

Enrolment No./Seat No _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-III (NEW) EXAMINATION – WINTER 2024

Subject Code: 3130507

Date: 29-11-2024

Subject Name: Chemical Engineering Thermodynamics I

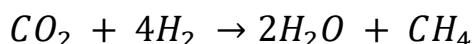
Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) What is an adiabatic process? Write the expression for work done during reversible adiabatic process	03
	(b) Distinguish between the terms 'state function' and 'path function'	04
	(c) Derive the first law of thermodynamics for closed system	07
Q.2	(a) Define equilibrium and state Phase rule	03
	(b) Explain the physical significance of the triple point and the critical point.	04
	(c) A steel casting at a temperature 725 K and weighing 35 kg is quenched in 150 kg oil at 275 K. If there are no heat losses, determine the change in entropy. The specific heat (C_p) of steel is 0.88 kJ/kg K and that of oil is 2.5 kJ/kg K.	07
OR		
	(c) With neat sketch explain PVT behaviour of pure substance using PT and PV diagrams.	07
Q.3	(a) How is the Hess's law of constant heat summation useful in thermo-chemical calculations?	03
	(b) Write fundamental property relations and Maxwell equations for homogeneous fluid of constant composition using Mnemonic diagram.	04
	(c) For the following reaction, the standard heat of reaction at 298K is 164.987 kJ	07



The constants in the heat capacity (J/mol K) are as below;

	α	$\beta \times 10^3$	$\gamma \times 10^6$
CO ₂	26.75	42.26	-14.25
H ₂	26.88	4.35	-0.33
H ₂ O	29.16	14.49	-2.02
CH ₄	13.41	77.03	-18.74

Calculate the standard heat of reaction at 500°C.

Use $C_p = \alpha + \beta T + \gamma T^2$

OR

Q.3	(a)	A heat engine operates between a heat source at 700 K and a heat sink at 300 K. What is the maximum efficiency of the engine?	03
	(b)	What is an equation of state? Give the expression for any three equations of state	04
	(c)	Derive Clausius – Clapeyron equation from the Clapeyron equation. What are the assumptions involved in the derivation?	07
Q.4	(a)	Explain adiabatic flame temperature in brief	03
	(b)	With suitable example explain reversible and irreversible process.	04
	(c)	What is law of corresponding states? Discuss about Pitzer’s modification to law of corresponding states?	07
OR			
Q.4	(a)	Define: (a) The heat of reaction, (b) The standard heat of reaction, (c) The standard heat of formation.	03
	(b)	Distinguish between: Extensive properties and intensive properties.	04
	(c)	Explain with a schematic diagram the working of an vapor compression refrigeration system	07
Q.5	(a)	Give any three statements of the Second law of thermodynamics	03
	(b)	Write in brief on Third law of thermodynamics	04
	(c)	Explain with a schematic diagram the working of an absorption refrigeration system	07
OR			
Q.5	(a)	Show that entropy is a state function.	03
	(b)	Show that in multistage compression for minimum work, the inter-stage pressure is the geometric mean of the initial and final pressures	04
	(c)	State various liquefaction processes and explain any one process used in the industry	07
