Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

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

Third Semester

Mechanical Engineering

UMETL24301 – Engineering Thermodynamics

(Use of Steam Table and chart are permitted)

Regulations - 2024

Duration : 3 Hrs *Maximum : 100 Marks*

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

Q.No	*Questions*	*BTL*	*CO*	*Marks*
1.	Distinguish between Open and Closed system.	L2	1	2
2.	What do you understand by PMM1?	L1	1	2
3.	Sketch P-V and T-S diagram of Carnot cycle.	L2	2	2
4.	Define entropy of pure substances.	L1	2	2
5.	What is mean by high grade energy? Give an example.	L2	3	2
6.	Define second law efficiency.	L1	3	2
7.	Define the Latent heat of vaporization.	L2	4	2
8.	State the Vander Waal's equation of a state.	L1	4	2
9.	Write any two Maxwell relations.	L1	5	2
10.	In what way the Clausius-Clapeyron equations is useful?	L2	5	2

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

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a	i	Air contained in the cylinder and piston arrangement comprises the system. A cycle is completed by four process 1-2, 2-3, 3-4 and 4-1. The energy transfers are listed below. Complete the table and determine the net work in KJ. Also check the validity of the first law of thermodynamics.	L3	1	10

Process	Q(KJ)	W(KJ)	ΔE(KJ)
1-2	40	?	25
2-3	20	-10	?
3-4	-20	?	?
4-1	0	+8	?

		ii	Prove that the internal energy is a property.	L3	1	6
			Or			
	b		Derive the general steady flow energy equation and deduce SFEE for (i) Boiler (ii) Condenser and evaporator (iii) Nozzle (iv) Turbine and compressor.	L3	1	16

12.	a	i	Derive the COP of the heat pump.	L2	2	4
		ii	Derive the efficiency of Carnot cycle and explain with neat sketch the help on p-v and T-s diagram.	L3	2	12
			Or			
	b	i	State and prove Clausius theorem.	L2	2	6
		ii	A fluid undergoes a reversible adiabatic compression from 0.5MPa and $0.2m^3$ to $0.05m^3$ according to the law $pv^{1.3}$= constant. Determine the change in entropy, change in internal energy and change in enthalpy. Also calculate the heat transfer and work transfer during the process.	L3	2	10
13.	a		Two kg of air at 500 kPa, 80°C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of the surroundings which is at 100 kPa and 5°C. For this process, determine (i) the maximum work (ii) the change in availability and (iii) the irreversibility. For air take, Cv = 0.718 kJ/kg K, u = Cv T Where Cv is constant and PV = mRT where P is pressure in kPa, V volume in m^3, 'm' mass in kg, R a constant equal to 0.287 kJ/kg K and Temperature in K.	L3	3	16
			Or			
	b	i	Compare the available energy and the unavailable energy of the thermodynamic system.	L3	3	6
		ii	A heat engine receives 800kJ of heat from the reservoir at 1000 K and rejects 400kJ at 400 K. If the surrounding is at 300 K. Calculate the first and second law efficiency and the relative efficiency of the heat engine.	L3	3	10
14.	a	i	Discuss the P-V-T surface of a pure substance.	L2	4	4
		ii	A vessel having a capacity of 0.05m3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10kg. Find the following (i) The pressure, (ii) The mass, (iii) The specific volume, (iv)The specific enthalpy, (v)The specific entropy, and(vi)The specific internal energy of the mixture.	L3	4	12
			Or			
	b	i	Discuss the physical significance of the compressibility factor Z.	L2	4	4
		ii	Determine the pressure of nitrogen gas at T=175 K and v=0.00375 m^3/kg on the basis of (i) The ideal-gas equation of state (ii) the Vander Waals equation of state. The Vanderwaals constants for nitrogen are a=0.175 m^6kPa/kg^2, b=0.00138 m^3/kg.	L3	4	12
15.	a		Derive the Tds equation when: (i) T and V as independent, (ii) T and P as independent, (iii) P and V as independent	L3	5	16
			Or			
	b		Derive the Joule – Thomson co-efficient equation and draw the inversion curve. What is role of joule – Thomson co-efficient in cooling and heating process?	L3	5	16