Reg. No.															

Question Paper Code	13571

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Third Semester

Mechanical Engineering

(Common to Mechanical and Automation Engineering)

20MEPC302 - ENGINEERING THERMODYNAMICS

Regulations - 2020

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart are permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Which of the following is an intensive property? (a) Volume (b) Mass (c) Pressure (d) Energy	1	K1	CO1
2.	The Zeroth law of thermodynamics defines (a) Work (b) Energy (c) Temperature (d) Heat	1	K1	CO1
3.	The performance of a refrigerator is measured by (a) Efficiency (b) COP (c) Work output (d) Power input	1	K1	CO2
4.	Entropy is a measure of (a) Energy loss (b) Irreversibility (c) Disorder or randomness (d) Useful work output	1	K1	CO2
5.	The dryness fraction of saturated steam is (a) 0 (b) 0.5 (c) Greater than 1 (d) 1	1	K1	CO3
6.	The steam at the turbine exit in a Rankine cycle is usually (a) Saturated vapor (b) Wet steam (c) Superheated vapor (d) Compressed liquid	1	K1	CO3
7.	A real gas behaves like an ideal gas at (a) High pressure and low temperature (b) Low pressure and high temperature (c) Low pressure and low temperature (d) High pressure and high temperature	1	K2	CO4
8.	The Joule-Thomson coefficient is used to determine (a) Temperature change in throttling process (b) Pressure change in an isothermal process (c) Volume change during an adiabatic process (d) Heat added to the system	1	K2	CO4
9.	Moist air is considered a mixture of (a) Dry air and water vapor (b) Dry air and liquid water. (c) Oxygen and nitrogen. (d) Oxygen and water vapor.	1	K1	CO5
10.	On a psychrometric chart, lines of constant wet-bulb temperature are (a) Nearly diagonal (b) Vertical (c) Horizontal (d) Curved	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

		Marks	K – Level	CO
11.	Define open system. Give an example.	2	K1	CO1
12.	Write the general steady flow energy equation.	2	K1	CO1
13.	When a system is said to be in" thermodynamic equilibrium "?	2	K2	CO1
14.	State Carnot theorem.	2	K1	CO2
15.	Write the expression for COP of a heat pump and a refrigerator.	2	K1	CO2
16.	Define Clausius statement.	2	K1	CO2
17.	Name the different process of Rankine cycle on T-S diagram.	2	K1	CO3
18.	Mention the improvement made to increase the ideal efficiency of Rankine cycle.	2	K1	CO3
19.	State Boyle's and Charles law.	2	K1	CO4
20.	State the Vander Waal's equation of state.	2	K1	CO4
21.	Define dry bulb and wet bulb temperature.	2	K1	CO5
22.	State Dalton's law of partial pressure.	2	K1	CO5

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	One kg of air is compressed polytropically (n=1.3) from 1 bar and 27 deg Celsius to 3 bar. Find (i) work transfer, (ii) Heat transfer and (iii) Change in internal energy.	*11*	*K3*	*CO1*
		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*	*CO1*
24.	a)	A heat engine receives heat from two reservoirs at 900K and 600K and rejects 8kWof heat to 300K reservoir. The engine develops 12kWof power. Determine (a) Efficiency of heat engine (b) Heat supplied by each of the reservoir.	*11*	*K3*	*CO2*
		OR			
	b)	State and Prove Clausius inequality.	*11*	*K3*	*CO2*
25.	a)	Steam initially at 1.5 MPa, 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam.	*11*	*K3*	*CO3*
		OR			
	b)	Consider a steam power plant operating on the ideal Rankine cycle Steam enters the turbine at 3 MPa and 623 K and is condensed in the condenser at a pressure of 10 kPa. Determine (i) the thermal efficiency of this power plant.	*11*	*K3*	*CO3*
26.	a)	Derive Maxwell's equation.	*11*	*K3*	*CO4*
		OR			
	b)	Derive Vander Waals equation.	*11*	*K3*	*CO4*
27.	a)	Atmospheric air at 1.0132 bar has a DBT of 30°C and WBT of 25°C. Compute; (i) The partial pressure of wat4er 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. Use the thermodynamic tables only.	*11*	*K3*	*CO5*
		OR			
	b)	Two air streams are mixed steadily and adiabatically, the first stream enters at 35°C and 30% R.H at a rate of $15m^3$/min, while the second stream enters at 12°C and 90% R.H. at a rate of $25m^3$/min. Assuming that the mixing process occurs at a pressure of 1 atm, determine the specific humidity, relative humidity, dry bulb temperature and volume flow rate of the mixture.	*11*	*K3*	*CO5*
28.	a) i)	State four Gibbs functions and Maxwell's relations.	*6*	*K2*	*CO4*
	ii)	Explain the sensible cooling and sensible heating process.	*5*	*K2*	*CO5*
		OR			
	b) i)	Derive the Clausius – Clapeyron equation and discuss its significance.	*6*	*K2*	*CO4*
	ii)	Explain the cooling and dehumidification process.	*5*	*K2*	*CO5*