FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF MINING ENGINEERING

SURFACE MINING

EMI 5202

Final Examination Paper

August 2021

This examination paper consists of 4 pages

Time Allowed: **3 hours**

Total Marks: **100**

Examiner's Name: **Mr. R Nyirenda**

INSTRUCTIONS

1. This paper contains **ONE** section with **FIVE** questions.
2. Answer **QUESTION ONE** and **any other THREE questions**.
3. Each question **carries 25 marks**.
4. Where a question contains subdivisions, the mark value of each subdivision is shown in brackets.
5. Illustrate your answer, where appropriate, with large clearly labelled diagrams.
6. Start each question on a new page.

Additional Requirements

Calculator

MARK ALLOCATION

Question 1 to 5	25Marks
Part Questions	As shown in each part question
Total Attainable	100

Question One

The following list describes the characteristics of a certain mineral deposit:

Shape = Tubular

Thickness = 30m

Dip = Intermediate (i.e., 20^0 to 55^0)

Minimum overburden depth = 14m

a) Select the most appropriate surface mining method to exploit this deposit. Explain your answer using a cross-sectional view of the topography, deposit, and chosen excavation geometry. **[6 marks]**

b) Describe the sequence of production and development operations which will be done to extract the deposit during application of the method suggested in (a). Suggest suitable equipment for each of the operations. **[12 marks]**

c) With the aid of a diagram, explain how the first excavation will be made in the overburden so as to gain access to the ore body for the method suggested in (a).

[7 marks]

Question Two

The Technical Services Manager at North-West Kangaroo open pit mine in Kalgoorlie, Australia has assigned you the task of optimising the in-pit and ex-pit haul road maintenance costs.

a) Specify all the necessary data that you need in your analysis. **[10 marks]**

b) Describe in detail how you would calculate the optimum road maintenance costs.

[15 marks]

Question Three

A particular open-cast loading and hauling system is single-queue single-server with the trucking time taking 15 to 18 minutes while loading time is about 4 minutes.

a) By making use of the match factor, calculate the number of trucks required in this material handling system. **[5 marks]**

a) Given that the expected truck availability for the material handling system mentioned in (a) is 80%, compute the fleet size required for such an operation. **[5 marks]**

b) Compute the expected waiting time if the trucks within the loading and hauling system are increased by 1 truck. **[3 marks]**

c) Describe the following:

    i.   Two (2) causes of a low match factor,   **[4 marks]**

    ii.   Two (2) effects of a low match factor, and   **[4 marks]**

    iii.   Two (2) solutions that increase the match factor to the required level.

                [4 marks]

Question Four

Appendix A is a block model cross section displaying gold grades (in g/t) of a mineral deposit in Rustenburg, South Africa. Determine the optimum pit geometry to mine this cross section using Lerchs-Grossman's 2D algorithm and calculate the reserve tonnage. **[25 marks]**

NB: The smallest block has the dimensions 4m height by 8m width. Assume that the 3rd dimension of all blocks is 4m. In addition, the dimensions of bigger blocks can be sub divided into smaller block dimensions using a suitable scale.

Additional data:

    i.   Density for all material in the block model is 2.4t/m³.

    ii.   Metallurgical recovery is at 88%.

    iii.   Selling price is at US$ 55.25/g.

    iv.   Processing cost is at US$ 11.25/t.

    v.   Ore and waste mining cost is both at US$ 3.50/t.

Question Five

a) i.   Briefly describe three (3) challenges associated with the transition from an open-pit mine to a suitable underground mining method so as to extract a deep-seated ore body.   **[9 marks]**

    ii.   Suggest two (2) approaches that can be used to determine the transition point mentioned in (a) (i).   **[4 marks]**

b) Pertaining to open cast extraction of old underground workings, explain the suitability of either the bord-and-pillar collapse or the bord collapse techniques in achieving the following:

    i.   Low dilution   **[6 marks]**

    ii.   Subsidence free benches   **[6 marks]**

END OF EXAMINATION PAPER

APPENDIX A: BLOCK MODEL CROSS SECTION

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	0	0	0.52	0.75	0	0	0			0		0	
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				1.82	1.82	0	0			0		0	
0		0		1.82	1.82	1.82	0						

Z
Y

AFTER WRITING THE WORKING FOR THIS QUESTION IN THE ANSWER BOOKLET, DRAW THE OPTIMUM PIT ON THE ABOVE BLOCK MODEL AND ATTACH THIS PAGE TO THE ANSWER BOOKLET.