Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: BE03005011 **Date: 15-12-2025**

Subject Name: Chemical Engineering Thermodynamics-1

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)**	List different equations of state used for real gases.	**03**
	(b)	Differentiate between work and heat.	**04**
	(c)	Describe the concepts of thermodynamic equilibrium and phase rule, and illustrate them with suitable examples.	**07**
Q.2	**(a)**	Define internal energy and enthalpy.	**03**
	(b)	Differentiate between ideal and non-ideal gases.	**04**
	(c)	Determine the molar volume of n-butane at 510 K and 25 bar by each of the following: (i) The ideal-gas equation. (ii) The generalized virial-coefficient correlation Data given: T_C = 425.1 K, P_C = 37.96 bar, and ω = 0.2	**07**
		OR	
	(c)	Explain the use of generalized correlations for estimating gas properties.	**07**
Q.3	**(a)**	Define sensible and latent heat.	**03**
	(b)	Explain the working principle of a nozzle.	**04**
	(c)	From a reservoir at 600 K, 1000 J of heat is transferred to an engine that operates on the Carnot cycle. The engine rejects heat to a reservoir at 300 K. Determine the thermal efficiency of the cycle and the work done by the engine.	**07**
		OR	
	(a)	State Kelvin–Planck and Clausius statements of the second law of thermodynamics.	**03**
	(b)	Analyze how the temperature dependence of heat capacity (Cp) affects the enthalpy change (ΔH) of a chemical reaction over a wide temperature range.	**04**
	(c)	Describe the application of the second law of thermodynamics in power generation systems.	**07**
Q.4	**(a)**	State the working principle of Carnot refrigerator.	**03**
	(b)	Discuss the concept of residual properties and their importance.	**04**

	(c)	Demonstrate how the Clapeyron equation is obtained from the equality of Gibbs energies of two coexisting phases.	**07**

OR

	(a)	State fundamental property relations for homogeneous fluid of constant composition.	**03**
	(b)	Explain vapor compression refrigeration cycle.	**04**
	(c)	Describe methods for estimation of latent heat for pure substances.	**07**
Q.5	**(a)**	A central power plant, rated at 800000 kW, generates steam at 585 K and discards heat to a river at 295 K. Calculate the actual thermal efficiency of the plant, which is 70% of the maximum possible value.	**03**
	(b)	Explain the selection criteria for refrigerants.	**04**
	(c)	Explain the role of thermodynamic diagrams in estimating thermodynamic properties.	**07**

OR

	(a)	An automobile having a mass of 1250 kg is traveling at 40 m s^{-1}. Calculate the kinetic energy in kJ?	**03**
	(b)	Explain the applications of refrigeration in chemical engineering.	**04**
	(c)	Define ejector and its working principle. Discuss its role in process industries.	**07**

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