Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL/MAY 2026

Fourth Semester

Agricultural Engineering

UMETL24301 – Engineering Thermodynamics

(Common to Third Semester Mechanical Engineering)

(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 'State' and 'Process'.	L2	1	2
2.	Mention the conditions of the steady flow process.	L1	1	2
3.	State Kelvin Planck statement of II law of thermodynamics.	L1	2	2
4.	Draw a schematic of a heat pump.	L2	2	2
5.	Define Exergy.	L1	3	2
6.	Differentiate available energy and unavailable energy.	L2	3	2
7.	Determine the condition of steam has a pressure of 10 bar and specific volume of 0.22 m^3 per kg.	L2	4	2
8.	What are the reduced properties?	L1	4	2
9.	Define molar fraction of a gas mixture.	L1	5	2
10.	Write down any two Tds relations.	L2	5	2

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

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	A piston and cylinder machines contain a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfer is (-170 kJ). The system completes 100 cycle per minute. Complete the following tables showing the method for each item, and solve the net rate of work output in kW.	L4	1	16

Process	Q (kJ/min)	W (kJ/min)	Δ E (kJ/min)
a-b	0	2170	-
b-c	21,000	0	-
c-d	-2,100	-	-36,600
d-a	-	-	-

Or

	b	100 liters of an ideal gas at 300 K and 1 bar is compressed adiabatically to 10 bar. It is then cooled at constant volume and further, expanded isothermally so as to reach the condition from where it is started. Draw the PV diagram and estimate (i) pressure at the end of constant volume cooling (ii) change in internal energy during constant volume process, and (iii) net work done, and heat transferred during the cycle. Assume, C_p = 14.3kJ/kg K, and C_v = 10.2 kJ/kg K.	L4	1	16

12.	a	Two Carnot engines A and B are operated in series. The first one (A) receives heat at 870 K and rejects heat to a reservoir at temperature T. The second engine (B) receives the heat rejected by the first engine and in turn reject to to a heat reservoir at 300 K. Calculate the intermediate temperature T between two heat engines for the following cases. (a) The work output of the two engines are equal and (b) The efficiencies of the two engines are equal	L3	2	16
		Or			
	b i	State and prove Clausius inequality.	L3	2	8
	ii	A 50 kg block of iron casting at 500 K is thrown into a large lake that is at a temperature of 285 K. The iron block eventually reaches thermal equilibrium with the lake water. Assuming an average specific heat of 0.45 kJ/kg K for the iron, determine (i) The entropy change of iron block (ii) The entropy change of lake water, and (iii) The entropy generated during this process.	L3	2	8
13.	a	200 m^3 rigid tank initially contains atmospheric air at 100 kPa and 300 K and is to be used as a storage vessel for compressed air at 1 MPa and 300 K. Compressed air is to be supplied by a compressor that takes in atmospheric air at p_0=100 kPa and T_0 = 300 K. Determine the minimum work required for this process.	L3	3	16
		Or			
	b	A single stage air turbine operates with air inlet pressure and temperature of 1 bar and 600 K. During the expansion, the turbine losses are 20 kJ/kg to the surroundings which is at 1 bar and 300 K. For 1 kg of mass flow rate determine (i) decrease in availability (ii) maximum work (iii) the irreversibility.	L3	3	16
14.	a	With the help of p-V and T-s plot explain the steam formation and explain various stages in detail.	L3	4	16
		Or			
	b i	A vessel of volume 0.3 m^3 contains 15 kg of air at 303 K. Determine the pressure exerted by the air using, (1) Perfect gas equation (2) Van der Waals equation. Take critical temperature of air as 132.8 K. Critical pressure of air is 37.7 bar.	L3	4	8
	ii	One kg of ideal gas is heated from 50^0C to 150^0C.If R= 280 kJ/kgK and Υ= 1.36 for the gas. Estimate the following: i) C_p and C_v ii) Change in internal energy iii) Change in enthalpy iv) Change in flow energy	L3	4	8
15.	a	Derive Maxwell's equations.	L3	5	16
		Or			
	b	The pressure and temperature of mixture of 4 kg of O_2 and 6 kg of N_2 are 4 bar and 27^0C respectively. For the mixture, Evaluate the following: a) The mole fraction of each component b) The average molecular weight c) The specific gas constant d) The volume and density e) The partial pressure and partial volume	L3	5	16