FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF MINING ENGINEERING

MINE VENTILATION PRACTICE

EMN 3110

Final Examination Paper

NOVEMBER/DECEMBER 2024

This examination paper consists of 3 pages.

Time Allowed: 3 hours.

Marks: 100 Total

Examiner's Name: Mr A Antonio

INSTRUCTIONS

1. This paper contains **SIX** questions.
2. Answer any FIVE **QUESTIONS**.
3. Each question carries 20 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.
7. This paper comprises 3 printed pages.

Additional Requirements

Calculator

QUESTION ONE [20 MARKS]

a. Identify three primary functions of a mine ventilation system and briefly describe how each contributes to safe and efficient mine operations. **[6 Marks]**

b. Describe the differences between underground mines' natural and mechanical ventilation systems, highlighting their advantages and disadvantages.

[9 Marks]

c. Explain the concept of fan laws and how they can be used to predict the performance of a centrifugal fan under different operating conditions. **[5 Marks]**

QUESTION TWO [20 MARKS]

a. A mining engineer needs to measure the pressure drop across a ventilation regulator in an underground mine. Outline the steps they would take to obtain an accurate pressure measurement, and discuss the potential sources of error that should be considered.

[10 Marks]

b. Describe the factors that influence the resistance to airflow in an underground mine.

[7 Marks]

c. Calculate the resistance to airflow in a mine roadway that is 1,200 m long, 5 m wide, and 3 m high, with a perimeter of 16 m and a roughness coefficient of 0.002. The airflow rate in this roadway is 50 m^3/s. **[3 Marks]**

QUESTION THREE [20 MARKS]

a. Describe the three main types of pneumoconiosis that are of concern in the mining industry, for each type discuss the primary causative mineral dust. **[6 Marks]**

b. Discuss the importance of monitoring dust levels in underground mines and describe the key methods and instruments used for measuring airborne dust concentrations.

[8 Marks]

c. A mining operation is considering installing a new ventilation system to improve silica dust exposure control. The engineer needs to estimate the potential reduction in worker exposure. Calculate the expected decrease in respirable silica dust concentrations if the new ventilation system can increase the airflow rate from 50 m^3/s to 75 m^3/s in the affected work area. Assume the initial silica dust concentration is 0.2 mg/m^3.

[6 marks]

QUESTION FOUR [20 MARKS]

a. Carbon monoxide (CO) gas is referred to as an ambush gas and methane (CH4) gas is firedamp because of their properties. Briefly describe the properties of each gas and their physiological effects on human beings. **[10 Marks]**

b. Briefly explain how you can control mine gases to prevent loss of life or occupational health problems. **[6 Marks]**

c. Write short notes on the dangers and effects posed by each of the gases (listed below) on human beings.

i. Hydrogen Sulphide

ii. Nitrous fumes **[4 Marks]**

QUESTION FIVE [20 MARKS]

a. Heat can be a major problem in underground mines. Outline major sources of heat in an underground mine. **[8 Marks]**

b. An underground metal mine is experiencing problems with excessive heat and humidity in some production areas. Describe how you would approach the design of a cooling system to address these environmental issues. **[4 Marks]**

c. Describe the signs and symptoms of heat exhaustion, a common heat-related illness encountered in hot and humid underground mining environments.

[8 Marks]

QUESTION SIX [20 MARKS]

a. Blanket Mine is expanding its operations and requires changes to the existing ventilation system. Outline the key factors you would evaluate to design an effective ventilation system for the expanded mine. **[5 Marks]**

b. A new underground mine is being planned. Describe the step-by-step design procedure you would follow to determine the optimal size, type, and placement of the main mine fans. **[7 Marks]**

c. Compare and contrast the advantages and disadvantages of exhaust versus force ventilation systems for underground mines. Which type of system would you recommend for a new coal mine and why? **[8 Marks]**