



## **MINING AND MINERAL PROCESSING ENGINEERING SYLLABUS OF EXAMINATIONS 2009 EDITION**

For textbook information please refer to the **Textbooks** section on page 6 of the document entitled **Information for Students and Examinations Candidates**.

### **GROUP A COMPULSORY EXAMINATIONS (SIX REQUIRED)**

#### **09-Mmp-A1 General Geology and Exploration**

Mineralogy, determination and identification of minerals, with emphasis on ore minerals. Structures and forms of orebodies; processes for the formation of ores; classification of ores; definition of reserves and resources. Petrology. Structural geology. Internal and external geologic processes. Structure and strategy of exploration programmes, exploration geochemistry, devising drilling/trenching programmes, surveying techniques and remote sensing.

#### **09-Mmp-A2 Underground Mining Methods and Design**

Description and usage of the following underground mining methods: room and pillar, long-hole, longwall, open stoping, shrinkage, cut and fill sub-level stoping, timbered stoping, top slicing, underhand and overhand stoping, block caving, sublevel caving, vertical crater retreat. Requirements for development and services including: shafts, hoists, ramp and multi-level access design. Design of pumping, ventilation, compressed air and power facilities. Underground design including: stope development, haulage systems, backfill, equipment selection, and scheduling of development and operations. Capital and operating cost estimation associated with underground mining activities.

#### **09-Mmp-A3 Mineral Processing**

Material balances. Measures of efficiency of mineral separations. Sampling systems and sampling errors, use of Gy's equation. Particle size measurement and presentation of results. Mineral liberation by crushing, grinding, screening, and classification. Mineral concentration using gravity, dense medium, magnetic and high tension separators. Froth flotation and flotation circuits. Use of reagents — collectors, frothers, depressants, and activators. Dewatering techniques — thickening, filtering, drying, flocculants, and filter aids. Flowsheet analysis emphasizing Canadian mineral processing plants.

#### **09-Mmp-A4 Mine Valuation and Mineral Resource Estimation**

Aspects of geological conditions and control relating to mineral resource estimation. Principles of mineral resource estimation using conventional and geostatistical methods. Aspects of mine valuation — assessment of market conditions, capital and operating cost estimation, estimation of revenue including smelter contracts, taxation, cash flow, sensitivity and risk analyses, and economic optimisation of mine development and extraction variables including cut-off grade, installed capacity utilisation and sequencing.

### **09-Mmp-A5 Surface Mining Methods and Design**

Surface mining methods including strip mining, open pit mining, (dragline, bucketwheel excavators, truck and shovel and dozer methods), hydraulic mining and dredging. Design criteria for surface mines including scheduling, material removal and capacity-rated equipment-sizing, availability and utilization calculations, slope design, stripping ratio, materials handling, pit ramp and waste dump design, pit dewatering and land reclamation. Capital and operating cost estimation associated with surface mining activities.

### **09-Mmp-A6 Mining and the Environment**

Overall understanding of environmental practices in mining including; waste rock and tailings disposal systems; prediction/prevention/treatment/control of acid rock drainage; control of dust/noise/gaseous emissions; environmental effects monitoring (surface water and groundwater); reclamation and decommissioning; government regulations relating to environmental protection in design/operation/closure of mines; sustainable development principles and application to mining; risk assessment and management principles with respect to the environment.

## **GROUP B**

### **ELECTIVE EXAMINATIONS (THREE REQUIRED)**

#### **09-Mmp-B1 Applied Rock Mechanics**

In situ and laboratory determination of rock properties. Subsurface investigations, structural surveys and rock mass classification systems. In situ stress determination in rock masses. Evaluation of stress fields around mine openings using analytical, empirical and numerical methods. Underground rock support systems. Mine subsidence. Field instrumentation, monitoring and control techniques, including seismic events, groundwater.

#### **09-Mmp-B2 Rock Fragmentation**

Principles and technologies of cutting, drilling, boring, and blasting, including vibration and shock effects. Explosives, including properties and classification, selection of chemical explosives and explosive mixtures, regulations and approved procedures for handling, storing, loading, and detonating. Blasting design, including detonators, delay systems, control blasting methods. Vibrations monitoring and blasting methods for vibrations control.

#### **09-Mmp-B3 Material Handling**

Classification of materials handling systems. Mining systems. Equipment selection criteria. Earthmoving fundamentals. Loading and haulage equipment. Belt conveyors. Rail haulage. Mine hoisting systems. Slurry transport. Technical and economic considerations.

#### **09-Mmp-B4 Occupational Health, Safety and Loss Management**

Control and detection of hazards in surface and underground mines: rock falls, slope failures, radiation, heat, noise, dust and gas. Ventilation requirements for underground mines, air flow through mine openings, air quality and control. Workplace health and safety. Industrial hygiene in mining environment. Risk analysis, risk management, loss prevention and control.

### **09-Mmp-B5 Mill Design and Operations**

Mineral processing flowsheet synthesis and circuit design. Material and energy balances. Selection and sizing of mineral processing equipment: comminution, classification, gravity, magnetic and electrostatic separations, froth flotation, dewatering, solids and slurry storage and transport. Sampling, data logging, process modelling and simulation of mineral process plants. Capital and operating cost estimations.

### **09-Mmp-B6 Mill Process Control**

Basic process control and analysis: PID (Proportional-Integral-Derivative) loops, feedback, feed forward, cascade, interacting control systems, data acquisition, control loop monitoring and control network technology (fieldbus, wireless, security). Controller settings — analytical and loop-tuning techniques. Computer control: modelling, adaptive, and supervisory. On-stream analysis and sampling for control; strategies for control of crushing, grinding, flotation, and dewatering circuits. Instrumentation for bin and sump level sensing, solids and slurry flow rates, pulp density, power draw, reagent addition, pH measurement. Alarm and interlock systems, sequencing problems. Benefits and justification of automatic control.

### **09-Mmp-B7 Extractive Metallurgy**

Thermodynamics of pyro- and hydro-metallurgical extraction processes. Kinetics of extraction processes. Slag and mattes. Pyrometallurgical processes including calcining, roasting, and smelting. Hydrometallurgical processes, including leaching (autoclave, agitation, and heap), purification and concentration via ion exchange, and solvent extraction, metal recovery via electrowinning, electrolysis or precipitation. Refining processes. Flowsheet studies.

### **09-Mmp-B8 Mine Management and Systems Analysis**

Mine organization and mine management. Budgeting and management accounting. Industrial engineering – work design and scheduling, work study and sampling, development of standard practices. Organizational structure of business in the mining industry. Contracting procedures. Labour/management relations. Operations Research methods – control networks (CPM, PERT), linear and nonlinear programming and simulation techniques. Experimental design. ISO 9000/14000 standard series.

### **09-Mmp-B9 Rock Slope Engineering**

Geologic investigations and field and laboratory testing. Detailed review of the mechanisms of rock slope instability. Evaluation of the influence of geology, groundwater and blasting on rock slope stability. Design of stable rock slopes. Dewatering methods for rock slopes. Field instrumentation and monitoring of rock slope behaviour. Stabilization of rock slope failures.

**Revised: July 2010**