Section A (Multiple Choice Questions): 0.5 mark each

Sl. No	Question							Answer
1	Transportation of methane from cleats to production well follows ……. of fluid through porous media							
	a	Fick's 1st law	b	Fick's 2nd law	✓	Darcy's law	d	All of the above	
2	The thermogenic methane is formed by ……							
	a	Bacterial action below 50 °C	b	Bacterial action above 50 °C	c	Bacterial action at 50 °C	✓	None of the above	
3	Coalbed methane is generated in the source rock and migrated into the reservoir.							
	✓	True	b	False	c	Partial True	d	Partial False	
4	Methane gas storage occurs by adsorption on macropore surfaces							
	a	True	✓	False	c	Partial True	d	Partial False	
5	Diffusion of methane from the pores to cleat network by following …							
	✓	Fick's 2nd law	b	Pressure gradient	c	Darcy's aw	d	Both (b) & (c)	
6	Gob wells are commonly used to recover high-quality methane (typically greater than 95% methane).							
	a	True	✓	False	c	Partial True	d	Partial False	
7	The surface-to-inseam (SIS) is suggested for high-permeability coal beds.							
	a	True	✓	False	c	Partial True	d	Partial False	
8	The minimum horizontal distance achieved by medium radius horizontal drilling…							
	a	3m	b	60 m	✓	460 m	d	600 m	
	Which of the following hydraulic fracturing fluids is preferred in highly fractured							

	fracture fluid	fluid			perforation fluid		fluid	
16	What is the most common purpose for hydro fracking ...							
	a	Mineral ores	b	Petroleum	c	Natural gas	d	Geothermal energy

Section B (Short Answer Question): 2 mark each

Sl. No	Question
17	In a longwall panel, the gas contents prior to mining and after mining are 120 ft^3/ton and 40 ft^3/ton, respectively. The rate of mining and the ventilation rate in a longwall face of 1000 ft length are 8 ton/min and 37,500 ft^3/min, respectively. What would the percentage of methane concentration at the tailgate if the average methane lost in the gob with air leakage is 250 ft^3/min?

Solution: |

	a			b	60 m	c	460 m	d	600 m	
9	Which of the following hydraulic fracturing fluids is preferred in highly fractured coal reservoirs for coalbed gas production?									
	a	Gelled fluids		b	Linear gels	c	Foam gels	d	Plain water ✓	
10	The value of COD is related to BOD as…									
	a	COD > BOD ✓		b	COD = BOD	c	COD < BOD	d	There is no relation	
11	The permissible value of COD in the effluent discharge from a coal mines is									
	a	120 mg/L		b	240 mg/L	c	150 mg/L	d	250 mg/L ✓	
12	The ultimate Bod value of a waste									
	a	Increases with temperature	b	Decreases with temperature	c	Remains the same at all temperature ✓		d	Doubles with every 10^0C rise in temperature		
13	When a mine water is disposed off in a river, the rate of depletion of dissolved oxygen of the river mainly depends on									
	a ✓	BOD of the mine water	b	COD of the mine water	c	Total organic carbon present in mine water		d	Dissolved oxygen present in the mine water		

P.T.O.

	Which of the following is correct regarding frac fluids?						
14	a	Fluid injected into a well for simulation purpose	b	Fluid produced from a well for stimulation purpose	c	Fluid produced from a well for simulation purpose	d	✓ Fluid injected into a well for stimulation purpose
	Which of the following is correct regarding slickwater?						
15	a ✓	A type of fracture fluid	b	A type of packer fluid	c	A type of perforation fluid	d	A type of kill fluid
	What is the most common purpose for hydro fracking …						
16	a	Mineral ores	b	Petroleum	c ✓	Natural gas	d	Geothermal energy

MID-SEMESTER EXAMINATION

Examination: 6th Sem B. Tech. (Mining Engineering)

Session: 2023-2024   **Semester**: Winter

Subject: Coal Mine Methane Recovery and Utilization (MNO304)
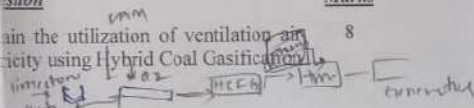
Time: 2 hrs   **Max. Mark**: 32

Instructions: *Answer ALL questions*

Q.No.	Question	Marks
1.	With the help of a diagram, explain the utilization of ventilation air methane for the generation of electricity using Hybrid Coal Gasification Technology.	8
2	Explain how you would obtain the methane emission factors and the methane emission from both surface and underground mines?	4+4
3	With the help of diagrams, describe any two technologies for improving the quality of coal mine methane.	4+4
4	With the help of diagrams, describe the formation of coalbed methane and the different phases of methane movement in coal.	3+5

END

Examination: 6th Sem B.Tech. (Mining Engineering)

Semester: Winter

Session: 2023-2024

Subject: Coal Mine Methane Recovery and Utilization (MNO304)

Max. Mark: 100

Time: 3 hrs

Instructions: *Answer any Five questions*

Q. No.	Questions	Marks
1.	a) With the help of a diagram, explain the application of vertical wells with hydraulic fracturing.	10
	b) The following data were measured in a gassy coal seam: • Total methane emissions when no mining is done = 100 ft³/min • The rate of mining = 8 ton/min • The gas contents of coal prior to mining = 120 ft³/ton • The gas contents of coal after mining = 60 ft³/ton • The average methane lost in the gob with air leakage in a 1000 ft long face = 200 ft³/min Calculate total methane emission at the tailgate. Also calculate the ventilation rate needed to dilute the total methane emission to 0.8%.	6+4
2.	a) With the help of a diagram, explain the coal seam degasification with In-mine horizontal drilling in the longwall panel.	8
	b) Calculate the steady-state gas production from a vertical well for the following given conditions: • Permeability of coal = 3 md • Thickness of the coal seam = 40 ft • Average viscosity of gas = 0.02 cp • Average compressibility factor = 0.90 • Temperature = 60 °F • The radius of the well = 0.25 ft • External radius = 1000 ft • Pressure at external radius = 500 psi • Pressure at the well radius = 50 psi. • Coal density = 0.04 ton/ft³ If the gas content of coal is 600 ft³/ton, how many fracture wells will be needed to degas a longwall panel of 1000 × 10,000 ft in 5 years? Assume that the total gas production declines by the following power law with the characteristic 'n' of the coal seam equal to 0.8: $Q = At^n$, where Q is the cumulative gas production, A is the initial production, t is the time in day.	6+6

3.	a)	Suppose P and V are the reservoir pressure in MPa and gas content in m^3/t of a coal seam. When an adsorption isotherm is plotted with P/V on Y-axis and P on X-axis, the following straight-line equation is obtained: $$P/V = 0.1641P + 0.1454$$ Calculate the maximum sorption capacity of coal and Langmuir pressure.	10

	b)	The following figure shows the adsorption isotherm for the prediction of methane recovery in a coal seam. From the figure, calculate the following parameters:
		  i. Percentage of undersaturation of initial reservoir pressure
		  ii. Percentage of maximum gas recovery.
			10

Langmuir volume (VI) determines for dry, ash free sample at 786.8 scf/ton (hb report)

Langmuir pressure (PI) determined from dry, ash free iseth/mm at 334.3 psi

Sample mxc gas storage capacity 590 scf/ton

Undersaturation

Critical desorption pressure 932 psi

Initial in-situ sample gas content 460 scf/ton

Initial reservoir pressure 1620 psi

Finalin-situ sample gas content 110 scf/ton

Abandonment pressure 75 psi

Gas storage capacity (scf/ton) — Reservoir pressure (psi)

4.	a)	With the help of a diagram, explain the different phases of coalbed methane gas production.	10
	b)	Explain how you would obtain the methane emission factors and the methane emission from both surface and underground mines.	10
5.	a)	With the help of diagrams, describe the open-hole and cased-hole coalbed gas wells used for the production of gas from multiple coalbeds of coal zones.	7+7
	b)	Explain the different utilisations of coal mine methane.	6

6.	Calculate the net methane reduction and electricity generation by using ventilation air methane for the following conditions of an underground coal mine: • Ventilation air methane fed to rotary kiln = 12000 m³/min • The average concentration of methane in ventilation air = 0.5% • The gross calorific value of methane = 33402 kJ/m³ • The efficiency of rotary kiln = 26% • Global warming potential of methane = 28 Assume the suitable data, if required.	20
7.	a) What are the guidelines for the recovery of methane from working coal mines?	10
	b) Describe the different gas adsoption isotherms and the method of measurement of the gas content of a coal sample.	10

End of the Question Paper

FORMULA

$$Q = \frac{707.8\, kh\, (p_e^2 - p_w^2)}{\mu z T \ln(^{r_e}/_{r_w})}$$

MID-SEMESTER EXAMINATION

Examination: 6th Sem B. Tech. (Mining Engineering)

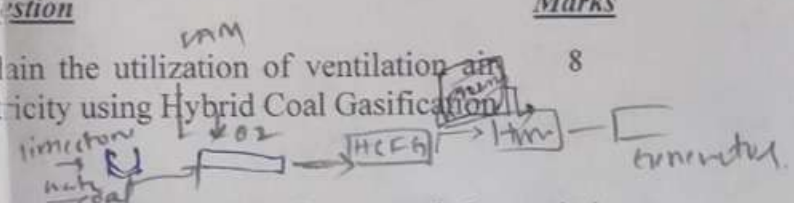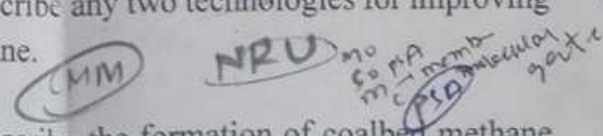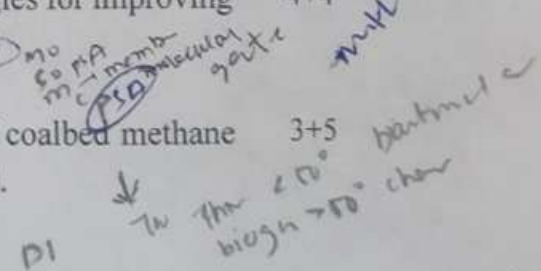**Session**: 2023-2024   **Semester**: Winter

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