



**FACULTY OF ENGINEERING AND THE ENVIRONMENT**

**DEPARTMENT OF MINING ENGINEERING**

**SURFACE MINING**

**EMI 5202**

**Final Examination Paper**

**June 2025**

This examination paper consists of 5 pages

**Time Allowed: 3 hours**

**Total Marks: 100**

**Examiner's Name: Mr A ANTONIO**

**INSTRUCTIONS**

1. The examination consists of **SIX** questions, Answer **ANY FOUR** questions.
2. Each question carries 25 marks

**Additional Requirements**

**NONE**

**MARK ALLOCATION**

Question 1 to 6	<b>25 Marks</b>
Part Questions	<b>As shown in each part question</b>
Total Attainable	<b>100</b>

### QUESTION ONE [25]

- a. Define the following terms in the context of surface mining.
- i. Ore [2]
  - ii. Exploration [2]
  - iii. Development [2]
  - iv. Production [2]
  - v. Reserve [2]
- b. Explain the differences between Measured Resource, Indicated Resource, and Inferred Resource. Include the basis for classification and the level of geological confidence associated with each type. [5]
- c. Discuss the characteristics of deposits that are amenable to open pit mining. Include at least three specific characteristics and explain why they are important for this mining method. [5]
- d. Describe the factors influencing the design of working benches in open pit mining. Discuss the significance of bench height and width in relation to equipment size and safety considerations. [5]

### QUESTION TWO [25]

- a. Define the terms bench face angle and overall pit slope angle. Why are these angles critical in open pit mining? [4]
- b. Discuss the factors that govern the approach to accessing an ore body. How do these factors influence the design of a drop-cut? [4]
- c. What are the consequences of stresses in open pit mining before and after excavation? How do these stresses affect slope stability? [4]

- d. Compare and contrast the declining, increasing, and constant stripping ratio methods. What are the advantages and disadvantages of each? [9]
- e. Discuss the significance of pit scheduling in surface mining. How can it influence overall project profitability and efficiency? [4]

### **QUESTION THREE [25]**

- a. Identify and describe four engineering properties of rock that influence drilling performance. Explain how each property affects the choice of drilling technique. [8]
- b. A rock sample yields a friability value of 25% after testing. Calculate the Drilling Rate Index (DRI) if the test volume is equivalent to 500g of rock. Discuss the implications of this DRI value on drilling performance. [3]
- c. Discuss the factors that influence rock blastibility. How do these factors determine the choice of explosives and blasting techniques? [5]
- d. Given a scenario where a mining operation requires drilling in hard rock formations with a need for precision, which drilling method (Top Hammer or Down-the-Hole) would you recommend and why? [3]
- e. List and explain three advantages of using rotary drilling in surface mining operations. How do these advantages impact drilling efficiency? [6]

### **QUESTION FOUR [25]**

In a particular open-pit loading and hauling operation, the system operates as a single-queue single-server arrangement. In this case, the trucking duration ranges from 12 to 16 minutes, while the average loading time is approximately 5 minutes.

- a. Using the match factor, determine the number of trucks required for this material handling operation. [5]
- b. Considering that the expected truck availability for this material handling operation is 75%, calculate the necessary fleet size for efficient performance. [5]
- c. If the number of trucks in the loading and hauling operation is increased by two, estimate the expected waiting time for the trucks. [3]
- d. Discuss the following:
  - i. Two reasons for a low match factor. [4]
  - ii. Two consequences of a low match factor on operational productivity. [4]
  - iii. Two measures to improve the match factor to the desired level. [4]

**QUESTION FIVE [25]**

- a. Identify and briefly explain three (3) challenges that arise when transitioning from an open-pit mining operation to an appropriate underground mining method for extracting a deep-seated ore body. [9]
- b. Propose two (2) methods that can be utilized to ascertain the transition point mentioned in part (a). [4]
- c. Discuss the effectiveness of either the bord-and-pillar collapse technique or the bord collapse method in the context of open-cast extraction of old underground workings, focusing on achieving the following objectives:
  - i. Minimizing dilution. [6]
  - ii. Ensuring subsidence-free benches. [6]

**QUESTION SIX [25]**

(a) A quarry is planned to extract limestone with an estimated production capacity of approximately 150,000 tonnes per month. What is the estimated monthly requirement for explosives? Assume that the specific gravity (SG) of limestone is 2.5 and the powder factor for limestone is 0.6 kg/m<sup>3</sup>. **[4]**

(b) A copper deposit has a strike length of 400 m, a width of 250 m, and a dip of 75°. Recent exploration efforts indicate that the deposit begins at 15 m below the surface and does not close down dip. Geologists have estimated a minimum reserve tonnage of 12 million tonnes. Identify the most suitable mining method and provide justification for your choice. **[6]**

(c) Discuss the mining method identified in part (b), including the operational cycles, the equipment that would be utilized, as well as the advantages and disadvantages of this method.

**[15]**

**END OF EXAMINATION PAPER**