GEOLOGICAL SCIENCES AND GEOLOGICAL ENGINEERING

Departmental Notes

Subject Code for Geological Sciences: **GEOL**
World Wide Web Address: http://www.queensu.ca/geol/

Head of Department: Vicki Remenda (geolhead@queensu.ca)

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Chair of Undergraduate Studies Geological Sciences: Daniel Layton-Matthews (dlayton@queensu.ca)
Chair of Undergraduate Studies Geological Engineering: Bas Vriens (bas.vriens@queensu.ca)

Overview

Geoscientists are the interpreters of our natural world. They bring methods such as geophysics, geochemistry, geobiology, and field geology together to understand the modern and ancient Earth. Clues concealed in rocks and fossils, minerals and fluids, mountains and sediments, glaciers and volcanoes are marshaled to understand and explain the Earth system at all scales. Managing water, mineral, and energy resources, developing sustainable strategies for industrial growth, and coping with natural and anthropogenic hazards facing increasing global populations, including climate change, all depend on a deep understanding of natural processes. Our graduates study the Earth in this context, with careers in diverse fields including, but not limited to, research, mineral and oil exploration, policy analysis, environmental science, and resource management. The programs offered by this Department focus on the whole planet and global processes as a dynamic and integrated system.

Departmental Policies

Field Trips

Field trips are a necessary part of geological training and are offered in each year of study because the Department wishes to provide the best education possible.

Students are required to possess basic safety equipment such as a hard hat, safety glasses, reflective vest, and appropriate footwear, as specified for each course, and to have reviewed and signed the Departmental Field Safety Form and the OCASP form developed for each field trip or course. Field equipment is available for sale in the Main Office.

The cost of field trips and courses, including transportation, accommodation, and food (when it is supplied), will be borne by the student.

A list of the field education costs for each course (https://www.queensu.ca/geol/undergrad/field-trips/fees-and-equipment/) is provided on the departmental web page. These costs are subject to change, and will be finalized by June 1 each year for the following academic year. These costs will be payable by the due dates listed in the table. Subsidies will be provided by the Department when funding permits.

For students who are not registered in a Plan offered by the Department there will be a charge per field trip. Students are required to possess basic safety equipment such as a hard hat, safety glasses, and appropriate footwear, and to have reviewed and signed the Departmental Field Safety Form and the OCASP form developed for each field trip or course.

Advice to Students

*Students should seek **academic advice** from one of the program consultants listed below*

Departmental Program	Consultant	Contact
Environmental Geology	Heather Jamieson	jamieson@queensu.ca
Structural Geology/ Tectonics/Economic Geology	Christopher Spencer	c.spencer@queensu.ca
Paleontology/ Sedimentary Geology	Guy M. Narbonne	narbonne@queensu.ca
Petrology/ Geochemistry	Gema R. Olivo	olivo@queensu.ca

Geology Plans are offered as components of a degree Program within both the Faculty of Arts and Science (p. 1) and the Faculty of Engineering and Applied Science (https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/geological-engineering/). Students applying to first year, with an interest in geology, should consult both *Calendars*. Within Arts and Science, a great deal of flexibility exists in the choice of Plans.

Students wishing to complete a Plan designed to train specialists in the Geological Sciences are encouraged to select one of the Geology Specialization (https://

queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-specialization-science-bs-honours/) or Major Plans (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-major-science-bs-honours/). The Geology Specialization Plan (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-specialization-science-bs-honours/) provides the opportunity for intensive study of Geology and the supporting sciences. It is intended to fulfill the 'Knowledge Requirements' for registration as a Professional Geoscientist. The Geology Major Plan (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-major-science-bs-honours/) is ideal for students who are interested in a career-oriented program in the geosciences that also allows a wider choice of supporting and elective courses. Another alternative route, for students who are particularly interested in the solid-earth aspects of environmental science, is the Environmental Geology Plan (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/environmental-geology-specialization-science-bs-honours/).

Students wishing to study geology and another subject should consider geology as one component of a Major-Minor degree combination. The Minor (Science) (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-minor-science/) may be combined with a Major in virtually any other subject, and provides a solid introduction to the Geological Sciences. As the General (Science) (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-general-science-bs/), this same Plan when taken alone leads to a 3-year B.Sc. degree in Geology. Students who want to explore the field of Geological Sciences but with greater flexibility in choice of courses should consider combining the Geology Minor (Arts) Plan (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-minor-arts/) in a Major-Minor degree combination. The General (Arts) in Geology (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-general-arts-ba/), leading to a 3-year B.A. degree, is also available using the same suite of courses as the Minor (Arts) (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-minor-arts/).

If you have questions about the differences between the various programs, or on particular course selections, consult with the Chair of Undergraduate Studies before registration. Additional information about the various degree programs can be found by consulting the Geoscience Program webpage (https://www.queensu.ca/geol/undergrad/geological-sciences/).

Special Study Opportunities

Specialized graduate courses in some areas of Geology are available to qualified students in their final year, and may be counted for advanced standing in a Master's degree at Queen' University. For details, consult the Chair of Undergraduate Studies.

Faculty

- Alexander Braun (https://can01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fsea-level.org%2F&data=02%7C01%7Cdumondl%40queensu.ca%7C6f0765e6815c42bd07a308d8234ccad3%7Cd61ecb3b38b142d5%7C1%7C0%7C637298160011050195&sdata=PZaExFZ0GKz31%2FryIm4HjcApNN%2BJjMLUzInbB%2BdQ%3D&reserved=0)
- Jennifer Day (https://www.queensu.ca/geol/jennifer-day/)
- Mark Diederichs (https://www.queensu.ca/geol/diederichs/)
- Georgia Fotopoulos (https://www.queensu.ca/geol/fotopoulos/)
- Hom Nath Gharti (https://www.queensu.ca/geol/hom-nath-gharti/)
- Laurent Godin (https://www.queensu.ca/geol/godin/)
- Rob Harrap (https://www.queensu.ca/geol/harrap/)
- Jean Hutchinso (https://www.queensu.ca/geol/hutchinson/)n
- Heather Jamieson (https://www.queensu.ca/geol/jamieson/)
- Daniel Layton-Matthews (https://www.queensu.ca/geol/layton-matthews/)
- Matthew Leybourne (https://www.queensu.ca/geol/people/faculty/)
- Guy Narbonne (https://www.queensu.ca/geol/narbonne/)
- Gema Olivo (https://www.queensu.ca/geol/olivo/)
- Peir Pufahl (https://www.queensu.ca/geol/peir-pufahl/)
- Vicki Remenda (http://www.universityresearch.ca/researchers/find-researchers/dr-victoria-remenda/)
- Christopher Spencer (https://www.queensu.ca/geol/christopher-spencer/)

- Elisabeth Steel (https://www.queensu.ca/geol/elisabeth-steel/)
- Bas Vriens (https://www.queensu.ca/geol/basvriens/)

Specializations

- Environmental Geology – Specialization (Science) – Bachelor of Science (Honours) (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/environmental-geology-specialization-science-bs-honours/)
- Geology – Specialization (Science) – Bachelor of Science (Honours) (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-specialization-science-bs-honours/)

Major

- Geology – Major (Science) – Bachelor of Science (Honours) (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-major-science-bs-honours/)

Generals/Minors

- Geology – General (Arts) – Bachelor of Arts (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-general-arts-ba/)
- Geology – General (Science) – Bachelor of Science (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-general-science-bs/)
- Geology – Minor (Arts) (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-minor-arts/)
- Geology – Minor (Science) (https://queensu-ca-public.courseleaf.com/arts-science/schools-departments-programs/geological-sciences-engineering/geology-minor-science/)

Courses

GEOL 102 Gemstones: Their Art, History and Science Units: 3.00
Gemstones have played an important role in society throughout history. The role of gemstones and other precious materials will be illustrated through the study of works of art and popular literature. The physical properties that make gems attractive are explained. Gemstone marketing and ethical considerations of mining methods will be explored.
LEARNING HOURS 120 (24L;12T;36O;48P).
Requirements: Prerequisite None.
Offering Faculty: Faculty of Arts and Science

GEOL 104 The Dynamic Earth Units: 3.00
Introduction to the internal structure of the Earth and the processes that have shaped its surface. Global tectonics and continental movement, rock genesis, mountain building, glaciations and geological time. Laboratories include rock and mineral identification, and problem solving in historical geology, earthquakes, groundwater flow and coastal erosion.
NOTE Also offered at the Bader International Studies Centre, Herstmonceux. Learning Hours may vary.
LEARNING HOURS 108 (36L;12Lb;60P).
Requirements: Prerequisite None.
Course Equivalencies: GEOL 104/105 / APSC 151
Offering Faculty: Faculty of Arts and Science

GEOL 106 Environmental Geology and Natural Hazards Units: 3.00
The relationship between human-kind and our ever-changing planet, with a focus on natural geologic hazards (volcanic eruptions, earthquakes, landslides, tsunamis, mass movement, floods, extraterrestrial impacts, etc.), and environmental impacts which result from population and land-use expansion and our increased use of water, energy and mineral resources. A study of the sources and impact of pollution and global climate change. Public perception of and response to geological risk.
NOTE Also offered at the Bader International Studies Centre, Herstmonceux. Learning Hours may vary.
LEARNING HOURS 120 (36L;12O;72P).
Requirements: Prerequisite None.
Offering Faculty: Faculty of Arts and Science

GEOL 107 History of Life Units: 3.00
The history of life, from its inception four billion years ago to the present day, focusing on the inter-relationship between organic evolution and global change. Coevolution of early life and the atmosphere; development of marine animals and their ecosystems; invasion of the land; dinosaurs and their world; mass extinctions; the Age of Mammals; and hominid evolution. Lectures plus three three-hour laboratories.
LEARNING HOURS 120 (36L;12Lb;12O;60P).
Requirements: Prerequisite None.
Offering Faculty: Faculty of Arts and Science

GEOL 200 Oceanography Units: 3.00
Introduction to marine science. Topics include: ocean basins and their sediments; seawater chemistry/biochemistry; ocean waves, tides and currents; ocean-atmosphere interaction; polar to tropical organism communities; marine resources; environmental concerns; global change.
LEARNING HOURS 114 (36L;12Pc;12O;48P).
Requirements: Prerequisite BIOL 102 or BIOL 103 or CHEM 112 or GEOL 104 or GEOL 106 or GEOL 107 or PHYS 104 or PHYS 106 or PHYS 107 or PHYS 117.
Offering Faculty: Faculty of Arts and Science

GEOL 211 Geological Engr Field Methods Units: 4.50
A field-based course stressing methods used in geological engineering site investigation. Includes field characterization of engineering properties and behaviour of earth materials and their structures. Student teams conduct eight site investigations that address geological engineering problems. Two of these involve the design of an infrastructure improvement project, with geological considerations. Results are presented in weekly engineering reports illustrated with maps and sections. (0/14/0/26/14)
Requirements: Must be registered in BASC
Offering Faculty: Faculty of Arts and Science

GEOL 212 Introduction to Mineralogy Units: 3.00
An introduction to the crystallography and crystal chemistry of rock-forming minerals for students not in the Geological Sciences. The structural, chemical and genetic aspects of the crystalline state as displayed by minerals are considered.
Requirements: Prerequisite GEOL 104 or permission of the Department. Exclusion GEOL 232. Recommended 4U Chemistry is required.
Offering Faculty: Faculty of Arts and Science

GEOL 221 Geological Field Methods Units: 3.00
The field study of surficial deposits, rock types, and geological processes, based on the geology of the Kingston area. Descriptions, samples and measurements acquired on several field trips will be analyzed, and the results recorded in maps, sections, and reports throughout the course.
NOTE Transportation for multiple half-day Field Trips: estimated cost $75.
NOTE Full Field Kit (or when multiple items are purchased individually): estimated cost $259.
NOTE Department may require GEOL 104 and GEOL 221 be taken concurrently.
LEARNING HOURS 120 (24L;48Lb;12T;4Oc;24P).
Requirements: Prerequisite GEOL 104 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 232 Mineralogy Units: 3.00
Characterization of rock- and soil-forming silicate and non-silicate minerals (their crystallography, optical and physical behaviour, and crystal chemistry). The structural, chemical and genetic aspects of the crystalline state as displayed by minerals are considered. Implications of mineral properties for the engineering behaviour of soils and rocks, and for human needs, are discussed.
LEARNING HOURS 120 (36L;36Lb;48P).
Requirements: Prerequisite GEOL 104 or permission of the Department. Exclusion GEOL 212. Recommended 4U Chemistry is required.
Offering Faculty: Faculty of Arts and Science

GEOL 235 Igneous and Metamorphic Petrology Units: 3.00
Introduction to the genesis and characterization of igneous and metamorphic rocks. Students will acquire skills to classify rocks and the theoretical background to place these rocks in the context of where, why, and how they form with implications for resource exploration and utilization. Macroscopic and microscopic properties will be studied.
Requirements: Prerequisite GEOL 232.
Offering Faculty: Faculty of Arts and Science

GEOL 238 Surficial Processes, Sedimentation and Stratigraphy Units: 3.00
An examination of the genetic link between surficial geological processes and the sedimentary record produced by these processes. Students obtain an integrated overview of the nature and operation of the Earth-surface environment. Topics include origin of sedimentary rocks and their sedimentary structures, depositional environments and stratigraphic successions; stratigraphic principles and their application to sedimentary basins, with implications for hydrocarbon genesis; interaction of natural processes with human society.
LEARNING HOURS 130 (36L;22Lb;72P).
Requirements: Prerequisite GEOL 104 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 249 Geophysical Characterization of the Earth Units: 3.00
The application of physical principles to examine and characterize the Earth at all scales. The Earth's physical properties and dynamic processes will be assessed and evaluated by integrating such topics as gravity, seismology, magnetism, geochronology, and heat flow, as related to scientific and engineering problems.
LEARNING HOURS 117 (36L;48Pc;7G;24P).
Requirements: Prerequisite GEOL 104 or permission of the Department. Corequisite (MATH 120 or MATH 121 or [MATH 123 and MATH 124]) and (PHYS 104 or PHYS 106 or PHYS 107 or PHYS 117 or PHYS 118) or permission of the Department. Exclusion GEOL 269.
Offering Faculty: Faculty of Arts and Science

GEOL 262 Geological Aspects of Mineral Deposits Units: 3.00
The basic mineralogy and petrology of mineral deposits are examined. The formation and classification of mineral deposits, considering such aspects as tectonic setting, age, rock composition, geometry, and mineralogy are investigated. Emphasis is placed on the processes by which mineral deposits are formed and transformed, and their influence on mining and production. Laboratory work integrates geological information from the scale of hand samples to regional maps as tools to assist with mine design, estimation of ore grade and evaluation of issues related to ore processing.
LEARNING HOURS 114 (36L;18Lb;60P).
Requirements: Prerequisite GEOL 104. One-Way Exclusion May not be taken with or after GEOL 232; GEOL 362.
Offering Faculty: Faculty of Arts and Science

GEOL 269 Physics of the Earth Units: 3.00
An examination of the physical principles and properties exhibited by the Earth which can be used to understand its origin, structure, dynamic processes, and evolution through time. Topics such as gravity, seismology, magnetism, geochronology, and heat flow are discussed in conjunction with the unifying theory of plate tectonics.
LEARNING HOURS 117 (36L;8T;42Pc;7G;24P).
Requirements: Prerequisite GEOL 104 or permission of the Department. Corequisite (MATH 120 or MATH 121 or [MATH 123 and MATH 124]) or permission of the Department. Exclusion GEOL 249. Recommended 4U Physics is required.
Offering Faculty: Faculty of Arts and Science

GEOL 281 Earth Systems Eng I Units: 4.00
Introduction to all of the integrated fields of Geological Engineering and the essence of engineering design in an earth-systems context. The focus is on geological engineering properties and processes, complementing the resource focus of Earth Systems Engineering II in the winter term. Projects involve engineering design problems with a particular focus on dealing with scale dependency, sampling confidence, natural variability and risk-assessment related to the quantification of engineering properties for geomaterials. Introductory geotechnical engineering, applied geophysics, and engineering hydrogeology methodology with emphasis on site investigation and design related to mining, tunnelling, infrastructure development, natural-hazard mitigation and environmental remediation and management. (0/0/0/32/16)
Requirements: Must be registered in BASC
Offering Faculty: Faculty of Arts and Science

GEOL 282 Managing Earth Systems: Resources and Environment Units: 3.00
An earth-system engineering perspective on the nature, acquisition and utilization of energy, mineral and water resources, with particular emphasis on the environmental considerations in their extraction, processing, and use. Criteria for designing resource exploration programs are examined. Practical exercises, projects and seminars (team and individual) deal with these issues, and include the design of risk-management plans, environmental life-cycle assessments, sustainable systems and ore-reserve estimations.
Requirements: Prerequisite GEOL 221 or GEOL 232 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 290 Worldbuilding Units: 3.00
A blended in-person and online lecture and design studio course on the design of worlds for fiction, art, game-design, communications, and more. Lectures and guest-lectures emphasize the requisite science , humanities, and social sciences to constrain a collaborative worldbuilding exercise delivering a partially realized world.
LEARNING HOURS 122 (24L;18S;8T;72P).
Requirements: Prerequisite Level 2 or above.
Offering Term: F
Offering Faculty: Fac of Engineering Appl Sci

GEOL 291 Technical Communication I Units: 0.00
This course provides instruction and practice in effective technical writing and oral presentation. The topics include amongst other things task definition, document structure and outlining. Many of the exercises will be linked to required oral and written communication tasks in other core courses. Open to Geological Engineering students only. (0/0/12/0/0)~ COURSE DELETED IN 2009/10) ~
Requirements: GEOL281
Offering Faculty: Faculty of Arts and Science

GEOL 292 Technical Communication II Units: 0.00
This course provides advanced instruction and practice in effective technical writing and oral presentation. Most exercises will be linked to required oral and written communication tasks in other courses. Open to Geological Engineering students only. (0/0/12/0/0)~ COURSE DELETED IN 2009/10 ~
Requirements: GEOL291
Offering Faculty: Faculty of Arts and Science

GEOL 300 Geological Field School Units: 3.00
An intensive one-week course taken immediately before the beginning of third year. Teams of students design and implement a geological field investigation program to produce and interpret geological field maps.
NOTE Multiday Field/Camping Trip (Kaladar, Ontario): estimated cost $450.
LEARNING HOURS 120 (120Oc).
Requirements: Prerequisite (GEOL 221 and GEOL 235) or permission of the Department. Note Visit the Department of Geological Science and Geological Engineering website for more information about this course.
Offering Faculty: Faculty of Arts and Science

GEOL 301 Field Studies in Geology I Units: 1.50
A multi-day field trip that uses stratigraphic, sedimentological, and paleontological data to interpret rock successions in a paleoenvironmental and tectonic context. Enrolment is limited.
NOTE Multiday Field Trip: estimated cost $500.
LEARNING HOURS 61 (1L;30Pc;15G;15P).
Requirements: Prerequisite GEOL 238. Corequisite (GEOL 321 or GEOL 337 or GEOL 368). Exclusion GEOL 302; GEOL 368 (prior to 2013); GEOL 478 (prior to 2013); GEOL 488 (prior to 2013). Note Visit the Department of Geological Science and Geological Engineering website for more information about this course.
Offering Faculty: Faculty of Arts and Science

GEOL 302 Problems in Sedimentary Geology Units: 1.50
An independent study of the general links between tectonics and the nature of the sedimentary record in a variety of carbonate and siliciclastic depositional environments.
NOTE This course is intended to provide an option for students in lieu of GEOL 301.
LEARNING HOURS 60 (10I;50P).
Requirements: Prerequisite GEOL 238. Corequisite ([GEOL 321 or GEOL 337 or GEOL 368] and permission of the Department). Exclusion GEOL 301; GEOL 368 (prior to 2013); GEOL 478 (prior to 2013); GEOL 488 (prior to 2013).
Offering Faculty: Faculty of Arts and Science

GEOL 310 Geological Engr Field School Units: 5.00
An intensive two-week course taken immediately after final examinations in second year. Teams of students apply geological field methods and geological engineering assessment techniques learned during second year, as the basis for an engineering assessment of overburden and bedrock for a suite of specific engineering design outcomes. These outcomes include mineral resource evaluation, mine design, geotechnical stability and environmental baseline assessment related to future engineering works. In addition the students are expected to optimize the design of their own site investigation program to maximize the practical value of information obtained. A final site investigation and engineering report, including design solutions for the aforementioned problems, is presented and defended. Field safety regulations and safe practice are emphasized. (0/0/0/15/45)
Requirements: GEOL221 OR (GEOL211 AND GEOL235)
Offering Faculty: Faculty of Arts and Science

GEOL 319 Applied Geophysics Units: 3.00
Geophysical methods (gravity, magnetic, electrical, and seismic) applied to engineering problems, including resource exploration and site investigation. Design of field programs considering physical principles, instrumentation, limitations, field procedures and data interpretation. Laboratory projects with geophysical equipment are undertaken.
LEARNING HOURS 121 (21L;18Lb;22T;12Oc;48P).
Requirements: Prerequisite GEOL 249 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 321 Analysis of Rock Structures Units: 3.00
The nature, origin, and interpretation of deformation and fracture of rocks, and the application of structural methods to site-investigation and resource exploitation. Topics include geometric, kinematic and dynamic analysis of brittle and ductile deformation features; and examination of deformation styles in selected tectonic environments.
NOTE Two single day Field Trips (Kaladar, Ontario): estimated cost $35.
LEARNING HOURS 122 (36L;18Lb;8Oc;60P).
Requirements: Prerequisite GEOL 221. Corequisite (GEOL 300 or permission from the Department).
Offering Faculty: Faculty of Arts and Science

GEOL 333 Terrain Evaluation Units: 3.00
An introduction to the principles of geomorphology relevant to Geological Sciences and Geological Engineering. Identification and evaluation of terrain features using analog and digital imagery via traditional and digital (GIS) methods. Digital terrain model acquisition and analysis. Introduction to digital terrain analysis.
LEARNING HOURS 124 (36L;33Lb;55Pc).
Requirements: Prerequisite GEOL 104 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 337 Paleontology Units: 3.00
Review of the major groups of invertebrate fossils, emphasizing functional morphology, paleoecology, evolution, and geological significance.
NOTE Field Trip (Prince Edward County, Ontario): estimated cost $35.
LEARNING HOURS 129 (36L;24Lb;6Pc;9Oc;54P).
Requirements: Prerequisite GEOL 238 or BIOL 202 or BIOL 200 or permission of the Department. Note Visit the Department of Geological Science and Geological Engineering website for more information about this course.
Offering Faculty: Faculty of Arts and Science

GEOL 340 Problems In Engr. Geology Units: 3.00
Each student investigates a problem in geological engineering that is not covered in any of the available courses, and submits a written report on the topic. This course is open to students only if a suitable faculty member is available. (0/36/0/0/0)
Requirements: Must be registered in BASC
Offering Faculty: Faculty of Arts and Science

GEOL 341 Problems in Geology Units: 3.00
A problem-oriented course involving a substantial amount of self-directed learning about a topic of the student's choosing, culminating in the submission of a written report. This course is open to students only if a suitable faculty member is available.
LEARNING HOURS 120 (6I;114P).
Requirements: Prerequisite (Level 3 or above and registration in a GEOL Major or Specialization Plan) or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 342 Special Topics in Geology Units: 3.00
Courses offered by visiting faculty on Geological Sciences topics related to their research interests. Consult the departmental homepage for further details of specific course offerings each academic year.
LEARNING HOURS 120 (36L;84P)
Requirements: Prerequisite (Level 3 or above and registration in a GEOL Major or Specialization Plan) or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 343 Hydrogeology Units: 3.00
Development of the equations governing flow and transport; sensitivity to sub-surface complexities. Field instrumentation, installation and sampling protocols, elements of groundwater investigation. Assessment of measurement techniques and interpretation of fundamental hydrogeological properties. Groundwater occurrence, flow system analysis, with a focus on designing extraction scheme.
NOTE One field trip with a transportation fee. Estimated $35.
Requirements: Prerequisite (GEOL 238 and CHEM 112) or permission of the Department. Note Visit the Department of Geological Science and Geological Engineering website for more information about this course.
Offering Faculty: Faculty of Arts and Science

GEOL 352 Topics in Mineralogy Units: 3.00
Through lectures, seminars and assigned readings selected topics in mineralogy are explored. Emphasis on the current literature and the details of mineralogical phenomena will lead to better understanding of petrologic systems.
NOTE This course may not be offered every year. Please see Departmental website.
LEARNING HOURS 120 (24L;36Lb;60P).
Requirements: Prerequisite GEOL 212 or GEOL 232.
Offering Faculty: Faculty of Arts and Science

GEOL 359 Applications of Quantitative Analysis in Geological Sciences Units: 3.00
The theory and use of numerical computational procedures to solve geo-engineering and geoscience problems. The utility, significance and widespread applicability of analytical and numerical techniques will be illustrated in the evaluation and solution of practical problems.
LEARNING HOURS 128 (36L;22T;6I;16Oc;48P).
Requirements: Prerequisite GEOL 249 and (MATH 225 or MATH 232). Corequisite STAT 263. Exclusion GEOL 349.
Offering Faculty: Faculty of Arts and Science

GEOL 362 Petrology Applied to Ore Deposit Units: 3.00
Characterization of major ore deposit types using mineralogical, petrological, geochemical, and geophysical attributes. Design and evaluation of ore deposit models and exploration programs, including ore processing and environmental issues. Laboratory work integrates techniques to evaluate paragenetic sequences, ore grades, and engineering issues.
LEARNING HOURS 121 (33L;33Lb;55P).
Requirements: Prerequisite GEOL 235 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 365 Geochemical Characterization of Earth Processes Units: 3.00
The application of thermodynamics and kinetics to the understanding of natural processes in the Earth Sciences. Distribution of the elements, and practical uses of isotopes and elemental tracers. Geochemical actions and transactions within, and among, the lithosphere, hydrosphere, atmosphere and biosphere, including the impact of human evolution and environmental geochemistry. Practical application of geochemistry to solving problems in natural systems will be emphasized. A practical involving problems, laboratory experience and field experience will be part of the course.
Requirements: Prerequisite (CHEM 112 and GEOL 232 and GEOL 235) or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 368 Carbonate Sedimentology Units: 3.00
The origin, composition and diagenesis of carbonate rocks. Study of modern carbonate sediments and depositional environments; development of facies models; petrographic and geochemical analysis of limestones and dolostones.
NOTE Field Trip: estimated $35.
LEARNING HOURS 121 (33L;18Lb;70P).
Requirements: Prerequisite GEOL 238 or permission of the Department. Corequisite GEOL 301. Note Visit the Department of Geological Science and Geological Engineering website for more information about this course.
Offering Faculty: Faculty of Arts and Science

GEOL 390 Technical Communications II Units: 1.00
Offering Term: W
Offering Faculty: Fac of Engineering Appl Sci

GEOL 395 Geological Practicum Units: 3.00
Students working for a company or government in geology or environmental geology can apply for a practicum credit. Requirements: minimum 12 weeks of continuous employment, securing a faculty member as an advisor and evaluator, agreement with employer prior to commencement of work, and submission of a final report.
LEARNING HOURS 120 (120Pc).
Requirements: Prerequisite GEOL 104 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 400 Advanced Geological Sciences Field School Units: 3.00
Intense one-week field course taken after third year. Field assignments of geological interest, local and regional geology and tectonic evolution of the area visited. Daily assignments when in the field on a diversity of geological problems.
NOTE Extra fees will apply to cover the cost of accommodation, travel and food. Will occur in the Fall, Winter or Summer.
LEARNING HOURS 120 (4.5L;4.5S;15G;90Oc;6P).
Requirements: Prerequisite (GEOL 300 and GEOL 321 and GEOL 365) or permission of the Department. Note Visit the Department of Geological Science and Geological Engineering website for more information about this course.
Offering Faculty: Faculty of Arts and Science

GEOL 401 Field Studies in Geology II Units: 1.50
A multi-day field trip that uses stratigraphic, sedimentological, paleontological, and structural data to interpret shall-and-deep-marine rock successions in paleoenvironmental and tectonic context. Enrollment is limited. Course runs during the week of Canadian Thanksgiving.
NOTE Multiday Field Trip (Quebec City, Quebec): estimated cost $500.
LEARNING HOURS 61 (1L;30Pc;15G;15P).
Requirements: Prerequisite (A minimum GPA of 2.90 in GEOL 221; GEOL 238; GEOL 321) or permission of the Department. Corequisite GEOL 488. Exclusion GEOL 402. Note Visit the Department of Geological Science and Geological Engineering website for more information about this course.
Offering Faculty: Faculty of Arts and Science

GEOL 402 Problems in North American Geology Units: 1.50
The self-directed detailed study of some aspect of the geological evolution of eastern North America. The topic will complement the knowledge gained in GEOL 488.
NOTE This course is intended to provide an option for students in lieu of GEOL 401.
LEARNING HOURS 60 (10I;50P).
Requirements: Prerequisite (A minimum GPA of 2.90 or a 'PASS' (obtained in Winter 2020) in GEOL 221; GEOL 238; GEOL 321) or permission of the Department. Corequisite (GEOL 488 and permission of the Department). Exclusion GEOL 401; GEOL 368 (prior to 2013); GEOL 488 (prior to 2013).
Offering Faculty: Faculty of Arts and Science

GEOL 403 Geotech & Geoenv Field Sch Units: 3.00
Taylor's theorem, optimization, implicit and inverse function theorems. Elementary topology of Euclidean spaces. Sequences and series of numbers and functions. Pointwise and uniform convergence. Power series. (36/6/0/0/0)
Requirements: (GEOL281 AND GEOL310)
Offering Faculty: Faculty of Arts and Science

GEOL 413 Eng Geomechanics & Rock Eng De Units: 4.00
Rigorous application of geomechanics and rock engineering principles to open-ended design problems related to surface and underground excavation, construction and geo-hazard mitigation. Presentation and discussion of design methodologies and case histories are followed up by related analysis and design problems incorporating industry standard software. Emphasis on the inherent variability of geomaterials and implications for integrated site-investigation planning, quantitative risk assessment, design decision-making and performance-monitoring. A field excursion will be included. (0/0/0/12/36)
Requirements: (GEOL281 AND GEOL310) OR (GEOL281 AND MINE325) OR (GEOL281 AND GEOL310) OR (GEOL281 AND GEOL321) OR (GEOL281 AND GEOL310)
Offering Faculty: Faculty of Arts and Science

GEOL 418 Petroleum Geology Units: 3.00
The origin, migration and accumulation of petroleum resources, emphasizing typical reservoir styles, potential reservoir lithologies, methods of exploration and basic concepts of formation evaluation. Concepts and applications equip students with the basic principles necessary to undertake petroleum industry exploration and production. Laboratory exercises include a major exploration problem and presentation. Offered in 2009-2010 and in alternate years thereafter.
NOTE This course may not be offered every year. Please see Departmental website.
LEARNING HOURS 129 (36L;33Lb;60P).
Requirements: Prerequisite GEOL 238 or permission of the Department. Corequisite GEOL 321.
Offering Faculty: Faculty of Arts and Science

GEOL 419 Geophysics Field School Units: 3.00
This 12-day, intensive field course focuses on field and laboratory techniques using a wide array of geophysical site investigation and exploration methods. Review lectures on instrument theory and principles of exploration program design. The course culminates in an exercise to design and implement an integrated geophysical site investigation.
NOTE Please contact the Department for more information. Estimated cost $800.
LEARNING HOURS 120 (8L;12G;60Pc;40P).
Requirements: Prerequisite GEOL 319 or permission of the Department. Note Visit the Department of Geological Science and Geological Engineering website for more information about this course.
Offering Faculty: Faculty of Arts and Science

GEOL 438 Topics in Sedimentary and Petroleum Geology Units: 3.00
A course on a topic in the field of sedimentary geology, sedimentary geochemistry, basin analysis and/or petroleum geology.
NOTE Consult the Chair of Undergraduate Studies for details of specific course offerings each academic year.
Requirements: Pre Lvl 3 in GEOL Maj/med or s
Offering Faculty: Faculty of Arts and Science

GEOL 439 Advanced Applied Geophysics Units: 3.00
Advanced theory and techniques for acquisition, processing and interpretation of geophysical data. Solve a problem from idea, strategy, data acquisition, processing, to interpretation and deliverables. Design projects exploit seismic, gravity, magnetic, EM methods, in oil/gas/mineral exploration, near-surface prospecting and site investigation.
LEARNING HOURS 128 (21L;24G;35I;24Oc;24P).
Requirements: Prerequisite (GEOL 249 and GEOL 319) or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 442 Geological Engineering Thesis Units: 3.00
Requirements: GEOL442 excludes GEOL443
Offering Faculty: Faculty of Arts and Science

GEOL 445 Site Invest. & Case Histories Units: 3.50
The course provides an overview of current geological engineering problems and innovative solutions, and relies on guest speakers, most of whom are practicing professional engineers. Topics such as professional practice and liability, engineering ethics, provincial and national environmental legislation, and the Occupational Health and Safety Act are presented and discussed. Guest lecture topics may include: buying and selling professional services, water supply management, contaminant abatement and/or remediation, management of engineering construction. Starting in Fall 2009, a one-day field exercise in engineering surveying methods will be held early in the term. (0/0/7/5/30)
Requirements: Must be registered in BASC
Offering Faculty: Faculty of Arts and Science

GEOL 446 Engineering Design Project I Units: 3.00
Student teams research, prepare a design work plan and carry out a "Phase I" engineering investigation for a major, open-ended geological engineering project, in consultation with a Management Board comprising geological engineering faculty. Work plans adhere to current national and/or provincial regulations as appropriate, and include scope definition, development of a range of technical solutions to the engineering problem, cost analyses and project scheduling tasks. Design meetings are recorded in the form of minutes submitted to the course Management Board and time sheets are submitted. Engineering project work plans are presented and defended to a committee comprising faculty and external engineers. Evaluation is based on the presentation and the team-written preliminary design report. These reports form the basis for more in depth design work in Geol 447 in the winter. Students must register in both GEOL 446 and 447. (0/0/6/0/30)
Requirements: Must be registered in BASC
Offering Faculty: Faculty of Arts and Science

GEOL 447 Engineering Design Project II Units: 5.00
Student teams carry out design work, including detailed analysis, synthesis, and presentation for the open-ended engineering projects proposed and initiated in GEOL 446. Projects adhere to current national and/or provincial regulations as appropriate, and include further development of engineering solutions while controlling project schedule, budget and critical path design objectives. Data are obtained from industrial sources, government documents, engineering reports, the appropriate literature, and field studies and testing. Design projects, including methodologies, budgeting and technical components will be defended in class to a committee. Evaluation is based on two presentations and the team-written design report. Students must register in both GEOL 446 and 447. (0/0/0/0/60)
Requirements: (GEOL445 AND GEOL446) OR (GEOL445 AND GEOL472) OR (GEOL445 AND GEOL446)
Offering Faculty: Faculty of Arts and Science

GEOL 452 Instrumental Techniques Applied to the Study of Solids Units: 3.00
The theory and practical aspects of the techniques of X-ray powder diffraction and scanning electron microscopy are studied. Other techniques including Mossbauer, infra-red spectroscopy, and nuclear magnetic resonance spectroscopy will also be covered. An extensive term project is required where the student employs these techniques to study a material of their choice.
NOTE This course may not be offered every year. Please see Departmental website.
LEARNING HOURS 120 (24L;36Lb;60P).
Requirements: Prerequisite GEOL 232 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 462 Advanced Petrogenesis and Metallogenesis Units: 3.00
Igneous petrology, geochemistry and fluid-rock interaction applied to metallogeny and ore genesis. Case studies in mineral chemistry and geochemistry. Lectures, critical reading, laboratory work and seminars will provide an advanced understanding of the major ore-forming processes in a geodynamic setting and applications to mineral exploration.
LEARNING HOURS 120 (24L;12S;36Lb;48P).
Requirements: Prerequisite (GEOL 362 and GEOL 365) or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 463 Spatial Information Management in the Geosciences Units: 3.00
An introduction to spatial information management focusing on methods to support and extend geological mapping, mineral and petroleum exploration, and engineering site investigation. Computers and computation, GIS software and theory, spatial simulation and analysis, databases and data management, and design of effective decision support solutions.
NOTE This course may not be offered every year. Please see Departmental website.
LEARNING HOURS 112 (33L;24Lb;55Pc).
Requirements: Prerequisite GPHY 243 or GEOL 333 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 464 Visualization in the Geosciences Units: 3.00
An introduction to 3D visualization of natural sciences data with a focus on methods relevant to geological engineering, mineral exploration, and geoscience research. Perception, representation, and analytical methods. Design tools and data integration methods. Temporal analysis of natural sciences data. LiDAR data analysis. Global and local models.
LEARNING HOURS 129 (24L;8S;27Lb;48Pc;22P).
Requirements: Prerequisite GEOL 463 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 466 Isotopes and the Environment Units: 3.00
This course is designed to expose advanced students in the fields of biology, chemistry, geography or geology to the principles of stable isotope and radiogenic isotope systematics in natural processes. Emphasis will be placed on the use of isotopes in tracing elemental cycles, biological cycles and hydrologic cycles and how some isotopes can be used to place constraints on the timing of specific events in these cycles.
NOTE This course may not be offered every year. Please see Departmental website.
LEARNING HOURS 120 (36L;12S;12Lb;60P).
Requirements: Prerequisite CHEM 112 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 472 Economic Analysis Methods in Geological Engineering Units: 3.00
Cost, risk, and return characteristics of mineral exploration; introduction to economic evaluation; cash flow and time value concepts; discounted cash flow methods; mining taxation considerations; sensitivity and risk analysis techniques; exploration economics and strategies; evaluation of exploration projects; exploration planning issues.
Requirements: Prerequisite GEOL 235 and permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 475 Exploration and Environmental Geochemistry Units: 3.00
Rock-water interaction and element migration in near surface environments applied to environmental and exploration problems. Students learn field and analytical techniques, evaluate and interpret geochemical data, and design solutions related to geochemical hazards to human health, environmental impact of mining, and detection of mineral deposits.
Requirements: PRE geol365 and excl
Offering Faculty: Faculty of Arts and Science

GEOL 478 Terrigenous Clastic Sedimentology Units: 3.00
Principles of sequence stratigraphy. Depositional processes, facies models, and sequence stratigraphy of fluvial, coastal, shelf, and deep-marine environments. Introduction to analysis of sedimentary basins.
NOTE This course may not be offered every year. Please see Departmental website.
LEARNING HOURS 130 (48L;10S;36Lb;36P).
Requirements: Prerequisite GEOL 238 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 479 Appl Geoph: Field&Elecmag Meth Units: 3.00
Advanced theory and practical considerations for static potential and time-varying electromagnetic fields as applied to near-surface prospecting and site-investigation. Implications of wide-ranging physical responses for technique selection and design, implementation, modelling and interpretation of an extended Earth system. Potential theory, rock physical properties, diffusive electromagnetic signals in the Earth, boundary-value problems, frequency and time-domain field systems, design limitations and advantages. (7/15/0/10/10)~ COURSE DELETED IN 2009/10 ~
Requirements: (MATH227 AND MATH338) OR (MATH227 AND GEOL319) OR (MATH227 AND MATH334) OR (MATH227 AND GEOL319)
Offering Faculty: Faculty of Arts and Science

GEOL 481 Advanced Structural Analysis Units: 3.00
Applications of the principles of brittle and ductile deformation to the fabric analysis of rocks in the optimization of strategies for open-ended resource exploration, resource engineering, continental tectonics studies, and geotechnical engineering problems. Emphasis is on fracture, fault, and vein analysis; structures in fold and thrust belts and continental collision zones; and studies of superposed deformation and their impact on effective and economical mineral resource development.
NOTE This course may not be offered every year. Please visit Departmental website.
LEARNING HOURS 120 (24L;24Lb;12T;60P).
Requirements: Prerequisite GEOL 321 or permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 488 Geology of North America Units: 3.00
An advanced course discussing the principles of earth evolution as exemplified by North America. The holistic approach illustrates the way in which geodynamics, geochemistry, sedimentation, paleo-biology and oceanography are used to unravel the history of the continent.
LEARNING HOURS 120 (36L;36S;48P).
Requirements: Prerequisite (GEOL 107 and GEOL 235 and GEOL 238 and GEOL 249 and GEOL 300 and GEOL 321 and GEOL 365) or permission of the Department. Note GEOL 321 may be taken concurrently with permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 489 Appl Geoph: Seismic Methods Units: 3.00
Characterization, processing and interpretation of exploration seismic digital data for the oil and gas, and mineral industries. Vector waves; Green functions and diffraction; attenuation, anisotropy and poroelasticity of earth materials; geometrical rays; resolution limits and survey design; processing sequence design, data optimization, depth-model building of earth systems. Theory and practice of pre and post-stack migration, limitations and advantages; examples of partially and fully processed data, consequences of different processing design decisions. (5/0/0/30/7)~ COURSE DELETED IN 2009/10 ~
Requirements: (MATH227 AND MATH334) OR (MATH227 AND GEOL319) OR (MATH227 AND MATH338) OR (MATH227 AND GEOL319)
Offering Faculty: Faculty of Arts and Science

GEOL 543 Research and Thesis Units: 6.00
Directed, independent research on geological problems. The thesis may be based on data or material collected during summer fieldwork or in the fall/winter around Kingston, on laboratory research, or using published data. Monthly tutorials will cover various aspects of literature review, writing skills and oral presentations. A seminar concerning the thesis topic will be presented at the end of Winter term.
NOTE An electronic copy of the final thesis, formatted to the supervisor's satisfaction, must be uploaded to Qspace. The supervisor may require one hardcopy.
LEARNING HOURS 258 (6L;12S;48I;192P).
Requirements: Prerequisite Level 4 or above and registration in a (GEOL Major or Specialization Plan) and a (GPA of 3.30 (obtained in any term) or a 'Pass' (obtained in Winter 2020) in 36.0 units in GEOL) and permission of the Department.
Offering Faculty: Faculty of Arts and Science

GEOL 594 Independent Study Units: 3.00
Offering Faculty: Faculty of Arts and Science

GEOL 595 Independent Study Program Units: 6.00
Offering Faculty: Faculty of Arts and Science