistry, along with practical training in the operation and maintenance of modern mass spectrometers. Through analysis of the scope and limitations of existing techniques and instrumentation, students will be empowered to incorporate isotopic analysis into their research and design methods to support new research directions.

Prerequisites: GEOSC 518A Recommended Preparations: Two semesters of college-level physics, 1-2 semesters of general chemistry, and 1 semester of analytical/instrumental chemistry. Previous exposure to the concepts of aqueous solvation, ion chromatograph

GEOSC 518E: Isotope Geochemistry: Solid Earth

2 Credits

This course covers specific tools using isotope geochemistry to understand the Solid Earth. Students will build on a fundamental knowledge of isotope geochemistry and learn how to apply that fundamental knowledge to specific problems in crustal evolution, geochronology, and high-temperature planetary processes. Through inclass discussions and weekly problem sets, students will gain awareness and practical experience with both solid Earth science questions, and the utility of isotope geochemistry for answering such questions. Students will leave this course with an understanding of which isotope systems can be used to answer particular scientific questions, and importantly, which cannot.

GEOSC 519: Mineral Equilibria

3 Credits

A thermodynamic treatment of minerals and their reactions under geochemically important conditions of temperature and pressure.

Prerequisite: CHEM 450

GEOSC 521: Thermal State of the Earth

2-3 Credits/Maximum of 3

Analytical and numerical solutions to earth-related heat conduction and convection problems; geothermal energy; earth's heat flow and temperature.

GEOSC 522: Geochemistry of Aqueous Systems

2-3 Credits/Maximum of 3

lonic and molecular equilibria related to stabilities and solubilities of minerals, with applications to ground water, sea water, and hydrothermal fluids.

Prerequisite: CHEM 450, CHEM 452

GEOSC 523: Sedimentary Geochemistry

2 Credits

Kinetics and thermodynamics of low-temperature processes in sediments. Applications to weathering processes, natural waters, deposition of sediments, and diagenesis.

GEOSC 533: Principles of Geochemistry

3 Credits

A comprehensive treatment of the principles of geochemistry applied to a wide variety of geologic settings and scales.

Prerequisite: CHEM 450

GEOSC 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, SOILS 536

GEOSC 542: Quantitative Methods in Hydrogeology

1-4 Credits/Maximum of 4

Investigation of groundwater systems and resources, emphasizing both the practical use and limitations of modeling techniques.

Prerequisite: GEOSC452

GEOSC 548: Surface Processes

3 Credits

Principles, application, and interpretation of Quaternary geochronology, surface process studies, and landscape evolution.

Prerequisite: GEOSC340

GEOSC 555: Advanced Structure and Petrofabrics

1-3 Credits/Maximum of 3

Macroscopic and mesoscopic recognition, measurement, and interpretation of small-scale rock structures and mineral orientation patterns in deformed rocks.

GEOSC 558: Multi-channel Seismic Processing and Interpretation

4 Credits

This course covers the basics of seismic energy propagation, modern 2- and 3-D multi-channel seismic data acquisition methods, and data processing.

Prerequisite: GEOSC454

GEOSC 559: Seismology II

3 Credits

Rigorously covers the methods of computing wave fields for point and distributed seismic sources in vertically inhomogeneous elastic media.

Prerequisite: E MCH524A , E MCH524B , or MATH 405 , MATH 406

GEOSC 560: Kinetics of Geological Processes

3 Credits

General development of the kinetic theory of crystal growth, diffusion, irreversible thermodynamics, and heterogeneous reactions needed for geosciences and related fields with applications to current problems.

Prerequisite: CHEM 450, GEOSC519

GEOSC 561: Mathematical Modeling in the Geosciences

4 Credits

The process of transforming a conceptual geoscience model into a numerical model is presented; students create and solve numerical models.

Prerequisite: undergraduate-level calculus and geology coursework is required; experience in computer programming and coursework in differential equations is recommended; or consent of instructor

GEOSC 565: Tectonic Geomorphology

3 Credits

Tectonic geomorphology examines interactions between tectonic and surface processes, paleosceismology, geodesy, structure, active deformation, and landform evolution.

Prerequisite: GEOSC340, GEOSC465

GEOSC 572: Field Stratigraphy

1-2 Credits/Maximum of 2

This course introduces students to field techniques used by stratigraphers, with the capstone experience being a field trip during May.

Prerequisite: GEOSC439, GEOSC472A, GEOSC472B, GEOSC479

GEOSC 585: Sedimentary Geology

3 Credits

An integrated approach to the study of modern and ancient sedimentary environments and their deposits.

Prerequisite: undergraduate coursework in sedimentology or consent of instructor

GEOSC 587: Preparing for an Academic Career in the Geosciences

3 Credits

The course focuses on successful strategies for the academic job market and for launching an academic career. GEOSC 587 Preparing for an Academic Career in the Geosciences (3) This seminar is designed for advanced doctoral students who are ready to launch their own search for an academic position. We will explore important elements of the transition into an academic career, including the application and interview process and strategies to establish teaching and research programs. During the semester students will: (a) learn about roles and responsibilities of faculty members in different educational settings (e.g., community colleges, four-year colleges, universities); (b) Design a teaching and research plan suitable for the next career stage and write teaching and research statements to summarize these plans; (c) Learn strategies for documenting their strengths and accomplishments in teaching and research; (d) Learn "the inside scope" about job searches including how to navigate the application process, interviews, and negotiation; (e) Learn how to give an effective job talk; (f) Discuss strategies for balancing the many demands and expectations they will face in an academic career. Finally, students will develop a self-inventory of preferred options for the next career stage and a personal action plan.

Prerequisite: Students must have passed their comprehensive exam and be within a year from receiving their Ph.D. degree.

GEOSC 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, SOILS 589

GEOSC 590: Colloquium

1-3 Credits/Maximum of 3

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

GEOSC 596: Individual Studies

1-9 Credits/Maximum of 9

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

4 Geosciences (GEOSC)

GEOSC 597: Special Topics

1-9 Credits/Maximum of 999

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

GEOSC 597C: **SPECIAL TOPICS**

3 Credits

GEOSC 597D: **SPECIAL TOPICS**

2 Credits

GEOSC 597E: **SPECIAL TOPICS**

1 Credits

GEOSC 597F: **SPECIAL TOPICS**

1 Credits

GEOSC 597I: **SPECIAL TOPICS**

2 Credits

GEOSC 598: Special Topics

1-9 Credits/Maximum of 9

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

GEOSC 600: Thesis Research

1-15 Credits/Maximum of 999

No description.

GEOSC 601: Ph.D. Dissertation Full-Time

0 Credits/Maximum of 999

No description.

GEOSC 602: Supervised Experience in College Teaching

1-3 Credits/Maximum of 6

Supervised experience in teaching geosciences courses.

GEOSC 610: Thesis Research Off Campus

1-15 Credits/Maximum of 999

No description.

GEOSC 611: Ph.D. Dissertation Part-Time

0 Credits/Maximum of 999

No description.