Register No : ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025

Fourth Semester

Chemical Engineering

CH3401-Chemical Engineering Thermodynamics - I

Regulations - 2021

Duration : 3 Hrs *Maximum : 100 Marks*

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

Q.No	Questions	BLT	CO	Marks
1.	Define thermodynamic system.	L1	1	2
2.	State the Zeroth law of Thermodynamics.	L1	1	2
3.	State First law of thermodynamics.	L1	2	2
4.	Differentiate between flow and non-flow processes. Give examples.	L2	2	2
5.	State Kelvin -Plank statement.	L1	3	2
6.	What is mean by Gibbs paradox?	L2	3	2
7.	What do you mean by saturation pressure and saturation temperature?	L1	4	2
8.	What is mean by “Acentric factor”?	L2	4	2
9.	Define adiabatic and isothermal compression.	L1	5	2
10.	Define stroke volume (or) displacement volume.	L1	5	2

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

Q.No			Questions	BLT	CO	Marks
11.	a	i	Explain in details about reversible and irreversible process with example.	L2	1	8
		ii	Differentiate between point and path properties.	L2	1	8
			Or			
	b	i	Outline the scope and Limitations of Thermodynamics.	L2	1	8
		ii	Explain Macroscopic and Microscopic aspects of Thermodynamics.	L2	1	8
12.	a	i	Derive the expression for first law of thermodynamics as applied to steady state flow processes. State the assumptions.	L3	2	8
		ii	Prove that PVγ = constant for adiabatic process.	L3	2	8
			Or			
	b	i	State and prove Carnot’s theorem.	L3	2	8
		ii	A lump of steel weighing 30Kg at a temperature of 427°C is dropped in 150Kg of oil at 27°C. The specific heats of the steel and oil are 0.5 and 2.5KJ/Kg K respectively. Estimate the entropy change of the steel, the oil and the system consisting of oil and the lump of steel.	L3	2	8

13.	a	i	Derive a relationship between the specific heat at constant pressure and constant volume in terms of coefficient of volume expansion and compressibility.	L3	3	8
		ii	Derive Gibbs-Helmholtz equation.	L3	3	8
			Or			
	b	i	Prove that $C_P - C_V = TV\beta^2/\kappa$.	L3	3	8
		ii	Derive the following relations; (a) $dG = -S\,dT + V\,dP$ (b) $dH = T\,dS + V\,dP$ (c) $dU = T\,dS - P\,dV$ (d) $dA = -S\,dT - P\,dV$	L3	3	8
14.	a	i	Prove that van der Wall's constants $a = \frac{27R^2T_c^2}{64P_c}$ and $b = \frac{RT_c}{8P_c}$ from fundamental principles.	L4	4	8
		ii	Describe with a neat PV diagram the isotherm of the liquid, liquid/vapor and vapor regions.	L4	4	8
			Or			
	b	i	Criticize about modified Vander Waals equation.	L4	4	8
		ii	Determine the molar volume of gaseous methane at 303K and 600 bar by: a. Using Vander Waals equation with a = 0.2285 N-m^4/mol^2 and b = 4.27×10^{-5} m^3/mol. b. Using Redlich-Kwong equation with T_C = 191K and P_C = 46.4 bar.	L4	4	8
15.	a	i	Classify and explain the different compression processes.	L3	5	8
		ii	A single stage compressor single acting compressor is used to deliver 100 m^3/hr of air at a pressure of 6 bar by taking the air at one atmospheric pressure and 15˚C. The index of performance is taken as 1.2. Calculate volume swept by the piston if compressor runs at 125 rpm. The mechanical efficiency and volumetric efficiency of the compressor are 80% and 75% respectively. The power required to drive the compressor.	L3	5	8
			Or			
	b	i	What is the effect of clearance on the work required and theoretical volumetric efficiency of a multistage adiabatic compressor.	L3	5	8
		ii	Air at 600 K and 2000 KPa enters a convergent –divergent nozzle whose throat area is one half that of the discharge of the divergent section. Assuming γ=1.4 for air determine the following: The pressure, temperature, velocity and density at the throat when the mach number is 0.8 at the throat.	L3	5	8