FACULTY OF ENGINEERING AND THE ENVIROMENT

DEPARTMENT OF MINING ENGINEERING

MINE ENVIRONMENTAL MANAGEMENT HEALTH AND SAFETY

EMN 3109

Final Examination Paper

November/December 2024

This examination paper consists of 3 pages

Time Allowed : 3 hours

Total Marks : 100

Examiner's Name : Miss B. Ncube

INSTRUCTIONS

1. This paper contains 5 questions.
2. Answer **Question One (25 marks)** and any **other Three Questions** (25 marks each).
3. Where a question contains subdivisions, the mark value of each subdivision is shown in brackets.
4. Start each question on a new page.

NB: DO NOT OVERTURN THE QUESTION PAPER OR COMMENCE WRITING UNTIL INSTRUCTED TO DO SO.

Additional requirements

Non-programmable calculator.

MARK ALLOCATION

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

QUESTION 1

a. Below are some of the gases found in underground mines. Fill in the properties of these mine gases in the chart below. (15)

Gas	**Formula**	**Sources**	**TLV-TWA (ppm)**	**Symptoms of Exposure to workers (Side effects)**
Carbon Monoxide				
Hydrogen Sulfide				
Ammonia				
Nitrogen oxide				
Methane				
mark allocation	***2.5***	***2.5***	***5***	***5***

b. Upon re-opening a gold mine with abundant pyrites; after a weekend shutdown, a miner discovered that one of the water sources had a funny "rotten egg smell". His gas tester alarm sounded indicating a concentration of 20 ppm for this gas.

   i) Which gas is highly likely to have been discovered by this miner (1)
   ii) What immediate steps should be taken to ensure safety; and to eliminate or control the source of this gas. (4)

c. Describe the role of Artificial Intelligence in improving safety in underground mining. How can AI powered systems predict and prevent potential safety hazards, and what benefits do they offer compared to traditional safety measures? (5)

QUESTION 2

a. Distinguish between an accident and an incident. (4)
b. i. On June 6, 1972; Hwange colliery mine had an accident that killed 427 miners. An investigation was made to find out the causes of this accident. Describe the primary cause and contributing factors that could have led to this accident. (8)

   ii) Give 3 safety measures that could have prevented or mitigated this accident. (3)

   iii) How did this accident change the safety standards of mining in Zimbabwe addressing the safety regulations, legislation, miner training, education and long term in the mining industry (10)

QUESTION 3

a. What is an ergonomic hazard. (2)
b. A miner operates a load-haul-dump (LHD) machine in an underground mine. The miner has reported discomfort and fatigue after a full shift of operation.
   i) Identify and discuss potential ergonomic hazards associated with operating this machinery. (8)
   ii) Recommend two ergonomic design modifications that can be added to LHDs to improve worker's safety and efficiency. (4)
c. Discuss the role of the National Social Security Authority (NSSA) to occupational health in the Zimbabwe Mining Industry. (11)

QUESTION 4

a. List 5 hazards associated with open pit mining. (5)
b. Discuss the environmental impacts of Open Pit Copper mining operations in Zimbabwe. (12)
c. As an operations manager, what factors would you consider when doing an Environmental Impact Assessment (EIA) prior to development and production in an open pit Copper mining project. (8)

QUESTION 5

OK Tedi Mine is a copper and gold mine located in the Western Province of Papua New Guinea. The mine has been operational since 1984 and is one if the largest mines in the country. However, the mine's tailings disposal system failed in 1984, releasing large amounts of toxic waste into the OK Tedi River. The waste contained high levels of copper, cadmium, and other heavy metals causing wide spread environmental damage to the surrounding human population and the ecosystem.

a. Discuss the impacts of poor mine waste disposal practices. (8)
b. Explain 5 factors you would consider when selecting a site for mine waste disposal. (10)
c. Briefly describe Acid Mine Drainage (AMD) and how it affects the environment. (7)

~THE END~