FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF MINING ENGINEERING

MINE VENTILATION

EMI 3204

Final Examination Paper

June 2020

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Mr A.A Mukichi

INSTRUCTIONS

1. This question paper consists of one section with 6 questions, **YOU MUST ANSWER QUESTION ONE (1)** and **ANY OTHER THREE (3) QUESTIONS.**
2. Each question carries 25 marks.
3. Answer each question on a new page and write as eligible as possible.

Additional Requirements:
Non-Programmable Calculator

MARK ALLOCATION

Question 1 to 6	**25Marks**
Part Questions	**As shown in each part question**
Total Attainable	**100**

NB: DO NOT TURN OVER THE QUESTION PAPER OR COMMENCE WRITING UNTIL INSTRUCTED TO DO SO

Question 1 [25marks]

a) Name three harmful gases generally found in a mine; describe properties, sources, detection and frequency of occurrence of any two. **[10marks]**

b) Mine cooling requirements should be estimated after mining methods, work sites, production rates, and equipment are specified, and heat sources are identified. Heat sources are classified as either temperature independent heat sources or temperature dependent heat sources. You are required to discuss briefly the different sources of heat in underground mines. **[10marks]**

c) Imagine you are the planning engineer for Kademo Mines and a ventilation engineering student from Zimbabwe School of Mines approaches you asking for the composition of explosives that are being used at the mine. What do you think is the reason why the student is asking the composition of explosives in use?
[5marks]

Question 2 [25marks]

a) Discuss the following ventilation surveys normally carried out on a mine:
   i. Air quantity survey;
   ii. Temperature – humidity survey;
   iii. Pressure survey.

In each case, state the instruments used and the importance of the results obtained from each survey. **[15marks]**

b) Calculate the specific resistance of a 3m x 4m airway 300m long and a 2m diameter raise borehole 80m long. Assume an air density of 1.2kgm^{-3}. What is the pressure loss for the two airways?
   i. In series;
   ii. In parallel. **[10marks]**

Question 3 [25marks]

a) Total mine air conditioning depends on the mining method. Discuss. **[10marks]**

b) Assuming moderate work, an oxygen content of 21%, and a carbon dioxide content of 0.03% in the intake air, find the quantity of air Q in cfm that must be supplied per individual if the downstream air current is to be maintained at acceptable levels (i.e., 19.5% 0 2 and 0.5% C02). Which value is used to govern the minimum quantity to be supplied per individual and why? **[7marks]**

Table 1: Respiratory Requirements

Type of Activity	Respiratory Rate, breaths/min	O_2 Consumed, cfm	Respiratory Quotient
At rest	12-18	0.01	0.75
Moderate work	30	0.07	0.90
Vigorous work	40	0.10	1.0

b) Briefly describe:

i. Natural Ventilation;
ii. Forced and exhaust ventilation. **[8marks]**

Question 4 [25marks]

a) A 3.2 m high by 4.3 m wide by 3 m long drift round is blasted in quartzite where the VRT is 47°C. Quartzite has 2700 kg/m^3 density and a 0.8 kJ/(kg•K) specific heat. By the time the rock is hoisted to the surface 4 hours later, it has cooled to 32°C. What is the heat load imposed on the drift and shaft. **[5marks]**

b) In the context of mine ventilation, why is it important to optimize the fragment size of ore from primary blasting? **[10marks]**

c) Discuss the main differences between axial flow fans and centrifugal fans, and state under what conditions what conditions each type would be preferred. **[10marks]**

Question 5 [25marks]

a) List five (5) ways in which dust or fumes may be generated in the underground working environment. **[5marks]**

b) When designing ventilation systems for a mine it should be flexible to accommodate varying operating conditions. Discuss these operating conditions that can affect the efficiency of the ventilation system and how they affect total air condition in the mine. **[10marks]**

c) Define reject temperature. As a ventilation engineer explain why it shouldn't be too high or too low? **[5marks]**

d) Where the "ore" is soft, continuous mining machinery can be applied. Compare and contrast "conventional" hard rock and "continuous" soft ore room and pillar operations with respect to ventilation. **[5marks]**

Question 6 [25marks]

a) Three splits A, B and C of a mine having resistances 0.2 NS^2m^{-8}, 0.4 NS^2m^{-8} and 0.6 NS^2m^{-8} respectively, are connected in parallel. An 800Pa fan is installed across them. Resistance of trunk air and shaft are negligible. Calculate the total airflow of mine and neatly draw the circuit diagram of the mine's ventilation system. **[10marks]**

b) What are the benefits of bulk cooling over spot cooling? Where is spot cooling applicable? **[10marks]**

c) You are a newly appointed ventilation officer and ventilation costs are increasing as depth of mining increases. What will be your explanation to the general manager who is trying to produce more with less? What is the major cost driver in ventilation? **[5marks]**

End of Examination

Three splits A, B and C of a mine having resistances 0.2 NS $^{2}m^{-8}$, 0.4 NS $^{2}m^{-8}$ and 0.6 NS $^{2}m^{-8}$ respectively, are connected in parallel. An 800 Pa fan is installed across them. Resistance of trunk air

and shaft are negligible.

Calculate the total airflow of mine and neatly draw the circuit diagram of the mine's ventilation system.

Three splits A, B and C of a mine having resistances 0.2 NS ^{2} m $^{-8}$, 0.4 NS ^{2} m $^{-8}$

and 0.6 NS^2 m^{-8} respectively, are connected in parallel. An 800 Pa fan is installed across them. Resistance of trunk air and shaft are negligible.
Calculate the total airflow of mine and neatly draw the circuit diagram of the mine’s ventilation system.