**Geology (GEO)**

**NOTE:** All prerequisites required for Geology (GEO) courses or courses counted toward major or minor requirements in geology must be completed with a grade of "C-" or better.

**Geology (GEO) Courses**

**GEO 1013. The Third Planet.** (3-0) 3 Credit Hours. (TCCN = GEO 1301)
Evolution of ideas concerning the earth's origin, structure, and age; social impact of recognizing the antiquity of the planet and humankind's brief presence; examination of how the distribution of planetary resources influenced the rise and clash of civilizations. May not be applied to a major in geology. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall, Spring, Summer. Course Fees: DL01 $75; LRC1 $12; LRS1 $45; STSI $21.

**GEO 103. Physical Geology.** (3-0) 3 Credit Hours. (TCCN = GEO 1303)
Prerequisite: Completion of or concurrent enrollment in CHE 1103, CHE 1121, and MAT 1093 or higher; or satisfactory performance on placement exam. Completion of or concurrent enrollment in GEO 1111 required. This course is intended for geology majors and minors as well as others interested in the geologic sciences. It constitutes an introduction to the geology major and skillsets needed by the practicing geologist including: mineral and rock identification, microscopy, deep time, outcrop descriptions, and mapping. The course includes an introduction to the theory of plate tectonics and its relation to the Earth's internal structure, surface features, hydrosphere, earthquakes, and volcanism. One or more field trips may be required. Generally offered: Fall, Spring. Course Fees: LRS1 $45; STSI $21.

**GEO 1103. Physical Geology Laboratory.** (1-3) 1 Credit Hour. (TCCN = GEO 1103)
Prerequisite: Completion of or concurrent enrollment in GEO 1103. Relation of the earth's present processes to its resources, structure, and internal composition. Field and laboratory study of minerals, rocks, maps, and aerial and satellite photos. Field trips may be required. (Formerly titled "Introduction to Earth Systems Laboratory") Generally offered: Fall, Spring. Course Fees: IUE1 $15; LRS1 $15; STSI $7.

**GEO 1123. Life Through Time.** (3-0) 3 Credit Hours. (TCCN = GEO 1304)
Concurrent enrollment in GEO 1131 recommended. A study of the origin and evolution of life on Earth including major events from the beginning of the Earth and solar system to the present, as well as the interaction of life with the lithosphere, atmosphere, and hydrosphere. This course will explore the fossil record, sedimentary rocks, plate tectonics, evolution, and climate change. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall, Spring. Course Fees: LRC1 $12; LRS1 $45; STSI $21.

**GEO 1131. Life Through Time Laboratory.** (1-3) 1 Credit Hour. (TCCN = GEO 1104)
Prerequisite: Completion of or concurrent enrollment in GEO 1123. Laboratory and field study of minerals, rocks, fossils, sequences of rocks, and mapping for the interpretation of life through time and the interpretation of Earth history. This course is intended and required for Geological Science majors and minors and will introduce students to many concepts covered in upper level courses. Field trips may be required. Generally offered: Fall, Spring. Course Fees: IUE1 $15; LRS1 $15; STSI $7.

**GEO 2003. Mineralogy.** (3-0) 3 Credit Hours.
Prerequisites: CHE 1103, CHE 1121, GEO 1103, GEO 1111, MAT 1093 or higher, or satisfactory performance on placement exam. Completion of or concurrent enrollment in GEO 2011. Crystallography, crystal chemistry, and the physical and optical properties of minerals. Principles of optical mineralogy and the microscopic determination of nonopaque minerals. Field trips may be required. Generally offered: Fall. Course Fees: LRS1 $45; STSI $21.

**GEO 2011. Mineralogy Laboratory.** (1-4) 1 Credit Hour.
Corequisite: GEO 2003. Laboratory study of crystal models, crystals, and minerals. Use of physical properties and the petrographic microscope for mineral identification. Field trips may be required. (Formerly GEO 2012. Credit cannot be earned for both GEO 2113 and GEO 2011.) Generally offered: Fall. Course Fees: LRS1 $15; STSI $7.

**GEO 2113. Fundamentals of Geographic Information Systems (GIS).** (2-2) 3 Credit Hours.
Prerequisite: CS 1173 or equivalent. This course will serve as a basic introduction to the concepts and techniques of utilizing a Geographic Information System (GIS) to study and model environmental issues. In lecture and laboratory, students will study methods of querying, analyzing, creating and displaying GIS data utilizing industry standard software. Students will also be introduced to using the Global Positioning System (GPS) as a means for creating GIS data. (Credit cannot be earned for both GEO 2113 and ES 2113.) Generally offered: Fall, Spring. Course Fees: LRS1 $45; STSI $21.

**GEO 3001. Preparation for the Geoscience Workforce.** (1-0) 1 Credit Hour.
Prerequisites: GEO 1103. GEO 1123, and at least junior standing. This course provides the opportunity to engage in professional development activities in preparation for a career in the geosciences and aligned fields. Activities will include workshops, seminars, and assignments. Differential Tuition: $50.

**GEO 3003. Fundamentals of Meteorology.** (3-0) 3 Credit Hours.
Prerequisites: GEO 1103 and GEO 1123. Introduction to atmospheric sciences and how the energy from the Sun shapes the weather on the Earth, from weather prediction to hurricanes forecast, to El Niño to La Niña. Generally offered: Fall (online), Spring (in class). Differential Tuition: $150.

**GEO 3004. Rocks, Fossils, and Global Tectonics.** (2-4) 4 Credit Hours.
Prerequisites: GEO 1103 and GEO 1111. An investigation of the major rock forming minerals, petrogenesis of the major rock types, and their plate tectonic context. Study of major trends in fauna and flora through time and their application to interpreting plate tectonics, paleoenvironments, and paleoclimate. Credit may not be applied to a B.S. or B.A. major in Geology. Differential Tuition: $200.

**GEO 3013. Fundamentals of Plate Tectonics.** (3-0) 3 Credit Hours.
Prerequisites: GEO 1103, GEO 1111, GEO 2003, GEO 2011, and MAT 1093. This course introduces the student to the mechanics of lithospheric plate motion and the physical phenomena driving the motion. The relationships between plate tectonics, mantle convection, and geomagnetism are explored, as well as common structures associated with plate boundaries. Mathematical models are introduced and used to describe plate motion on a sphere. Historical development of plate tectonic theory is also covered. Generally offered spring. Differential Tuition: $150.

**GEO 3043. Petrology.** (3-0) 3 Credit Hours.
Prerequisites: GEO 2003, GEO 2011, MAT 1214, and completion of or concurrent enrollment in GEO 3051. Description, classification, occurrence, and origin of igneous and metamorphic rocks. Field trips may be required. Generally offered: Spring. Differential Tuition: $150.
GEO 3051. Petrology Laboratory. (1-4) 1 Credit Hour.
Prerequisites: GEO 2003, GEO 2011, and completion of or concurrent enrollment in GEO 3043. Laboratory study of igneous and metamorphic rocks in hand specimen and thin section. Field trips may be required. (Formerly GEO 3052. Credit cannot be earned for both GEO 3051 and GEO 3052.) Generally offered: Spring. Differential Tuition: $50.

GEO 3063. Paleontology. (3-0) 3 Credit Hours.

GEO 3071. Paleontology Laboratory. (1-3) 1 Credit Hour.

GEO 3103. Structural Geology. (3-0) 3 Credit Hours.
Prerequisites: GEO 3043, GEO 3051, GEO 3113, and completion of or concurrent enrollment in GEO 3111. Description and origin of geologic structures at the microscopic, hand specimen and mountain scale with emphasis on the response of Earth materials to stress and the role of rheology. Relationships between structure and tectonics will be explored. Field trips may be required. Generally offered: Spring. Differential Tuition: $150.

GEO 3111. Structural Geology Laboratory. (1-3) 1 Credit Hour.
Prerequisite: Completion of or concurrent enrollment in GEO 3103. Laboratory study of structural features and concepts using maps, cross-sections, photographs, and descriptive geometric and stereographic methods. Field trips may be required. Generally offered: Spring. Differential Tuition: $50.

GEO 3113. Geologic Field Investigations. (1-4) 3 Credit Hours.
Prerequisites: GEO 2003 and GEO 2011. Introduction to techniques for studying geologic features and processes in the field, including rock identification, construction of geological maps, orientation analysis, and report writing. Some half-day and Saturday field trips may be required. (Formerly GEO 3112. Credit cannot be earned for both GEO 3112 and GEO 3113.) Generally offered: Fall, Spring. Differential Tuition: $150.

GEO 3123. Sedimentation and Stratigraphy. (3-0) 3 Credit Hours.
Prerequisites: GEO 2003, GEO 2011, GEO 3063, GEO 3071, and completion of or concurrent enrollment in GEO 3123. Laboratory study of sedimentary processes and their products. Hand specimens, thin sections, sedimentary structures, and interpretation of depositional environments. Stratigraphic case studies, including surface, subsurface, and sequence stratigraphic analysis. Field trips may be required. (Formerly titled "Sedimentary Geology Laboratory.") Generally offered: Spring. Differential Tuition: $50. Course Fee: IUE1 $15.

GEO 3163. Oceanography. (3-0) 3 Credit Hours.
General oceanography, with emphasis on marine geology and especially the continental margins. An optional field trip may be offered. (Credit cannot be earned for both GEO 3163 and ES 3133.) Generally offered: Fall (in class), Spring (online). Differential Tuition: $150. Course Fee: DL01 $75.

GEO 3173. Polar Regions and Climate Change. (3-0) 3 Credit Hours.
This course covers properties, areal distribution, seasonal change and climatic change of the major constituents of the Polar Regions: the large ice sheets of Greenland and Antarctica; seasonal snow cover in the high and mid latitudes; sea ice covers in the Arctic, Southern Ocean and other seas; mountain glaciers from the tropics to the polar regions; and permafrost in the high latitude land areas of the Northern Hemisphere. How to examine these constituents will be presented with illustrative examples of monitoring of climate-induced changes in the Polar Regions using remote sensing and field investigations of processes and properties. Applications discussed will include: snow and ice covers as agents of geological change, snow and ice impacts as water resources in Asia and western North America, and global environmental impact through for example, effects on the earth’s radiation budget, and contributions to sea level change. Human impacts covered will include effects of ice covers of rivers and sea ice such as on petroleum extraction, transportation and navigation, frost and freezing damage to crops, and hazards of blizzards and avalanches. Differential Tuition: $150.

GEO 3343. Introduction to Geospatial Technologies. (3-0) 3 Credit Hours.
This course introduces several aspects of geospatial technologies, not only what they are but how they are used in hands-on applications, all based on free internet resources not commercial software packages. This course provides a solid foundation on which further knowledge in more specialized classes, such as Geographic Information Systems, Global Positioning Systems, and Remote Sensing, can be built on. Differential Tuition: $150.

GEO 3374. Geochemistry. (2-4) 4 Credit Hours.

GEO 3383. General Geophysics. (3-0) 3 Credit Hours.
Prerequisites: Completion of or concurrent enrollment in MAT 1224 and PHY 1963. This course examines the interrelated geology and physics of the Earth's interior as deduced from earthquake seismology, gravity and magnetic fields, and the application of geophysical methods to the exploration of near-surface cultural and natural resources. Topics in archeological, environmental, and engineering geophysics will be explored through the methods of refraction seismology, electrical resistivity, electromagnetic induction, microgravity, and ground penetrating radar. Field trips may be required. Generally offered: Fall. Differential Tuition: $150.
GEO 3393. Introduction to Isotope Geochemistry. (3-0) 3 Credit Hours. 
Prerequisites: GEO 1103, GEO 1111, CHE 1103, CHE 1121, and MAT 1214. 
The course includes a review of theories of nuclear structure, stability of 
nucleus, nucleosynthesis and origin of elements, and introduces both 
radiogenic and stable isotope geochemistry. Topics include radioactive 
decay schemes for tritium-helium, U-Pb, Rb-Sr, Sm-Nd, K-Ar, and U-Th-Pb- 
He systems; isotopic fractionations of stable isotopes of C, H, O, N, and S; and 
application of radiogenic and stable isotopes to petrology, evolution of 
the crust and mantle, geochronology, geothermometry, archaeology, 
ecology, hydrology, and paleoclimatic interpretation. Generally offered: 
Fall. Differential Tuition: $150.

GEO 4001. Experiential Learning Experience. (0-0) 1 Credit Hour. 
Prerequisites: Completion of GEO 3001 with at least a B grade on +/- 
scale and a major grade point average of 2.67 or better. The opportunity to 
apply geological principles and skills during a semester-long internship in 
an organization that utilizes geoscience to accomplish its mission. 
The grade report for this course is either “CR” (satisfactory participation 
in the internship) or “NC” (unsatisfactory participation in the internship). 
Differential Tuition: $50.

GEO 4002. Experiential Learning Experience. (0-0) 2 Credit Hours. 
Prerequisites: Completion of GEO 3001 with at least a B grade on +/- 
scale and a major grade point average of 2.67 or better. The opportunity to 
apply geological principles and skills during a semester-long internship in 
an organization that utilizes geoscience to accomplish its mission. 
The grade report for this course is either “CR” (satisfactory participation 
in the internship) or “NC” (unsatisfactory participation in the internship). 
Differential Tuition: $100.

GEO 4003. Experiential Learning Experience. (0-0) 3 Credit Hours. 
Prerequisites: Completion of GEO 3001 with at least a B grade on +/- 
scale and a major grade point average of 2.67 or better. The opportunity to 
apply geological principles and skills during a semester-long internship in 
an organization that utilizes geoscience to accomplish its mission. 
The grade report for this course is either “CR” (satisfactory participation 
in the internship) or “NC” (unsatisfactory participation in the internship). 
Differential Tuition: $150.

GEO 4013. Volcanology. (3-0) 3 Credit Hours. 
Prerequisite: GEO 3043 or consent of instructor. A survey of volcanoes and 
volcanic processes, including historically important volcanic eruptions and the prediction and mitigation of volcanic hazards. Field 
trips may be required. Generally offered: Fall. Differential Tuition: $150.

GEO 4023. Engineering Geology. (3-0) 3 Credit Hours. 
Prerequisites: PHY 1963 (engineering majors only) or PHY 1603 or 
PHY 1943, and MAT 1214; or consent of instructor. Geologic factors in 
construction. Geotechnical properties of minerals, rocks, and soils. Case 
studies. May not be applied to a major in geology. Generally offered: Fall, 
Spring, Summer. Differential Tuition: $150.

GEO 4033. Profession of Geology. (3-0) 3 Credit Hours. 
Prerequisites: GEO 2113, GEO 3123, GEO 3131, GEO 3113. This course is 
designed to provide the basic knowledge required by the ASBOG National 
Geologist Examination (Fundamentals) for licensure as a Professional 
Geologist, and introduces the geoscience student to the fundamentals of 
professional practice that impact, health, safety, and well-being of the 
public. The emphasis will be on principles and practices of geoscience that 
affect the economy, feasibility and design of engineering works, 
siting criteria, site selection and investigation, human-land interactions, 
site assessment, liability, responsibility, professional report writing, and 
licensure. Differential Tuition: $150.

GEO 4053. Climate Change: Past, Present, Future. (3-0) 3 Credit Hours. 
Prerequisite: GEO 3003. Investigation of the climate system and its 
evolution during the Earth’s history, to build a comprehensive and 
greater understanding of issues linked to climate change, its impact 
on ecosystems vulnerabilities and human needs in natural resources. 
Generally offered: Fall (online) and Spring (in class). Differential Tuition: 
$150.

GEO 4063. Advanced Environmental Geology. (3-0) 3 Credit Hours. 
Prerequisites: GEO 1103 and GEO 1111. An analysis of human interaction 
with geologic systems; the risks and effects of natural geologic hazards 
such as volcanic eruptions, earthquakes, and floods. Topics will include 
the effects of human activity on natural systems such as groundwater 
quality and recharge, river systems, coastal hazards, energy resources, 
and climate change. The meaning of "sustainability" as a long-term 
concept and tools to assess and work with Earth systems to avoid 
endangering human life and property are also topics that are applied 
and addressed. GEO 4063 is a writing intensive course and project 
management skills are utilized in working on geologic investigations 
and solutions for resource management and in analyzing and mitigating 
natural hazard events. Differential Tuition: $150.

GEO 4073. Web GIS. (2-2) 3 Credit Hours. 
Prerequisites: ES 2113 or GEO 2113 or GEO 3343, or consent of instructor. 
This course will focus upon developing GIS applications to be served out 
via the Internet or a Local Area Network (LAN). Additional topics include 
the use of Web authoring software. The course presents and introductory 
level skill set for the creation and publishing of web mapping applications 
using the ESRI ArcGIS Online resources and available tools. The technical 
focus of the course includes computer lab tutorials and case studies. 
Differential Tuition: $150.

GEO 4083. Computer Application for Geoscience. (2-2) 3 Credit Hours. 
In this course, Geosciences students will be introduced to means to input 
their valuable field and lab measurements into computer systems for 
further processing and analysis. Students will learn the principles and 
fundamentals of computer programming from the Project Management 
point of view. By visualizing and implementing the Program Development 
Cycle and introducing a few programming environments (Visual Basic for 
Applications, Python, UNIX shell programming) students will learn how 
to define a problem, devise a computational solution and implement it. 
Differential Tuition: $150.

GEO 4093. Principles of Remote Sensing. (2-2) 3 Credit Hours. 
Prerequisites: MAT 1214 or higher and PHY 1943. This course will 
provide a thorough introduction to remote sensing theory, technology, 
and application. The emphasis in this course is on understanding the 
underlying principles of acquiring, interpreting, and applying data from 
imaging systems covering the electromagnetic spectrum from the 
ultraviolet through the microwave. Generally offered: Fall. Differential 
Tuition: $150.

GEO 4103. Programming and Statistics for GIS. (2-2) 3 Credit Hours. 
Prerequisites: ES 2113 or GEO 2113 or GEO 3343, or consent of instructor. 
This course provides students with the basics of Python programming 
language and how GIS uses it as a scripting language to perform 
sophisticated statistical, map, and analysis calculations. They will be able 
to understand the desired outcomes of a project and organize tasks and 
processes to achieve said goal. Students will learn and master powerful 
Python tools that automate procedures, and carry out integration with 
data from many applications. As a result, they will have the ability to 
transform or create robust GIS datasets, and provide with in depth 
analysis leading to solid decision making. Differential Tuition: $150.
GEO 4113. Geomorphology. (3-0) 3 Credit Hours.
Prerequisites: GEO 1103 or GES 2613, or consent of instructor, and junior or senior standing, and concurrent enrollment in GEO 4121. Examination of landforms on the Earth's surface and landscape-forming processes. Field trips may be required. Differential Tuition: $150.

GEO 4121. Geomorphology Laboratory. (1-3) 1 Credit Hour.
Prerequisites: GEO 1103 or GEO 2613, or consent of instructor, and junior or senior standing, and concurrent enrollment in GEO 4113. Interpretation of landforms and their formative processes from maps, aerial photographs, and calculations. Field trips may be required. Differential Tuition: $50. Course Fee: IUE1 $15.

GEO 4133. River Science. (3-0) 3 Credit Hours.
Prerequisites: GEO 1103 or GEO 2613, or consent of instructor, and junior or senior standing. An in-depth examination of river sediment transport principles. Topics include water and sediment supply, sediment dynamics, river morphology, and channel instability. Field trips may be required. Differential Tuition: $150.

GEO 4203. Aqueous Geochemistry. (3-0) 3 Credit Hours.
Prerequisites: GEO 3374, or consent of instructor. This course will facilitate to understand in detail the fundamental (primarily thermodynamic) controls on the composition of natural waters and the response of natural waters to variations in various physico-chemical parameters. Characterization of dissolved organic matter in natural waters will be introduced. This course will explore applications to environmental problems like contaminants migration in waters (ground waters, surface waters), weathering, etc., learn to solve numerical problems related to the behavior of chemical components in natural waters, and gain familiarity with simple analytical techniques for the characterization of natural waters. Differential Tuition: $150.

GEO 4204. Chemical Hydrology. (3-2) 4 Credit Hours.
Prerequisites: GEO 3374 or GEO 4623, or consent of instructor. Discussion of the basic chemical principles of the water cycle, as well as environmentally relevant applications based on case studies. Detailed Groundwater Hydrogeochemistry, Surface Water Hydrogeochemistry, Surface water and Groundwater Interaction - Geochemical Principles governing, Quantitative and Modeling analysis and geologic effects on quality and flow of groundwater. Coverage of contemporary global issues related to water resources, including pollution control, environmental rehabilitation, sustainable development, and global warming exploration of anthropogenic. Topics include land-atmosphere interactions, movement of water and water rock interaction, contaminant transport in groundwater systems. ASBOG Test Syllabus and web-based teaching are followed. Differential Tuition: $200.

GEO 4503. Hydrogeophysics. (3-0) 3 Credit Hours.
Prerequisites: MAT 1214 or higher and PHY 1963. Completion of or concurrent enrollment in GEO 4511. The presence of water and other fluids in subsurface formations, from the macro aquifer level to the micro pore level, are ultimately detected and observed through the application of geophysical principles and survey methods. This course will explore the fundamental science of hydrological geophysics, through the examination of the fundamental petrophysics and the various geophysical surface and borehole methods, such as seismic refraction, electrical resistivity and induced polarization, electromagnetic induction, microgravimetry, and geo-radar as applied to hydrogeologic investigations. Differential Tuition: $150.

GEO 4511. Hydrogeophysics Laboratory. (1-3) 1 Credit Hour.
Prerequisite: Completion of or concurrent enrollment in GEO 4503. Laboratory and field-based course exploring geophysical survey systems, survey planning, data collection and analysis. Differential Tuition: $50.

GEO 4623. Groundwater Hydrogeology. (3-0) 3 Credit Hours.
Prerequisites: GEO 1103, GEO 4111, PHY 1943, and MAT 1214. Hydrologic cycle and the occurrence and movement of groundwater. Recharge and discharge of aquifers; water quality; exploration and development of ground-water supplies. Field trips may be required. Generally offered: Spring. Differential Tuition: $150.

GEO 4813. Planetary Geology. (3-0) 3 Credit Hours.
Prerequisites: PHY 1963, or consent of instructor. This course is designed for students in the Sciences or Engineering and no prior Geological knowledge is assumed, although Earth will be our point of reference. Survey of the interior and surface geology of solid bodies in our Solar System and beyond (planets, moons, asteroids, comets, Kuiper Belt Objects and exoplanets). Topics will include bulk composition and differentiation of planetary interiors, surface processes such as (cryo-) volcanism and meteorite impacts, erosion and sedimentation by fluids and wind, and heat transfer styles. There will be an emphasis on how we know things and what we don’t know, quantifying uncertainties in measurements and models, and the nature of planetary scientific enquiry. Differential Tuition: $150.
GEO 4953. Special Studies in Geology. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the
opportunity for specialized study not normally or not often available as
part of the regular course offerings. Special Studies may be repeated
for credit when the topics vary, but not more than 6 semester credit
hours, regardless of discipline, will apply to a bachelor’s degree. Generally
offered: Fall. Differential Tuition: $150.

GEO 4961. Special Studies in Geology Laboratory. (1-3) 1 Credit Hour.
Prerequisite: Consent of instructor. An organized laboratory course
offering the opportunity for specialized study not normally or not often
available as part of the regular course offerings. Special Studies may be
repeated for credit when the topics vary, but not more than 6 semester
credit hours, regardless of discipline, will apply to a bachelor’s degree.
Differential Tuition: $50.

GEO 4993. Honors Research. (0-0) 3 Credit Hours.
Prerequisites: Enrollment limited to candidates for College Honors during
their last two semesters; approval by the College Honors Committee.
Supervised research and preparation of an honors thesis. May be
repeated only once with approval. Differential Tuition: $150.