GEOLOGY (GEOL)

GEOL 5. Geology Of Mexico. 4 Units
General Education Area/Graduation Requirement: Laboratory (5-C), Physical Science (5-A)
Term Typically Offered: Fall, Spring

Introduction to Geology through examination of aspects of the geology of Mexico. Emphasizes problem-based approach to learning Geology and the process of scientific investigation. Topics include a wide range of geological concepts including plate tectonic setting of Mexico, living with volcanoes: the Mexican volcanic belt, the Mexico City earthquake, issues of water supply, flooding and atmospheric pollution in Mexico City, the Chicxulub crater and geologic time, ore deposits of Mexico. Lecture three hours; laboratory three hours.

GEOL 5A. Geology of Mexico Field Trip. 2 Units
Prerequisite(s): GEOL 5
Term Typically Offered: Fall, Spring

Focuses on fundamental geologic concepts as seen from real world examples in Mexico that will be visited during several strategic field stops. Field stops will emphasize a problem-based approach to learning geology and the process of scientific investigation. Topics include a wide range of geological concepts including plate tectonic setting of Mexico, living with volcanoes, the Mexico City earthquake, issues of water supply, flooding, climate change and atmospheric pollution in Mexico City, the Chicxulub meteor impact crater, geologic time, ore deposits of Mexico, and natural hazards. Field trip ten days.
Field trip(s) may be required.

GEOL 7. Natural Disasters. 3 Units
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

Examination of earth materials and earth processes through the study of natural disasters. Topics include earthquakes, volcanoes, landslides, floods, tsunamis, hurricanes, tornadoes and meteorite impacts. Examination of causes, effects and mitigation of natural disasters.

GEOL 8. Earth Science. 3 Units
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring, Summer

Earth and its neighbors in space. Scientific method and discovery in the study of stars, planets, weather, rivers, glaciers, oceans, rocks, volcanoes, earthquakes, landslides, mountains, drifting continents, the earth in time.
Note: Students contemplating a geology major or minor in geology should enroll in GEOL 10, not in GEOL 8. No credit for those who have taken GEOL 10 or equivalent.

GEOL 8L. Earth Science Lab. 1 Unit
Prerequisite(s): GEOL 8; may be taken concurrently.
General Education Area/Graduation Requirement: Laboratory (5-C), Physical Science (5-A)
Term Typically Offered: Fall, Spring

Emphasizes scientific methods and systematic laboratory procedures. Includes weather analysis, rock and mineral identification, study of geologic concepts by means of topographic maps, and exercises in astronomy and oceanography. Laboratory three hours.

GEOL 8T. Earth Science Lab for Teachers. 1 Unit
Prerequisite(s): GEOL 8; may be taken concurrently.
Term Typically Offered: Fall, Spring

Exploration of the solid Earth, its atmosphere and oceans, and the Earth's place in the solar system. Emphasizes learning Earth science through investigation, and uses Earth science to understand the processes of science. Laboratory three hours.

GEOL 10. Physical Geology. 3 Units
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

Rocks and their mineral constituents, geological processes such as weathering, erosion, glaciation, mountain building, etc., volcanoes, earthquakes, folds, faults, the earth's interior, plate tectonics and earth resources. Field trip. Fee course.
Fee course.
Field trip(s) may be required.

GEOL 10L. Physical Geology Lab. 1 Unit
Prerequisite(s): GEOL 10; may be taken concurrently.
General Education Area/Graduation Requirement: Laboratory (5-C), Physical Science (5-A)
Term Typically Offered: Fall, Spring

Laboratory supplement to GEOL 10. Emphasizes scientific method and systematic laboratory procedures. Identification of common minerals and rocks. Introduction to and analysis of topographic and geologic maps. Field trip. Laboratory three hours. Fee course.
Fee course.
Field trip(s) may be required.

GEOL 11. Digital Methods in Geoscience. 1 Unit
Prerequisite(s): GEOL 5 or GEOL 10/10L. GEOL 10L can be taken concurrently.
Term Typically Offered: Fall, Spring

Introductory course to the basic computing needs to be successful in the geosciences. Topics include Microsoft Office, Adobe Suite and reference software.

GEOL 12. Historical Geology. 3 Units
Prerequisite(s): GEOL 5 or GEOL 10 and GEOL 10L.
Term Typically Offered: Fall, Spring

Origin and geological history of the earth and the evolution of its animal and plant inhabitants. Fee course.
Note: Lecture 3 hours.

Fee course.

GEOL 12L. Historical Geology Lab. 1 Unit
Prerequisite(s): GEOL 12; and GEOL 5 or GEOL 10 and GEOL 10L. GEOL 12 may be taken concurrently.
Term Typically Offered: Fall, Spring

Supplements GEOL 12. Use of sedimentary rocks, fossils, geologic maps, and structural sections in interpreting ancient environments, tectonic settings, and geologic history. Age relations and correlation of rock and time-rock units. Introduction to fossil identification and biostratigraphy. Laboratory three hours.

GEOL 84. Western US Geology Field Trip. 1 Unit
Term Typically Offered: Fall, Spring

3 to 4-day field trip to a region of outstanding western US geology. Attendance at preliminary meetings is required. Analysis and interpretation of geologic features is highlighted. Previous or concurrent enrollment in a geology course recommended but not required. May be taken more than once for credit. Fee course.
Credit/No Credit
Fee course.
Field trip(s) may be required.

GEOL 100. Earth Materials - Rocks and Minerals. 4 Units
Prerequisite(s): CHEM 1A, GEOL 10 and GEOL 10L 5 or GEOL 5, GEOL 11, GEOL12 and 12L (GEOL 11 and GEOL 12/12L 12 can be taken concurrently)
Term Typically Offered: Fall only

Properties and identification of minerals and rocks; rock formation and the rock cycle. Lecture three hours; laboratory three hours; Field Trip.
Note: This course requires safety training and personal protective equipment (PPE).

Field trip(s) may be required.

GEOL 101. Optical Mineralogy. 2 Units
Prerequisite(s): CHEM 1A, GEOL 5 or GEOL 10 + GEO 10L, GEOL 100 (GEOL 100 can be taken concurrently)
Term Typically Offered: Fall, Spring

Introduction to advanced mineral identification by physical and optical properties. Techniques and theory of optical mineral analysis and crystallography. Lecture 1 hour; laboratory 3 hours.

GEOL 102. Igneous and Metamorphic Petrology. 4 Units
Prerequisite(s): GEOL 100, GEOL 101, and GEOL 103
Term Typically Offered: Fall only

Study of the origin, evolution, occurrence, geochemistry, dynamics and physical characteristics of igneous and metamorphic systems. The laboratory will focus on both hand-specimen and petrographic-microscope studies. Lecture three hours, laboratory three hours. Field Trip. Fee course.
Note: This course requires safety training and personal protective equipment (PPE).

Fee course.
Field trip(s) may be required.

GEOL 103. Sedimentology/Stratigraphy. 4 Units
Prerequisite(s): GEOL 12, GEOL 12L, and GEOL 100
Term Typically Offered: Spring only

Compositions, textures, classification, origins and structures of sediments and sedimentary rocks. Hand specimen observation and interpretation. Facies models, classification and correlation of stratigraphic units, subsurface techniques. Lab emphasizes hand specimen and microscope identification and subsurface techniques. Field trip. Lecture three hours; laboratory three hours. Fee course.
Fee course.
Field trip(s) may be required.

GEOL 105. Paleontology. 4 Units
Prerequisite(s): GEOL 5 or GEOL 10 and GEOL 10L, GEOL 12 and GEOL 12L.
Term Typically Offered: Spring only

Biology, evolution, classification and paleoecology of important groups of fossil organisms. Uses of fossils in solving geologic problems.
Note: Lecture = 3 units; Lab = 1 unit. Fee Course. Field Trip.

Fee course.
Field trip(s) may be required.

GEOL 110A. Structural Geology and Tectonics. 4 Units
Prerequisite(s): GEOL 111A and GEOL 111B, PHYS 5A or PHYS 11A, MATH 26A or MATH 30.
Term Typically Offered: Fall, Spring

Description, analysis and interpretation of geologic structures and tectonic settings. Theory of stress and strain as it pertains to the origin of folds, faults, joints, cleavage, and other structural elements. Laboratory includes techniques of structural analysis such as orthographic projections, stereonets, structure contours, Mohr diagrams, interpretation of maps and cross sections. Lecture three hours, laboratory three hours.
Fee Course.
Fee course.

GEOL 110B. Structural Geology Field. 1 Unit
Prerequisite(s): GEOL 103, GEOL 111A, GEOL 111B, and GEOL 110A. It is recommended that GEOL 110A be taken concurrently.
Term Typically Offered: Fall, Spring

Field description, mapping and interpretation of geologic structures. Includes techniques of taking detailed field notes, field photography measurement of structures using a pocket transit, geologic map and cross section construction, stereonet analysis, and report writing. Consists of off-campus fieldwork. Fee course.
Fee course.

GEOL 111A. Field Geology. 2 Units
Prerequisite(s): GEOL 12L and GEOL 100
Corequisite(s): GEOL 111B
Term Typically Offered: Spring only

Science and art of recognizing, describing and interpreting geologic features in the field. Lecture and laboratory course on the preparation and use of topographic and geologic maps, stratigraphic and cross sections, compass and GPS instrument. Lecture one hour; laboratory three hours.
Fee course.
Fee course.

GEOL 111B. Field Techniques. 2 Units
Prerequisite(s): GEOL 100 and GEOL 103. GEOL 103 may be taken concurrently.
Corequisite(s): GEOL 111A
Term Typically Offered: Spring only

Geologic field methods including descriptions of rocks, geologic mapping, observation, interpretation and geologic report writing. Detailed mapping techniques will also be covered. Consists of off-campus fieldwork. Fee course.
Note: This course requires safety training and personal protective equipment (PPE).

Fee course.

GEOL 112. Geophysics For Geologists. 3 Units
Prerequisite(s): GEOL 5 or GEOL 10 and GEOL 10L, PHYS 5A, PHYS 5B which may be taken concurrently.
Term Typically Offered: Fall, Spring

Introduction to the principal geophysical concepts and techniques useful to geologists in the study of tectonics, the Earth's interior and rresource exploration. Includes the study of seismology, heat flow, gravity, borehole geophysics, electromagnetism and geodynamics. Fee Course/Field Trip.
Fee course.
Field trip(s) may be required.

GEOL 114. Volcanology. 3 Units
Prerequisite(s): GEOL 100; May be taken concurrently.
Term Typically Offered: Fall, Spring

An advanced exploration of physical volcanic processes, chemistry of magmas, interpretation of volcanic deposits, historic eruptions and volcanic hazard assessment.
Note: Field trip. Weekend field trip to volcanic areas (typically in California. Fee course. Field trip student fee.

Fee course.
Field trip(s) may be required.

GEOL 115. Volcanoes: An Introduction. 3 Units
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

An introductory to volcanoes including volcanic landforms, eruption styles, properties of magma, and volcanic hazards/ mitigation.

GEOL 120. Surficial Processes. 4 Units
Prerequisite(s): GEOL 5 or GEOL 10 and GEOL 10L; GEOL 12, GEOL 12L.
Term Typically Offered: Fall, Spring

Focused study on the basic forces that drive surficial processes such as wind water and gravity and the role of weathering, sediment transport and deposition on landform and landscape development. A laboratory component will enhance student understanding by solving applied problems as well as develop proficiencies with various geologic tools.
Note: 150 minutes Lecture = 3 units, 150 minutes Lab = 1 unit. Fee Course.

Fee course.

GEOL 121. Geology of California. 3 Units
Prerequisite(s): GEOL 103
Term Typically Offered: Spring only

Regional study of California and certain surrounding areas with regard to geologic development, plate tectonics, economic resources and geologic hazards. Lecture and field trip(s). Fee course.
Note: This course requires safety training and personal protective equipment (PPE).

Fee course.
Field trip(s) may be required.

GEOL 122. Hydrology Research Experience. 3 Units
Hydrology research and professional development experience. Students will learn hypothesis development and testing, data interpretation, and science communication skills focusing on data collected during a summer Hydrology field experience. Students will also learn about Hydrology career paths, apply for internships, and present research findings. Students must participate in the summer Hydrology field experience prior to taking this class.

GEOL 123. Geochemistry. 3 Units
Prerequisite(s): GEOL 5 or GEOL 10 and GEOL 10L, CHEM 1A.
Term Typically Offered: Fall, Spring

Fundamentals of the geochemistry of Earth materials. Thermodynamics and kinetics of geological environments, silicates and carbonates, major element geochemistry, trace and rare earth element geochemistry, stable and radiogenic isotopes. Applications to studies of aqueous, pedogenic, igneous, sedimentary, and metamorphic environments. Analysis of geochemical aspects of contemporary resource, environmental, and paleoenvironmental problems.

GEOL 125. Metallic Ore Deposits. 3 Units
Prerequisite(s): GEOL 100, CHEM 1A.
Term Typically Offered: Fall, Spring

Origin, geology, and distribution of metallic ore deposits. Introduction to ore minerals. Exploration methods. Field trip. Fee course.
Fee course.
Field trip(s) may be required.

GEOL 126. Environmental Field Methods. 3 Units
Prerequisite(s): GEOL 10 or GEOL 10L or instructor permission.
Field analysis of the local environment, including soil and water systems. Students will learn monitoring design, sample collections, sample analysis, data interpretation, and presentation methodologies for environmental geology applications.

GEOL 127. Hydrogeology. 4 Units
Prerequisite(s): CHEM 1A, GEOL 10, GEOL 10L, PHYS 5A, and MATH 26A or MATH 30, or instructor permission.
Term Typically Offered: Spring only

Presents fundamentals of groundwater flow, as influenced by topography and geology; geological aspects of groundwater supply, contamination, remediation, and protection of hydrogeological regions of the U.S. and their critical groundwater issues. Lecture three hours; laboratory three hours. Lecture three hours.

GEOL 130. Oceanography. 3 Units
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring, Summer

Survey of geological, physical, chemical and biological oceanography including the sea floor; waves, tides, currents; the physical and chemical properties of seawater and their distribution in the sea; planktonic life and its relation to nutrients.

GEOL 132. Marine Geology. 3 Units
Prerequisite(s): GEOL 10 and GEOL 10L or GEOL 12 and GEOL 12L
Term Typically Offered: Spring only

Origin, structure and evolution of the ocean basins and their margins. Topics covered will include marine sediments, seafloor bathymetry, seismic stratigraphy, sea level history, and marine micropaleontology. Fee course. Field trip: Weekend trip to Moss Landing, California to collect marine samples.
Fee course.
Field trip(s) may be required.

GEOL 140. Geology and the Environment. 3 Units
Prerequisite(s): Junior standing; a WPJ Portfolio score OR ENGL 109M or ENGL 109W
General Education Area/Graduation Requirement: Writing Intensive Graduation Requirement (WI), Social and Behavioral Sciences (4-A)
Term Typically Offered: Fall, Spring

Applies geologic data and principles to situations affecting our environment. The geologic study of earthquakes, volcanoes, floods, landslides, groundwater and similar topics supplies the background data for lectures on land use and other social choices. Topics such as geopolitics and mineral supply provide a basis for understanding international politics, social costs, and world economics. Fee course.
Fee course.

GEOL 150. Computer Mapping in Geology. 3 Units
Prerequisite(s): GEOG 109 or instructor permission
Term Typically Offered: Fall, Spring

This course is designed to enhance the mapping skills of geology majors by providing them an opportunity to learn modern computer aided mapping techniques - methods and tools widely used across industry, government, and academe. The course is designed to teach students how to effectively use various tools and mapping software by applying their developing skills in solving a variety of geological problems. This course strategy will help develop both student technical map making and innovative problem solving skills.

GEOL 170. Age of Dinosaurs. 3 Units
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

Applies to the fundamental principles of geology, biology, and ecology to understanding the evolution of the Mesozoic world. Emphasis is placed on the nature and evolution of dinosaurs in the context of global regional changes in the Mesozoic ecosystem. Included are considerations of the data, methods, and uncertainties in paleontology and other historical sciences.

GEOL 171. Petroleum Geology. 3 Units
Prerequisite(s): PHYS 5A & GEOL 103. GEOL 103 may be taken concurrently.
Term Typically Offered: Fall, Spring

Introduction to the origin, migration, and accumulation of hydrocarbons in the context of stratigraphic and structural systems. Exploration and production of both conventional and unconventional resources. Lecture three hours. Field trip. Fee Course.
Fee course.
Field trip(s) may be required.

GEOL 177. Hawaii Volcanic Field Trip. 2 Units
Prerequisite(s): Geology 10 or another physical geology course approved by instructor; Field Trip, 2 units. Fee course.
Term Typically Offered: Fall, Spring

An investigation and visit to the many interesting volcanic features and eruption activities of Hawaiian volcanism. Topics include tectonics, physical volcanology, and volcanic monitoring techniques.
Credit/No Credit
Fee course.

GEOL 180. Water Planet. 3 Units
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

Investigating the physical processes that control water movement and supply across the planet. Subjects include the hydrological cycle, oceans, waves and tides, fisheries, water in the atmosphere, water and wildfire, landslides, river systems, groundwater and water quality, water management, and the future of water resources on a changing planet.

GEOL 184. Geological Field Trip. 2 Units
Term Typically Offered: Fall only

10-day field trip to a region of outstanding geology. Attendance at preliminary meetings is required. Analyzes and interpretation of geologic features is emphasized. Fee course.
Note: Student should consult the Geology Department during the semester before planning to take the course. May be taken more than once for credit.

Credit/No Credit
Fee course.
Field trip(s) may be required.

GEOL 188. Advanced Geologic Mapping. 6 Units
Prerequisite(s): GEOL 102, GEOL 103, GEOL 110A, GEOL 110B, GEOL 111A, GEOL 111B and instructor permission.
Term Typically Offered: Fall, Spring

Advanced principles/methods of geologic mapping, interpretation and geologic report writing for selected field areas in the western United States. Mapping techniques include the use of aerial photographs and global position systems. Consists of on-campus field preparation and off-campus fieldwork. Fee course.
Fee course.

GEOL 189. Geology Colloquium. 1 Unit
Term Typically Offered: Fall, Spring

Students will attend and participate in the joint Geology, Environmental Studies, Ecology weekly colloquium series and will be exposed to a variety of geologic and environmental topics. Speakers include those from CSUS, the USGS, government and professional organizations, and other academic institutions. Topics and speakers vary each semester.
Note: This course must be taken twice.

Credit/No Credit

GEOL 190A. Geology and Tectonic Development of California Seminar. 3 Units
Prerequisite(s): GEOL 5 or GEOL 10, GEOL 12; GEOL 110A recommended.
Term Typically Offered: Fall, Spring

Seminar in the geologic and tectonic development of California.

GEOL 193C. Engineering Geology. 3 Units
Prerequisite(s): GEOL 5 or GEOL 10 and GEOL 10L, GEOL 12, PHYS 5A or PHYS 11A, MATH 29 or high school trigonometry.
Term Typically Offered: Fall, Spring

Investigates the engineering properties of earth materials, the engineering considerations required to build safe and durable structures on and within the Earth, and problems associated with structures designed and built neglecting physical environmental conditions. Designed to introduce engineering concepts to students who have a competent grasp of general geologic principles and processes. Lecture 3 hours.

GEOL 195. Geology Internship. 1 - 3 Units
Term Typically Offered: Fall, Spring

Supervised unpaid work experience in government or industry. Supervision is provided by the faculty instructor and responsible officials in the work situations.
Note: Open to all upper division Geology majors with instructor permission. Number of units earned depends on number of hours worked.

Credit/No Credit

GEOL 196C. Introduction to Volcanoes Field Trip. 1 Unit
Prerequisite(s): GEOL 115 (can be taken concurrently).
Term Typically Offered: Fall, Summer

3-day field trip to regional volcanic sites such as Lassen Volcanic National Park. Course emphasizes analysis and interpretation of volcanic features as well as the impact of volcanic hazards on humans and society. Attendance at preliminary meetings is required. Fee course.
Prerequisite: GEOL 115, can be taken concurrently
Credit/No Credit
Fee course.
Field trip(s) may be required.

GEOL 197. Advanced Laboratory Techniques for Geology. 1 - 3 Units
Prerequisite(s): Appropriate upper division courses and instructor permission.
Term Typically Offered: Fall, Spring

Supervised individual instruction on techniques applied in geology laboratories for advanced research in mineralogy, petrology, geochemistry, geophysics, and paleontology.
Credit/No Credit

GEOL 198A. Senior Research Preparation. 1 Unit
Prerequisite(s): Senior status and appropriate courses as determined by a Departmental faculty committee. The proposed project must be approved by a Department committee; instructor permission.
Term Typically Offered: Fall, Spring

Selection and design of an independent research project. A final written report is required and includes: research proposal, bibliography, and results of preliminary review of the literature. Student must choose a supervising instructor.

GEOL 198B. Senior Research Project. 2 Units
Prerequisite(s): Senior status and appropriate courses as determined by a Departmental faculty committee. The proposed project must be approved by the Department committee; instructor permission.
Term Typically Offered: Fall, Spring

Completion of an independent research project. A final written report is required. Progress reports may be required by the supervision instructor. Presentation of an oral report on the research project during the same semester is required.

GEOL 199A. Beginning Special Problems. 1 - 3 Units
Term Typically Offered: Fall, Spring

Individual projects or special studies at a beginning level, including fieldwork, lab work, library study, or other learning activities.
Note: Open only to students judged competent to carry on individual work. Credit/noncredit grading also available.

GEOL 199B. Intermediate Special Problems. 1 - 3 Units
Individual projects or special studies at an intermediate level, including fieldwork, lab work, library study, or other learning activities.
Note: Open only to students judged competent to carry on individual work. Credit/noncredit grading also available.

GEOL 199C. Advanced Special Problems. 1 - 3 Units
Individual projects or special studies at an advanced level, including fieldwork, lab work, library study, or other learning activities.
Note: Open only to students judged competent to carry on individual work. Credit/noncredit grading also available.

GEOL 200. Graduate Research Methods Seminar. 3 Units
Term Typically Offered: Fall, Spring

Developing a research proposal, library and internet searches, seeking external funding, presentation graphics, and publication formats. Students will develop a research project in preparation for thesis requirement. Seminar three hours.
Note: Graduate Writing Intensive (GWI).

GEOL 201. Seminar in Petrology. 3 Units
Prerequisite(s): GEOL 102, GEOL 103, graduate-level status in Geology, or instructor permission.
Term Typically Offered: Fall, Spring

Advanced study of petrology. Topics may include the origin and evolution of igneous/metamorphic/sedimentary rocks in different tectonic settings; application of advanced petrologic tools to explore current research questions including rock and mineral chemistry, optical analysis, geochronology, thermochronology.
Note: This course requires one or more field trips. May be taken for credit multiple times if covering different topics.

Field trip(s) may be required.

GEOL 202. Aqueous Geochemistry. 3 Units
Prerequisite(s): CHEM 1B; instructor permission.
Term Typically Offered: Fall, Spring

Low temperature geochemical reactions in aqueous environments. Chemical kinetics, thermodynamics, mixing and dilution, mineral stability, chemical composition of surface water, stable isotopes. Three hours lecture.

GEOL 204. Contaminant Hydrogeology. 3 Units
Prerequisite(s): CHEM 1B and CHEM 6B or CHEM 20, GEOL 202.
Term Typically Offered: Fall, Spring

Contaminants and contaminant transport in near-surface environments. Fluid-sediment interaction, fluid partitioning, common geochemical reactions, stability and mobility of groundwater contaminants, multi-phase systems, sampling considerations and overview of analytical techniques.

GEOL 208. Groundwater Modeling. 3 Units
Prerequisite(s): GEOL 127, MATH 45.
Term Typically Offered: Fall, Spring

Computer modeling of groundwater systems using 2 and 3 dimensional numerical solutions and common software packages. Topics will include data acquisition, constructing a numerical model, model calibration, flow paths, particle tracking and model output.

GEOL 212. Geologic Remote Imaging. 3 Units
Prerequisite(s): PHYS 5B or PHYS 11B; GEOL 102, GEOL 110A; and proficiency using a personal computer.
Term Typically Offered: Fall, Spring

Use of remote imaging in geologic applications. Types of imagery, acquisition, production, processing, and interpretation are covered.

GEOL 213. Seminar in Structural Geology and Tectonics. 3 Units
Prerequisite(s): GEOL 110A, MATH 30, graduate-level status in geology, or instructor permission.
Term Typically Offered: Fall, Spring

Advanced treatment of deformation of the lithosphere of the Earth over short and long timescales. Topics may include structural analysis, tectonic geochemistry, field studies, geochronology, use of technical analytical software, and interpretation of geologic mapping; review of published literature, collection and analysis of data, and preparation of technical manuscript.
Note: This course requires one or more field trips. May be repeated for credit if covering different topics.

Field trip(s) may be required.

GEOL 214. Advanced Volcanology. 3 Units
Term Typically Offered: Fall, Spring

Analyzes volcanic eruption processes. Interpretation of volcanic deposits in the evaluation of volcanic hazards, risk, eruption processes, and geologic history. Field trip.
Field trip(s) may be required.

GEOL 218. Seminar in Geophysics. 3 Units
Prerequisite(s): PHYS 5B or PHYS 11C, GEOL 112, graduate-level status in geology, or instructor permission.
Term Typically Offered: Fall, Spring

Advanced study of geophysics. The focus of this course is the quantitative analysis of physical processes and the physical properties of the Earth at both local and global scale. Course may include field measurements in addition to analytical and numerical modeling. Topics covered in the course may include heat flow, seismology, gravity, magnetics, geodesy, plate tectonics, borehole techniques, and near surface exploration.
Note: This course requires one or more field trips. May be taken for credit multiple times if covering different topics.

Field trip(s) may be required.

GEOL 220. Seminar in Surficial Processes. 3 Units
Prerequisite(s): GEOL 120 or equivalent, graduate status in Geology, or instructor permission.
Term Typically Offered: Fall, Spring

Course explores the dynamics of geological and hydrologic processes operating at the earth's surface and the landscapes in which they interact. Topics may include hydrologic and geologic surface processes, system thresholds and responses, process linkages, problem solving, data generation and evaluation that characterize processes and the landscapes with which they interact.
Note: May be taken for credit multiple times if covering different topics.

GEOL 223. Seminar in Advanced Geochemistry. 3 Units
Prerequisite(s): CHEM 1A or equivalent, graduate-level status in Geology, or instructor permission.
Term Typically Offered: Fall, Spring

Advanced topics covering the geochemistry on Earth and of Earth materials. Topics may include: thermodynamics and kinetics of geological environments, silicate and carbonate systems, major element geochemistry, trace and rare earth element geochemistry, stable and radiogenic isotopes; applications to studies of aqueous, pedogenic, marine, igneous, sedimentary, or metamorphic environments; analysis of geochemical aspects of contemporary resource, environmental, and paleoenvironmental problems.
Note: May be taken for credit multiple times if covering different topics.

GEOL 227. Seminar in Advanced Hydrogeology. 3 Units
Prerequisite(s): GEOL 127, graduate-level status in geology, or instructor permission.
Term Typically Offered: Fall, Spring

Advanced study of hydrogeology. Topics may include: water budgets, groundwater flow to wells, aquifer testing, fracture flow, dewatering, salt water intrusion, groundwater chemistry and dating, tracers, and contaminant transport and remediation.
Note: May be taken for credit multiple times if covering different topics.

GEOL 230. Seminar In Geology. 3 Units
Term Typically Offered: Fall, Spring

Reading, analysis and discussion of the geologic literature on selected topics in geology. Student presentations and reports are required.
Note: May be taken twice for credit.

GEOL 240. Advanced Special Topics in Geology. 3 Units
Prerequisite(s): Graduate-level status in geology and/or instructor permission.
Term Typically Offered: Fall, Spring

Advanced special topics in Geology that may include structural geology, volcanology, hydrogeology, engineering geology or other specialized topics selected to meet student demand or respond to industry trends in geology.
Note: May be taken for credit multiple times if covering different topics.

GEOL 275. Quantitative and Numerical Research Methods. 3 Units
Prerequisite(s): MATH 31
Term Typically Offered: Fall, Spring

Introduction to quantitative and numerical methods of solving geologic problems using high level programming.

GEOL 280. Seminar in Earth's Climate History. 3 Units
Prerequisite(s): Graduate-level status in geology and/or instructor permission.
Term Typically Offered: Fall, Spring

Seminar course on global climate change through Earth's geologic history. Topics may include the mechanisms of climate change, climate archives (how we determine Earth's climate history), the snow-ball earth hypothesis, Paleocene-Eocene Thermal Maximum, glacial/interglacial climate change, humans and climate change, and mitigation and adaptation to climate change.
Note: May be taken for credit multiple times if covering different topics.

GEOL 290. Regional Geology of the Western US. 3 Units
Prerequisite(s): GEOL 100, GEOL 102, GEOL 103 and GEOL 110A.
Term Typically Offered: Fall, Spring

Application of advanced geological concepts in tectonics, stratigraphy, sedimentology, petrology, and volconism to the geologic evolution of the Western United States from Precambrian to present. Field trip. Course Fee.
Field trip(s) may be required.

GEOL 293. Engineering Geology. 3 Units
Prerequisite(s): GEOL 193C.
Term Typically Offered: Fall, Spring

Takes a geological approach to evaluating engineering issues associated with building with or on natural earthen materials. Rock and soil mechanics, slope stability, geophysical investigation of rock and soil properties.
Note: 150 minutes Lecture = 3 units.

GEOL 299. Special Problems in Geology. 1 - 4 Units
Prerequisite(s): Graduate-level status in geology, approval of project by a faculty sponsor and Department Chair; instructor permission.
Term Typically Offered: Fall, Spring

Graduate research. Independent research in geology that may include library research, short-term original research, technique development, fieldwork, or laboratory research. May include research toward thesis proposal. Culminating experience will be in the form of a written report, oral presentation, or scientific paper.

GEOL 500. Master's Thesis. 6 Units
Prerequisite(s): Advanced to candidacy and chair permission of his/her thesis committee.
Term Typically Offered: Fall, Spring

Completion of a thesis approved for the Master's degree. Should be taken in the final semester prior to the completion of all requirements for the degree.

GEOL 596. Comprehensive Examination. 0 Units
Term Typically Offered: Fall, Spring

A written comprehensive examination administed by a committee of three faculty members. Assesses the student's ability to integrate knowledge from core and elective courses, show critical and independent thinking, and demonstrate mastery of the subject matter. Required for the non-thesis option. Graded: CR/NC. May be retaken one time after 4 calendar months. Units: 0.
Credit/No Credit