Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

Third Semester

Mechanical Engineering

ME3391 - Engineering Thermodynamics

(Common to Fourth Semester Agricultural Engineering)

Use of Steam Tables with Mollier diagram 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.	Based on mass and energy transfer, classify the thermodynamic system.	UN	1	2
2.	Define zeroth law of thermodynamics.	RE	1	2
3.	Compare heat engine and refrigerator.	UN	2	2
4.	Write the Tds equations.	RE	2	2
5.	Recall high- and low-grade energy with one example.	RE	3	2
6.	Identify the causes of Irreversibility.	UN	3	2
7.	Sketch p-v diagram of pure substance and specify the critical point.	RE	4	2
8.	Give the significance of Mollier Chart in thermodynamics.	UN	4	2
9.	List out the difference between ideal gas and real gas.	UN	5	2
10.	What is meant by Joule-Kelvin coefficient.	RE	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	A piston cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfers is -170 kJ. The system completes 100 cycles per minute. Complete the following table showing the method for each item.	AP	1	13

Process	Q (kJ/min)	W(kJ/min)	Δ (kJ/min)
a-b	0	2170	--
b-c	21000	0	--
c-d	-2100	--	-36600
d-a	--	--	--

Or

	b	0.1 m^3 of an ideal gas at 300 K and 1 bar is compressed adiabatically to 8 bar. It is then cooled at constant volume and further expanded isothermally so as to reach the condition from where it started. Calculate: 1. Pressure at the end of constant volume cooling 2. Change in internal energy during constant volume process 3. Net work done and heat transferred during the cycle Assume c_p = 14.3 kJ/kg K, c_v = 10.2 kJ/kg K.	AP	1	13

12.	a	State the second law of thermodynamics and prove their equivalence and corollaries.	UN	2	13
		Or			
	b	State and prove Clausius inequality in detail and give the conditions for the cycle is reversible or irreversible or impossible.	UN	2	13
13.	a	A fluid undergoes a reversible adiabatic compression from 0.5 MPa, 0.2 m^3 to 0.05 m^3 according to the law $pv^{1.3}$ = constant. Determine the change in enthalpy, internal energy and entropy, and the heat transfer and work transfer during the process.	AN	3	13
		Or			
	b	Calculate the decrease in available energy when 25 kg of water at 95°C mix with 35 kg of water at 35°C, the pressure being taken as constant and temperature of surrounding being 15°C (c_p of water = 4.2 kJ/kgK).	AN	3	13
14.	a	A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9 kg. Find the pressure, mass, specific volume, enthalpy and entropy.	AN	4	13
		Or			
	b	Steam initially at 1.5 MPa, 300°C expands reversibly and adiabatically in steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam.	AN	4	13
15.	a	0.1 m^3 of hydrogen initially at 1.2 MPa, 200°C undergoes a reversible isothermal expansion to 0.1 MPa. Find the work done, heat transferred and entropy change during the process.	AP	5	13
		Or			
	b	Derive Maxwell's equations and give its significations in thermodynamics.	AP	5	13

*PART – C (Marks 1*15 = 15)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
16.	a	The velocity and enthalpy of fluid at the inlet of a certain nozzle are 50 m/sec and 2800 kJ/kg respectively. The enthalpy at the exit of nozzle is 2600 kJ/kg. The nozzle is horizontal and insulated so that no heat transfer takes place from it. Find 1. Velocity of the fluid at exit of the nozzle 2. Mass flow rate, if the area at inlet of nozzle is 0.09 m^3 3. Exit area of the nozzle, if the specific volume at the exit of the nozzle is 0.495 m^3/kg	AP	1	15
		Or			
	b	Using P-T diagram, derive and explain Clausius - Claperyon equation.	AP	5	15