

courses are designed to meet the needs of individuals with several different career goals. Accordingly, the objectives of the program are as follows: (1) to prepare students for enrollment in Ph.D. programs in geology and related sciences, (2) to prepare students for employment as professional geoscientists with industry or government, and (3) to further the content knowledge and teaching skills of secondary school and junior college teachers in the earth sciences.

Graduate studies offered in traditional geology include sedimentary geology (paleoecology, diagenesis, depositional environments, basin analysis, stratigraphy); structural geology and field mapping; petrology (plutonic, volcanic, sedimentary, metamorphic, and mineralized and hydrothermally altered rocks); and geochemistry.

In addition to classical geology, the graduate program offers studies in applied geology. The curriculum is usually interdisciplinary with an environmental focus, involving coursework in geology, civil engineering, chemistry, soil sciences, and other areas. Three applied geology emphases are offered: (1) engineering and geotechnical geology, (2) hydrogeology (physical or chemical options), and (3) ore deposits. Students of applied geology are encouraged to undertake theses involving support and supervision by professionals in private and public sectors.

University requirements are met through satisfactory completion of core courses and specialty courses in the curriculum emphasis.

**Core courses.** All students in the graduate program are required to complete the following core courses:

- GEOL 201 Seminar in Geology (3 units)
- GEOL 299 Thesis (6 units)

In addition, students studying applied geology should take the following courses before or during their graduate experience:

- GEOL 114 Engineering Geology (3 units)
- GEOL 117 Hydrogeology (3 units)
- GEOL 124 Geochemistry (3 units)

All other students not in applied geology must complete GEOL 201 and one of the following three courses: GEOL 114, GEOL 117, or GEOL 124.

## Master of Science Degree Requirements

The graduate program for the Master of Science degree in Geology is based on the equivalent of the undergraduate major in geology at California State University,

Fresno. Two-thirds of the 30 units required for the degree must be in geology, and at least 21 of the 30 units must be 200-series courses. For specific requirements consult the geology graduate program coordinator; for general requirements see *Division of Graduate Studies*. (See also *Admission to Graduate Standing, Advancement to Candidacy, Program Requirements, Foreign Language Requirements, and Criteria for Thesis and Project*.)

Under the direction of his/her graduate faculty adviser, each student prepares and submits an individually designed program within the following framework: courses including at least 21 units in 200-series.

### Units

Specific requirements .....	
(see next section) .....	20
Approved upper-division or graduate course electives in geology or related fields such as biology, chemistry, physics, engineering, and mathematics. Electives determined in consultation with graduate adviser .....	10
Approved electives in geology or related fields .....	0-6
<b>Total .....</b>	<b>30</b>

**Specific Requirements.** Students in applied geology should follow the curriculum specified for each of the three emphases. Modifications may be made with approval of the graduate faculty adviser. GEOL 299 (may be taken in 2-6 unit increments, 6 units total). An oral presentation of thesis is required. Graduate students of geology doing a thesis on a foreign country must be proficient in the language in which source materials are published.

## COURSES

### Environmental Science (ENSC)

#### 1. Environmental Science (4)

Introduction to environmental science, focusing on environmental principles and processes. Topics include global systems and change, resource management and conservation, energy and mineral resources, population dynamics, ecosystems and biodiversity, environmental degradation and pollution, and environmental economics and ethics.

### Geology (GEOL)

#### 1. Natural Disasters and Earth Resources (4)

Prerequisite: MATH 4R or second-year high school algebra. Processes and materials that produce the different geologic resources and hazards (earthquakes, volcanoes, floods, landslides). Plate tectonic theory (including

continental drift) as the unifying model to explain geologic phenomena. Emphasizes the relationship between geology and humans. G.E. Breadth B1. (3 lecture, 2 lab hours; optional field trips) (CAN GEOL 2)

#### 3. Geology Field Trip (1; max total 3)

Extended weekend field trip to areas of geologic interest including Yosemite National Park, Death Valley, or coastal California. May be repeated. Nonmajors encouraged. *CR/NC* grading only. (Field trip fee may be required.)

#### 12. Mineralogy (3)

GEOL 13 concurrent in the geology major. Prerequisite: high school chemistry. Properties, relationships, uses origin of minerals; determination of common minerals by physical and other tests. Field trips may be required. (2 lecture, 3 lab hours)

#### 13. Crystallography (1)

GEOL 12 concurrent in the geology major. Prerequisite: MATH 5 or 72 or 75. Symmetry, structure, standard nomenclature, reference systems of crystals. (3 lab hours)

#### 15. The Earth and Its History (5)

Portion of *Humans and the Natural Environment* Cluster. Physical and historical geology, including man's use of the earth and the impact of that use on the earth. Lecture, lab, and fieldwork. G.E. Breadth B1. (HNE program field trip fee, \$300)

#### 20. Atmospheric Science and Pollution (4)

Physical and chemical principles applied to the study of the atmosphere, evolution of Earth and its atmosphere, biogeochemical cycles, atmospheric pollution, and global atmospheric change and the environmental crisis. Field trips may be required. (3 lecture hours, 2 lab hours.)

#### 30. Introductory Field Methods (2)

Prerequisites: GEOL 1 or 15, MATH 5. Introduction to methods and instruments used in geologic fieldwork. *CR/NC* grading only. (6 lab/field hours) (Weekend field trips required; field trip fee may be required)

#### 100. Optical Mineralogy (2)

Prerequisites: GEOL 12, 13. Optical properties of minerals; identification of minerals by optical methods. Theory and use of petrographic microscope. (1 lecture, 3 lab hours)

#### 101. Igneous and Metamorphic Petrology (4)

Prerequisites: GEOL 30, 100; CHEM 1B (or concurrently). Origin classification, textures, structures, and geologic setting of igneous and metamorphic rocks; examination of samples in outcrop, hand specimen, and thin section. Weekend field trips required. (3 lecture, 3 lab hours)