Reg. No.																

Question Paper Code	14723

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

Third Semester

Mechanical Engineering

(Common to Mechanical and Automation)

20MEPC302 - ENGINEERING THERMODYNAMICS

Regulations - 2020

(Use of *Steam Table, Psychrometric Chart, Mollier Chart*are permitted)

Duration: 3 Hours | Max. Marks: 100

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

		Marks	K – Level	CO
1.	Which of the following is an intensive property?	1	K1	CO1
	a) Volume b) Mass			
	c) Temperature d) Energy			
2.	The first law of thermodynamics is a statement of:	1	K1	CO1
	a) Conservation of mass b) Conservation of energy			
	c) Entropy increase d) Temperature equilibrium			
3.	In a steady flow adiabatic turbine, the work output equals:	1	K2	CO1
	a) Change in enthalpy b) Change in internal energy			
	c) Change in entropy d) Change in pressure			
4.	The Clausius inequality for an irreversible cycle is:	1	K1	CO2
	a) $\oint \delta Q/T = 0$ b) $\oint \delta Q/T < 0$			
	c) $\oint \delta Q/T > 0$ d) $\oint \delta Q/T \geq 0$			
5.	A Carnot engine operates between 800 K and 400 K. Its efficiency is:	1	K1	CO2
	a) 50% b) 25%			
	c) 75% d) 100%			
6.	Which best defines exergy (available energy)?	1	K2	CO2
	a) Maximum useful work as system reaches equilibrium b) Total energy of system			
	c) Heat transfer at constant T d) Internal energy			
7.	At the critical point of a pure substance, latent heat of vaporization is:	1	K1	CO3
	a) Maximum b) Minimum			
	c) Zero d) Infinite			
8.	The Rankine cycle consists of:	1	K1	CO3
	a) Two isotherms & Two isentropic b) Two isobars & Two isentropic			
	c) Two isochoric & Two isotherms d) Two adiabatic & Two isotherms			
9.	Reheating in a Rankine cycle primarily increases:	1	K2	CO3
	a) Pump work b) Turbine work & dryness fraction			
	c) Condenser pressure d) Boiler efficiency			
10.	The compressibility factor Z for an ideal gas is:	1	K1	CO4
	a) 0 b) 1			
	c) >1 d) <1			

11.	Van der Waals equation is an equation of state for: a) Ideal gas b) Real gas c) Incompressible fluid d) Perfect gas	*1*	*K1*	*CO4*
12.	The difference Cp – Cv for an ideal gas is equal to: a) R b) γR c) R/T d) Zero	*1*	*K2*	*CO4*
13.	Dalton's law of partial pressures states that total pressure of a gas mixture equals: a) Sum of partial volumes b) Sum of partial pressures c) Product of partial pressures d) Average of partial pressures	*1*	*K1*	*CO5*
14.	Specific humidity is defined as the ratio of: a) Mass of water vapor to mass of dry air b) Mass of water vapor to total mass c) Volume of water vapor to volume of dry air d) Partial pressure of vapor to total pressure	*1*	*K1*	*CO5*
15.	During adiabatic saturation of air, the wet bulb temperature: a) Increases b) Decreases c) Remains constant d) First increases then decreases	*1*	*K2*	*CO5*
16.	Evaporative cooling is most effective when ambient air is: a) Hot and humid b) Cold and dry c) Hot and dry d) Cold and humid	*1*	*K2*	*CO5*

PART – A (ii) (Short Answer Questions)
(8 × 3 = 24 Marks)
Answer ALL Questions

17.	Distinguish between reversible and irreversible processes with one example each.	*3*	*K2*	*CO1*
18.	Apply the concept of First law of thermodynamics and Write the general steady flow energy equation.	*3*	*K3*	*CO1*
19.	Explain the Kelvin - Planck and Clausius statements of the second law of thermodynamics.	*3*	*K2*	*CO2*
20.	A Carnot heat pump operates between 5°C and 30°C. Calculate its COP.	*3*	*K3*	*CO2*
21.	Plot the T-s diagram for a Reheat rankine cycle.	*3*	*K3*	*CO3*
22.	Explain the concept of compressibility factor Z. How does it help in determining the behavior of a real gas?	*3*	*K2*	*CO4*
23.	Write Joule-Thomson coefficient.	*3*	*K3*	*CO4*
24.	Describe the adiabatic saturation process on a psychrometric chart, indicating the changes in dry bulb temperature, wet bulb temperature, and specific humidity.	*3*	*K3*	*CO5*

PART - B (Descriptive Answer Questions)
(5 × 12 = 60 Marks)
Answer ALL Questions

25.	a)	A closed system undergoes a cycle consisting of three processes: Process 1-2: adiabatic compression from 0.1 m^3 to 0.05 m^3, work input 50 kJ Process 2-3: constant volume heat addition, net heat transfer 200 kJ Process 3-1: constant pressure expansion with heat rejection of 100 kJ Determine the net work output and indicate whether it is a power or refrigeration cycle.	*12*	*K3*	*CO1*
		OR			
	b)	Air flows steadily through an adiabatic turbine at 1.5 MPa, 600 °C, 50 m/s and leaves at 100 kPa, 150 °C, 100 m/s. The mass flow rate is 2 kg/s. Using the first law for open systems, Calculate the power output. Neglect potential energy change. Take Cp of air = 1.005 kJ/kg K.	*12*	*K3*	*CO1*

26.	a)	A heat engine operates between a reservoir at 800 K and a sink at 300 K. It receives 2000 kJ/min from the hot reservoir. The actual power output is 25 kW. Calculate: (a) Carnot efficiency and power output and (b) Actual efficiency.	*12*	*K3*	*CO2*
		OR			
	b)	Apply the concept of the second law of thermodynamics to derive the Clausius theorem for a reversible cyclic process.	*12*	*K3*	*CO2*
27.	a)	In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. The flow rate of steam is 9.5 kg/s. Determine (a) The pump work, (b) The turbine work, (c) Rankine efficiency and (d) Work ratio	*12*	*K3*	*CO3*
		OR			
	b)	1.5 kg of steam at 1 bar, 15 ^{0}C is compressed reversibly and isothermally to a specific volume of 0.3m^3/kg. Discover the change in internal energy and entropy, heat transferred and work done during the process.	*12*	*K3*	*CO3*
28.	a)	Derive the Maxwell relation from the Gibbs function G = H – T S	*12*	*K3*	*CO4*
		OR			
	b)	Derive the Clausius - Clapeyron equation and explain its application in phase change processes.	*12*	*K3*	*CO4*
29.	a)	Consider a gas mixture that consists of 3 kg of O_2, 5 kg of N_2, and 12 kg of CH_4. Discover (a) The mass fraction of each component, (b) The mole fraction of each component and (c) The average molar mass and gas constant of the mixture.	*12*	*K3*	*CO5*
		OR			
	b)	Atmospheric air at 35°C dry bulb temperature and 20°C wet bulb temperature is to be cooled to 22°C dry bulb temperature by an evaporative cooler. Using a psychrometric chart, Calculate the Initial relative humidity, Specific humidity, and Dew point temperature.	*12*	*K3*	*CO5*