Reg. No.																

Question Paper Code	14681

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Third Semester

Mechanical Engineering

24MEPC301 - ENGINEERING THERMODYNAMICS

Regulations - 2024

(Use of Steam Tables, Psychrometric Chart and Molier Chart is permitted)

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	What is the first law of thermodynamics also known as? a) Law of Conservation of Energy b) Boyle's Law c) Law of Entropy d) Zeroth Law of Thermodynamics	1	K1	CO1
2.	In which state of matter do particles have the least amount of energy? a) Solid b) Plasma c) Liquid d) Gas	1	K2	CO1
3.	What is the primary focus of thermodynamics? a) Heat transfer b) Chemical reactions c) Properties of matter d) Energy transformations	1	K1	CO1
4.	Identify the process where Q = W a) Isobaric b) Isochoric c) Isothermal d) Adiabatic	1	K2	CO2
5.	Which of the following is true for a cyclic process in a closed system? a) Heat transfer equals internal energy change b) Internal energy change is equal to work done c) Net heat and work are equal and opposite d) Net work done is always zero	1	K2	CO2
6.	A closed system receives 500 kJ of heat and performs 200 kJ of boundary work. What is the change in internal energy of the system? a) 500 kJ b) 300 kJ c) 200 kJ d) 700 kJ	1	K2	CO2
7.	What direction does heat always flow in? a) From high temperature to low temperature b) From low temperature to high temperature c) It remains stagnant d) In a cyclical pattern	1	K1	CO3
8.	The Clausius inequality holds good for a) Only reversible process b) Only reversible cycle c) Any cycle d) Any process	1	K2	CO3
9.	What SI unit is used for thermodynamic temperature? a) Pascal (Pa) b) Joule c) Kelvin (K) d) Celsius (°C)	1	K1	CO3

10.	In which process an ideal Rankine cycle differs from an ideal Carnot cycle?		*1*	*K1*	*CO4*
	a) Heat supply	b) Heat rejection			
	c) Work done	d) All of them			
11.	Among the following, what reduces the turbine blade erosion?		*1*	*K1*	*CO4*
	a) Increasing condenser pressure	b) Superheating and reheating steam			
	c) Increasing boiler pressure	d) Regenerative feed heating			
12.	Efficiency of a Rankine cycle power plant will:		*1*	*K1*	*CO4*
	a) May increase or decrease with climatic conditions	b) Remain unaffected with changes in climatic conditions			
	c) Improve in winter as compared to summer	d) Improve in summer as compared to winter			
13.	What is the value of the universal gas constant R_u?		*1*	*K1*	*CO5*
	a) 8.314 J/kg·K	b) 287 J/kg·K			
	c) 287 J/mol·K	d) 8314 J/mol·K			
14.	For an ideal gas, the Joule-Thomson coefficient (μ) is		*1*	*K1*	*CO5*
	a) Negative	b) Zero			
	c) Positive	d) May be positive or negative			
15.	The wet bulb depression is zero when relative humidity is		*1*	*K1*	*CO6*
	a) Infinity	b) More than 100%			
	c) Zero	d) 100%			
16.	Sensible heating		*1*	*K2*	*CO6*
	a) Does not change specific humidity	b) Decreases relative humidity			
	c) Decreases specific humidity	d) Both (a) and (b)			

PART – A (ii) (Short Answer Questions)
(6 × 3 = 18 Marks)
Answer ALL Questions

17.	When a system is said to be in" Thermodynamic equilibrium "?	*3*	*K2*	*CO1*
18.	Write the steady flow energy equation for nozzle.	*3*	*K2*	*CO2*
19.	Apply the Carnot efficiency relation to determine the maximum theoretical efficiency of a heat engine operating between temperature reservoirs at 800 K and 400 K.	*3*	*K3*	*CO3*
20.	Apply your understanding of the Rankine cycle to identify and explain the modifications that can be implemented to improve its ideal efficiency.	*3*	*K3*	*CO4*
21.	Show that for an ideal gas, Cp-Cv = R	*3*	*K2*	*CO5*
22.	Apply the concept of specific humidity to determine its variation in an air–water vapor mixture and identify the conditions under which it becomes maximum.	*3*	*K3*	*CO6*

PART - B (Descriptive Answer Questions)
(6 × 11 = 66 Marks)
Answer ALL Questions

23.	a) (i)	Apply the concept of continuum to justify its validity in analyzing thermodynamic systems.	*6*	*K3*	*CO1*
	(ii)	Apply the concept of thermal equilibrium to determine the direction of heat flow when object A (in equilibrium with object B at 30°C) is brought into contact with object C at 20°C.	*5*	*K3*	*CO1*

OR

	b) (i)	Apply the principles of thermodynamics to demonstrate that internal energy is a property of a system.	6	K3	CO1
	(ii)	Apply the concept of thermodynamic equilibrium to explain why it is a necessary condition for defining state functions in a system.	5	K3	CO1
24.	a)	A room for four persons has two fans, each consuming 0.18 kW power, and three 100 W lamps. Ventilation air at the rate of 80 kg/h enters with an enthalpy of 84 kJ/kg and leaves with an enthalpy of 59 kJ/kg. If each person puts out heat at the rate of 630 kJ/h determine the rate at which heat is to be re moved by a room cooler, so that a steady state is maintained in the room.	11	K3	CO2
		OR			
	b)	Derive the general steady flow energy equation for an open system and Deduce the energy equation for (a) a nozzle, (b) evaporator and (c) the condenser.	11	K3	CO2
25.	a)	A heat engine receives heat from two reservoirs at 900K and 600K and rejects 8KW of heat to 300K reservoir. The engine develops 12KW of power. Determine (a) Efficiency of heat engine, (b)Heat supplied by each of the reservoir	11	K3	CO3
		OR			
	b)	1.6 Kg of air compressed according to the law $pV^{1.3} = C$ form pressure of 1.2 bar and temperature of 20°C to a pressure of 17.5 bar. Determine (a) The final volume and temperature (b) Work done (c) Heat transferred and (d) Change in entropy.	11	K3	CO3
26.	a)	A simple Rankine cycle operates between boiler pressure of 3 MPa, 350°C and condenser pressure of 10 kPa. Calculate the cycle efficiency.	11	K3	CO4
		OR			
	b)	1.5 kg of steam at 1 bar, 15°C is compressed reversibly and isothermally to a specific volume of 0.3 m^3/kg. Determine The Change in internal energy and entropy, Heat transferred and Work done during the process.	11	K3	CO4
27.	a)	Derive Clausius –Clapeyron equation. What assumptions are made in this equation?	11	K3	CO5
		OR			
	b)	Derive Maxwell's equation.	11	K3	CO5
28.	a)	Air at 20°C, 40% RH is mixed adiabatically with air at 40°C, 40% RH in the ratio of 1 kg of the former with 2 kg of the latter (on dry basis). Find the final condition of air.	11	K3	CO6
		OR			
	b)	Atmospheric air at 1.0132 bar has a DBT of 30°C and WBT of 25°C. Compute; (i) The partial pressure of water vapour (ii) Specific humidity (iii) The dew point temperature (iv) The relative humidity (v) The degree of saturation (vi) The density of air in the mixture (vii) The density of vapour in the mixture and the enthalpy of the mixture.	11	K3	CO6