Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2025

Fourth Semester

Chemical Engineering

CH3401 - Chemical Engineering Thermodynamics-I

Steam Tables, Mollier chart Can be Permitted

Regulations – 2021

Duration : 3 Hrs ***Maximum : 100 Marks***

PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	List the different types of thermodynamic systems with one example each.	L1	1	2
2.	Identify the point and path functions involved in thermodynamic processes.	L2	1	2
3.	Indicate how generalized compressibility factor helps in estimating real gas behavior.	L2	2	2
4.	Compare ideal gas behavior with real gas behavior based on the PVT relationship.	L2	2	2
5.	Why is the second law of thermodynamics important in defining entropy?	L1	3	2
6.	Differentiate between heat engine and heat pump with an example	L2	3	2
7.	How are Maxwell relations derived from thermodynamic potentials?	L1	4	2
8.	Identify any four thermodynamic properties and classify them as intensive or extensive	L2	4	2
9.	How does duct flow affect pressure and temperature in compressible fluids?	L1	5	2
10.	Differentiate between isentropic and polytropic compression processes.	L2	5	2

PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a	i	Identify the different types of thermodynamic systems and analyze their boundary characteristics with suitable examples.	L2	1	8
		ii	Analyze the behavior of a thermodynamic system undergoing a cyclic process. Explain the differences between path-dependent and path-independent functions, and identify how energy transfer is different in each case.	L4	1	8
			Or			
	b	i	Illustrate the Zeroth law of thermodynamics with a practical example. Recommend suitable temperature measuring devices based on the Zeroth law.	L2	1	8
		ii	Analyze the impact of boundary conditions on the work done and	L4	1	8

		i	heat transfer in a thermodynamic system. How does this affect the efficiency of a cyclic process?			
12.	a	i	Analyze the behavior of real gases using the Van der Waals equation of state. How do the compressibility factor and Van der Waals constants affect the predictions for real gas behavior?	L4	2	8
		i i	A gas undergoes an isothermal expansion from 0.5 m^3 to 1.0 m^3 at a constant temperature of 300K. Calculate the work done and the heat transfer using the first law.	L3	2	8
			Or			
	b	i	Analyze the differences between flow and non-flow processes using the first law of thermodynamics. How does the conservation of mass and energy apply to each type of process?	L4	2	8
		i i	Given two systems undergoing different thermodynamic processes (one isothermal and one adiabatic), evaluate which process is more suitable for maximum work extraction and justify your reasoning.	L3	2	8
13.	a	i	A Carnot heat engine receives heat at 800 K and rejects heat at 300 K. It produces 150 kJ of work. (a) Apply Carnot efficiency to determine the amount of heat supplied and rejected. (b) Analyze how the efficiency would change if the sink temperature increases to 400 K. (c) Evaluate the theoretical limits imposed by Carnot theorem and whether real engines can reach them.	L3	3	8
		i i	Derive the efficiency of a Carnot engine operating between two temperature reservoirs. Compare this efficiency to the efficiencies of real-world engines. Is the Carnot engine a practical model? Justify your answer.	L3	3	8
			Or			
	b	i	A Carnot engine receives 500 kJ of heat from a reservoir at 600 K and rejects heat to a reservoir at 300 K. Apply the Carnot efficiency formula and determine: a) The efficiency b) Heat rejected c) Net work output	L3	3	8
		i i	Analyze how Carnot's theorems establish the upper limit for the efficiency of all possible heat engines operating between two thermal reservoirs. Also, indicate impact of lowering the sink temperature on the Carnot cycle efficiency. Support your answer with case study calculations.	L3	3	8
14.	a	i	Show how Gibbs free energy is derived from enthalpy and entropy. What is its significance in phase change analysis?	L2	4	8
		i	Compare and evaluate the significance of Helmholtz and Gibbs free	L4	4	8

		i	energies in open and closed systems.			

Or

	b	i	Derive the expression for residual enthalpy and explain how it is used to evaluate real gas behavior.	L2	4	8
		i i	Critically evaluate the limitations of using thermodynamic property diagrams versus tables in practical applications.	L4	4	8
15.	a	i	Compare and analyze the expansion process in a reciprocating engine and a steam turbine. Highlight how irreversibilities affect each process.	L2	5	8
		i i	Exemplify the flow of compressible fluid through a convergent-divergent nozzle and indicate the changes in pressure, velocity, and area.	L2	5	8

Or

	b	i	Break down the Rankine cycle into its individual processes and analyze the thermodynamic function of each component in the power plant.	L2	5	8
		i i	Illustrate the working of the steam power plant, and what modifications would you suggest based on thermodynamic principles?	L2	5	8