FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF MINING ENGINEERING

MINE VENTILATION

EMI 3204

Final Examination Paper

August 2021

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Miss N.R Gwati

Additional 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 subdivision, the mark value of each subdivision is shown in brackets
5. Start each question on a new page

Additional Requirements

None

MARK ALLOCATION

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

QUESTION 1

a) What is the purpose of ventilating a mine? (3 marks)
b) Give six factors that you would consider key in the design of a ventilation system and briefly explain any three factors of your choice. (9 marks)
c) At what stage of a life mine cycle do you think ventilation planning should be done and how should future plans be incorporated. (5 marks)
d) Given 3 airways, 1, 2, and 3 in series, Q = 9.44m/s with pressure drops P1 = 497.68Pa, P2 = 248.84Pa and P3 = 746.52Pa find Q, P and R. (3 marks)
e) Given the three airways in the previous question with resistances R1 = 5.585, R2 = 2.793, and R3 = 8.378 in N-s2/m8), arranged in parallel, with the total Q = 47.195 m3/s; find system P and R and the quantities Q1, Q2, and Q3.(5 marks)

QUESTION 2

a) What is natural ventilation and explain the disadvantages of using natural ventilation in ventilating an underground mine. (5 marks)
b) Discuss the advantages and disadvantages of using a positive mine pressure or blowing ventilation system (5 marks)
c) What is the effect of using the following as means of controlling the flow of air underground?
   I)   Ventilation doors and stoppings (4 marks)
   II)   Air crossings and Regulators (4 marks)
d) Calculate the pressure difference (drop) across a concrete lined shaft 3.5m diameter 350m long. The airflow measure with an anemometer is 175 m/s. Assume standard density for air (1.2 kg/m3). Given the following

Airway Type	"k" Factor (Ns^2/m^4)
Smooth Pipe	0.0028
Normal rigid ducting	0.0030 to 0.0035
Flexible ducting	0.0030 to 0.0065
Concrete surface	0.0035 to 0.0040
Rock Surfaced	0.0010 to 0.0200
Raisebored	0.0035 to 0.0050

III)   What is the pressure drop for the same flow if the shaft was rock walled (7 marks)

QUESTION 3

a) Name three harmful gases generally found in a mine; describe properties, sources detection and frequency of occurrence of any two. (10marks)
b) What are the three systems that are used in ventilating a development end? What are the advantages and disadvantages of each of the systems? Illustrate using diagrams. (12 marks)
c) What factors in a ventilation duct determine the size of a fan to be installed? (3marks)

QUESTION 4

a) List any five sources of heat in a mine and give a brief explanation of three from your list. (8 marks)
b) Total mine air conditioning depends on the mining method. Discuss. (8 marks)
c) Briefly describe the process of carrying out an air quantity survey. (5 marks)
d) Give two problems that can be encountered when carrying out this procedure and suggest the solutions. (4 marks)

QUESTION 5

a) What are the main differences between axial flow fans and centrifugal fans, and state under what conditions what conditions each type would be preferred? (4 marks)
b) Compare and contrast between the forward bladed and the back bladed fans under these headings. Size, pressure, speed, quality, reversibility and efficiency. (9 marks)

c) A fan is running at a speed of 10 revs per second and the density of air is 1.2 kg/m3. The fan will deliver 115m3/s at 13.7 mbar using 225KW and an efficiency of 70.2%. If the fan runs at 13.3 rps and handling air density of 1.04kg/m3 what will be the new:

     i.   Quantity
    ii.   Pressure
   iii.   Input Power
   iv.   Efficiency.   (12 marks)