

# MINING ENGINEERING (MINE)

All courses are 3.0 credit units, except MINE 899 and 999, which are 6.0 credit units.

## **APSC 801 Master of Engineering Foundations**

An introduction to the Master of Engineering (MEng) graduate studies program at Queen's University. The course provides students with essential administrative information, an introduction to information literacy within the Faculty of Engineering and Applied Science, as well as an overview of the various support services on campus. Additionally, the course contains several modules on professional and career skills. This non credit course is comprised of a number of individual modules, and its completion is a requirement to graduate from the MEng program. Graded on a Pass/Fail basis.

Prerequisite: Enrolment in the MEng program.

Exclusion: Students not enrolled in the MEng program.

## **APSC 810 Teaching and Learning in Engineering**

This course is an introduction to learning principles and effective teaching in engineering, intended to prepare for roles like teaching assistant, university course instruction, or training in engineering industry. The course includes relevant theories of teaching and learning with practical elements like classroom management, designing sessions and assessments, signature engineering teaching approaches, and using digital pedagogies.

## **APSC 812 AI Ethics and Society**

This course investigates the ethical implications of Artificial Intelligence (AI) as a social, technological and cultural phenomenon. Given the increasing use of intelligent systems for decision-making and autonomous control, it is essential that designers and developers are aware of the ethical and social implications that AI can have. The course materials will examine fundamental ethical principles related to the application of AI and investigate its influence in a number of industries including self-driving vehicles, healthcare, law and defense. The course will also examine the delicate balance between innovations in AI versus regulation, privacy, and individual rights. This course is graded on a Pass/Fail basis.

## **APSC 877 Engineering Project Management**

The course will examine the essential skills and knowledge required for effective engineering project management. The foundational principles of project management including integration, scope, cost, time, human resources, stakeholders and procurement are examined. The course will be delivered online.

EXCLUSIONS: MECH 896, APSC 223

## **APSC 888 Engineering Innovation and Entrepreneurship**

This course will help learners from across engineering develop an entrepreneurial mindset capable of turning problems into opportunities. Learners will investigate the relationships between innovation and industrial dynamics, and seek to understand the fundamental forces that drive the science and technology industries' evolution and industry life cycles.

EXCLUSION: CHEE 410

## **APSC 896 Engineering Leadership**

The course is designed to develop a range of leadership skills essential for engineering professional practice. Students will explore their own leadership abilities and develop their competencies in areas such as managing conflict, team dynamics and developing others. The course content will be presented through lectures, case studies, panel discussions and other active learning activities. Fall. P. Hungler

## **MINE 800 Mining Systems and Processes**

This course provides an overview of mining systems and processes and is intended to be presented to graduate students and professionals interested in the mining industry. The course is given in modules by faculty and spans a range of topics from mining to mineral processing with emphasis being placed on mining methods, methods of rock breakage, review of ground stability, ventilation, materials handling, mineral beneficiation, economic and environmental assessments, and corporate social responsibility. Three-term hours. Not offered 2022-23.

## **MINE 801 Community Aspects of Mineral Resource Development**

This course provides students with a thorough understanding of community issues associated with mineral resource development. It provides context and examples to demonstrate how the industry response to these issues has changed over time. The business case for a disciplined approach to community engagement and relationship building is outlined. It introduces the topics of community development, community engagement, and indigenous issues which are further explored in subsequent courses. Fall term. E.A. Johnson.

## **MINE 803 Community Engagement and Mining**

This course extends the exploration of a range of community development and community engagement domains, techniques and skills, relating to social technique, participatory approach to community development planning and programming; the use of partnerships as a vehicle for participatory development; social impact assessment; community engagement planning; program monitoring



and evaluation. It expands and reinforces the participant's understanding of how the application of professional approaches and methods can assist communities and companies to build sustainable, organized relationships and structures within the broader context of mining and development practice, locally, nationally, and globally. Winter term. E.A. Johnson

#### **MINE 804 Mining Projects and Indigenous Peoples**

This course examines the social, political and economic relationships that exist between Indigenous Peoples and external parties in the development of commercial mining operations. The course will review specific social, political and economic issues arising from the engagement of Indigenous Peoples with the minerals industry, and the skill sets and knowledge base that are critical to negotiating positive relationships between Indigenous Peoples and mining companies. Winter term. E.A. Johnson

#### **MINE 812 Underground Mining**

This course provides a comprehensive discourse of all aspects of underground mining. It is designed to provide engineers with full knowledge to develop strategic and tactical mine planning and to incorporate all aspects of underground mining, including method selection, design, planning, scheduling, development and production. Classification methodologies are introduced to permit selection of a mining method based on orebody characteristics. The program includes description and application of underground mining methods, equipment selection and basic requirements. Layout and design of underground mine development and production and related equipment requirements are presented. Support services, including ground control, ventilation, dewatering, backfill, compressed air are introduced. Not offered 2022-23.

#### **MINE 814 Advanced Ventilation and Environmental Mine Engineering**

The development of basic airflow models and complex ventilation networks are discussed in depth, and practical design studies using computerized techniques are developed. Topics related to ventilation calculation and design include: mine regulations and engineering design criteria, basic and complex circuit evaluation and design, natural ventilation, fan selection, auxiliary ventilation design, ventilation surveys and ventilation economics. The total environment of mines and air quality control are studied in detail, and include mine gases, mine dust, heat control and radiation hazard and control in mines. Three term-hours, lectures. Not offered 2022-23.

#### **MINE 817 Advanced Explosives Technology**

Detonation theory and its applications. Topics include: Detonation theory, equations of state, experimental

techniques for measuring explosive properties, initiation and sensitivity, shaped charges, metal working with explosives, commercial explosives, metal loaded explosives, dust explosions, pressure desensitization, numerical methods. Three term-hours, lectures.

#### **MINE 818 Rock Mechanics**

Theories and application of rock mechanics principles in underground and open pit mine design are discussed. General areas of concentration include assessment of elastic for rock; the determination and influence of in-situ stress on excavation stability; evaluation of ground movement, subsidence and convergence; review of rock slope stability factors and mitigation techniques for stabilization; and assessment of contemporary and innovative measures for ground support provision in underground mines. Three term-hours. Not offered 2022-23.

#### **MINE 819 Numerical modelling in mining geomechanics**

This course introduces numerical modelling methods used in mining geomechanics. The basic theory and use of finite difference, finite element, boundary element continuum and discrete particle discontinuum codes will be reviewed with the objective of providing an understanding of the mathematical basis for each method, and their major differences. The emphasis will be on building and interpreting models. Three term-hours, lectures. Not offered 2022-23.

#### **MINE 820 Topics in Drilling and Blasting**

Rock failure in blasting. Topics include fragmentation, influence of joints and rock structure, theory of fracturing and crack propagation, cratering, blasting-induced vibrations and damage, wall control techniques, numerical methods. Three term- hours, lectures. Winter term; P. Katsabanis.

#### **MINE 821 Hydrometallurgy and electrometallurgy: Theory and practice**

This lecture- and seminar-based course covers the advanced topics about hydrometallurgy and electrometallurgy. The course involves the theory of leaching, solid liquid separation, solvent extraction and ion exchange, chemical precipitation and electrometallurgy. In addition, several process options and flowsheets for the recovery of selected base metals (copper, zinc and nickel)and gold will be presented. Each student will perform a literature survey, write a report and present on a topic of interest. Three term-hours, lectures. Not offered 2022-23.

#### **MINE 828 Seismicity in Mines**

This course provides a broad overview of seismicity in mines, ranging from its causes, source mechanisms, waveform analysis, influence of geological factors including stresses, monitoring systems, analysis of seismic data, and applications of seismic data analysis in mining geomechanics

and mine design. Familiarity with principles of rock mechanics and structural geology are assumed for the course. Three term-hours; lectures. Not offered 2022-23.

### **MINE 832 Flotation Science and Technology**

Roles and applications of flotation in the mining industry, tailings management, recycling and environmental clean-up are discussed. The topics include both interfacial aspects such as wettability, electrical double layer theories, dispersion/coagulation/flocculation, reagent interactions, as well as the engineering aspects such as sampling/mass balancing, kinetics and circuit design. Primary examples of technologies related to processing of sulphide ores, non-sulphide ores, salts, coals and tar sands are covered. The course includes laboratory sessions on selected topics. Three term hours plus 3 lab sessions; Fall and/or Winter term. S. Kelebek.

### **MINE- 834 Advanced Geostatistics for Modelling Uncertainty in the Earth Sciences**

This course introduces the theory and practice of advanced geostatistics to characterize the uncertainty in spatially distributed attributes in the Earth Sciences. The course presents tools and modelling workflows, including multi-Gaussian simulation, indicator simulation, and multiple-point statistics. Multivariate techniques will also be reviewed, and examples will be provided in a mining context. The audience is engineers and geoscientists from all relevant engineering and applied science disciplines who have an interest in models of Earth systems. Fall or Winter term. J. Ortiz.

### **MINE 835 Applied Machine Learning**

This course introduces the theory and practice of machine learning for graduate engineering students. The course presents tools for analysis and prediction using machine learning techniques, including regression, support vector machines, hidden Markov models, ensemble methods, supervised and unsupervised learning. The course will be focused on the fundamentals of these techniques, the advantage, disadvantage and usage context of each technique, and their application in the engineering field. Engineering examples for each topic will be provided. Winter term. Y. A. Sari.

PREREQUISITE: Students must have taken a probability and statistics course (e.g. MTHE 367 or equivalent.)

### **MINE 836 Mineral Processing and the Environment**

The objective of this course is to provide an introduction to mineral processing unit operations with regards to final product production. Process selection criteria will be highlighted including economics, efficiency, and geographic location. Environmental issues associated with producing metals from a variety of ore types will be examined

including tailings treatment/impoundment methods and pyrometallurgical and hydrometallurgical refining techniques. Three term-hours, fall and/or winter term, lectures. S. Kelebek.

### **MINE 838 Project Decision-making in Extractive Metallurgy**

The goal of this course is to provide an opportunity for students to use information from their undergraduate courses to make decisions on projects of the type that they may face in their future careers. The course will analyze actual project case histories in mining and process metallurgy and evaluate them from technical, economic, and risk perspectives. The objective of each case will be to confront the student and/or group with a decision point similar to that faced in the actual situation. The students will work individually and/or in small groups in an interactive tutorial setting to develop each case for class presentation. There will also be opportunities for interaction with invited experts from industry. The course will show students how to use the key evaluation tools for objective project and process decision-making in mining and process metallurgy. Three term-hours, lectures. Not offered 2022-23.

### **MINE 839 Advanced Pyrometallurgy**

In this course, pyrometallurgical technologies for metals extraction are discussed and evaluated. This includes basic thermodynamics, solution thermodynamics and alternative standard states. Models of metallurgical solutions are examined. Stability diagrams are utilized to understand processes and predominance area diagrams are used to explain roasting. Current research areas in pyrometallurgy are discussed with emphasis on energy and the environment. Three term-hours, lectures. Fall term. C.A. Pickles

### **MINE 851 Risk Analysis for Industrial Asset Management, Health and Safety**

This course covers the analytical techniques and tools which form the foundations required for effective life-cycle management of physical assets, as well as for occupational health and safety management systems. The course uses risk analysis as the primary lens to investigate and evaluate a broad range of industrial challenges, ranging from equipment reliability and maintenance planning strategies, through to identification and mitigation of workplace health and safety hazards. Selected topics in industrial hygiene, including exposure limits, are surveyed. Methodologies covered include Failure Mode, Effects, and Criticality Analysis (FMECA), Reliability Centred Maintenance (RCM), and Internal Responsibility Systems (IRS) for Safety Management. Three term-hours, lectures. Winter term. L.K. Daneshmend.

### **MINE 852 Mine Mechanization and Automation**



Objectives, constraints, and methodologies for mechanization and automation. Modelling and simulation of mining processes and equipment. Equipment monitoring. Production monitoring. Navigation and automatic guidance of mobile equipment, including inertial navigation and GPS. Dispatching and scheduling systems. Mine-wide communications systems. SCADA (Supervisory control and data acquisition) systems. Teleoperation and Telerobotics technologies. Machine design in the context of mechanization and automation; reliability and maintainability. Technology transfer issues. Case studies of both surface and underground mines. Not offered 2022-23.

#### **MINE 860 Selected Topics in Mining Engineering**

This course is intended for students at both the Masters and Doctoral levels who already have a good background in fundamental topics related to their research or course-based programs of study, and who are interested in broadening their exposure to other subject areas of mining engineering that are not offered through existing graduate courses. Topics will focus on either mining, mineral processing or mine-mechanical-related areas of mining engineering, and will be presented through lectures, seminar presentations, open classroom discussion and self-directed independent study. The specific course content to be taught to students will be posted in writing at the beginning of each term in which this course will be given, and the deliverable will be presented publicly at the end of the term, and will take the form of a lecture, bibliographic review, proof of concept or other deemed appropriate by the supervisor. Marking for the course will be assessed on the basis of student assignments, written reports and classroom presentations. Fall and/or Winter term.

#### **MINE 865 Directed Research**

This course is intended for students at both the Masters and Doctoral levels who already have a good background in fundamental topics related to their research or course-based programs of study. The course is created by a professor in agreement with a student to explore an area of common interest that may have the potential of adding to the student's research thesis topic. The course deliverable may consist of a final report, a lecture, a short research project, a paper, a prototype, or a computer code. Fall and/or Winter term.

#### **MINE 881 Mining Systems**

This course reviews the processes involved in a mining operation in the context of efficiencies in the use of resources, energy and water. The engineering design stages and unit operations are discussed from a systems perspective. Case studies illustrate factors for success and failure of projects. Fall term. This course is exclusively online.

EXCLUSIONS: MNTC 305/MINE 800.

#### **MINE 882 Advanced Mineral Economics**

Mineral economics spans theory, industry knowledge, government policies, finance and investment. Students will explore topics in foundational economic theories, regulation of the industry, tools and applications, feasibility assessment and disclosure, project evaluation, and changes needed in tools and practices to better integrate sustainability. Fall term. This course is exclusively online.

#### **MINE 885 Mineral Processing**

This course presents the unit operations in mineral processing, and discusses process selection criteria, considering new available technologies. Equipment selection, efficiencies, and performance are analyzed in light of product requirements for subsequent metallurgical operations. Techno-economic and environmental aspects are discussed.

#### **MINE 897 Graduate Seminar**

Each student is required to make a presentation concerning his project or research at least once per calendar year. For those students who may only be enrolled in part-time studies, or who may be completing their degree requirements off campus, this requirement may be met through submission of electronic media presentation, which can be viewed, by staff and students, during a regularly scheduled seminar session. This is a non-credit course which each student must pass successfully. C. Pickles

#### **MINE 898 Master's Project**

(3.0 credit units)

#### **MINE 899 Master's Thesis Research**

#### **MINE-999 Ph.D. Thesis Research**

### **Courses for the Graduate Diploma in Social Performance Management in the Extractive Industries**

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