



FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF MINING ENGINEERING

SMALL-SCALE/ ARTISANAL MINING

EMI 2209

Final Examination Paper

JUNE 2023

Time Allowed: 3 hours.

Total Marks: 100

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

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 | 25 Marks |
| Part Questions | As shown in each part question |
| Total Attainable | 100 |

Question One [25 marks]

1. From an international perspective, there is no universal definition of small-scale and artisanal mining as the mining methods and thus conditions differ from one region to another and recent efforts to agree on one definition have failed. Define ASM in the Zimbabwean context and South African context.

[7 marks]

2. Zimbabwe ratified the Minamata Convention on Mercury which was signed in October 2013 after it had been proven through various research studies “that artisanal and small-scale gold mining and processing in its territory is more than insignificant.” As a critical stakeholder in the Artisanal Small-scale Gold Mining (ASGM) sector explain:

(a) Two methods of reducing open-air burning of mercury gold amalgamation by ASGM

[4 marks]

(b) Three mercury-free methods of gold processing that could be used by ASGM miners.

[9 marks]

(c) What are the possible policy measures that could be put in place in Zimbabwe to reduce the use of mercury by ASM?

[5 marks]

Question Two [25 marks]

Discuss the challenges being faced by ASM in Zimbabwe under the following guiding headings:

- a. Technology
- b. Geology
- c. Finance
- d. Law
- e. Marketing

[25 marks]

Question Three [25 marks]

Identify and explain in detail five negative environmental impacts of artisanal small-scale mining with high severity and suggest practical mitigation measures for each identified impact.

[25 marks]

Question Four [25 marks]

(a) Considering the legal framework governing small to medium-scale miners in Zimbabwe, clearly outline fundamental gaps (lacuna) and/or challenges in the current Mines and Minerals Act Chapter 21:05 administered by the Ministry of Mines and Mining Development (MMMD)

[12 marks]

(b) As a mining engineer, what amendments would you make to the current Mines and Minerals Act Chapter 21:05 to create a win-win situation for the ASM miners and the Government of Zimbabwe?

[8 marks]

(c) Describe the significant role that Zimbabwe's ASM industry has played in the economic growth of the nation.

[5 marks]

Question Five [25 marks]

How would you redesign a model of a sustainable small to medium-scale gold mine with three (3) parameters in mind?

- i. Production cycle
- ii. Processing of gold
- iii. Revenue generation

Given that the mine was commissioned 3 years ago and has failed to break even and you have also been provided with information in Table 1.

Table 1 Production, processing, and tailings generated at the mine

| | |
|--------------------------------------|-----------------|
| Tonnage per annum | 480 tonnes |
| Average grade | 19 g/t |
| Diesel consumption | 40 liters/tonne |
| Costs of other consumables | US\$383/t |
| Hammer consumption | 0.9 kg/t |
| Mill capacity | 1.6 t/hr |
| Rate of recovery of gold | 49.7% |
| True content of gold in the tailings | 9.7 g/t |

Assumption: Price of gold remains at \$ 1 249. 20 per ounce for the next 6 months

1 ounce is equal to 28.34 g

[25 marks]

