FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF MINING ENGINEERING

TECHNICAL VALUATION

EMI 3102

Final Examination Paper

JUNE 2023

Time Allowed: **3 hours.**

Total Marks: **100**

Examiner's Name: **Mr. A.M . Antonio**

Authorized material: **Calculator**

INSTRUCTIONS

1. This paper contains **ONE** section with **FIVE** questions
2. Answer **QUESTION 1** and **any other THREE questions**
3. Each question **carries 25 marks.**
4. Where a question contains a subdivision, the mark value of each subdivision is shown in brackets.
5. Answer each question on a new page and write as eligible as possible
6. List of formulae is attached at the end of the exam.

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Question 1 (25 marks)

a) As the exploration geologist at TK mine, imagine that you are in charge of converting mine resources into reserves. Briefly describe the modifying factors you would consider. **[10marks]**

b) Using the information below, determine the grade of an unknown exploration drill hole using IDW.

Table 1: Showing grade and distance from an unknown point

Grade, g/t	Distance from the unknown hole, m
3.9	6
5.8	7
4.3	5

[5marks]

c) Data from a phosphate deposit exploration are shown in Table 2. You are required to compute the correlation coefficient and make a comment regarding the link between depth and grade using the information in Table 2 as a basis.

Table 2: Showing the variation in grade and depth.

Depth/m,	0	1	2	3	3	5	5	5	6	7	7	10
Grade/%	91	75	85	64	97	88	76	96	58	75	78	60

[10marks]

Question 2 (25 marks)

a) Explain the significance of collecting samples at each stage of a mining project and any steps you are taking to control the assay results' quality. **[12 marks]**

b) Name five sources of error that could lead to contamination during sampling, transportation, or assaying. **[5 marks]**

c) Calculate the rate of error propagation when sampling, transportation, and assaying error percentages are 4%, 7%, and 8%, respectively. **[3 marks]**

d) As a technical services manager, what factors should you take into account when choosing a sampling technique? **[5 marks]**

Question 3 (25 marks)

a) Explain the meaning of the stripping ratio and describe it as a pay limit. **[5 marks]**

b) What is the meaning of the intersection point on a grade-tonnage curve? **[5marks]**

c) What are grade-tonnage curves' limitations? **[5marks]**

d) A gold mine produces 2504t of ore of which 805t at a grade of 0.36g/t comes from development rock which is below the cut-off grade. The ore grade is 3.47g/t. Calculate the mill feed grade. **[5marks]**

e) ROM ore from different sections of a platinum mine was heaped separately as heap 1 to 5 and sampling was done, and the grades were observed as shown in Table 2. Calculate the weighted mean grade for the platinum deposit with grades and tonnage as shown in Table 2.

Table 1: Tonnage and grade of platinum

Heap	Tons (t)	Grade (g/t)
1	15	12.3
2	18	7.7
3	22	11.2
4	8	20.3
5	17	5.8

[5marks]

Question 4 (25 marks)

a) Define the following terms.
   i. Dilution
   ii. Pay limit.
   iii. Real losses
   iv. Mineral resources
   v. Mineral reserves **[10marks]**

b) Justify the reporting of resources and reserves using SAMREC and JORC reporting codes. **[5marks]**

c) Calculate the pay limit of iron ore of which 90% is recovered by concentration methods. This concentrate assays 54% iron which is sold to Antonio smelters. The payment for iron is $10500 per tonne of 89.6% of the contained tin in the concentrate. Treatment costs $100 per tonne of concentrate. Mine working costs $20 per tonne mined. MCF 90%. Freight charges $25 per ton.

[10marks]

Question 5 (25 marks)

a) A chicken feed (density = 0.69 g/cm3) contains an average of 0.06% of an enzyme powder that has a density of 1.18 g/cm3.The size distribution of the enzyme particle d= 1.00mm and the size range factor g=0.5 could be estimated.

Estimate the fundamental sampling error for the following analytical procedure. First a 500g sample is taken from a 25kg bag. This sample is ground to a particle size – 0.5mm. Then the enzyme is extracted from a 2g sample by using a proper solvent and the concentration is determined by using liquid chromatography. The relative standard deviation of the chromatographic measurement is 5%. **[10marks]**

b) Write down the formula used to determine the constant on P.Gy's fundamental sampling error model and explain all the variables present. **[5marks]**

c) You have to oversee the ore grade in your capacity as technical services manager for the Ndlovu mine. Explain five strategies you will use to keep your grade above the cutoff. **[10marks]**

List of formulae

$$E = t_c s_e \sqrt{1 + \frac{1}{n} + n¿¿¿}$$

$$t = \frac{r}{\sigma_r} = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}}$$

$$s_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}}$$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_{\bar{x}_1 - \bar{x}_2}}$$

$$s_e = \sqrt{\sum ¿¿¿}$$

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n\sum x^2 - (\sum x)^2}\sqrt{n\sum y^2 - (\sum y)^2}}$$

$$\sigma_n = \sqrt{\mu_n}$$

$$\sigma_r = \frac{1}{\sqrt{\mu_n}}$$

$$\sigma_{FE}^2 = C\, d_N^3 \left(\frac{1}{M_S} - \frac{1}{M_L}\right) \qquad C = f \cdot g \cdot \beta \cdot c$$

$$\beta = \sqrt{\frac{L}{d}}$$

$$s_x = \sqrt{\sum s_i^2}$$

$$z_0 = \frac{\sum_{i=1}^{s} \frac{z_i}{d_i^k}}{\sum_{i=1}^{s} \frac{1}{d_i^k}}$$

$$F = \frac{S_1^2}{S_2^2}$$

$$t = \frac{r}{\sqrt{\frac{1 - r^2}{n - 2}}}$$

$$\hat{y} = mx_i + b$$

$$m = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{n\Sigma x^2 - (\Sigma x)^2}$$

$$r = \frac{\sum \mathrm{xy} - \frac{\sum x \sum y}{n}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{n}\right).\left(\sum y^2 - \frac{(\sum y)^2}{n}\right)}}$$