

# COURSES FOR GEOLOGICAL SCIENCES

## Geological Sciences Courses

### **GEO101 The Dynamic Earth**

N

Hours 4

Three lectures and one laboratory. Study of the earth including materials, internal and external processes, deformational events, and plate tectonics. Offered in the fall, spring, and summer semesters.

Natural Science

### **GEO102 The Earth Through Time**

N

Hours 4

Three lectures and one laboratory. Survey of earth's history including origin of the earth, plate tectonics and evolution of the continents and ocean basins, and the development of life. Offered in the fall, spring, and summer semesters.

Natural Science

### **GEO103 Introduction to Oceanography**

N

Hours 4

This course is an introductory study of the Earth Ocean system, including processes shaping the ocean floor and coastlines; basic physical and chemical properties of the seawater; ocean circulation and climate change, and biological productivity and marine life.

Prerequisite(s): None

Prerequisite(s) with concurrency: None

Natural Science

### **GEO104 Hazardous Earth**

N

Hours 4

This natural science course examines geologic and other Earth hazards that impact humans and ways that human activities often increase these hazards. The course consists of lecture and lab, and includes field trips and videos that illustrate various natural hazards.

Natural Science

### **GEO105 Sustainable Earth**

N

Hours 4

Three lectures and one laboratory. Lecture and laboratory provide an understanding of important earth resources (rocks and minerals, soil, water, fossil fuels, alternative energy) and how their utilization by humans impacts the environment. Includes discussion of water pollution, air pollution and waste disposal as primary issues related to resource utilization.

Natural Science

### **GEO201 Foundations of Earth Science**

Hours 4

An introductory course that builds upon Earth Science concepts through applied, hands-on assignments, laboratories, and field exercises.

This course investigates rigorous concepts in mineralogy, structural geology, tectonics, petrology, sedimentology/stratigraphy, hydrogeology, geochemistry, paleontology, geophysics/seismology, planetary sciences, and topics directly related to the exploration and sustainability of Earth's resources including impacts of climate change on Earth's resources and systems from small to global scales. Specifically, this course investigates relevant topics in critical minerals and energy resources, geological and climate related hazards, environmental restoration, ocean circulation and nutrient availability, water resources and groundwater sustainability, artificial intelligence and machine learning to develop improved resources and climate related challenges, and new paradigms in planetary and solar system evolution, among others. This course will cover field techniques, laboratory/experimental/analytical approaches, and computer-based applications/methods in Earth Sciences that are at the forefront of related multidisciplinary sub-fields. This course will prepare students for various Earth science careers and development, and for success in obtaining highly relevant certifications/licenses for the field.

Prerequisite(s): GEO 101 OR GEO 102 OR GEO 103 OR GEO 104 OR GEO 105; or permission of the instructor.

### **GEO210 Mineralogy**

Hours 4

Two lectures and two laboratories. Introduction to crystallography, crystal chemistry, rock-forming minerals, physical properties of minerals, hand sample mineral identification, and optical mineralogy. Offered in the fall semester.

Prerequisite(s): CH 101 or CH 100 or CH 117; and GEO 101

### **GEO305 Fundamentals of Water Science**

Hours 3

This course will focus on building a solid set of fundamental skills necessary for various Water Science careers. These skills are critical for solving multiple challenges that we are facing in managing water resources to maintain healthy ecosystems, clean environments, and economic wellbeing. The course will discuss geological, physical, chemical, and biological aspects of Water Science and train students in field techniques, laboratory analytical approaches, and computer-based applications in Water Sciences. Students will be exposed to a variety of topics, such as the Hydrological Cycle, Water Quality, Environmental Measurements and Statistics, and Watershed Dynamics. These topics will prepare students for success in upper-level core and elective courses for Water Science and Sustainability major and minor.

Prerequisite(s): GEO 101, or GEO 103, or GEO 105, or Permission of the instructor

### **GEO306 Hydrogeology**

Hours 3

Introduction to the principles of groundwater flow, groundwater exploration, water quality, and groundwater contamination; environmental topics in groundwater. Offered in the fall semester.

Prerequisite(s): GEO 101

## 2 Courses for Geological Sciences

### **GEO314 Ign. & Meta. Petrology**

Hours 4

Three lectures and one laboratory. Megascopic and microscopic study of igneous and metamorphic rocks, with emphasis on identification, classification, genesis, and relationships to tectonism. Offered in the spring semester.

Prerequisite(s): GEO 210

### **GEO346 Computers in Earth Science**

C

Hours 4

This course provides an introduction to computer programming in the Earth, Environmental, and Planetary Sciences. The course covers basic coding concepts, theory, and logic in context of examples related to modeling and data analysis in the Earth Sciences. Students that take this course will have a foundation in basic programming in an interpreted language sufficient for more advanced computational courses in the discipline. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): MATH 125 or MATH 145; and CS 101, CS 102, or CS 111

Computer Science

### **GEO355 Invertebrate Paleontology**

Hours 3

Two lectures and one laboratory. Study of the taxonomy and morphology of major invertebrate fossil groups. Offered in the spring semester.

Prerequisite(s): GEO 101 and GEO 102

### **GEO363 Geomorphology**

Hours 3

Two lectures and one laboratory. Study of landforms with emphasis on the basic geomorphic processes that contribute to their origin. Offered in the fall semester.

Prerequisite(s): GEO 101

### **GEO364 Dinosaur Paleobiology**

W

Hours 3

This is an introductory course that focuses on the current study of the evolution, adaptation, and extinction of dinosaurs, and other Mesozoic reptiles. Using dinosaurs as a "biological model", students will be introduced to key concepts of evolutionary biology, historical geology, fossilization, functional morphology, physiology, biomechanics, among others. Also, this is a writing course and therefore, writing proficiency within the discipline is required for a passing grade in this course.

Writing

### **GEO365 Structural Geology**

Hours 3

Two lectures and one laboratory. An introductory study of the deformation of rocks, including mechanical principles, description and identification of folds and faults, map interpretation, and regional tectonics. Offered in the fall semester.

Prerequisite(s): GEO 101, and PH 101 or PH 105

### **GEO367 Sedimentology/Stratigraphy**

Hours 4

Three lectures and one laboratory. Study of the principles involved in the description and classification of sedimentary rocks and stratigraphic units, with emphasis on sedimentary processes and depositional environments. Offered in the spring semester.

Prerequisite(s): GEO 102 and GEO 210

### **GEO369 Introduction Geophysics**

Hours 3

Introduction to the major fields of exploration geophysics such as seismology, isostasy, heat flow, gravity and magnetic prospecting, and electrical methods. The course includes both principles and applications to petroleum, mining, and environmental problems. Offered in the fall semester.

Prerequisite(s): MATH 125 and PH 102 and GEO 101

### **GEO399 Undergraduate Research**

Hours 1-6

A maximum of 4 hours can be applied toward the major in geology. Approval of the department chairperson is required prior to registration. Offered according to demand.

### **GEO401 Paleoclimatology**

W

Hours 3

Survey of the history of global climate change and the methods used to measure paleoclimate in the geological record. Offered in the Spring semester. 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.

Prerequisite(s): GEO 101 or GEO 102

Writing

### **GEO403 Petroleum System Analysis**

Hours 3

This course will cover the geologic events that leads to formation of petroleum systems and petroleum plays in different type of sedimentary basins which are filled by coupled processes that cause subsidence and delivery of sediments to the basin. The sedimentary fill is modified by compaction as well as the transport of heat and reactive fluids through the rock matrix during the 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): GEO 101

**GEO405 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.

Prerequisite(s): GEO 105: Sustainable Earth OR Instructor's approval

**GEO406 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.

**GEO407 Seismology**

Hours 3

This course provides an overview of earthquake seismology for both upper-level and graduate geo-science students. Topics include elastic wave propagation, seismic ray theory, travel time interpretations, surface wave dispersion, and seismic tomography.

Prerequisite(s): MATH 126 or MATH 146

**GEO410 Soil & Groundwater Restoration**

Hours 3

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

Prerequisite(s): GEO 101 and CH 101 or CH 117 and CH 102 or 118

**GEO411 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

**GEO416 Volcanology**

W

Hours 3

Study of the physical properties of magmas, eruptive mechanisms, volcanic products, and the relationship between volcanism and tectonism. 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. Offered in the fall semester.

Prerequisite(s): GEO 101 The Dynamic Earth GEO 314 Ign. & Meta. Petrology

Writing

**GEO424 Topics In Geology**

SP

Hours 1-4

Special topics in the following areas: economic geology, geochemistry, geophysics, geomorphology, hydrogeology, mineralogy, paleontology, petrology, sedimentology, stratigraphy, structural geology, and tectonics. Offered according to demand.

Prerequisite(s): GEO 101 The Dynamic Earth / Minimum Grade of C-Special Topics Course

**GEO430 Ore Deposits**

Hours 3

Introduction to sedimentary hydrothermal, metasomatic, and magmatic ore deposits, including geologic setting and genesis. Offered on demand.

Prerequisite(s): GEO 210 and permission of instructor.

**GEO433 Tectonics and Sedimentation**

Hours 3

Sedimentary basins are formed in a particular Plate Tectonics context as they relate to share certain characteristics. This course covers tectonics and sedimentation in basins formed in extensional, compressional and strike slip tectonic settings. The basins are classified based on their tectonics settings. This course will cover the tectonic settings of basins, their sedimentary fill, and their economic resources.

Prerequisite(s): GEO 101 Instructor's permission

**GEO435 Honors Sem In Geology**

Hours 1

Oral presentations on current geological topics. Offered in the fall semester.

**GEO436 Honors Sem In Geology**

UH

Hours 1

Oral presentations on current geological topics. Offered in the spring semester.

University Honors

**GEO450 Geostatistics**

C, W

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 or CS 102

Computer Science, Writing

**GEO455 Marine Science**

Hours 3

This course is an introduction to the main elemental budgets (N, C, P, Si) in the ocean system.

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

**GEO465 Introduction to Planetary Science**

W

Hours 3

This course will provide an overview of the major processes that have shaped our Solar System, with some focus on extra-terrestrial materials and mission 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. 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.

Prerequisite(s): GEO 210, or PH 106 plus one GEO 101-105 course.

Recommended: AY 204, GEO 470.

Writing

**GEO469 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 118 (C- or better), and GEO 101 or 102 (C- or better), and MATH 112 or 115 (C- or better)

**GEO470 Introduction to Geochemistry**

W

Hours 3

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. 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. Offered in the Spring semester.

Prerequisite(s): CH 101 or CH 117, and CH 102 or CH 118

Prerequisite(s) with concurrency: GEO 314

Writing

**GEO476 Environmental Field and Laboratory Methods**

Hours 3

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

Prerequisite(s): CH 101 or CH 117, and CH 102 or CH 118, Senior/Graduate standing, or permission of instructor.

**GEO480 Cosmochemistry and Techniques**

W

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. 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. This course covers broad topics in Cosmochemistry and Analytical Techniques. Many topics here will be learned in-class, though some background in geochemical/astronomy themes is strongly encouraged. The following UA courses AY 204, GEO 416, or GEO 470 would provide some background into this overall topic. Students are encouraged to read additional materials to expand on broader concepts.

Prerequisite(s): GEO 314 or GEO 465

Writing

**GEO495 Field Geology**

Hours 6

Five-week field course involving the application of geologic techniques and principles. Includes geologic mapping, data collection, and report writing. Offered during the first summer term.

Prerequisite(s): GEO 314 and GEO 365 and GEO 367

**GEO497 Geological Internships**

Hours 1-4

A maximum of 4 hours can be applied toward the major in Geology. Field and laboratory projects with government and industry. Offered according to demand.

Prerequisite(s): GEO 101 and GEO 102 or GEO 105

**GEO499 Research In Geology**

Hours 1-4

Offered according to demand.