TA Opportunities for Graduate Students – 2024-25
Queen's Department of Geological Sciences and Geological Engineering

- The descriptions below refer to courses for which Teaching Assistantships are available to graduate students.
- 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.). Fourth-year courses offered in alternate years are not included.
- TA and Marker roles are 65 hours, with a few exceptions.
- Head TA roles range between 65 and 130 hours, depending on the course.

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.

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.

Mineralogy, Petrology, and Structural Geology Courses

Geological Field Methods
GEOL/E 221
Role: 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/E 232
Role: 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/E 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/E 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/E 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.

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/E 238
Role: TA
An examination of the 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 sedimentary structures; depositional environments and stratigraphic successions; stratigraphic principles, application to sedimentary basins and hydrocarbon genesis; interaction of natural processes with human society.

Paleontology
GEOL/E 337
Role: TA
Review of the major groups of invertebrate fossils, emphasizing functional morphology, paleoecology, evolution, and geological significance.

Carbonate Sedimentology
GEOL/E 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/E 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/E 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/E 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.

Spatial Information Management in the Geosciences
GEOL/E 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

Applied Hydrogeology
GEOL/E 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/E 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.

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. 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.

Applications of Quantitative Analysis
GEOL/E 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.

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.

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.

Field Courses

Geological Field School
GEOL/E 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/E 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

Role: TA

A one-week course taken immediately after the end of third year.

Field Studies in Geology II

GEOL/E 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.