SYLLABUS (PART B) – MINING

MINING AND MINERAL RESOURCES PAPER SYLLABUS

The candidates who are sitting for the Mining or Mineral Resources Engineering are expected to have sufficient knowledge and understanding of the latest relevant Acts, Enactments, Rules, Regulations, Standards, Codes of Practices, and good engineering practices in Malaysia related to all activities for mining and quarrying.

1. Legislations, Rules and Regulations

i. Registration of Engineers Act 1967 (revised 2015)
ii. Registration of Engineers Regulations 1990
iii. Mineral Development Act 1994
iv. Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014
v. Mineral Development (Licensing) Regulations 2016
vi. Mineral Development (Effluent) Regulations 2016
vii. Mineral Development (Blasting) Regulations 2013
viii. State Mineral Enactments (for all states in the Federation of Malaysia)
ix. State Mineral Regulations (for all states in the Federation of Malaysia)
x. National Land Code 1965
xi. State Quarry Rules (for all states in the Federation of Malaysia)
xii. Raw Gold Dealings Enactment (Kelantan) 1991
xiii. Explosives Act, 1957
xiv. Explosive Rules, 1923
xv. Environmental Quality Act 1974
xvi. Regulations under the Environmental Quality Acts
xvii. Factory and Machinery Act 1967
xviii. Occupational Safety and Health Act 1994
xix. Joint Ore Reserve Committee (JORC) Code
xx. Street, Drainage and Building Act, 1974
xxi. Criminal Procedure Code (Act 593)
xxii. Penal Code (Act 574)
xxiii. Evidence Act 1950
xxiv. Interpretation Act 1948
xxv. Street, Drainage and Building Act, 1974

xxvi. Lembaga Pembangunan Industri Pembinaan Malaysia Act 1994 (CIDB Act)

2. Mining and mineral resources engineering practice in Malaysia

Proficiency and good working knowledge and experience of mining or mineral resources engineering practice in Malaysia will cover on all processes for the production of mineral ore and rock materials. These include mineral prospecting/exploration, mine feasibility studies, mining, mineral processing, tailings management and mine rehabilitation. A good knowledge of rock blasting (for both surface and underground mining) is required where drill and blast is the main operation for mining. Stresses induced from drill and blast or excavation operation will require an engineer to have a good knowledge in geomechanic in harnessing the optimum potential of mineral deposits and for maintaining the stability of all excavations and realising or able to predict the dangerous situation so that appropriate actions can be taken.

A. **GENERAL MATTER**

a. Procedures in the application of Exploration/Prospecting Licences, Mining Lease, Proprietary Mining Licence and other relevant licence and permit in accordance to the mineral legislations.
b. Knowledge in geological features of mineral deposits and general occurrence of common mineral deposits in Malaysia.
c. Knowledge in mineral exploration or prospecting works.
d. Knowledge of types of drilling rigs that are commonly used for exploration of mineral deposits in Malaysia.
e. Working knowledge in mine surveying and able to present the location of any mineral property.
f. Safety of workers while carrying out all stages of mineral exploitation that begin with mineral exploration until the production of mineral products.
g. Well aware of the guidelines imposed by government agencies with regard to best practices in mining, quarrying, blasting, environment and rehabilitation.

B. **MINERAL ECONOMICS AND MANAGEMENT**

a. Knowledge in the general mineral resource assessment – using simple statistic calculation, weighted average and others. Using geostatistics will be an added advantage but not necessarily used in most cases.
b. Knowledge on the general relationship between exploration results, mineral resources and ore reserves.
c. Knowledge on mine evaluation methods such as using discounted cash flow method.

- Able to estimate the capital cost and operating cost in starting a mine and operating a mine for a certain period of time.
- Able to decide the optimum life of the mine and recommend the type of suitable machineries and equipment to be used.

d. Management of a mine in accordance to the land, mineral legislations and related legislations.

C. **MINING WORKS**

a. Mine planning

- Understand surveying works required for land titles (mining lease) and surveying works for mining purposes for both surface and underground mining.
- For making sure that high grade ore is given priority to be mined first for better cash flow of the mine.
- For making sure that development works are to be carried out appropriate to the location of the mineral reserves and in competent ground, such as the location of the main shaft for underground mines or the location of the mine office and mineral processing plant for both surface and underground mines.
- Exploration never stops, even while mining, so nature of ore or any change in the "behaviour" of the ore is always recorded and mining will advance accordingly.
- Understand mining geology and the geology of the area to be mined.

b. Development works

- Good knowledge in development works to be carried out before mining begins, and even so would continue during mining.
- Development works are land clearing, construction of access roads, site office, mine workers quarters, mineral processing plant, workshops for maintenance, stripping works, sinking of shafts (main shafts and ventilation shafts) and others for underground mines.
- Able to make sure that development works are to be carried out on competent grounds i.e. could withstand the ground stresses due to mining activities.

c. Surface and underground mining methods

- Understand the standard mining terms with respect to mining methods.
- Understand the standard mining methods for both surface and underground mines.
- Understand mine drainage and be able to designate proper pumps to drain water out of the mine.
- Understand the ventilation requirements and ventilation monitoring systems for underground mines.

d. Preparation of mine tailings area and inspection of tailing embankments.

- Understand the requirement of mines' tailing area.
- Understand the requirements of mines' waste dumps.
- Inspection of tailing embankments and remedial measures that can be undertaken to address defects.
- Able to design workable tailing embankments and spillways

e. Knowledge of common types of dry waste dumps including aspects on safety and protection of the environment.

f. Knowledge in designing appropriate pump system at appropriate locations for controlling water resources for mineral processing works and for domestic used for the mine workers.

D. **ROCK BLASTING WORKS IN MINING, QUARRYING AND CONSTRUCTION**

a. Knowledge in common types of explosives used for mining and quarrying (e.g. ANFO, watergels, emulsions) and blasting accessories (e.g. safety fuse, detonators, plain detonators, electric detonators, electric delay detonators, electronic detonators, detonating cord, nonel system and others).
b. Initiation of explosives.
c. Improvise workable blast design appropriate to general safety of lives and nearby properties, its function and purpose and the requirement of the end products.
d. Methods of blasting in surface mining.
e. Methods of blasting in underground mines i.e. for tunnelling, stoping, shaft sinking.
f. Controlled blasting for surface and underground mining.
g. Safe practice in blasting – handling of explosives, dealing with misfires, disposal of deteriorated explosives, destruction of explosives materials, transportation of explosives, storage of explosives, record keeping and others.
h. Blasting for non-mining purpose such as tunnelling, underground excavation and demolition.
i. Knowledge in blast monitoring and reporting.
j. Knowledge in conducting dilapidation inspection report.

E. **MINERAL PROCESSING WORKS**

a. Ore handling – the processes of transportation, storage, feeding and washing of the ore en route to, or during, its various stages of treatment in the mill.

b. Metallurgical accounting and control – to determine the distribution of the various products of the mill.
c. Particle size analysis – Appropriate techniques to be used in the laboratory as the sample used has to be representative
d. Comminution – principles
e. Crushers – Primary and secondary
f. Grinding mills – tumbling mills (rod, ball and autogenous) and grinding circuits
g. Classification – working principles and types of classifier
h. Gravity concentration – palong, jigs, spiral concentrators, shaking tables
i. Heavy medium separation, froth flotation
j. Magnetic and high tension separation
k. Dewatering
l. Tailings disposal

F. **MINING GEOMECHANICS WORKS**

a. Planning of subsurface investigation field works and sampling

- For determining the type of excavation methods to be used, both for stripping and mining.
- For cut and fill in hill-site development, road works and mining on hilly terrain.
- For filling and levelling of mined-out areas.
- For foundation design for the installation of mineral processing plant and other surface facilities.
- For stability analysis of foundation of mineral surface facilities with respect to mining excavation nearby.
- For stability analysis of the slope of open pit mines for the safety of workers and machinery.
- For studying the effect of continuous drilling and blasting on the stability of mine slopes for surface mining or for underground mining excavations.

b. Design of stable excavations and management of rock mass behaviour under stress conditions

c. Tailing dam design – the foundation has to be competent enough.

d. Rock mass classification of any area of interest within the mineral property.

e. Analysis of slope stability for open pit mines in soil and hard rock.

f. Understand the effect of rock structures (joints, fractures, faults, discontinuities and others). The knowledge of stereographic analysis is an advantage.

g. Rock bolts and cables for rock stabilisation for both surface and underground mines.

h. Shotcrete support

i. Basting damage in rock

G. **ENVIRONMENTAL ENGINEERING**

a. Environmental engineering in mining operation (include mineral processing activities) is more towards sustaining the environmental quality outside the accepted distance from the disturbed area of mining. Beside that it also involves in lessening the effect of mining operation towards the mining workers. So a professional mining engineer must understand the following:

i. The effect of dust, blasting noise, heat in underground mines (requirement of refrigeration plant in underground mines), air quality in surface and underground mines, water quality, optimum ventilation requirements for each worker, (optimum number of shafts and the number of shafts required), treatment of mining effluent.

ii. Visual impact of mining operation and its mitigation.

Professional engineer who are registered with the Department of Environment may be required to produce Environmental Impact Assessment for mining and quarrying projects.

b. Erosion and Sediment Control Plan (ESCP)

- Knowledge in preparing an ESCP that details temporary measures that will be implemented during the mining or quarrying phase and may include permanent measures that will remain in place once mining or quarrying is complete to control the environmental impacts of erosion and sedimentation.
- An effective ESCP aims to prevent uncontrollable erosion and to minimise the adverse effects of sediment transport from on-site to off-site areas.

c. Mine Rehabilitation Plan – to ensure activities associated with the mining activities will be designed to prevent, minimise or mitigate adverse long-term environmental and social impacts and create a self-sustaining ecosystem.

- Knowledge on progressive rehabilitation
- Knowledge on common methods of mine rehabilitation

d. Acid Mine Drainage (AMD)

- Knowledge on the likely occurrence of AMD including geochemical tests to determine whether rock/soil is Potential Acid Forming (PAF).
- Knowledge on common approaches to preventing and cleaning up AMD

H. **OCCUPATIONAL SAFETY AND HEALTH**

General knowledge on safety and health requirement as stipulated in the Factory Machinery Act and the Occupational Safety and Health Act which may include on personal protective equipment, fire safety, safety meetings, safety drills, good working ethics to prevent accidents, safety gadgets or provisions, cleanliness of the working area to prevent the spread of diseases, poisoning, allergies etc.

3. Professional Drawing

A. Location maps for soil samplings, pittings, diamond drillings and other prospecting or exploration maps.

a. Ability to decide the location of points for soil sampling, diamond drilling and pits based on the local geological knowledge of the area.
b. Ability to locate the actual position on site of the points based on land surveying knowledge that include the usage of GPS and other instruments.

B. Operational Mining Schemes Plan (required under section 10 of the Mineral Development Act, 1994).

a. Ability to design an appropriate mining scheme.
b. Ability to describe and justify for every proposal in the mining scheme based on the prospecting/exploration results and other requirements from Authorities.

C. Quarrying Schemes (required by the State Quarry Rules)

a. Ability to design an appropriate quarrying scheme.
b. Ability to justify for every proposal in the quarrying scheme.

D. Mine workings plan: The plans are required under section 16 of Mineral Development Act to be prepared by a licensed surveyor, but a professional engineer must be able to justify any deviation from the original operational mining scheme as it is needed to cater for the safest production method of the ore or rock in accordance to the changing nature of the ore or the rock while mining.

E. Flow sheet diagrams for a mineral processing plant.

a. Ability to describe each element in the flow sheet.
b. Ability to justify for every proposal in the flow sheet.

c. Ability to propose/decide on the most appropriate equipment to be used for mineral processing.

F. Blast design diagram

a. Ability to decide the most appropriate blast design for surface or underground blasting.
b. Ability to describe and justify the blast design.

G. Explosive storage buildings (magazines) or facilities diagram.

a. Ability to design an appropriate magazine buildings based on the blasting requirements or based on the amount of explosives materials required to be stored at any one period of time.
b. Understand the safety aspects based on the types of explosives (period of storage for each type of explosives), fire hazards within and outside the explosive storage buildings.
c. Ability to answer on most issues with respect to safety of explosives storage for any type of explosives and accessories.

H. Mine tailing dams design diagrams.

a. Understand all types of tailing dams possible to be built and understand the advantages and disadvantages for each type of dams.
b. Ability to design appropriate dams for the specific mineral tailings within the specific area.

I. Final spillway drawings of a tailing dam.

a. Understand the purpose of each type of final spillway e.g. for box spillway (wooden and concrete), concrete spillways and decant tower.

b. Ability to design spillways in accordance to the scale of mining or type of mining.

J. Maps and drawings on the proposed river deviation to allow mining of the original river bed.

a. Ability to make proposal/s on river deviation in accordance to the requirements of the Drainage and Irrigation Department.
b. Ability to describe the river deviation proposal.

K. Mine abandonment plan (section 20 of the Mineral Development Act)

a. Ability to make appropriate plans, sectional drawings or appropriate drawings of the mine upon abandonment.
b. Ability to describe the drawings and their justifications.

L. Mine rehabilitation plan drawings (section 126 of State Mineral Enactments for Peninsula Malaysia and Sabah and section 108 of Sarawak Mineral Ordinance)

a. Ability to make appropriate or practical proposals with the plans or drawings as illustrations.
b. Ability to justify every proposal made.