



**PAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**FACULTY OF ENGINEERING AND THE BUILT  
ENVIRONMENT**

**DEPARTMENT OF CIVIL, MINING AND PROCESS ENGINEERING**

<b>QUALIFICATION : BACHELOR OF ENGINEERING IN MINING ENGINEERING</b>	
<b>QUALIFICATION CODE: 08BMEG</b>	<b>LEVEL: 7</b>
<b>COURSE CODE: SUM710S</b>	<b>COURSE NAME: SURFACE MINING 315</b>
<b>SESSION: JUNE 2023</b>	<b>PAPER: THEORY</b>
<b>DURATION: 2 HOURS</b>	<b>MARKS: 100</b>

<b>FIRST OPPORTUNITY EXAMINATION</b>	
<b>EXAMINER(S)</b>	<b>Privilege Rangarirai Shava, Pr.Eng.</b>
<b>MODERATOR:</b>	<b>Prof. Mallikarjun Rao Pillalamarry</b>

<b>INSTRUCTIONS</b>	
<ol style="list-style-type: none"><li>1. Answer all questions.</li><li>2. Read all the questions carefully before answering.</li><li>3. Marks for each question are indicated at the end of each question.</li><li>4. Please ensure that your writing is legible, neat and presentable.</li></ol>	

**PERMISSIBLE MATERIALS**

1. Examination paper.
2. Scientific Calculator.
3. Queue Table.

**THIS QUESTION PAPER CONSISTS OF 3 PAGES (Including this front page)**

### Question 1

The conventional mining cycle generally consists of unit operations in the form of drilling, blasting, loading and hauling. Outline how advances in technology, with specific reference to the fourth industrial revolution (also known as Industry 4.0 or 4IR), are likely to change (or currently changing) these operations in the future and how this may/may not impact the mining industry in general. [25]

*Candidates are advised to present the answer to the above question in essay form.*

### Question 2

ABC Mining Company has recently discovered a significant offshore diamond deposit off the coast of Namibia.

- a) Explain the process leading to the discovery of the diamond deposit and identify the factors that the company would have considered to declare the deposit mineable? [4]
- b) With the aid of a suitable diagram, advise the company on a potentially suitable mining method to economically exploit the deposit. [6]
- c) One of the key factors in the equipment selection for the proposed offshore project is capital cost versus Life-of-Mine. Explain this factor within the context of the proposed mining method in b. [5]
- d) With the aid of a suitable diagram, explain Strip Mining. [10]  
*General Guide: type of deposits amenable to strip mining, equipment used, production cycle, and how it differs from other conventional surface mining methods.*

### Question 3

- a) With the aid of an appropriate diagram, define the term Break Even Stripping Ratio. [5]
- b) A Zinc (Zn) deposit containing 60 000 000 tonnes of ore at an average head grade of 7.9% has been discovered in Namibia. Initial recoverability tests indicate a potential mill recovery of 0.85 with a concentrate grade of 50% and a Smelting Loss (SL) of 8.5kg/tonne of concentrate. It is also established that the deposit contains traces of recoverable Lead (Pb) that will be credited at the Refining stage at \$100/tonne of ore as a by-product credit. Refining Loss (RL) in consultation with the Zinc Refinery is established at 6.2kg/tonne of zinc ingots.  
The sum of mining and milling costs is estimated at \$300 /tonne of ore while General and Administration (G&A) costs are pegged at an industry average of 18% of mining and milling costs.  
Total Depreciation and Amortisation is estimated at \$500 000 000 (Five hundred million dollars) and will be charged against each tonne of ore to account for capital investment in plant and equipment.  
Treatment, Refining, and Transportation costs are provided as follows:  
Transport Costs per tonne of concentrate – \$154  
Smelting Costs per tonne of concentrate – \$154  
Transport Costs per tonne of Zn Ingots - \$154  
Refining Cost per tonne of Zn Ingots - \$125  
The London Metal Exchange (LME) quoted price for refined Zn as of 09 March 2023 is \$1.37/lb and 1 lb is equivalent to 0.453592 kg.

- I. You are required to determine the Net economic value per tonne of ore, hence the net economic value of the deposit. [15]
- II. Using interpolation, estimate the break-even cut-off grade for this project. [5]

#### Question 4

According to information available in the public domain, Otjikoto Gold Mine, a gold mine located in the central part of Namibia, with a workforce of approximately 1000 workers, is in the process of a phased mine closure. It is reasonable to assume that the mining operation will reach its economic life of mine within the next few years.

- a) In your view, provide three (3) advantages of a phased approach to mine closure as opposed to abrupt mine closure. [6]
- b) Assuming that you are appointed to lead the closure planning at B2Gold, identify any four (4) key issues would you expect the mine closure plan to address? [4]
- c) Mine closure often leads to the emergence of ghost towns. Suggest practical ways in which the mine closure of B2Gold mine can mitigate against the possibility of ghost towns. [6]
- d) Assuming that the orebody extends further than the ultimate pit depth, what advice would you give to the mine to extend life-of-mine and outline key design factors that you would take into account in your proposal? [9]

---End of Examination Paper---