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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2023

Semester : Semester V - 2020
Course Code : PET2015
Course Name : Sem V - PET2015 - Coal Bed Methane
Program : B.Tech. Petroleum Engineering

Date : 13-JAN-2023
Time : 9.30AM - 12.30PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.

PART A

ANSWER ALL THE TEN QUESTIONS **10 X 2 = 20M**

1. Identify the characteristics used in classifying coal.

(CO1) [Knowledge]

2. Describe 'Coal Petrology'.

(CO1) [Knowledge]

3. Discuss the process of biogenic gas generation.

(CO2) [Knowledge]

4. Define 'Face Cleat' and 'Butt Cleat'.

(CO2) [Knowledge]

5. _____ casing must be designed to withstand fracturing stimulation treatment pressures and large enough to allow_____of water and gas.

(CO3) [Knowledge]

6. When the coals are at an overpressured condition, or the formations encountered are unstable, it may be necessary to drill in an overbalanced condition to provide borehole_____and_____control.

(CO3) [Knowledge]

7. Discuss "Lost Circulation".

(CO3) [Knowledge]

8. List down any two disadvantages of Open Hole Completions.

(CO3) [Knowledge]

9. Write the full form for CMM and CSG.

(CO4) [Knowledge]

10. Write the full form of DGMS and CIMFR.

(CO4) [Knowledge]

PART B

ANSWER ALL THE FOUR QUESTIONS **4 X 10 = 40M**

11. A cross-plot between coal rank and cleat frequency is shown in Figure A below. Illustrate the importance of Figure A.

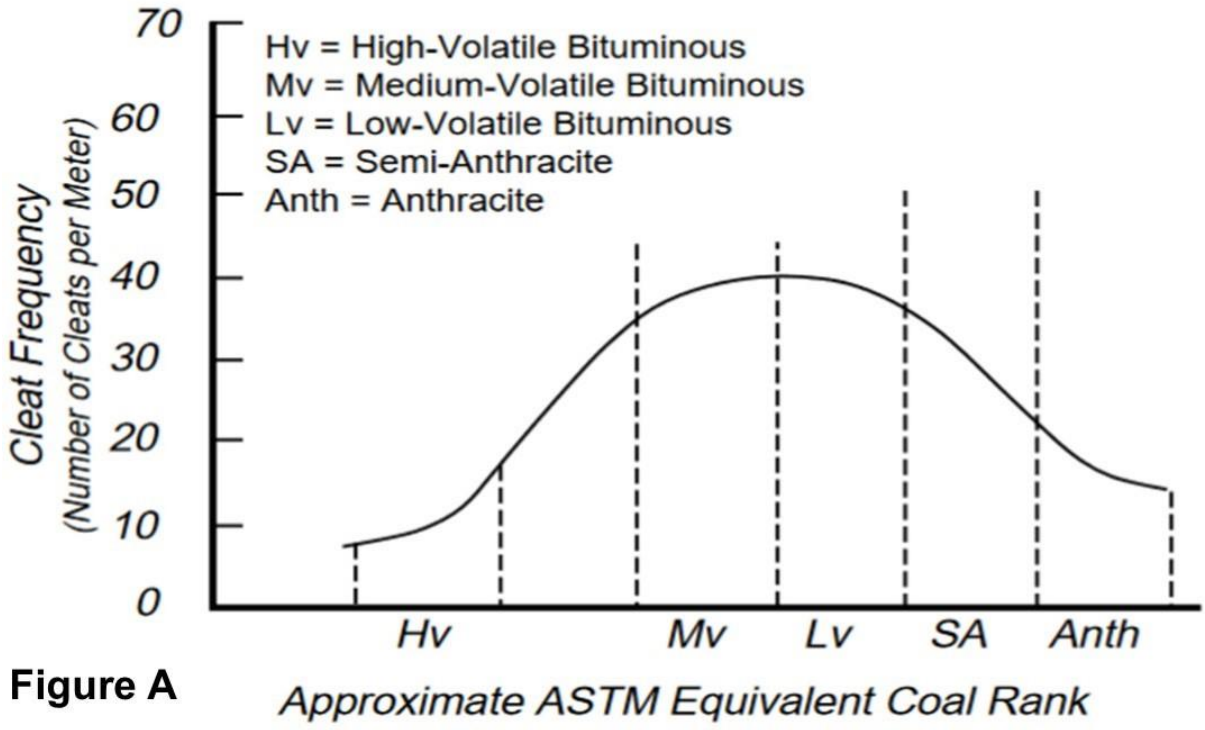

Figure A

(CO1) [Comprehension]

12. "The two-phase flow in the cleat system can be adequately represented by Darcy's law. Cleat system porosity, permeability, and relative permeability control the fluid flow within the cleat system. As the desorption process continues, gas saturation within the cleat system increases, and the flow of methane becomes increasingly more dominant. Thus, the water production declines rapidly until the gas rate reaches the peak value and water saturation approaches the irreducible water saturation. Keeping the above observation in mind, draw and illustrate a typical production history curve of a coal bed methane reservoir."

(CO2) [Comprehension]

13. The vast majority of the gas in coals is stored by adsorption in the coal matrix. As a result, pressure–volume relationship is defined by the sorption isotherm. A sorption isotherm relates the gas storage capacity of coal to pressure and depends on the rank, temperature, and moisture content of the coal. The sorption isotherm can be used to predict the volume of gas that will be released from the coal as the reservoir pressure is lowered. Explain the typical sorption isotherm presented in Figure X1.

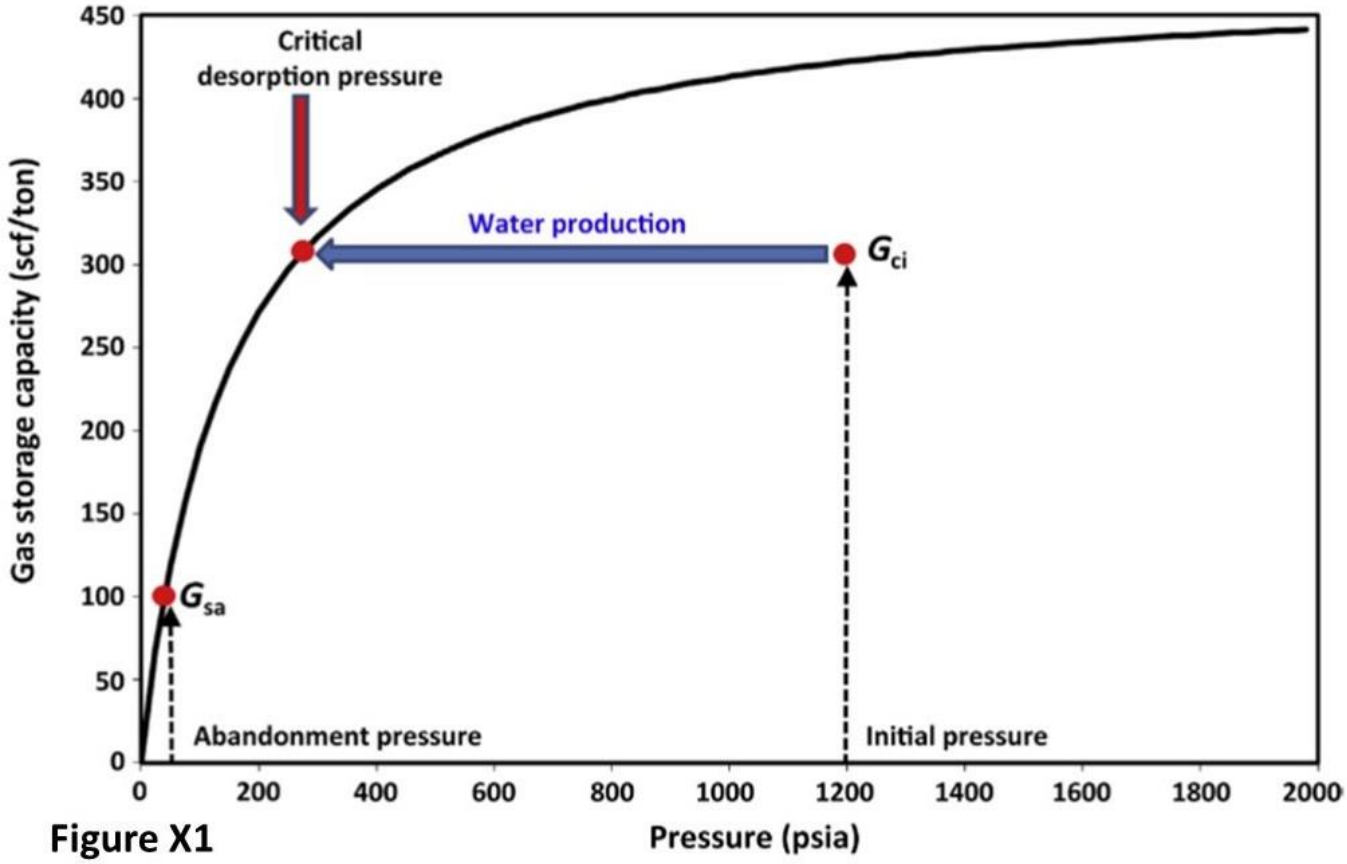

Figure X1

(CO3) [Comprehension]

14. Kalidaspur, which is situated on the southern bank of Damodar River in the Raniganj coalfield, is a Degree III gassy mine where extraction of coal from R-IX (Ghusick) and R-IXA (Ghusick A) seams has been in progress by conventional Bord and Pillar method. The average thickness of R-IX seam is 3.2 m and that of the R-IXA seam is 2.75 m. These seams are separated by 18–20 m of parting. The leasehold area of Kalidaspur project is 9.34 km2. Presently R-IX seam is fully developed whereas R-IXA seam is being developed. Mining methods involve drill and blast and load out techniques. The mine is serviced via a drift and was opened in 1984. The colliery currently produces thermal coal. The current production target rate is 450 tonnes per day, 350 tonnes is more than usual. The area appears to be minimally affected by faulting and has not experienced outbursts. R-I is the lowermost coal seam whereas R-IX is the top most coal seam. Table A displays in-situ gas content, sorption time, and proximate analysis of coal core samples retrieved from the borehole drilled near Kalidaspur Colliery.

(a) Interpret the data given in Table A and list down the observations.

(b) Plot Seam Name versus Gas Content and explain the variation in gas content with depth. Assume the depth gap (parting) between each seam is 100 m.

Table A:

Seam name	Thickness (m)	Gas content (m^3/t)	Sorption time (t_0) (days)	Moisture (%)	Ash (%)	VM (%)	FC (%)
R-IX	2.76	0.70	4.16	6.67	14.45	32.13	46.75
R-IXA	2.90	1.00	3.48	4.31	14.27	33.90	47.52
R-VIII	1.09	1.2	3.53	3.65	18.96	33.22	44.16
R-VII	4.95	1.87	4.67	3.20	51.35	20.44	25.00
L-2	1.55	3.09	3.91	3.12	31.76	26.70	38.42
R-VI	1.67	3.43	3.49	2.58	22.15	30.99	44.28
R-VA	0.50	4.77	4.90	3.14	35.37	25.88	35.61
R-VB	0.50	4.89	4.17	2.26	25.26	28.95	43.53
R-VC	0.50	5.17	4.31	1.90	46.46	23.42	28.21
R-IV	2.20	5.10	3.87	1.93	22.60	31.35	44.12
R-III	1.00	5.36	4.25	1.87	30.19	27.99	39.95
R-II	1.19	5.64	4.73	2.12	48.13	20.66	29.10
R-I	0.53	5.55	5.81	2.05	35.34	26.02	36.60

(CO4) [Comprehension]

PART C

ANSWER ALL THE TWO QUESTIONS **2 X 20 = 40M**

15. Prepare a summary of current practices implemented in the industry related to CBM Produced Water Treatment.

(CO3) [Application]

16. The major issues concerned with the CBM possibilities are (i) identification of suitable areas with the potential of generating methane in substantial quantity in the selected coal basins, (ii) critical evaluation of the retention capability of the reservoir, and near accurate assessment of the retained quantum keeping the migration and dissipation aspects in view, (iii) extraction of the gas from the coal horizons of suitable/induced enhanced permeability to ensure sustained production and (iv) keeping the balance of the surrounding environment and hydrological regime as intact as possible. The merit of CBM possibilities of the high rank coals of the potential coalfields, may be examined in the backdrop of the following equation:

Volume of Methane Generated (Meissner's Equation):

Gg = -325.6 x log(VMdaf/37.8), Where, Gg is Volume of Methane generated in cc/g, VMdaf = Volatile Matter in percent on dry ash free basis

Calculate Gg for the data given in the table below:

Seam Name	Depth (m)	Proximate Analysis Results from Laboratory				VRo (%)
		Moisture (%)	Ash (%)	Volatile Matter (%)	Fixed Carbon (%)	
R	291.95	1.05	17.86	19.50	50.41	1.26
Q	457.12	1.03	22.31	18.92	50.51	1.33
P	530.25	0.80	17.45	17.48	50.77	1.37
O	544.70	0.78	20.83	17.27	49.52	1.38
N	564.00	0.75	21.31	17.15	49.96	1.42

(CO4) [Application]

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