

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.

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

GEO106 The Science of Caves

N

Hours 4

This course is designed to introduce students to the integrated nature of science through the understanding and exploration of caves. The course aims to cover the broad nature of caves, from the evidence they provide on our changing climate to understanding human evolution, along with their evolving cultural context (from slavery to the spectacle of cave rescue). Advances in cave science, such as how understanding how to protect clean water to the history of our changing world, the course will illustrate how caves can provide solutions to some of our most pressing modern problems, such as sustainability.

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/licensures 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

EXP

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

Experiential Learning

GEO306 Hydrogeology

EXP, USGC, W

Hours 3

This introductory hydrogeology course covers fundamental concepts in surface and groundwater flow, the water cycle, well hydraulics, and environmental issues related to water resources. Students will examine real-world applications of hydrogeology, including water scarcity, management policies, and governance. Through critical analysis and applied assignments, the course encourages an understanding of water-related global cultural and societal issues. 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

Experiential Learning, US and Global Citizenship, Writing

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, EXP

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, Experiential Learning

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

EXP

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.

Experiential Learning

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

GEO408 Introduction to Hydrology

Hours 3

This senior-level course aims to provide undergraduate students with a theoretical foundation for understanding and quantifying watershed hydrologic processes. The course covers key hydrological processes occurring at or near the Earth's surface, including rainfall, streamflow, open channel flow, surface runoff, and atmospheric water, as well as hydrologic analysis techniques such as unit hydrograph and lumped flow routing.

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 CH 118

GEO411 Contaminant Transport

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 and PH 102 and CH 102 and 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 and GEO 314

Writing

GEO419 The Cryosphere

Hours 3

The study of glaciers and ice sheets, their growth and decay, response to climate change, the history of glaciation and glacial contribution to sea-level rise.

Prerequisite(s): GEO 101 or GEO 102 or GEO 103 or GEO 104 or GEO 105 or GEO 106 or GY 100 or GY 101 or GY 102

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 - 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

GEO441 Soil Physics

Hours 3

This is course aims to provide students with basic knowledge of the physical and hydrological properties of soils. The course explores essential hydrological processes at or near the Earth's surface, focusing on mass and thermal exchange and transport in partially saturated soils. Students will learn about soil moisture dynamics, infiltration, evaporation, and the movement of water and solutes through soil. Additionally, the course covers soil-water relationships, soil hydraulic conductivity, and the thermal properties of soils.

Prerequisite(s): GEO 306 or Instructor Permission

GEO444 Surface Water – Groundwater Interaction

Hours 3

This course provides seniors with a theoretical foundation for understanding and quantifying surface water-groundwater (SW-GW) interactions, encompassing physical, chemical, and biological processes. Focus areas include: (a) The Hyporheic Zone: Its functions and significance in hydrology; (b) Fundamental Processes: Water movement, solute transport, and biological exchanges; (c) Natural Mechanisms: The hydrologic cycle and chemical interactions; and (d) Human Impact: Effects of agriculture, urbanization, and climate change on SW-GW interactions.

Prerequisite(s): GEO 441 or Instructor Permission

GEO450 Geostatistics

C, EXP, 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, Experiential Learning, 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.

GEO460 Intro Groundwater Modeling

Hours 3

This provides undergraduate students with a foundational understanding of the mathematical representation of flow processes in models, from simple conceptual models to forensic-standard finite difference models. Emphasis is placed on introducing the fundamentals of groundwater models, including physical theories, numerical solvers, and widely used software—ideal for geology, hydrology, and civil engineering students with limited modeling experience. The course focuses on developing practical skills and knowledge essential for careers in industrial engineering, oil production, environmental consulting, and academia.

GEO462 Contaminant Hydrology and Modeling

Hours 3

This course addresses contaminant transport in surface and groundwater. Given the critical importance of predicting contaminant behavior for water resource protection, this course covers the essential physical processes, mathematical descriptions, and numerical solvers. Designed for students in hydrology and civil engineering, it provides foundational skills to build contaminant transport models, detailing each step from differential equations to post-processing analysis.

Prerequisite(s): GEO 460 with a minimum grade of D-

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 or GEO102 or GEO 103 or GEO 104 or GEO 105 Recommended: AY 204, GEO 470.

Writing

GEO468 Paleo Seminar

SP

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.

Special Topics Course

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 CH 118 (C- or better), and GEO 101 or CH 102 (C- or better), and MATH 112 or MATH 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

EXP

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, or permission of instructor.

Experiential Learning

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

GEO494 Geology Research Capstone

EXP, SP

Hours 4

This course serves as the capstone for Geology BA majors. It offers students a wide array of experiential learning opportunities and should result in a presentation at a scientific conference, submission of a scientific manuscript, or some other summary report at the discretion of the advisor(s).

Prerequisite(s): GEO 101 or GEO 102 or GEO 103 or GEO 104 or GEO 105

Prerequisite(s) with concurrency: GEO 399

Experiential Learning, Special Topics Course

GEO495 Field Geology

EXP

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

Experiential Learning

GEO497 Geological Internships

EXP

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

Experiential Learning

GEO499 Research In Geology

EXP

Hours 1-4

Offered according to demand.

Experiential Learning