

TA Opportunities for Graduate Students

Department of Geological Sciences and Geological Engineering

Fall 2023 and Winter 2024

- The descriptions below refer to courses for which Teaching Assistantships are usually available to graduate students. Note that some courses are not offered in 2023-24.
- The prefix GEOE indicates Geological Engineering; GEOL is Geological Science; GEOL/E is combined Geological Science and Geological Engineering; APSC is Applied Science. Courses are numbered according to year level (100s are first-year, 200s are 2nd-year, etc.).
- TA and Marker roles are 65 hours, with a few exceptions.
- Head TA roles are 65 to 130 hours, depending on the course structure.

Introductory and Cross-Disciplinary Courses

Earth Systems Engineering

APSC 151

Roles: TA, Head TA

An introduction to the complex Earth System (the solid earth, hydrosphere, atmosphere, and biosphere) and our interactions with it. The science behind our exploration and understanding of our planet and its ongoing evolution is explored in combination with the engineering geology of geo-materials, geo-resources, geo-dynamics and geo-risk. The connection between the Earth System and human activity is explored in depth, including local and global-scale impacts of engineering works, geopolitics, and resource issues.

Gemstones: Their Art, History and Science

GEOL 102

Not offered

The Dynamic Earth

GEOL 104

Role: TA, Head TA

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.

Environmental Geology and Natural Hazards

GEOL 106

Roles: Marker, Head TA

The relationship between humankind 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, and of public perception of and response to geological risk.

Oceanography

GEOL 200

Role: Marker

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.

Geology of the Solar System

GEOL 204 / GEOE 204

Role: TA

This course provides an overview of the Solar System from a geologic perspective. In addition to introducing the origin and evolution of our planetary neighbourhood, discussion will extend to new frontiers of exploration, habitation and mining in space, and the geoengineering challenges that these present. Emphasis is placed on investigating the processes that shape the planetary bodies in the Solar System and how these processes may have shaped the evolution of life.

Mineralogy, Petrology, and Structural Geology Courses

Geological Field Methods

GEOL 221 / GEOE 221

Roles: TA, Head TA

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.

Mineralogy

GEOL 232 / GEOE 232

Roles: TA, Head TA

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.

Igneous and Metamorphic Petrology

GEOL 235 / GEOE 235

Role: TA

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.

Analysis of Rock Structures**GEOL 321 / GEOE 321**

Role: TA

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.

Petrology Applied to Ore Deposits**GEOL 362 / GEOE 362**

Role: TA

Characterization of major ore deposit types using petrological, geochemical, and geophysical engineering sciences. Tectonic setting, age, rock composition, geometry, mineralogy and textures, geochemical and geophysical signatures. Metallogenic epochs and provinces. Design and evaluation of ore deposit models and exploration programs, including ore processing and environmental issues. Laboratory work integrates techniques of ore microscopy to determine paragenetic sequences, estimation of ore grade and evaluation of issues related to ore processing and site contamination.

Advanced Petrogenesis and Metallogenesis**GEOL 462 / GEOE 462**

Not offered

Sedimentology, Stratigraphy, and Paleontology Courses

History of Life**GEOL 107 / GEOE 207**

Roles: TA, Head TA, Marker

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.

Surficial Processes, Sedimentation and Stratigraphy**GEOL 238 / GEOE 238**

Role: TA

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.

Paleontology**GEOL 337 / GEOE 337**

Role: TA

Review of the major groups of invertebrate fossils, emphasizing functional morphology, paleoecology, evolution, and geological significance.

Carbonate Sedimentology**GEOL 368 / GEOE 368**

Role: TA

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.

Geophysics and Remote Sensing Courses

Geophysical Characterization of the Earth**GEOL 249 / GEOE 249**

Role: Marker

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.

Applied Geophysics**GEOL 319 / GEOE 319**

Role: TA

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.

Terrain Evaluation**GEOL 333 / GEOE 333**

Role: TA

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.

Applications of Quantitative Analysis**GEOL 359 / GEOE 359**

Role: TA

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.

Spatial Information Management in the Geosciences

GEOL 463 / GEOE 463

Role: TA

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.

Geochemistry and Hydrogeology Courses

Hydrogeology

GEOL 343 / GEOE 343

Role: TA

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.

Geochemical Characterization of Earth Processes

GEOL 365 / GEOE 365

Role: TA

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 practicum involving problems, laboratory experience and field experience will be part of the course.

Instrumental Techniques Applied to the Study of Solids

GEOL 452

Not offered

Isotopes and the Environment

GEOL 466

Role: TA

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, biological and hydrologic cycles, and how some isotopes can be used to constrain the timing of specific events in these cycles.

Exploration and Environmental Geochemistry

GEOL 475 / GEOE 475

Not offered

Geological Engineering Courses

Geology of Ore Deposits for Mining Engineers

GEOE 262

Role: TA

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.

Introduction to Geological Engineering

GEOE 281

Role: TA

Introduction to all integrated fields of Geological Engineering and the essence of engineering design in an earth-systems context. Focus is on geological engineering properties and processes and their impact on design, with a particular focus on scale dependency, natural variability, and risk-assessment. Introductory geotechnical engineering, applied geophysics, resource engineering, hydrogeology and geo-environmental engineering is highlighted with emphasis on the following: mining related site investigation and design, tunnelling, infrastructure development, natural-hazard mitigation and environmental remediation and resource exploration and management. A one-day field trip is required.

Geomechanics

GEOE 313

Role: TA

Application of geomechanical principles to rock characterization, engineering analysis and design problems related to surface and underground construction in rock and surface slope stability. Presentation and discussion of geomechanics theory, including stress, strain, strength of materials and post yield behaviour, and analysis tools with application to typical rock engineering problems and to case histories involving empirical, analytical, and numerical solutions. Emphasis on the inherent variability of geomaterials at the lab and field scale and implications for design.

Site Investigation

GEOE 345

Role: TA

The course involves a team approach to tackling current geological engineering problems and developing innovative design solutions. Critical site investigation and site selection decisions are proposed,

undertaken, and tested with consideration of “downstream” engineering issues and constraints. The course relies on student consultation with guest participants, most of whom are practicing professional engineers. Additionally, topics such as professional liability and ethics, equity, environmental legislation, and the Occupational Health and Safety Act are presented and discussed. Formalized engineering design tools including FMEA, QRA will be utilized. Course includes a major geological engineering design project involving technical concepts, key elements of project management and communication of proposed design solutions.

Rock Engineering Design

GEOE 413

Role: TA

Rigorous application of geomechanics and rock engineering principles to open-ended design problems related to surface and underground excavation, construction, and geo-hazard mitigation. Student-led projects will compliment 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.

Foundations of the Oil and Gas Industry

GEOE 414 / CHEE 414

Not offered

Project-based Courses

Engineering Design Project I & II - Full Year

GEOE 446 & GEOE 447

Role: TA

GEOE 446 – Fall term: Student teams research, prepare a design work plan and carry out a “Phase 1” engineering investigation for a major, open-ended geological engineering project. Evaluation is based on the presentation and preliminary design report.

GEOE 447 – Winter term: Student teams carry out design work, including detailed analysis, synthesis, and presentation for the open-ended engineering projects initiated in GEOE 446. Evaluation is based on two presentations and the team-written design report.

Research and Thesis - Full Year

GEOL 543

Role: TA

Directed, independent research by 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.

Field Courses

Geological Field School

GEOL 300 / GEOE 300

Roles: TA, Head TA

An intensive field course in which teams design and implement a geological field investigation program to produce and interpret geological field maps. The course takes place at a field camp north of Kingston, lasting 8-10 days, immediately before the beginning of third year.

Field Studies in Geology I

GEOL 301 / GEOE 301

Role: TA

A multi-day field trip concentrating on Paleozoic strata of Ontario, Upper New York State and Vermont, and using stratigraphic, sedimentological, and paleontological data to interpret rock successions in a paleoenvironmental and tectonic context. Usually takes place during the Fall Break in mid-October.

Advanced Geological Field School

GEOL 400 / GEOE 400

Not offered

Field Studies in Geology II

GEOL 401 / GEOE 401

Role: TA

A multi-day field trip concentrating on Paleozoic strata of Eastern Ontario and Southern Quebec. Students focus on aspects of sedimentology and tectonostratigraphy. Usually takes place during the Fall Break in mid-October.

Geological Engineering Field School

GEOE 410

Not offered