

Roll No																			
---------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



**PRESIDENCY UNIVERSITY  
BENGALURU**

**SET A**

**SCHOOL OF ENGINEERING  
END TERM EXAMINATION - JAN 2024**

**Semester :** Semester III -2022

**Course Code :** PET2009

**Course Name :** Thermodynamics of Reservoir Fluids

**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**

**5 X 2M = 10M**

1. Outline the difference between Microscopic and Macroscopic approach of Thermodynamics.  
(CO3) [Knowledge]
2. Define Reversible process and Irreversible process.  
(CO2) [Knowledge]
3. Define Intensive and Extensive property with examples.  
(CO2) [Knowledge]
4. Define solution gas oil ratio.  
(CO1) [Knowledge]
5. State Gibbs phase rule with expression. What is the degree of freedom at triple point of water.  
(CO2) [Knowledge]

**PART B**

**ANSWER ALL THE QUESTIONS**

**5 X 10M = 50M**

6. First Law of Thermodynamics is crucial in open systems for maintaining an energy balance, understanding energy interactions, and guiding engineering practices. It provides a foundation for analyzing and optimizing processes, designing efficient systems, and ensuring energy conservation in open systems. Express and derive the equation of 1st law of thermodynamics for steady state open system. State the assumptions made.

(CO2) [Comprehension]

7. PVT experiments and compositional analysis are fundamental tools for reservoir engineers, production engineers, and facility designers. They provide critical insights into the behavior and composition of hydrocarbons. Conducting laboratory experiments with reservoir fluids is crucial for understanding the characteristics and actions of substances present in underground reservoirs, including crude oil, natural gas, and water. Explain the significance of PVT experiments and compositional analysis with a thorough explanation.

(CO1) [Comprehension]

8. The Pressure-Temperature diagram is a fundamental tool in the exploration, production, and processing of reservoir fluids. It provides valuable insights into the behavior of fluids under different conditions, guiding engineering decisions and ensuring the safe and efficient operation of oil and gas facilities. A pressure-temperature (P-T) diagram representing a multi-component mixture, as seen in natural gas or intricate hydrocarbon systems, is more complicated compared to a straight forward P-T diagram for a single-component fluid. Explain each curve and property of the P-T diagram for a multi-component mixture with a clear illustration.

(CO1) [Comprehension]

9. The refrigerating effect is a fundamental parameter in the design, operation, and optimization of refrigeration and air conditioning systems. It provides valuable information for assessing system performance, ensuring energy efficiency, and addressing economic and environmental considerations. You have been assigned to estimate the cooling effect of a combined heat engine and refrigerator so that overall cooling can be done for the following situation. A reversible heat engine operates between 600°C and 40°C. This engine drives a reversible refrigerator operating between 40°C and -18°C (minus 18°C), still there is a network output of 370KJ while the heat received by the engine is 2100KJ. Estimate the cooling effect of the refrigerator.

(CO3) [Comprehension]

10. The importance of calculating work in a closed system is foundational in thermodynamics and engineering. It allows for a comprehensive understanding of energy transfer, supports the application of the First Law of Thermodynamics, aids in the analysis of mechanical processes, and guides the design and optimization of various energy systems and devices. Express and derive the expression of work in a closed system for a process and also deduce the work done for isochoric and isobaric process.

(CO2) [Comprehension]

### PART C

**ANSWER ALL THE QUESTIONS**

**2 X 20M = 40M**

11. A pressure-temperature (P-T) diagram, commonly known as a phase diagram or phase envelope, visually depicts the phases and boundaries of reservoir fluids (usually oil and gas) across various pressure and temperature scenarios. In the oil and gas sector, this diagram is essential for comprehending and forecasting the actions of reservoir fluids. Draw and explain the P-T diagrams of different types of reservoir fluids with an analytical approach.

(CO2) [Application]

12. Determination of various properties of gas is one of most important tasks for successful application of thermodynamic concepts. You have been assigned to a gas whose composition is known to you and predict the apparent molecular weight, specific gravity, pseudocritical pressure, and pseudocritical temperature of the gas.

Compound	yi	Mwi	Pci (psia)	Tci (R)
C1	0.775	16.04	673	344
C2	0.083	30.07	709	550
C3	0.021	44.1	618	666
i-C4	0.006	58.12	530	733
n-C4	0.002	58.12	551	766
i-C5	0.003	72.15	482	830
n-C5	0.008	72.12	485	847
C6	0.001	86.18	434	915
C7+	0.001	114.23	361	1024
N2	0.05	28.02	227	492
CO2	0.03	44.01	1073	548
H2S	0.02	34.08	672	1306

(CO3) [Application]