

GEOLOGY (GEOL)

GEOL 1200 Understanding the Earth

3 credit hours

Our understanding of Earth evolution is mostly based on the study of minerals, rocks, soils, fossils, and geological structures. With in-class, lab and field components, students study the processes that shape our planet, such as plate tectonics, volcanism, erosion and deposition, metamorphism, and ore formation. Classes 3 hrs. and lab 3 hrs. per week.

Note: Credit for this course cannot be obtained in combination with GEOL 1204 Geology for Engineers.

GEOL 1201 The Dynamic Earth

3 credit hours

Earth is a dynamic and evolving planet, in constant transformation since the beginning. Using examples from Atlantic Canada, students examine surface and subsurface processes (e.g., weathering and erosion involving gravity, wind, waves, river currents and ice; groundwater flow; tectonics), and consider geological time, history, resources and hazards. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 1202 Planet Earth: Atlantic Canada Perspective

3 credit hours

Why is the Atlantic Ocean getting wider? Where in Atlantic Canada are there remnants of huge volcanic explosions and lava flows? How did a fault as big as the San Andreas cut through Nova Scotia? This course will provide an understanding of the Earth and the processes which affect it, using examples drawn from the geology of our region. You will study plate tectonics, learn to recognize and interpret Earth materials, and understand their impact on Atlantic Canada. Sections of this course may be offered via world-wide web. This course is intended mainly for non-science students including those in Atlantic Canada Studies.

Note: Please note that this course may not be taken concurrently or subsequently to GEOL 1200 or 1201

GEOL 1203 Earth History: Atlantic Canada Perspective

3 credit hours

What was the origin of the Earth and when did life develop? When did dinosaurs and other fossil groups appear in our region, and how did they disappear? How have ancient deserts, rivers, oceans, and ice ages influenced our landscape? You will trace four billion years of Earth history using examples from the rock and fossil record of Atlantic Canada. Sections of this course may be offered via world-wide web. This course is intended mainly for non-science students including those in Atlantic Canada Studies.

Note: Please note that this course may not be taken concurrently or subsequently to GEOL 1200 or 1201

GEOL 1204 Geology for Engineers

3 credit hours

Students are introduced to the aspects of the physical properties of rocks and minerals, with emphasis on the features controlling the mechanical strength of rocks. Laboratory work focuses on the interpretation of geological maps and aerial photographs, and case studies of civil engineering projects. Classes 3hrs. and lab 3hrs. per week.

Note: Credit for this course cannot be obtained in combination with GEOL 1200 Understanding the Earth.

GEOL 1206 Global Change

3 credit hours

This course examines global changes in the Earth's crust, oceans, biota and atmosphere caused by natural processes and human activity. Topics covered include the reconstruction of ancient environments, some of which were dramatically changed by meteorite impacts, volcanic activity and glaciation, and the evaluation of accelerating environmental change caused by phenomena such as ozone depletion and greenhouse gas emissions.

GEOL 1207 Environment, Radiation and Society

3 credit hours

Radioactivity has an impact on our society and environment. Radiation given off during the process of radioactive decay is harmful, but is accompanied by the release of energy that can be harvested. The course reviews radioactive decay and explores geological sources of radiation, uranium deposits and mining, economics of nuclear power and the geological aspects of radioactive waste disposal. The course will foster an understanding of issues that surround the use of nuclear technology in our society.

GEOL 1208 Environmental Geology: Atlantic Canada Perspective

3 credit hours

This course examines geological principles that lie behind environmental problems facing society. Topics considered may include geological hazards such as volcanoes, earthquakes, slope instability, and pollution and waste disposal, as well as energy and mineral resources, and the quality of water. The course will include examples of environmental geology in the Atlantic Provinces.

GEOL 1209 Gemology

3 credit hours

Students examine the nature and properties of a variety of precious and semi-precious gemstones. Other topics may also include non-destructive methods in gemstone identification, gemstone fashioning, gemstone quality and grading, gemstone enhancement techniques, synthetic gemstones, gemstone forensics, gemstones of Canada, and the influence of gemstones on human history.

GEOL 1210 Dinosaurs and Their World

3 credit hours

This course focuses on dinosaurs and the world in which they flourished for 135 million years, up to the time of their (near) extinction. Spectacular and sometimes controversial evidence indicates how dinosaurs and other creatures lived, died, and were preserved as fossils over geological time. Nova Scotian dinosaur localities will receive special attention in the class.

GEOL 1211 Atlantic Ocean: Formation, Fossils, Phenomena

3 credit hours

Students will take an in-depth look at the Atlantic Ocean - including the polar regions, the equator, and everywhere in between. Course topics will include aspects of the Atlantic Ocean's formation, marine geology, marine vertebrate and invertebrate species, and atmospheric and oceanic circulation patterns/phenomena.

GEOL 1800 – 1825 Special Topics in Geology

6 credit hours

Course content varies from year to year.

GEOL 1826 – 1849 Special Topics in Geology

3 credit hours

Course content varies from year to year.

GEOL 2301 Mineralogy

3 credit hours

Prerequisite: GEOL 1200 or GEOL 1204 (may be taken concurrently)

Students study the major mineral groups, including their crystal structure, chemical composition, physical properties, identification and practical use. Classes 3 hrs. and lab 3 hrs. per week.

GEOL 2302 Optical and Analytical Mineralogy

3 credit hours

Prerequisite: GEOL 2301

Students will investigate determinative mineralogy, with a focus on using optical methods in mineral identification, petrography, and phase equilibria. Associated spectrochemical techniques applied to petrographic analyses are also introduced including micro-X-Ray Fluorescence Spectroscopy, Scanning Electron Microscopy, and X-Ray Crystallography. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 2305 Geophysics

3 credit hours

Prerequisite: GEOL 1200 and 1201

The physics of the Earth, including rotation, gravity, seismology and internal structure, magnetic and electrical properties, radioactivity, and the Earth's heat. Geophysical exploration of the Earth's crust, including seismic refraction, seismic reflection, magnetic, gravity and electrical methods. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 2325 Sedimentology GEOG 2325

3 credit hours

Prerequisite: GEOL 1200 or GEOL 1201

Weathering and the origin of sedimentary materials. Introduction to sediments and sedimentary rocks. Processes of sedimentation and the origin of sedimentary structures. Interpretation of clastic and carbonate sedimentary rocks in the light of comparison with modern environments in non-marine, marginal marine and marine settings. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 2373 Geomorphology GEOG 2313

3 credit hours

Prerequisite: GEOG 1200 or GEOL 1200 or GEOL 1201

Geomorphology is the scientific study of landforms and landscapes. Students explore the basic principles of geomorphology, with an emphasis on Canadian landscapes. In lab exercises, students investigate and apply common techniques of geomorphological data collection and analysis. Classes 3 hrs. and lab 3 hrs. per week.

GEOL 2800 – 2825 Special Topics in Geology

6 credit hours

Course content varies from year to year.

GEOL 2826 – 2849 Special Topics in Geology

3 credit hours

Course content varies from year to year.

GEOL 3213 Applied Geomorphology GEOG 3213

3 credit hours

Prerequisite: GEOG 2313 [GEOL 2373] or GEOG 2333

Students consider geomorphological processes that are of societal significance, including habitat loss and hazards such as flooding, landslides, slope failure and coastal erosion. Approaches to mitigating and adapting to natural and human induced geomorphic changes will be explored using global case studies and local hands-on examples. Students undertake 12 hours of volunteer practicum-service learning hours with local practitioners throughout the term. Classes 3 hrs. and lab/practicum 3 hrs. a week.

GEOL 3300 Field Methods

3 credit hours

Prerequisite: GEOL 1200, 1201, 2325 and permission of the instructor

This course introduces the student to basic field techniques used by geologists. Field observations and measurements collected during a 10 day field camp are summarized by the student as a series of reports. Lab 3 hrs. a week plus field work.

GEOL 3305 Geomatics

3 credit hours

Prerequisite: GEOL 3300

Students are introduced to the application of geographic information systems (GIS) to geological problems. Topics include projections, coordinate systems, relational databases and data organization. Data will be drawn from multiple sources, including online databases and published map data. Emphasis will be on data collection, organization, and manipulation to illustrate structural and field relationships of bedrock geology. Basic field mapping and computer skills are required.

GEOL 3312 Igneous Petrology

3 credit hours

Prerequisite: GEOL 2302

This course emphasises the mineralogical and chemical characteristics of igneous rocks, and their classification, petrography, and tectonic setting. The processes responsible for the evolution of diverse igneous rock associations are also considered. Laboratory work involves the study of igneous rocks in hand sample and thin section. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 3313 Metamorphic Petrology

3 credit hours

Prerequisite: GEOL 2302

This course introduces aspects of the description and interpretation of metamorphic rocks by citing the effects of the progressive metamorphism of mafic, pelitic and carbonate rocks. Other topics include the use of composition-assemblage diagrams, methods of quantitative geothermobarometry, and the interpretation of pressure-temperature-time trajectories for metamorphic rocks. Laboratory work involves the study of metamorphic rocks in hand sample and thin section. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 3323 Paleontology: History of Life

3 credit hours

Prerequisite: one of GEOL 1200, GEOL 1201, GEOL 1202, GEOL 1208, BIOL 1211 (formerly BIOL 1201), BIOL 1212 (formerly BIOL 1202)

An account of the 3800 million-year history of life on Earth, including theories of the origin of life, and modes of preservation of organisms as fossils, and the practical use of fossils for geological age, paleogeographic, and paleoenvironment determinations. The course covers the expression of biological evolution in the fossil record, and the major patterns and crises in the history of life, such as mass extinctions. Although the main focus is on the paleontology of invertebrate macrofossils, there will be some coverage of fossil plants, vertebrates, and microfossils. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 3326 Sedimentary Petrology and Stratigraphy

3 credit hours

Prerequisite: GEOL 2302 and GEOL 2325

Composition, provenance, and diagenesis of clastic sedimentary rocks, including conglomerates, sandstones and shales. Components and diagenesis of the main classes of non-clastic sedimentary rocks including carbonates, evaporites, siliceous and iron-rich sediments. Stratigraphy: correlation and the definition of stratigraphic units in outcrop and in the subsurface. Unconformities, sequences, sea-level change, and the interpretation of the stratigraphic record. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 3340 Principles of Hydrogeology ENVS 3340

3 credit hours

Prerequisite: GEOL 1200, and GEOL 1201

Students are introduced to the essential concepts of groundwater flow and wells. Topics include: flow through varying geologic material, water resources management, baseline groundwater quality, contamination of sub-surface environments, and an introduction to quantitative methods. Students will learn to recognize and interpret groundwater flow and chemical data, and have an opportunity to apply this knowledge via course work, laboratory exercises and field work. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 3386 Concepts in Geographic Information Systems (GIS)**Analysis GEOG 3386**

3 credit hours

Prerequisite: GEOG 2386 or GEOL 3305

Students focus on applied geospatial analyses using ArcGIS and associated extensions. Topics include spatial analysis and geostatistics, 3D surface modelling, visualization, network analysis, predictive modelling and multiple criteria evaluations. Examples are drawn from earth and environment science, geography, environmental studies, anthropology and business. Classes 3 hrs. and lab 3 hrs. per week.

GEOL 3410 Environmental Impact Assessment ENVS 3410

3 credit hours

Prerequisite: 45 credit hours, including one of ENVS 1203, 2200, 2300 or 2310

This course describes the legislative background and techniques for the prediction of impacts on biophysical and socio-economic environments. This course will cover screening, scoping, baseline studies, impact prediction, mitigation, monitoring and auditing. Classes 3 hrs. and lab 3 hrs.

GEOL 3413 Structural Geology

3 credit hours

Prerequisite: GEOL 1200 and 1201

Structures produced by deformation in the Earth's crust, including fabrics, folds, faults, and shear zones. Geometric, kinematic, and dynamic analysis of structures. Use of geometric and stereographic projection techniques in the interpretation of geological structures and geological maps. Introduction to stress and strain. Structures characteristic of selected tectonic environments, including rifts, thrust belts, and zones of strike-slip movement. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 3433 Fluvial Geomorphology GEOG 3433

3 credit hours

Prerequisite: GEOG 2313 [GEOL 2373] or GEOL 2325 [GEOG 2325]

Students examine processes and landforms associated with rivers. Topics include drainage basin controls, channel processes and morphology, erosional and depositional fluvial landforms, and evolution of fluvial landscapes. Classes 3 hrs. and lab 3 hrs. per week.

GEOL 3453 Principles of Geochemistry

3 credit hours

Prerequisite: GEOL 1200, GEOL 1201 and CHEM 1210

This course exposes students to the application of chemical thermodynamics in the prediction of geochemical processes in surficial, hydrothermal systems and igneous environments both on Earth and in the rest of the Solar system. Mineral formation and mineral stability are examined through the construction and use of phase and mineral stability diagrams for aqueous environments. The geochemical basis for the origins of life on Earth, the carbon cycle, stable and radiogenic isotopes, and the evolution of the most important reservoirs of Earth materials are evaluated through problem sets and laboratories. Classes 3 hrs. and lab 3 hrs. a week.

Note: To fulfill the CCPG requirements for professional geologists, this course may be used as either a geosciences course or as a second chemistry course.

GEOL 3454 Applied Geochemistry

3 credit hours

Prerequisite: GEOL 1200, GEOL 1201, GEOL 2301 and GEOL 2302 (the latter can be taken concurrently)

Students examine geochemical sampling, instrumental analytical methods, statistical evaluation of real geochemical data, and methods of reporting and quality control. Students are introduced to novel methods for describing the chemical composition of Earth materials (fluid and melt inclusion microanalysis, infrared spectroscopic mapping of hydrothermal alteration, reaction path modeling, forensic geochemistry). The application of graphical and numerical tools is studied through lab-, field and computer-based laboratories. Classes 3 hrs. and lab 3 hrs. a week.

Note: To fulfill the CCPG requirements for professional geologists, this course may be used as either a geosciences course or as a second chemistry course.

GEOL 3800- 3825 Special Topics in Geology

3 credit hours

Course content varies from year to year.

GEOL 3826-3849 Special Topics in Geology

3 credit hours

Course content varies from year to year.

GEOL 3876-99 Directed Study in Geology

3 credit hours

Course content varies from year to year.

GEOL 4301 Geological Mapping

3 credit hours

Prerequisite: GEOL 3300, and GEOL 3305

This course expands upon traditional mapping techniques that were briefly introduced in GEOL 3300 Field Methods by involving field traverses over larger mapping areas, and by introducing modern methods using mobile digital devices. Emphasis is primarily on field data collected during a 10-day field camp, and their integration into Geographic Information Systems to produce geological maps.

GEOL 4400 International Field Camp

3 credit hours

Prerequisite: GEOL 3300 and permission of the instructor

This course is offered on an irregular basis in the form of a Geology field trip abroad, allowing the students to be exposed to geological features that cannot be found in Canada. In practical terms, this course will acquaint the student with modern methods of structural, stratigraphic, petrologic and/or geophysical analysis. After mastering these skills, students will undertake an independent geological report project. Students may be required to travel at their own expense.

GEOL 4414 Tectonics

3 credit hours

Prerequisite: GEOL 1200, GEOL 1201, GEOL 3413 (the latter can be taken concurrently)

This course describes the major features of the Earth and its place in the solar system. It introduces the evidence for plate tectonics, the analysis of plate movements, and the characteristic rock associations formed in different tectonic environments. Aspects of global change will be considered, including the evolution of tectonic processes through geologic time, changes in the atmosphere and oceans, and the importance of meteorite impacts. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 4423 Advanced Palaeontology

3 credit hours

Prerequisite: GEOL 3323

This course focuses on more specialized areas of palaeontology and their application to geological questions. One portion of the course deals with paleobotany (fossil plants) and microfossils (palynology, conodonts, foraminifera). The remainder focuses on applications of palaeontology. Among the topics to be covered are biostratigraphic techniques in subsurface wells and outcrop, integration with radiometric and sequence stratigraphic techniques, fossil sampling and preparation, practical nomenclature and taxonomy, and the use of fossils for paleoenvironmental determination. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 4441 Mineral Resources

3 credit hours

Prerequisite: GEOL 1200, GEOL 1201, GEOL 2301 and GEOL 2302 (the latter can be taken concurrently)

A study of Earth's mineral resources, their classification, genesis and distribution in time and space. Important examples from Canada and abroad will be discussed. Topics will also include mineral exploration techniques, mining methods, metallurgical recovery, net smelter return, and ore reserve estimation/classification. Laboratories will examine a variety of base and precious metal ore deposit types in hand sample and thin section. Mining/exploration practice and resource exploitation are also examined in terms of their environmental impact. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 4442 Economic Geology Field School

3 credit hours

Prerequisite: GEOL 4441

Students discuss concepts of underground mining, mineral processing, mineral economics, environmental site assessment, and reclamation and remediation, in addition to links between geological resource assessment and mining and mineral processing methods in Canada's major mining districts. Practical sessions in lectures involve characterization of ore materials from an applied and environmental mineralogy perspective (applied ore microscopy, deleterious metal toxicity, process mineralogy). A 1-week intensive field excursion to major mining camps in northern Ontario (Sudbury, Timmins, Cobalt) provides students with an opportunity to study ore deposits, mineral processing technologies, and reclamation/remediation activities directly in districts hosting world-class precious and base metals operations. Classes: 2.5 hrs. in class/week. Lab: 55 hours of field-based instruction in Ontario (mandatory).

GEOL 4450 Advanced Igneous and Metamorphic Petrology

3 credit hours

Prerequisite: GEOL 3312 and 3313.

Students examine igneous and metamorphic petrogenesis relevant to the interpretation of complex geological settings. The relationship between magma type and tectonic setting, differentiation and distribution trends, trace element partitioning, crystallization systematics, metamorphic phase equilibria, reaction balancing methods; porphyroblast-matrix relations and; quantification of P-T-time trajectories are discussed. Laboratories focus on the acquisition/manipulation of analytical data from rocks, minerals and melt inclusions. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 4465 Advanced Sedimentology GEOG 4465

3 credit hours

Prerequisite: GEOL 2325 [GEOG 2325] and GEOL 3326.

This course examines current research on sedimentary rocks and basins and the methods used to understand them. Among the topics to be covered are modern carbonate and evaporite environments, exotic chemical sedimentary rocks and diagenetic cements, volcanogenic sedimentary rocks, sequence stratigraphy in carbonate and siliciclastic successions, applications of ichnology (trace fossils), the use of stable isotopes in the study of terrestrial carbonates, and the use of detrital minerals to interpret basin evolution. Classes 3 hrs. and lab 3 hrs. per week.

GEOL 4466 Petroleum Geology

3 credit hours

Prerequisite: GEOL 1200, 1201, 2305 and 2325 (the latter two can be taken concurrently).

The origin, migration and accumulation of oil and natural gas. Types of oil bearing structures and basic principles in oil exploration. Classes 3 hrs. and lab 3 hrs. a week.

GEOL 4467 Principles of Organic Geochemistry

3 credit hours

Prerequisite: GEOL 1200 or GEOL 1201, and at least 3 credit hours in CHEM

Students are provided with an in-depth look at Earth's carbon cycle. Students examine the production and preservation of organic matter from the most basic formation of carbon in the solar system to pathways of lipid biosynthesis; its assimilation into sedimentary organic matter; and its ultimate fate to become methane, carbon dioxide, and graphite.

GEOL 4475 Glaciers and Glaciation GEOG 4423

3 credit hours

Prerequisite: GEOG 2313 [GEOL 2373] or GEOL 2325 [GEOG 2325]

Glaciers have profound effects on landscapes and are an important component of global physical systems. Glaciology, causes and records of fluctuations in glacial coverage, glacial processes, glacial landforms, and the legacy of past glacial activity on earth will be examined. Broader impacts of glacial activity and changes on humans and the environment will also be investigated. Classes 3 hrs. and lab 3 hrs. per week.

GEOL 4476 Coastal Geomorphology GEOG 4413

3 credit hours

Prerequisite: GEOG 2313 [GEOL 2373] or GEOL 2325 [GEOG 2325]

Students examine both the physical processes that operate in the coastal zone, at a range of spatial and temporal scales, and the resulting landforms. The actions of waves, tides, currents, wind, sea level changes, biota, and humans are examined through the lens of geomorphodynamics and process response models in sandy, cohesive, estuarine, rocky, tropical and permafrost coastal systems. Classes 3 hrs. and lab 3 hrs. per week.

GEOL 4496 Applications in Geographic Information Systems GEOG 4496

3 credit hours

Prerequisite: GEOG 3356 or GEOG 3386 [GEOL 3386]

Students further develop their understanding of geomatics and its applications. Students focus on the use of either geographic information systems (GIS) or remote sensing to address practical problems in areas such as resource management, marketing, regional planning, natural hazards and geomorphology. Students undertake a major research project using various GIS analytical functions, and develop skills relating to data creation, manipulation, quality assessment and presentation. Classes 3 hrs. and lab 3 hrs. per week.

GEOL 4550 Honours Project GEOL

6 credit hours

Prerequisite: Honours standing and permission of Department.

Research project carried out under the supervision of one member of the Department or jointly by more than one faculty member. Originality of the research project is emphasized.

GEOL 4650 Research Methods in Geology

3 credit hours

Prerequisite: Students must have Honours standing. This course is offered to Honours students in Geology who are simultaneously enrolled in GEOL 4550.

Students develop skills for solving problems in quantitative research in Geosciences. Topics include developing and formulating research hypotheses, ethics and bias in research, the application of graphical and numerical tools (including standardized geological software packages), and technical writing and oral/poster presentation. Students present at Departmental Seminars.

GEOL 4800 – 4825 Special Topics in Geology

3 credit hours

Prerequisite: restricted to Year 4 students in the Honours program or permission of Department.

Readings and discussions of current literature in geology on selected topics. Such topics as plate tectonics, geochemistry, statistics in geology, isotope geochemistry, petrogenesis, ore genesis, may be included. Classes 72 hrs. per semester; classes and labs.

GEOL 4826 – 4849 Special Topics in Geology

3 credit hours

Prerequisite: restricted to Year 4 students in the Honours program or permission of Department.

Readings and discussions of current literature in geology on selected topics. Such topics as plate tectonics, geochemistry, statistics in geology, isotope geochemistry, petrogenesis, ore genesis, may be included. Classes 72 hrs. per semester; classes and labs.

GEOL 4876 – 4899 Directed Study in Geology

3 credit hours

Prerequisite: restricted to Year 4 students in the Honours program or permission of Department.

Intended to supplement or provide an alternative to the regular geology courses in order to meet the special needs and interests of students. The course provides an opportunity to study a particular subject in detail and requires from the student some measure of independence and initiative. Classes 72 hrs. per semester; classes and labs