

# COURSES FOR GEOLOGICAL SCIENCES

## Geological Sciences Courses

### **GEO501 Paleoclimatology**

Hours 3

Survey of the variability of global climate through geologic time and investigation of the mechanisms of change.

Prerequisite(s): MATH 126 or MATH 146; and PH 102

### **GEO502 Communicating Geology**

Hours 3

Evaluate and develop effective scientific communication skills including writing, oral presentations and poster presentations.

Prerequisite(s): None

### **GEO503 Petroleum System Analysis**

Hours 3

The course will cover the geologic events that lead to the formation of petroleum systems and plays. Geologic events form sedimentary basins by causing subsidence and delivery of sediments to a basin. This sedimentary fill is modified by compaction as well as the transport of heat and reactive fluids through the rock matrix during sedimentation and lithification. These processes determine the amount and nature of oil and/or gas accumulation and production in a basin. Petroleum system analysis requires the integration of geology, geophysics, petrophysics, geochemistry, and risk analysis. The generated basin models incorporate data obtained directly from outcrops via geologic mapping, petrographic thin section analysis, geochemical data, seismic reflection profiles and well log analysis if there are wells drilled for oil and gas exploration in a sedimentary basin.

Prerequisite(s): Department of Geological Sciences Graduate student standing or Instructor's consent.

### **GEO505 Introduction to Environmental Biogeochemistry**

Hours 3

An introduction to fundamental concepts in biogeochemistry, a scientific discipline that integrates the study of geological, physical, chemical, and biological principles that govern the natural environment. The course discusses the lithosphere, hydrosphere, atmosphere, and biosphere, and emphasizes their interactions and connectivity through the cycles of elements and energy. Students will learn through lectures, discussions, field trips, and laboratory exercises.

### **GEO506 Organic Geochemistry**

Hours 3

This is an introductory course to molecular biomarkers, which are a group of source-specific compounds preserved in the environment. Biomarkers have core structures that are generally resistant to environmental degradation. These structures allow tracing back to the source biota and making interpretations of modern and past activities of life and associated environmental and climatic changes. Lectures acquaint students with different classes of biomarkers and their applications to geological and environmental research. Labs familiarize students with the analytical methods including extraction, purification, chromatographic separation, and instrumental analysis of biomarkers.

### **GEO507 Seismology**

Hours 3

This course provides an overview of earthquake seismology for both undergrad and graduate geoscience students. Topics include elastic wave propagation, seismic ray theory, travel time interpretation, surface wave dispersion and seismic tomography.

Prerequisite(s): MATH 126 or MATH 146

### **GEO509 Advanced Hydrogeology**

Hours 3

An advanced level hydrogeology course that investigates groundwater flow and continuum approach in groundwater hydrology, applied stochastic subsurface hydrology, development of governing groundwater flow equations, analytical and numerical modeling of groundwater flow, unsaturated flow, well hydraulics, and environmental topics of interest related to water resources.

Prerequisite(s): GEO 306; MATH 125; MATH 126; PH 101 or PH 105; PH 102 or PH 106.

### **GEO510 Soil & Groundwater Restoration**

Hours 3

Methods for restoring contaminated soil and groundwater by examining the factors and processes influencing the efficacy of remediation systems. An emphasis will be placed on the scientific principles upon which soil and groundwater remediation is based.

### **GEO511 Contaminant Transport in Porous Media**

Hours 3

This course will cover topics related to the transport and fate of contaminants in subsurface systems. Specifically, this course will discuss the many factors and processes influencing contaminant transport such as the effects of dispersion, inter-phase mass transfer, transformation reactions, and porous-media heterogeneity. In addition, representative conceptual/mathematical models describing contaminant transport phenomena will be discussed.

Prerequisite(s): MATH 125, PH 102, CH 102, GEO 306 or equivalents; and/or with instructor's permission.

### **GEO515 Metamorphic Petrology**

Hours 3

Study of metamorphic processes, types, textures, and petrogenesis and the use of metamorphic rocks for understanding tectonism. Offered on demand.

### **GEO516 Volcanology**

Hours 3

Rheologic properties of magmatic systems and application of these principles to the understanding of volcanic processes. Offered on demand.

### **GEO522 Sedimentary Basin Analysis**

Hours 3

Examination of the evolution and development of sedimentary basins. Emphasis is on sedimentary, tectonic, and geochemical processes and their influence in petroleum generation, accumulation, and preservation. Offered on demand.

Prerequisite(s): GEO 365 and GEO 367 and GEO 210

**GEO525 Adv Topics In Geology**

SP

Hours 1-6

Advanced topics in the following areas: economic geology, geochemistry, geohydrology, geophysics, geomorphology, mineralogy, paleontology, petrology, sedimentation, stratigraphy, structural geology, and tectonics. Offered on demand.

Special Topics Course

**GEO535 Graduate Seminar**

Hours 1

Oral presentations on current geological topics. Offered fall and spring semesters.

**GEO536 Graduate Seminar**

Hours 1

Oral presentations on current geological topics. Offered fall and spring semesters.

**GEO542 Geodynamics**

Hours 3

Introduction to the structure of the Earth's interior and theory of plate tectonics. Quantitative analysis of the physical processes governing the formation of major tectonic and magmatic features on the Earth. Emphasis is on understanding geodynamic processes in orogenic belts, volcanic arcs, intraplate magmatism, sedimentary basins and continental extensional provinces. Offered spring semester.

Prerequisite(s): GEO 365 or GEO 314; and PH 102 and MATH 126 or MATH 146

**GEO550 Geostatistics**

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Hours 3

This course serves as an introduction to statistics for the Earth and Environmental Sciences. Topics include an introduction to probability theory, experimental design, statistical hypothesis testing, regression, clustering, Kriging and other forms of spatial analysis, time series analysis, and an introduction to machine learning. All material is covered theoretically and with practical implementation in Matlab. Computing proficiency is required for a passing grade in this course. Writing proficiency is required for a passing grade in this course. A student who does not write with the skill normally required of an upper-division student will not earn a passing grade, no matter how well the student performs in other areas of the course. The course includes two lectures and one computer lab weekly.

Prerequisite(s): MATH 125 or MATH 145; and CS 101, CS 102, or CS 110

Computer Science, Writing

**GEO551 Tracers in Water Science**

Hours 3

The objective of this course is to introduce students to currently used isotope techniques in aquatic science. Emphasis will be given to the application of the U/Th- naturally occurring radioactive decay series.

Prerequisite(s): MATH 126 or MATH 146 and PH 102 or instructor's approval

**GEO554 Electron Microscopy in the Earth Sciences**

Hours 4

This course will involve operation and use of the scanning electron microscope (SEM) for applications relevant to the Earth, environmental, and planetary sciences. Topics will include sample preparation, secondary electron imaging, backscattered electron imaging, x-ray element mapping, and energy/wavelength dispersive spectroscopy. Laboratory exercises will provide hands-on experience in preparing geologic samples and obtaining data on those samples with the SEM.

**GEO555 Marine Science**

Hours 3

This class is an upper level introduction to the elemental budgets on the global ocean.

Prerequisite(s): CH 101 and CH 102, or permission of instructor.

**GEO565 Compactive Struct Geology**

Hours 3

Analysis of the original literature on structural families and deformation-mechanism associations, emphasizing the low-temperature environment.

**GEO566 Introduction to Planetary Science**

Hours 3

This course in Planetary Science will provide an overview of the major processes that have shaped our Solar System, with some focus on extra-terrestrial materials and associated data. The course will examine the major aspects of our Solar System, considering physical, chemical and geological concepts. We will explore the different bodies in the Solar System, and learn from the data collected from missions and analytics on samples.

Prerequisite(s): For graduate students, there are no prerequisites aside from a GEO, CHEM or PHYSICS background.

**GEO568 Paleo Seminar**

Hours 1

Weekly seminar meetings on 'Paleo' topics as guided by enrolled students. Typical semesters will focus on specific areas or concepts within Paleo-related sciences, including, but not limited to paleobiology, paleoclimatology, and paleoecology. Meeting times may also be used to discuss active Paleo research by participating students, faculty, or visiting scholars.

Prerequisite(s): None, permission of instructor.

**GEO569 Light Stable Isotope Geochemistry**

Hours 3

This course is an introduction to concepts of stable isotope fractionation, and the application of stable isotopic measurements to answering geological questions. This class specifically focuses on light elements, primarily H, C, O, S, and N, though other elements/systems may be explored if there is time/interest.

Prerequisite(s): CH 102 or CH 118 (C- or better, and, GEO 101 or GEO 102 (C- or better), and MATH 112 or MATH 115 (C- or better)

**GEO570 Introduction to Geochemistry**

Hours 4

Introduction to the field of low-temperature geochemistry (elementary chemical equilibria and thermodynamics, solubility and redox equilibria, organic geochemistry), with an emphasis on solving geologic problems. Three lectures and one seminar per week. Offered in the Spring semester.

Prerequisite(s): GEO 314

**GEO571 Thermodynamics For Geologists**

Hours 3

Semi-derivational approach to understanding the thermodynamic relations most useful to geologists. Emphasis is on using the derived relations to solve common geologic problems. Offered alternate fall semesters.

Prerequisite(s): MATH 126 or MATH 146

**GEO576 Environmental Field and Laboratory Methods**

Hours 3

Theory, techniques, and application of methods for the environmental sampling and geochemical analysis of rocks, ores, and aqueous fluids. Offered in alternate Fall semesters.

Prerequisite(s): CH 101 and CH 102, or permission of instructor.

**GEO580 Cosmochemistry and Techniques**

Hours 3

This course in cosmochemistry and analytical techniques will examine notable topics, geological concepts and analytical methods used to better understand our Solar System. The course will be part-lecture and part discussion/seminar based, where students will read journal articles on topics and make short presentations for discussion, to develop scientific curiosity and critical thinking. Writing proficiency within the discipline is required for a passing grade in this course.

Prerequisite(s): Some background in geochemical/astronomy themes is strongly encouraged. GEO 566 or permission of the instructor

**GEO583 Global Tectonics**

Hours 3

Study of tectonics, plate motions, and tectonic environments. Includes discussion of controlling factors, driving forces, and resulting structures with emphasis on island arcs, trenches, backarc basins, transform boundaries, and continental margins. Offered alternate spring semesters or on demand.

Prerequisite(s): GEO 365 and GEO 367

**GEO597 Geological Internships**

Hours 3

Field and laboratory projects with government and industry.

**GEO598 Non-Thesis Research**

Hours 1-6

Non-Thesis Research.

**GEO599 Thesis Research**

Hours 1-12

This independent research course partially fulfills required master's-level research thesis hours toward the master's degree in Geology (Geological Sciences). The course is conducted under the guidance of the thesis advisor. Material covered will be of an advanced nature aimed at providing master's students with an understanding of the latest research and current developments within the field. Discussion and advisor guidance will be directed towards readings of research articles and development of research methodology, with the aim of producing an original research contribution that represents a novel development in the field, or a novel perspective on a pre-existing topic in the field.

**GEO602 Communicating Geology**

Hours 3

Evaluate and develop effective scientific communication skills including writing, oral presentations and poster presentations.

Prerequisite(s): None

**GEO626 Adv Topics In Geology**

SP

Hours 1-6

Advanced topics in the following areas: economic geology, geochemistry, geohydrology, geophysics, geomorphology, mineralogy, paleontology, petrology, sedimentation, stratigraphy, structural geology, and tectonics. Offered on demand.

Special Topics Course

**GEO635 Graduate Seminar**

Hours 1

Oral presentations on current geological topics. Offered fall and spring semesters.

**GEO636 Graduate Seminar**

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Oral presentations on current geological topics. Offered fall and spring semesters.

**GEO698 Non-Dissertation Res**

Hours 1-12

Non-Dissertation Res.

**GEO699 Dissertation Research**

Hours 1-12

This independent research course partially fulfills required doctoral-level research dissertation hours toward the doctoral (Ph.D.) degree in Geology (Geological Sciences). The course is conducted under the guidance of the dissertation advisor. Material covered will be of an advanced nature aimed at providing doctoral students with an understanding of the latest research and current developments within the field. Discussion and advisor guidance will be directed towards readings of research articles and development of research methodology, with the aim of producing an original research contribution that represents a novel development in the field, or a novel perspective on a pre-existing topic in the field.