Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SET A

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2024

Semester : Semester V - 2021
Course Code : PET2017
Course Name : Natural Gas Hydrates
Program : B.Tech.

Date : 08-JAN-2024
Time : 9:30AM - 12:30 PM
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.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **4 X 5M = 20M**

1. Define gas hydrate and mention its formation conditions and components.
Identify the range of temperature where a hydrate form for pure methane at a pressure of 1000 psia.

Temperature (°C)	Pressure (MPa)
0.0	2.60
2.5	3.31
5.0	4.26
7.5	5.53
10.0	7.25
12.5	9.59
15.0	12.79
17.5	17.22
20.0	23.4
22.5	32.0
25.0	44.1
27.5	61.3
30.0	85.9

(CO1) [Knowledge]

2. Explain the process of hydrate plug formation in oil-dominated systems.

(CO2) [Knowledge]

3. Describe the working of gauge pig and caliper pig.

(CO3) [Knowledge]

4. Describe different gas hydrate structures and mention the types of cavities present in different structures.

(CO4) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **5 X 10M = 50M**

5. Rocking cell apparatus is extensively used in laboratories to study the formation and dissociation of gas hydrates. Draw the schematic of a rocking cell apparatus, label different parts and explain the working of rocking cell apparatus.

(CO1) [Comprehension]

6. Gas hydrate formation in nature takes place in particular temperature and pressure ranges and that is why certain parts of the earth contain gas hydrate reserves. Mention and describe the two distinct kinds of hydrates found in nature, taking into account their locations and modes of existence. Use the temperature vs. depth diagram to identify the stability zones for the two forms of hydrates.

(CO2) [Comprehension]

7. Explain the step-by-step operational procedure for implementing Solid-Desiccant Dehydration as a primary method for removing water from natural gas extracted from a remote offshore drilling rig. Describe the selection criteria for the desiccant material and the setup of the dehydration unit.

(CO3) [Comprehension]

8. Gas hydrate nucleation is stochastic in nature and varies depending on pressure, temperature and gas composition. Describe in detail about different categories of gas hydrate nucleation. Also discuss different nucleation hypothesis with the help of figures.

(CO4) [Comprehension]

9. Assess the advantages and limitations of utilizing refrigeration as a technique for extracting water from natural gas in comparison to other dehydration methods. Provide a detailed analysis of the technique with the help of neat diagram.

(CO4) [Comprehension]

PART C

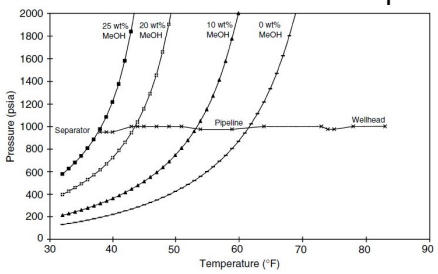
ANSWER ALL THE QUESTIONS **2 X 15M = 30M**

10. **a)** The stability of natural gas hydrates changes with varying temperature and pressure conditions. Analyze and explain different scenarios of effect of pressure and temperature on hydrate stability.
b) Methane hydrates have been discovered on the ocean floor in a number of different places worldwide. In this instance, the water's hydrostatic head is the source of the pressure needed for hydrate formation. Determine how deep you would have to go before coming across methane hydrates, assuming that hydrates form at the same temperature and pressure in seawater as they do in pure water. Let's say the saltwater has a density of 1040 kg/m3 (64.9 lb/ft3) and is at 2.5 degrees Celsius (35.6 degrees Fahrenheit). Additionally, suppose that there is enough methane to create a hydrate and at sea level, the atmospheric pressure is 101.325 kPa.

Temperature (°C)	Pressure (MPa)
0.0	2.60
2.5	3.31
5.0	4.26
7.5	5.53
10.0	7.25
12.5	9.59
15.0	12.79
17.5	17.22
20.0	23.4
22.5	32.0
25.0	44.1
27.5	61.3
30.0	85.9

(CO3) [Application]

11. The wellhead at 1000 psia and 85◦F, far from hydrate forming conditions. As the gas moves down the pipeline, it is cooled toward ambient temperatures. Once the temperature reaches approximately 62◦F, hydrates will form, so methanol must be added to avoid blockage. The figure shows pipeline conditions and the hydrate formation curves for various concentrations of methanol, indicating that 25 wt% methanol in the free water phase is needed to inhibit hydrates.



Explain the following with the help of diagram.

a) According to the diagram, identify the method to reduce the amount of MeOH from 25 wt%.

b) Execute the method where all locations come out from the hydrate zone.

(CO4) [Application]