

# DEPARTMENT OF GEOSCIENCES

## Courses Geosciences (GEOL)

**GEOL 110 Introduction to Geology-Parks and Monuments (GT-SC2) Credits: 3 (3-0-0)**

**Course Description:** Understanding the physical processes, natural hazards, earth materials, and natural resources of planet Earth, and the relationship of humans to this planet. Outstanding examples of natural features from national and local parks and monuments, using narrated high-resolution (including aerial) video.

**Prerequisite:** None.

**Registration Information:** This is a partial semester course. Offered as an online course only. Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, or GEOL 150.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**GEOL 120 Exploring Earth - Physical Geology (GT-SC2) Credits: 3 (3-0-0)**

**Course Description:** Develops scientific understanding through introduction to earth processes, materials, resources, and hazards.

**Prerequisite:** None.

**Registration Information:** Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, or GEOL 150.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**GEOL 121 Introductory Geology Laboratory (GT-SC1) Credit: 1 (0-2-0)**

**Course Description:** Laboratory applications of introductory geology.

**Prerequisite:** GEOL 110, may be taken concurrently or GEOL 120, may be taken concurrently or GEOL 122, may be taken concurrently or GEOL 124, may be taken concurrently.

**Registration Information:** Required field trips. Credit not allowed for both GEOL 121 and GEOL 150.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

**GEOL 122 The Blue Planet - Geology of Our Environment (GT-SC2) Credits: 3 (3-0-0)**

**Course Description:** Develops scientific understanding through introduction to geological processes, natural hazards, earth resources, and their impacts on society.

**Prerequisite:** None.

**Registration Information:** Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, or GEOL 150.

**Terms Offered:** Fall, Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**GEOL 124 Geology of Natural Resources (GT-SC2) Credits: 3 (3-0-0)**

**Course Description:** Develops scientific understanding through introduction to the origin, use and environmental impact of geological resources extracted from the Earth.

**Prerequisite:** None.

**Registration Information:** Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, GEOL 150.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**GEOL 150 Physical Geology for Scientists and Engineers Credits: 4 (3-3-0)**

**Course Description:** Earth materials, structures, and surface processes. Geologic analysis using field data, topographic and geologic maps, and aerial photos.

**Prerequisite:** None.

**Registration Information:** Must register for lecture and laboratory. Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, GEOL 150. Credit not allowed for both GEOL 121 and GEOL 150. Required field trips.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**Additional Information:** Biological & Physical Sciences 3A.

**GEOL 154 Historical and Analytical Geology Credits: 4 (3-3-0)**

**Course Description:** Physical and biological history of Earth with introduction to laboratory, computer, and field techniques.

**Prerequisite:** GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150.

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Modes:** S/U within Student Option, Trad within Student Option.

**Special Course Fee:** Yes.

**GEOL 192 New Student Seminar--Exploring Geosciences Credit: 1 (0-0-1)**

**Course Description:** Geosciences as a field of study; exploration of the major and career paths; strategies for academic success and beyond.

**Prerequisite:** None.

**Restriction:** Must be a: Undergraduate.

**Registration Information:** Freshman and sophomore geology majors only. This is a partial semester course.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 201 Field Geology of the Colorado Front Range Credit: 1 (0-2-0)**

**Course Description:** Geology of the Rocky Mountain Front Range taught primarily through field trips and field exercises, emphasizing hands-on experiences. Learn to make basic field observations and measurements on a variety of rock types and surficial features.

**Prerequisite:** GEOL 121 or GEOL 150.

**Registration Information:** Freshman, sophomore or junior standing only. Geology majors or minors only. This is a partial semester course. Required field trips.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 232 Mineralogy Credits: 3 (2-3-0)**

**Course Description:** Crystal structures, crystal chemistry, rock-forming and economically important minerals, crystal growth and defects, physical properties of minerals.

**Prerequisite:** (CHEM 111, may be taken concurrently) and (GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (MATH 120 or MATH 124 or MATH 127 or MATH 155 or MATH 160 or MATH 161 or MATH 255).

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 250 The Solid Earth Credits: 3 (2-2-0)**

**Course Description:** Structure, flow, and composition of the deep Earth; introduction to geophysics; tests of plate tectonic theory.

**Prerequisite:** (GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (MATH 124) and (MATH 125 or MATH 127 or MATH 155 or MATH 160 or MATH 161 or MATH 255).

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 332 Optical Mineralogy Credits: 2 (1-2-0)**

**Course Description:** Fundamental light optics in crystalline substances; optical indicatrix; isotropic, uniaxial, and biaxial substances; common minerals in thin section.

**Prerequisite:** GEOL 232, may be taken concurrently.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 340 Glacial Geology Credits: 3 (3-0-0)**

**Course Description:** Glacier physics (mass balance, ice dynamics, heat flow, and hydrology), glacial erosion and sedimentation, glacial landforms, and the relationship between forcings (orbital, climate, tectonic, biological) and glaciations in Earth's history.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (PH 121 or PH 141).

**Restriction:** Must not be a: Freshman.

**Registration Information:** Sophomore standing. Required field trips. Credit not allowed for both GEOL 340 and GEOL 380A2.

**Term Offered:** Fall (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 342 Paleontology Credits: 3 (2-3-0)**

**Course Description:** Description of invertebrates, vertebrates, and plants and their distribution in earth history.

**Prerequisite:** GEOL 154.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 343 Dinosaur Paleontology Field Camp Credit: 1 (0-0-2)**

**Course Description:** Develops field-based skills in sedimentology and paleontology, including general sedimentary geology techniques (interpreting depositional environments, measuring section, collecting samples, note taking) and paleontological techniques (prospecting, data collection, excavation, mapping, inventory), to reconstruct and interpret fossil ecosystems.

**Prerequisite:** GEOL 154.

**Registration Information:** Required field trips. Class will spend one week camping at the Denver Museum of Nature and Science field station. Credit not allowed for both GEOL 343 and GEOL 380A3.

**Term Offered:** Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 344 Stratigraphy and Sedimentology Credits: 4 (3-3-0)**

**Course Description:** Description, genesis, correlation, and age of sediments, sedimentary rocks and layered rock sequences.

**Prerequisite:** GEOL 154 with a minimum grade of C.

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Fall.

**Grade Modes:** S/U within Student Option, Trad within Student Option.

**Special Course Fee:** Yes.

**GEOL 364 Igneous and Metamorphic Petrology Credits: 4 (3-3-0)**

**Course Description:** Identification, classification, geochemistry, petrogenesis of igneous and metamorphic rocks; textural interpretation of hand samples and thin sections.

**Prerequisite:** GEOL 232 with a minimum grade of C-.

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 366 Sedimentary Petrology and Geochemistry Credits: 4 (3-3-0)**

**Course Description:** Composition, identification, and classification of sedimentary rocks; geochemical processes affecting sedimentary rocks and surficial deposits.

**Prerequisite:** CHEM 113 and GEOL 154 and GEOL 364.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 372 Structural Geology Credits: 4 (3-3-0)**

**Course Description:** Stress and strain in rocks, geometry of deformed rocks, and tectonic principles.

**Prerequisite:** (GEOL 154, may be taken concurrently) and (MATH 125 or MATH 127 or MATH 155 or MATH 160 or MATH 161 or MATH 255) and (PH 121, may be taken concurrently or PH 141, may be taken concurrently).

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Modes:** S/U within Student Option, Trad within Student Option.

**Special Course Fee:** Yes.

**GEOL 376 Geologic Field Methods Credits: 3 (1-4-0)**

**Course Description:** Scientific, surveying, and mapping methods used in geologic field studies; proposal, map, and report preparation.

**Prerequisite:** GEOL 344 and GEOL 372, may be taken concurrently.

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 384 Supervised College Teaching Credits: Var[1-5] (0-0-0)**

**Course Description:** Instruction and practice in laboratory instruction in lower-division departmental courses.

**Prerequisite:** None.

**Registration Information:** Written consent of instructor. A maximum of 10 combined credits for all 384 and 484 courses are counted towards graduation requirements.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 401 Geology of the Rocky Mountain Region Credit: 1 (0-3-0)**

**Course Description:** Field course; geology of the local Rocky Mountain region.

**Prerequisite:** GEOL 154.

**Registration Information:** May be taken up to 3 times for credit. Required field trips.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 415 Critical Zone Science Credits: 3 (3-0-0)**

**Course Description:** Focus on the Earth's terrestrial near-surface environment that sustains most non-marine life on the planet, known as the Critical Zone. Gain experience with the architecture and geologic and geomorphologic context of the Critical Zone in different environments.

Explore the interactions between the solid earth, atmosphere, hydrosphere and biosphere that give rise to the Critical Zone, and learn how the Critical Zone modulates various Earth surface processes.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 150 or ESS 210 or GR 210 or SOCR 240) and (CHEM 107 or CHEM 111) and (MATH 155 or MATH 159 or MATH 160 or STAT 301).

**Restriction:** Must not be a: Freshman.

**Registration Information:** Required field trips. Credit not allowed for both GEOL 380A1 and GEOL 415.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 436 Geology Summer Field Course Credits: 6 (0-12-0)**

**Course Description:** Geologic mapping, measuring sections, interpreting geologic history in Colorado. Required comprehensive reports, geologic maps, and cross sections.

**Prerequisite:** GEOL 364 and GEOL 372 and GEOL 376.

**Registration Information:** This is a partial semester course. Required field trips.

**Term Offered:** Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 440 Geodetic and Near-Surface Geophysical Methods Credits: 4 (3-3-0)**

**Course Description:** Introduction to geodetic and near-surface geophysical methods to answer societally-relevant geological and environmental questions. Methods include (i) dataloggers and instruments, (ii) geodetic tools (GNSS surveys, lidar, and Structure from Motion), and (iii) near-surface geophysical methods (ground-penetrating radar, active seismic profiling, and electrical resistivity imaging). Emphasizes learning to collect, analyze/interpret, and synthesize multiple types of geophysical data.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (GEOL 344, may be taken concurrently) and (PH 122 or PH 142) and (MATH 161 or MATH 255).

**Restriction:** Must not be a: Freshman.

**Registration Information:** Sophomore standing. Must register for lecture and laboratory. Required field trips. Credit not allowed for both GEOL 440 and GEOL 480A4.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 442 Applied Geophysics Credits: 4 (3-2-0)**

**Course Description:** Geophysical exploration methods emphasizing hydrocarbon and mineral exploration, hydrogeology, and engineering applications.

**Prerequisite:** GEOL 372 and MATH 161 and PH 142.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 446 Environmental Geology Credits: 3 (3-0-0)**

**Course Description:** Geology applied to environmental problems.

**Prerequisite:** (CHEM 111) and (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (MATH 155 or MATH 160) and (PH 121 or PH 141).

**Registration Information:** Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 447 Mineral Deposits Credits: 3 (2-3-0)**

**Course Description:** Occurrence, origin, and exploration of economic metallic mineral deposits.

**Prerequisite:** GEOL 366, may be taken concurrently and GEOL 372.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 452 Hydrogeology Credits: 4 (3-3-0)**

**Course Description:** Interaction of water and geologic materials; surface and groundwater; quantitative analysis and geologic effects on quality and flow of groundwater.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150 or GR 210) and (MATH 161 or MATH 255) and (PH 121 or PH 141).

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 454 Geomorphology Credits: 4 (3-3-0)**

**Course Description:** Origin of landforms; morphology and processes.

**Prerequisite:** (GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150 or GR 210) and (STAT 301 or STAT 307 or STAT 315).

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 492 Seminar Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494A Independent Study: Environmental/Engineering Geology Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494B Independent Study: Geomorphology Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494C Independent Study: Mineralogy/Petrology Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494D Independent Study: Geoscience Field Studies Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494E Independent Study: Paleontology/Stratigraphy Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494F Independent Study: Sedimentology Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494G Independent Study: Structural Geology Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494I Independent Study: Geophysics Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 498 Research Credits: Var[1-6] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Registration Information:** Written consent of instructor.

**Term Offered:** Spring.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 530 Advanced Petrology Credits: 3 (2-2-0)**

**Course Description:** Igneous and metamorphic processes and products explored through thermodynamics, phase equilibria, and textural analysis.

**Prerequisite:** GEOL 364.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Spring (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 535 Microtectonics Credits: 3 (2-2-0)**

**Course Description:** Focuses on microstructural features, processes, mechanisms, and measurements. Structurally interesting rocks especially on the microscale, development of structural fabrics and reactivation, analysis of fault rocks and kinematic indicators especially in fault and shear zones, stress measurement through microstructural indicators, shock deformation/metamorphism in impact structures, chemical changes with deformation, deformation mechanisms, and isotopic investigation of deformation.

**Prerequisite:** GEOL 332 and GEOL 372.

**Registration Information:** Must register for lecture and laboratory. Credit not allowed for both GEOL 535 and GEOL 580A3.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 540 Petrophysics and Well Log Interpretation Credits: 3 (3-0-0)**

**Course Description:** Petrophysics and well log interpretation as it relates to hydrocarbon exploration and production. Wireline logs, calculating rock and fluid properties from log measurements, and recognizing zones of potential hydrocarbons. Map and calculate volumes of hydrocarbons in the subsurface using the analysis of petrophysical properties from wireline well logs.

**Prerequisite:** GEOL 344 and GEOL 366 and PH 142.

**Registration Information:** Senior or graduate standing in Geosciences, Engineering, or Physics. Credit not allowed for both GEOL 540 and GEOL 581A4.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.



**GEOL 541 Geostatistics Credits: 2 (2-0-0)**

**Course Description:** Geostatistics for earth science applications. Aquifer and reservoir heterogeneity, spatial data analysis, variogram modeling, spatial estimation, kriging, and geostatistical simulation.

**Prerequisite:** (GEOL 150) and (MATH 161 or MATH 255) and (STAT 301 or STAT 315).

**Registration Information:** Credit not allowed for both GEOL 541 and GEOL 581A5.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 543 Carbonate Sedimentology Credits: 2 (1-3-0)**

**Course Description:** Recognition of carbonate grains, cement types, and carbonate depositional environments, and their response to sea-level changes.

**Prerequisite:** GEOL 344.

**Registration Information:** Junior standing.

**Term Offered:** Fall (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 545 Shale Sedimentology Credits: 2 (2-0-0)**

**Course Description:** Recognize and interpret mud and mudstone facies and their depositional environments, as well as reconstructing their diagenetic history. Observe stacking patterns and reconstruct sea-level fluctuations from mudstone/shale successions and their impact on the 3D distribution of mudstones/shales.

**Prerequisite:** GEOL 344.

**Registration Information:** Junior standing. Credit not allowed for both GEOL 545 and GEOL 580A6.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 546 Sedimentary Basin Analysis Credits: 4 (3-3-0)**

**Course Description:** Sedimentologic data base, correlation, mapping, facies models, classification, and evolution of sedimentary basins. Applications to petroleum exploration.

**Prerequisite:** GEOL 344.

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 547 Ore Deposit Geochemistry Credits: 3 (3-0-0)**

**Course Description:** Geochemical techniques applied to the geology, exploration, and environmental analysis of ore deposits.

**Prerequisite:** GEOL 447.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 548 Petroleum Geology Credits: 4 (3-2-0)**

**Course Description:** Comprehensive treatment of the petroleum system with a focus on hydrocarbon exploration and production data and methods.

**Prerequisite:** GEOL 344 and GEOL 372.

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Must register for lecture and laboratory. Credit allowed for only one of the following: GEOL 548, GEOL 565, or GEOL 581A6.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 551 Groundwater Modeling Credits: 3 (3-0-0)**

**Course Description:** Groundwater modeling from a geologic perspective. Conceptual models and computer modeling of groundwater flow and solute transport.

**Prerequisite:** CIVE 423 or GEOL 452.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 552 Advanced Topics in Hydrogeology Credits: Var[2-3] (0-0-0)**

**Course Description:** Current literature, new techniques, legislative and political developments in hydrogeology, and appropriate case histories.

**Prerequisite:** GEOL 452.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 553 Use of Tracers in Hydrogeology Credits: 3 (3-0-0)**

**Course Description:** Use of environmental and applied tracers in hydrogeology to understand groundwater flow and transport properties. Environmental tracers are used to determine groundwater age and recharge rates, ground/water surface water interactions and to estimate the average temperature when the groundwater was recharged. Applied tracers are used to determine flow and transport processes in porous media to understand controls on solute transport, especially related to contaminant movement.

**Prerequisite:** CIVE 423 or GEOL 452.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 554 Remote Sensing of the Earth System Credits: 3 (2-2-0)**

**Course Description:** Introduction to the physics and specific applications of common passive and active remote sensing techniques to study the Earth system. Gain an understanding of how to access, process, analyze and interpret remote sensing observations to answer specific research questions focused on the Earth system.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (PH 122 or PH 142).

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior geology majors or graduate students. Must register for lecture and laboratory. Credit not allowed for both GEOL 554 and GEOL 580B2.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 570 Plate Tectonics Credits: 3 (3-0-0)**

**Course Description:** Examination of the historical development of plate tectonic theory and its application to understanding geological processes.

**Prerequisite:** GEOL 364 and GEOL 372 and PH 142.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 571 Tectonic Geomorphology Credits: 3 (3-0-0)**

**Course Description:** Interactions between tectonic, climatic and earth surface processes that give rise to mountainous landscapes. Topics range from landscape response to single earthquake events to geochronological tools used to constrain rates of landscape change to orogen-scale interactions and feedbacks between tectonics and climate through lectures, in-class activities, data analysis, modeling, and reading assignments.

**Prerequisite:** GEOL 372 and GEOL 454, may be taken concurrently and MATH 160.

**Registration Information:** Required field trips. One weekend field trip to study tectonic geomorphology in southern CO is required. Credit not allowed for both GEOL 571 and GEOL 581B1.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 572 Advanced Structural Geology Credits: 4 (3-3-0)**

**Course Description:** Rheology, deformation mechanisms, structural associations and advanced methods of structural analysis.

**Prerequisite:** GEOL 436.

**Registration Information:** Must register for lecture and laboratory. Required field trips. Graduate standing can substitute for prerequisite course.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 574 Geodynamics Credits: 3 (3-0-0)**

**Course Description:** Continuum mechanics applied to understanding of deformation within the earth. Stress and strain as tensors, with application to various geological settings; plate flexure and isostasy; steady state and time dependent heat conduction in a geological context; fluid mechanics of the earth.

**Prerequisite:** GEOL 250 and MATH 261 and PH 141.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 575 Subsurface Geophysical Mapping Credits: 4 (3-2-0)**

**Course Description:** Advanced techniques for creating subsurface geological maps based on seismic reflection and well log data.

**Prerequisite:** GEOL 344 and GEOL 372 and MATH 161 and PH 142.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Spring (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 576 Exploration Seismology Credits: 3 (3-0-0)**

**Course Description:** Seismic exploration methods, including theory, data acquisition, and data processing.

**Prerequisite:** GEOL 344 and GEOL 372 and MATH 161 and PH 142.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 578 Global Seismology Credits: 4 (3-2-0)**

**Course Description:** Quantitative introduction to seismology; basics of seismic data analysis; fundamentals of wave propagation; earthquakes; structure of the Earth.

**Prerequisite:** PH 142 and MATH 261.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 579 Solid Earth Inverse Methods and Practices Credits: 3 (3-0-0)**

**Course Description:** Inverse and parameter estimation theory and applications in the earth sciences in the context of Frequentist and Bayesian approaches to estimating and interpreting data-driven models. Review of linear algebra, statistical, and other mathematical underpinnings, and of basic MATLAB programming. Linear and nonlinear inverse problems. Nonuniqueness, ill-posedness, rank-deficiency. Regularization methods for geophysical problems.

**Prerequisite:** (MATH 161 or MATH 255) and (MATH 229) and (STAT 301 or STAT 315).

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 601 Professional Development for Geoscientists Credit: 1 (0-0-1)**

**Course Description:** The conduct of science, role of scientific publications, publication process, proposal writing, responsible conduct of research, and professional ethics.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 652 Fluvial Geomorphology Credits: 3 (3-0-0)**

**Course Description:** Geomorphology of channels, slopes, and drainage systems.

**Prerequisite:** GEOL 120.

**Restriction:** Must be a: Graduate, Professional.

**Term Offered:** Fall.

**Grade Modes:** S/U within Student Option, Trad within Student Option.

**Special Course Fee:** Yes.

**GEOL 662 Field Geomorphology Credits: 2 (1-2-0)**

**Course Description:** Field-based geomorphologic analysis of landscape forms and processes. Apply appropriate field techniques to address relevant research hypotheses related to advanced subject matter in geomorphology. Analyze and interpret field-based data, orally present findings in a symposium setting, and discuss and critically evaluate relevant literature.

**Prerequisite:** GEOL 454.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Must register for lecture and laboratory. This is a partial semester course. Required field trips. Credit not allowed for both GEOL 662 and GEOL 680A1.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 684 Supervised College Teaching Credits: Var[1-5] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Registration Information:** Written consent of instructor.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**GEOL 692 Seminar Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**GEOL 695 Independent Study Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**GEOL 696 Group Study Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**GEOL 698 Research Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**GEOL 699 Thesis Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**GEOL 798 Research Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**GEOL 799 Dissertation Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.