Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, May/June 2024

Mining Engineering

Fourth Semester

MI 5402 – Mine environment and ventilation

(Regulation 2019)

Time: 3 hrs **Answer ALL Questions** Max.Marks: 100

CO1	Obtain a basic knowledge about mine gases their properties and effects.
CO2	Have basic knowledge of underground mine atmosphere, parameters influencing mine environment, measurement methods and instrumentation.
CO3	Have knowledge about the principal laws governing mine ventilation systems.
CO4	Have knowledge about natural ventilation, ventilation methods and air distribution in mines.
CO5	Obtain knowledge about mechanical ventilation systems, ventilation monitoring and planning

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10 x 2 = 20 Marks)

Q.No	Questions	Marks	CO	BL
1	What is the reaction of methane in air?	2	1	1
2	What is the principle of working of M.S.A Methanometer?	2	1	2
3	What is dew point?	2	2	2
4	What is geothermic gradient?	2	2	1
5	What would be the pressure needed to circulate $40m^3s^{-1}$ of air through a roadway of dimensions 2.5m x 2.8m, with a length of 350m. ($k = 0.0092\ Ns^2m^{-4}$)	2	3	3
6	What is kata Factor?	2	3	2
7	Calculate the Natural ventilating pressure in a mine with the following data: Depth of the mine: 1000m Pit top barometer reading: 101.5 kPa Pit bottom barometer reading: 99.5 kPa Average temperature of upcast shaft: 309 K Average temperature of downcast shaft: 302 K	2	4	3
8	Explain the usage of a regulator for ventilation control.	2	4	2
9	What is the suitable system of ventilation for an underground coal mine?	2	5	2
10	What are the basic characteristics of centrifugal fans?	2	5	1

PART- B (5 x 13 = 65 Marks)

Q.No	Questions	Marks	CO	BL
11 (a) (i)	An advancing longwall face with a daily production of 25000 tonnes of coal emits $30m^3$ of methane per tonne of coal. Calculate the ventilation necessary to keep the methane concentration below 0.75%.	4	1	3
(ii)	With a neat diagram explain the working of bellow type CO detector tube.	9	1	2
	OR			
11 (b) (i)	Explain the scope and importance of ventilation surveys.	6	1	3
(ii)	Explain the various tests done with a flame safety lamp.	7	1	3
12 (a) (i)	Analyze the various sources of heat in mine air, and conclude on the sources that have a considerable effect on the miner.	11	2	3
(ii)	Calculate the heat added to the mine by a mine hoist of 2000 kW capacity working with an efficiency of 65%.	2	2	3
	OR			
12 (b) (i)	With neat diagram, explain the construction and working of surface air conditioning plant at Champion reef mine, Kolar gold Fields.	10	2	2
(ii)	List the advantages and disadvantages of surface and underground refrigeration plants.	3	2	2
13 (a) (i)	A mine airway 3.1m wide, 2.9m high and 800m long contains a normal bend with a deflection of $\pi/5$ radians and a radius of curvature of 8m. The quantity of air passing is 19.5 m^3s^{-1}. Calculate the pressure loss as well as the resistance of the airway. Also calculate the length of the straight airway of similar size and surface which will cause the same pressure loss. Assume the value of k to be equal to 0.0098 Ns^2m^{-4}.	10	3	3
(ii)	What are shock and frictional resistances?	3	3	2
	OR			
13 (b) A rectangular roadway 3.4 x 2.8m in cross section and 900m long passes 5500 m^3/min of air. What would be the saving in power if				
(i)	The entire length of the roadway is enlarged to a height of 3.75m maintaining the same width of 4m throughout,	3	3	3
(ii)	The roadway is concreted to a finished section of 3.1 x 2.0 m throughout assuming the flow to remain unchanged and the coefficient of friction for unlined and concrete lined roadways to	10	3	3

	be 0.02 Ns^2m^{-4} and 0.004 Ns^2m^{-4} respectively. Further assuming the cost of electric power to be Rs 15 per unit, and an overall fan and drive efficiency to be 65%, calculate the most economic one of the alternatives (i and ii) if the cost of stripping is Rs 12,000 per meter and the cost of lining is Rs 10,000 per meter length of the roadway, having an expected life of 15 years.			
14 (a) (i)	Two parallel splits A and B have a pressure of 400 Pa acting across them, causing a flow of 15 m^3s^{-1}in split A and 16 m^3s^{-1}in split B. It is desired to reduce the quantity in split A to 18 m^3s^{-1} by placing a regulator in it. Calculate the size of the regulator and the quantity in split B after regulation if the surface fan pressure is 4.5 kPa.	9	4	3
(ii)	Explain the working of automatic doors in underground mines.	4	4	1
	OR			
14 (b) (i)	With neat diagrams, explain the boundary system of ventilation.	4	4	2
(ii)	Two splits A and B pass 36 m^3s^{-1} and 46$m^3s^{-1}$of air respectively with a pressure drop of 500 Pa across them. The trunk airways consume a pressure of 400 Pa. Calculate the size of the regulator required to equalize the flow in the two splits. What will be the flow through the mine now? Assume fan pressure to remain constant.	9	4	3
15 (a) (i)	Explain the series and parallel operation of mine fans with relevant graphs.	9	5	2
(ii)	Explain the applicability of air lock and air crossing.	4	5	2
	OR			
15 (b) (i)	The impeller of a backward bladed centrifugal fan has a diameter of 2800mm and a width of 1200mm at the outlet. Calculate the maximum theoretical head the fan will develop when rotating at a speed of 1500 rad/min. Assume meridional entry into the impeller. What will be the theoretical head developed when circulating 50$m^3s^{-1}$of air if the outlet vane angle is 1.35 radians? What is the maximum theoretical capacity of the fan?	9	5	3
(ii)	A mine produces 1000 tonnes of coal per day employing 50 persons releasing 0.5m^3 methane per tonne of coal. What should be the basic ventilation standards as per CMR, with reference to quantity of air supplied and methane percentage in the mine?	4	5	2

PART- C (1 x 15 = 15 Marks)

Q.No	Questions	Marks	CO	BL
16.	A coal seam has an inclination of 5^0 dip and is located at a depth of 300m from the surface. It is planned to mine the deposit using bord and pillar method of mining. If the surface fan pressure is 10 kPa with a capacity of $20m^3s^{-1}$, estimate the number of roadways that can be maintained with the available pressure (series and parallel roadways). The average width, height and length of the roadways can be 2.5m, 2.4m and 100m. N.V.P of 1 kPa can be taken into account throughout the year. How does the use of ventilation control devices at appropriate locations modify the air flow?	15	5	3