

Department of Geology

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The Department of Geology offers programs leading to the degree of Bachelor of Science in Geology, and Master of Science degrees in certain areas of the vast field of geological sciences. It also offers a more broadly based program leading to the degree of Bachelor of Science in Petroleum Studies. Students wishing to major in geology or petroleum studies must secure the approval of the department. In addition, students must have a strong background in sciences and have taken the freshman science program or its equivalent.

The department also offers the following undergraduate elective courses: GEOL 101, GEOL 102, GEOL 103, and GEOL 201 in the area of general geology, and GEOL 205 in environmental geology.

Field trips are required parts of most geology courses.

Undergraduate Program

Geology majors must attain a grade of 70 or more in GEOL 201 and GEOL 203, and pass their next two geology courses with a grade of 70 or more. Majors must complete the following courses, in which a general average of 70 or more must be maintained: GEOL 202, GEOL 210, GEOL 211, GEOL 212, GEOL 213, GEOL 214, GEOL 219, GEOL 221, GEOL 222, GEOL 224, and GEOL 229, which is a total of 40 credits. In addition, two required elective courses—CMPS 209 (or a 200-level CMPS course), and a 200-level economics course (3 credits—must be completed. No course may be taken without its prerequisite unless authorized by the departmental faculty. Students are encouraged to take additional geology courses such as GEOL 205, GEOL 207, GEOL 215 or GEOL 225, and also courses from the graduate level, provided other requirements permit.

The core courses of the **petroleum studies** program (totaling 58 credits) are GEOL 201, GEOL 202, GEOL 203, GEOL 211, GEOL 212, GEOL 213, GEOL 214, GEOL 219, GEOL 221, GEOL 222, GEOL 225, GEOL 229; CHEM 201, CHEM 208; ACCT 210, MNGT 215, MKTG 210, and ECON 211. In addition, a required elective course, CMPS 209 (or a 200-level CMPS course) must be completed.

Petroleum studies majors must attain a grade of 70 or more in GEOL 201, and GEOL 203, and also pass the next two geology courses with a grade of 70 or more.

To obtain a **minor** in geology, students must complete the following core courses: GEOL 201, GEOL 202, GEOL 203, and GEOL 205, and two of the following elective courses: GEOL 210, GEOL 211, and GEOL 222 (with a total of 16 credits).

GEOL 101 The Earth, Present and Past 3.0; 3 cr.

A freshman level survey of the present day processes that shape the earth we live on, such as plate tectonic activity, rock formation and erosion, coupled with an overview of the origin and history of the earth and life. *Each semester.*

GEOL 102 Environmental Physical Geography 3.0; 3 cr.

An introduction to the structure, classification, physical processes and characteristics of the earth's atmosphere, hydrosphere and biosphere, dynamics of change, and associated environmental impacts. *Each semester.*

GEOL 103 Introduction to Marine Geology 3.0; 3 cr.

A freshman level survey of oceanic geological processes, wave dynamics, submarine springs, marine economic mineral resources, marine communities, pollution, global change, and marine-related environmental issues. *Each semester.*

GEOL 104 Natural Disasters 3.0, 3 cr.

A freshman level course covering events involving natural forces that have major devastating effects on humankind. These include mud flows, land slides and slope failure, earthquakes, tsunamis, explosive eruptions and volcanic hazards, meteoritic impact and mass extinctions, hurricanes and tornadoes, flooding, and forest fires. *Each semester.*

GEOL 201 Physical Geology 3.0; 3 cr.

An introduction to minerals, igneous, sedimentary and metamorphic rocks, geological structures, and external earth processes, including the geologic work of streams, glaciers, groundwater, wind, and plate tectonic theory. *Each semester.*

GEOL 202 Historical Geology 2.2; 3 cr.

An introduction to earth history, including the principles of interpreting the past, origin, and development of the solar system. This course also provides an introduction to the systematic study of fossils, their classification, and identification. *Prerequisites: GEOL 201, GEOL 203, or consent of instructor. Annually.*

GEOL 203 Physical Geology Laboratory 0.2; 1 cr.

An introduction to the identification of rocks and minerals in hand specimen, geographic and geological maps, and basic interpretation of geological data. *Pre- or corequisite: GEOL 101, GEOL 102, GEOL 103, or GEOL 201, or consent of instructor. Each semester.*

GEOL 205 Earth Resources and Energy 3.0; 3 cr.

A study of the main economic mineral resources and traditional and alternate energy resources, with an emphasis on the environmental impacts of their use and misuse. A special emphasis is given to regional issues. Open to both arts and sciences students. *Each semester.*

GEOL 207 Map Interpretation 2.2; 3 cr.

A course on the description, reading and interpretation of topographic and geological maps. This course also introduces stereographic projections, construction of cross-sections across geologic structures, and basic field mapping techniques. *Prerequisites: GEOL 201, GEOL 203, or consent of instructor. Occasionally.*

GEOL 210 Geomorphology 3.0; 3 cr.

An introduction to the study of land forms and the interaction of external geological forces and erosion agents with the structure and composition of their surface rocks. This course is also an examination of the interaction between the internal and external earth processes responsible for the development of land forms. *Prerequisites: GEOL 201 and GEOL 203, or concurrently, with consent of instructor. Annually.*

- GEOL 211 Crystallography and Physical Mineralogy 2.2; 3 cr.**
An introduction to the study and classification of crystals; properties of minerals as related to their crystal structure; identification, description, and classification of minerals. This course entails practical work with crystal models and hand specimens of common minerals. *Annually.*
- GEOL 212 Optical Mineralogy 2.2; 3 cr.**
An introduction to the theory of crystal optics, the polarizing microscope, and methods of mineral identification based on their optical properties. This course is also a systematic study of the common rock forming minerals in thin section. *Prerequisite: GEOL 211 or consent of instructor. Annually.*
- GEOL 213 Structural Geology 2.2; 3 cr.**
Introduction to the study of rock deformation, the relationship between stress and strain, and the interpretation of structures and their significance to regional and global tectonics. *Prerequisite: GEOL 201. Annually.*
- GEOL 214 Stratigraphy 2.2; 3 cr.**
A course on the principles of interpretation of the sedimentary rocks and methods of correlation and an introduction to the stratigraphy of Lebanon in the context of the regional geology of the Middle East. *Prerequisite: GEOL 222 or consent of instructor. Annually.*
- GEOL 215 Invertebrate Paleontology 2.2; 3 cr.**
An introduction to the systematic study of invertebrate fossils, their classification and identification, using macro-specimens and thin sections. *Prerequisite: GEOL 202. Annually.*
- GEOL 219 Geologic Field Methods 0.6; 3 cr.**
An introduction to applied methods used in field geological mapping. This course also provides a description and interpretation of geological maps, and construction of cross sections. *Prerequisites: GEOL 201, GEOL 213, or consent of instructor. Annually.*
- GEOL 221 Petrology 2.2; 3 cr.**
A course on the origin, composition, occurrence, and classification of igneous and metamorphic rocks and their systematic identification in hand specimens and in thin section. *Prerequisite: GEOL 212 or consent of instructor. Annually.*
- GEOL 222 Sedimentology 2.2; 3 cr.**
A study of the characteristics and classification of sedimentary rocks using petrographic and field study methods, with some focus on diagenetic processes, depositional environments, and elementary basin analysis. *Pre- or corequisites: GEOL 202 and GEOL 212, or consent of instructor. Annually.*
- GEOL 224 Regional Geology 3.0; 3 cr.**
A course on the geology of the Middle East region, with emphasis on its stratigraphy, structure, geological history, and tectonic evolution, and with reference to oil and mineral resources in the region. *Prerequisites: GEOL 213 and GEOL 222, or consent of instructor. Annually.*
- GEOL 225 Petroleum Geology 3.0; 3 cr.**
A course on hydrocarbon formation and occurrence as oil and gas fields, as well as exploration and extraction methods. *Prerequisites: GEOL 213, GEOL 222, or consent of instructor. Annually.*
- GEOL 229 Individual Field Work Project 0.18; 6 cr.**
A complete and independent geological investigation of a designated area and preparation of a detailed geological map, cross-sections, and report. For juniors and seniors. *Pre- or corequisite: GEOL 219. Annually.*
- GEOL 271/272 Senior Tutorial Course 1–3 cr.**
A tutorial that may be repeated for credit with different topics or may replace a required course. *Occasionally.*

40 Credits¹ in Geology

Modes of Analysis	English and Arabic (9)	Humanities (12)	Social Sciences (3+Unspecified)	Sciences, Math, and Technology (40+3)
Lecture Courses (9+12+3+40+3)	<ol style="list-style-type: none"> Required Arabic course: ARAB 201A or B, or any upper level course (3) Required English courses: ENGL 203(3), 204(3) 	Required credits in the humanities: 12 credits including 6 credits from CVSP (see pp. 163–65)	Required elective economics courses: a 200-level economics course (3)	<ol style="list-style-type: none"> Required geology courses: GEOL 201²(3), 202^{2,3}(3), 210^{2,3}(3), 211⁴(3), 212^{2,4}(3), 213^{2,3,4}(3), 214^{2,3}(3), 219^{2,4}(3), 221^{2,3,4}(3), 222^{2,3,4}(3), 224^{2,3}(3), 229^{2,3}(6) Required elective computer science courses: CMPS 209(3) or 200(3) Elective geology courses: GEOL 205^{2,3}(3), 225^{2,3}(3) 271^{2,3}(3), 272^{2,3}(3)
Seminar (24+12)				<ol style="list-style-type: none"> Required geology courses: GEOL 201b(3), 202^{2,3}(3), 210^{2,3}(3), 213^{2,3,4}(3), 214^{2,3}(3), 221^{2,3,4}(3), 222^{2,3,4}(3), 224^{2,3}(3) Elective geology courses: GEOL 205^{2,3}(3), 225^{2,3}(3), 271^{2,3}(3), 272^{2,3}(3)
Laboratory (25,3)				<ol style="list-style-type: none"> Required geology courses: GEOL 203(1), 211b(3), 212^{2,4}(3), 213^{2,3,4}(3), 219^{2,4}(3), 221^{2,3,4}(3), 222^{2,3,4}(3), 229^{2,3}(6) Required elective computer science courses: CMPS 209(3) or 200(3)
Research Project (36+12)				<ol style="list-style-type: none"> Required geology courses: 201²(3), 202^{2,3}(3), 210^{2,3}(3), 212^{2,4}(3), 213^{2,3,4}(3), 214^{2,3}(3), 219^{2,4}(3), 221^{2,3,4}(3), 222^{2,3,4}(3), 224^{2,3}(3), 229^{2,3}(6) Elective geology courses: GEOL 205^{2,3}(3), 225^{2,3}(3), 271^{2,3}(3), 272^{2,3}(3)

1 Plus 50 required and elective credits

2 Combined lecture, laboratory (field), and research project courses

3 Combined lecture and seminar courses

4 Combined lecture and lab courses

THE REQUIREMENTS LISTED ABOVE APPLY TO STUDENTS WHO JOINED THEIR MAJOR AS OF OCTOBER 1, 2001–02. STUDENTS WHO JOINED A MAJOR PRIOR TO THAT DATE SHOULD CONSULT THE 2000–01 CATALOGUE.

37 Credits¹ in Petroleum Studies

Modes of Analysis	English and Arabic (9)	Humanities (12)	Social Sciences (12)	Sciences, Math, and Technology (37+6+3)
Lecture Courses (9+12+9+3+37+6+3)	<ol style="list-style-type: none"> Required Arabic course: 201A or B or any upper level course (3) Required English courses: 203(3), 204(3) 	Required credits in the humanities: 12 credits including 6 credits from CVSP (see pp. 163–65)	<ol style="list-style-type: none"> Required business courses: ACCT 210(3), MNGT215(3), MKTG 210(3) Economics courses: ECON 211(3) 	<ol style="list-style-type: none"> Required geology courses: GEOL 201²(3), 202^{2,3}(3), 211¹(3), 212^{2,4}(3), 213^{2,3,4}(3), 214^{2,3}(3), 219^{2,4}(3), 221^{2,3,4}(3), 222^{2,3,4}(3), 225^{2,3}(3), 229^{2,3}(6) Chemistry courses: CHEM 201(3), 208(3) Required elective computer science courses: CMPS 209(3) or 200-level(3) Elective geology courses: GEOL 205^{2,3}(3), 210^{2,3}(3), 271^{2,3}(3), 272^{2,3}(3)
Seminar (30+12)				<ol style="list-style-type: none"> Required geology courses: GEOL 201²(3), 202^{2,3}(3), 213^{2,3,4}(3), 214^{2,3}(3), 219^{2,4}(3), 221^{2,3,4}(3), 222^{2,3,4}(3), 225^{2,3}(3), 229^{2,3}(6) Elective geology courses: GEOL 205^{2,3}(3), 210^{2,3}(3), 271^{2,3}(3), 272^{2,3}(3)
Laboratory (13,3)				<ol style="list-style-type: none"> Required geology courses: GEOL 203(1), 211d(3), 212^{2,4}(3), 213^{2,3,4}(3), 222^{2,3,4}(3) Required electives computer science courses: CMPS 209(3) or 200-level(3)
Research Project (30+12)				<ol style="list-style-type: none"> Required geology courses: GEOL 201¹(3), 202^{2,3}(3), 213^{2,3,4}(3), 214^{2,3}(3), 219^{2,4}(3), 221^{2,3,4}(3), 222^{2,3,4}(3), 225^{2,3}(3), 229^{2,3}(6) Elective geology courses: GEOL 205^{2,3}(3), 210^{2,3}(3), 271^{2,3}(3), 272^{2,3}(3)

1 Plus 21 required credits in business, economics, and chemistry, in addition to 38 required and elective credits

2 Combined lecture and research project courses.

3 Combined lecture and seminar courses.

4 Combined lecture and lab courses.

THE REQUIREMENTS LISTED ABOVE APPLY TO STUDENTS WHO JOINED THEIR MAJOR AS OF OCTOBER 1, 2001–02. STUDENTS WHO JOINED A MAJOR PRIOR TO THAT DATE SHOULD CONSULT THE 2000–01 CATALOGUE.

Graduate Program

Candidates pursuing the Master of Science program in geology must complete seven graduate courses (21 cr.) and a thesis (9 cr.). Students may select courses from the graduate courses offered in the department depending on their fields of interest. Note that the GRE general test is required for admission, but the GRE subject test is no longer required.

GEOL 303 Geochemistry 3.0; 3 cr.

An application of chemical concepts to the evolution of the earth, particularly its weathering, magmatic and metamorphic cycles, and the distribution of elements; cosmochemistry, crystal chemistry, and aqueous geo-chemistry. *Prerequisite: GEOL 211.*

GEOL 304 Geophysics I 3.0; 3 cr.

An introduction to seismic, gravity, and magnetic methods and their interpretation procedures and applications in the exploration for petroleum and other resources.

GEOL 305 Geophysics II 3.0; 3 cr.

A course on electrical, radiometric, and thermal geophysical methods, as well as well logging for general geophysical applications and their methods of interpretation. *Pre- or corequisites: GEOL 221 and GEOL 222.*

GEOL 306 Economic Minerals Geology 3.0; 3 cr.

A course on the occurrence and classification of mineral ore deposits and theories of their formation; ore forming processes and ore deposit models; advanced techniques to evaluate ore genesis; and mineral exploration techniques. *Prerequisite: GEOL 211.*

GEOL 307 Advanced Petroleum Geology 3.0; 3 cr.

A course that covers the origin, migration, and accumulation of petroleum; surface and subsurface geological and geophysical exploration methods and production, and development processes; and Middle East hydrocarbon exploration and development.

GEOL 308 Alternate Energy Sources 3.0; 3 cr.

A course on energy and energy use, including a detailed treatment of non-fossil fuel energy options including nuclear, biomass, hydro, wind, solar, and geothermal methods, with practical applications.

GEOL 310 Global Tectonics 3.0; 3 cr.

A course on large-scale processes of rock deformation within the Earth, the theory of "plate tectonics," and the origins and modes of deformation of major tectonic features. These include ocean ridges and continental rifts, transform and transcurrent faults, subduction zones, and mountain ranges. *Prerequisite: GEOL 213.*

GEOL 313 Photogeology 2.2; 3 cr.

A course on the principles of air photo interpretation and remote sensing; the construction of planimetric geological maps, profiles and mosaics from vertical photographs using pocket and mirror stereoscopes; and an introduction to analysis of satellite imagery.

GEOL 317 Micropaleontology 2.2; 3 cr.

An introduction to the study of the main groups of microfossils and their application, with emphasis on the foraminifera, and techniques in their preparation for examination.

- GEOL 318 Hydrogeology 3.0; 3 cr.**
A course on the fundamentals of hydrogeology; groundwater occurrence, movement, development and management; pumping tests; and groundwater chemistry, quality, and contamination.
- GEOL 319 Geostatistics 2.2; 3 cr.**
This course deals with the study and application of different statistical techniques of interest to the geological sciences. Topics to be covered include analysis of sequences of data, map analysis, and analysis of multivariate data. *Prerequisite: GEOL 213 or consent of instructor.*
- GEOL 320 Graduate Seminar 3.0; 3 cr.**
Seminars given by department and graduate students attending the course are designed to cover a particular theme on one of the various aspects of the geology of the Middle East, such as earthquakes, tectonism, and stratigraphy of the region, magmatism in the Nubian shield, etc.
- GEOL 321 Diagenesis I: Advanced Petrography of Sedimentary Rocks 3.0; 3 cr.**
A course that covers some advanced petrographic techniques used in the study of sedimentary rocks (e.g., conventional and cathodoluminescence microscopy, scanning electron microscopy), major diagenetic processes, and the resultant products in sedimentary environments. *Prerequisites: GEOL 212, GEOL 214, and GEOL 222, or consent of instructor. Bi-annually.*
- GEOL 322 Diagenesis II: Advanced Techniques in Geochemistry of Sedimentary Rocks 3.0; 3 cr.**
A course on the various geochemical methods (e.g., trace elements, stable isotopes, radiogenic isotopes, fluid inclusions, and microthermometry) commonly used in the study of diagenesis of both carbonate and clastic reservoirs. *Prerequisites: GEOL 212 and GEOL 222; corequisites: GEOL 214 and GEOL 221; or consent of instructor. Bi-annually.*
- GEOL 323 Geological Oceanography 3.0; 3 cr.**
A general introduction to climatic and oceanographic interactions, characteristics of oceans, and a detailed analysis of near shore and coastal environments.
- GEOL 324 Engineering Geology I 2.2; 3 cr.**
A course on engineering geology and earth materials that focuses on the interaction between engineering and geology in relation to the geotechnical properties of soil and rock mechanics and site investigations.
- GEOL 325 Engineering Geology II 3.0; 3 cr.**
A course on environmental and applied engineering geology that deals with environmental planning, natural disasters, and terrain evaluation, with special applications to mass movements, geology of man-made structures, and the urban environment.
- GEOL 329/330 Selected Topics in Advanced Geology 3 cr.**
May be repeated for credit.
- GEOL 399 MS Thesis 9 cr.**