Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations –MAY 2025

Date: 30-05-2025 **Time:** 01.00 pm – 04:00 pm

School: SOE	**Program:** Bachelor of Technology (B. Tech)	
Course Code : PET2017	**Course Name:** Natural Gas Hydrates	
Semester: IV	**Max Marks**:100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**
Marks	**22**	**22**	**28**	**28**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	State the process involved in hydrate growth and outline the factors that determine the rate of crystal growth.	**2 Marks**	**L1**	**CO1**
2.	State the role of quadruple points in a phase diagram for understanding gas hydrate systems with hydrocarbons.	**2 Marks**	**L1**	**CO2**
3.	State and write the Hammerschmidt Equation.	**2 Marks**	**L1**	**CO3**
4.	List the difference between thermodynamic and kinetic gas hydrate inhibitors. Provide examples.	**2 Marks**	**L1**	**CO3**
5.	name the reasons why ammonia, despite being a more effective hydrate inhibitor compared to methanol and glycols, is not preferred for use in industry.	**2 Marks**	**L1**	**CO3**
6.	List the factors that make desalination using gas hydrates a sustainable solution for water scarcity.	**2 Marks**	**L1**	**CO3**

7.	Outline the role of inhibitors in controlling hydrate formation during gas transport and storage.	**2 Marks**	**L1**	**CO4**
8.	Recall the "memory effect" phenomenon.	**2 Marks**	**L1**	**CO4**
9.	Define the concept of the hydrate stability zone in subsea sediments	**2 Marks**	**L1**	**CO4**
10.	Describe the difference between hydrate growth and dissociation in kinetic studies.	**2 Marks**	**L1**	**CO4**

Part B

Answer the Questions. **Total Marks 80M**

11.	Describe the techniques used for three-phase (L_W–H–V) equilibrium calculations in gas hydrate systems, with a detailed focus on: a. The Distribution Coefficient Method. b. The Gas Gravity Method. Compare and contrast these approaches, explaining their principles, processes, and significance in hydrate phase equilibrium analysis. Include examples to illustrate their practical applications and effectiveness.	**20 Marks**	**L2**	**CO1**
	Or			
12.	Summarize the statistical thermodynamic approach to hydrate phase equilibria, focusing on the role of the Grand Canonical Partition Function, chemical potential, Langmuir adsorption model, Gibbs free energy method, and the performance of CSMGem in equilibrium prediction.	**20 Marks**	**L2**	**CO1**

13.	Explain the concept of the hydrate stability zone in subsea sediments, and illustrate your explanation with a properly labeled plot. Additionally, provide an explanation of the flow assurance challenges associated with gas hydrate systems, focusing on the mechanisms involved and their impact on field operations.	**20 Marks**	**L2**	**CO2**
	Or			
14.	Discuss in detail how geological factors impact the structure and formation of gas hydrates. Provide a comprehensive definition of the water molecule cage structure in gas hydrates, identify the cavities that trap gas molecules, and elaborate on the different hydrate structures (I, II, H) with relevant examples.	**20 Marks**	**L2**	**CO2**

15.	Explain the initial detection tools used for identifying gas hydrates in oceanic geological settings, focusing on the hydrate pressure–temperature stability envelope, seismic velocity techniques and bottom simulating reflections, and methane solubility. Discuss the	**20 Marks**	**L2**	**CO3**

	principles, field applications, and unique features of each method in detail.			
	Or			
16.	Infer four significant differences between homogeneous and heterogeneous nucleation. Also, discuss how these distinctions impact the following kinetics of phase transitions: a. Super cooled water b. Solubility of natural gases in water **c.** Basic nucleation theory of ice **d.** Site of hydrate nucleation	**20 Marks**	**L2**	**CO3**

17.	Identify the role of gas hydrates in gas transport and storage systems. Discuss the advantages and challenges associated with using gas hydrates for storing hydrocarbons, including their stability under varying pressure and temperature conditions. Analyze how gas hydrate-based storage systems compare to conventional storage methods in terms of efficiency, safety, and environmental impact.	**20 Marks**	**L2**	**CO4**
	Or			
18.	Recognize the applications of gas hydrates in CO_2 sequestration and desalination. Discuss how gas hydrates can be utilized for capturing and storing CO_2, highlighting the thermodynamic and environmental implications. Also, assess the potential of gas hydrates in desalination processes, evaluating their efficiency, scalability, and environmental benefits in addressing global water scarcity. Provide suitable sketch.	**20 Marks**	**L2**	**CO4**