Reg. No.												

Question Paper Code	12517

B.E. / B.Tech - DEGREE EXAMINATIONS, NOV / DEC 2023

Third Semester

Mechanical Engineering

(Common to Mechanical and Automation Engineering)

20MEPC302 - ENGINEERING THERMODYNAMICS

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

(Regulations 2020)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	In an open system what kinds of energy gets transferred? Explain with an example.	*2,K2,CO1*
2.	When do we imply work with a negative sign, explain?	*2,K2,CO1*
3.	Work and Heat – Which energy is known as higher form of energy? Explain.	*2,K2,CO2*
4.	What happens to the change in entropy of universe when something happens around?	*2,K2,CO2*
5.	When do we call a steam to be superheated?	*2,K2,CO3*
6.	Draw and mark the critical points in a T–V diagram for water.	*2,K1,CO3*
7.	When the ideal gas does behave as a real gas?	*2,K2,CO4*
8.	What does Clausius Clapeyron equation of state?	*2,K2,CO4*
9.	How can we find the density of a gas mixture?	*2,K2,CO5*
10.	Why do we use psychrometric charts?	*2,K2,CO5*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	A fluid is filled in a cylinder by a spring loaded piston, so that the pressure in the fluid is linear function of the volume. P=a+bV. The internal energy is given by the following equation U=34+3.15PV, where U is in KJ/Kg. P is in KPa, and V is in m^3. If the fluid changes form an initial state of 170KPa, 0.03m^3 to a final state of 400KPa, 0.06m^3, find the direction of heat flow and work.	*13,K3,CO1*
		OR	
	b)	Air flows steadily at a rate of 0.4 kg/s through an air compressor entering at 6 m/s with a pressure of 1 bar and specific volume of 0.85m^3/kg and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16m^3/kg. The internal energy of air leaving is 88	*13,K3,CO1*

kJ/kg greater than that of air entering. Cooling water in the jacket surrounding the cylinder absorbs heat from the air at the rate of 59 kW. Calculate the power required to drive the compressor and the inlet and outlet cross sectional area.

12. a) A reversible heat engine operates between two reservoirs at temperature of 600^0C and 40^0C. The engine drives a reversible refrigerator which operates between reservoirs at a temperature of 40^0C and -20^0C. The heat transfer to the engine is 2000kJ and network output of the combined engine refrigerator plant is 360kJ. Find out the heat transfer to the refrigerant and net heat transfer to the reservoir at 40^0C. *13,K3,CO2*

OR

b) 3 kg of gas (C_v= 0.81 kJ/kg K) initially at 2.5 bar and 400K receives 600KJ of heat from an infinite source at 1200K. If the surrounding temperature is 290K, find the loss in available energy due to above heat transfer. *13,K3,CO2*

13. a) In a steam turbine steam at 20 bar, 360 ^{0}C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal process, find per kg of steam, net work and the cycle efficiency. *13,K3,CO3*

OR

b) In a single heater regenerative cycle the steam enters the turbine at 30 bar and 400^0C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find: *13,K3,CO3*

(i) The efficiency and the steam rate of the cycle
(ii) The increase in mean temperature of heat addition,
(iii) Efficiency and steam rate as compared to the normal rankine cycle.

14. a) Derive all the four Maxwell relations. *13,K2,CO4*

OR

b) Derive Tds Equations. *13,K2,CO4*

15. a) A vessel of capacity 3 m^3 contains 1kg mol of N_2 at 90^0C *13,K3,CO5*
(i) Calculate pressure and the specific volume of the gas
(ii) If the ratio of specific heats is 1.4, evaluate the values C_p and C_v
(iii) If the gas cools to atmospheric temperature of 20^0C
(iv) Evaluate the final pressure of gas.
(v) Evaluate the increase in specific internal energy,
(vi) increase in specific enthalpy
(vii) increase in specific entropy and the magnitude and sign of heat transfer.

OR

b) Air has a dry bulb temperature of 25^0C and wet bulb temperature of 15^0C. If the barometer reads 1bar, Calculate *13,K3,CO5*

(i) Vapour pressure
(ii) Specific humidity
(iii) Saturation ratio
(iv) Relative humidity
(v) Dew Point Temperature
(vi) Vapour Density
(vii) Enthalpy of Mixture

PART - C (1 × 15 = 15 Marks)

16. a) A rankine cycle operates between pressure of 80 bar and 0.1 bar. The maximum cycle temperature is 600^0C. If the steam turbine and condensate pump efficiencies are 0.9 and 0.8 respectively, calculate the specific work and thermal efficiency. *15,K3,CO6*

OR

b) A turbine is supplied with steam at a pressure of 32 bar and a temperature of 410^0C. The steam then expands isentropically to a pressure of 0.8 bar. Find the dryness fraction at the end of expansion and thermal efficiency of the cycle. *15,K3,CO6*

If the steam is reheated at 5.5 bar to a temperature of 395^0C and then expanded isentropically to a pressure of 0.08 bar, what will be the dryness fraction and thermal efficiency of the cycle?