Reg. No.															

Question Paper Code	12921

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Third Semester

Mechanical Engineering

(Common to Mechanical and Automation Engineering)

20MEPC302 - ENGINEERING THERMODYNAMICS

Regulations - 2020

(Use of steam table, Mollier chart and Psychrometric chart are permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	State quasi-static process in thermodynamics.	2	K2	CO1
2.	Define closed system.	2	K1	CO1
3.	What is PMM2?	2	K2	CO2
4.	State the principle of entropy.	2	K2	CO3
5.	What is a pure substance? Give examples.	2	K1	CO4
6.	Define dryness fraction.	2	K1	CO4
7.	What is meant by equation of state?	2	K2	CO5
8.	What is compressibility factor?	2	K1	CO5
9.	What is the relative humidity of air if the DPT and DBT are 25°C and 30°C at 1 atmospheric pressure?	2	K2	CO6
10.	What is adiabatic evaporative cooling process?	2	K1	CO6

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11. a) A gas of mass 1.5 kg undergoes a quasistatic expansion, which follows a relationship P = a +bV, where 'a' and 'b' are constants. The initial and final pressures are 1000 kpa and 200kpa respectively and the corresponding volumes are 0.2 m^3 and 1.2 m^3. The specific internal energy of the gas is given by the relation U = (1.5PV – 85) kJ/kg, where P is in kPa and V is in m^3. Calculate the heat transfer and the maximum internal energy of the gas attained during expansion. *13 K2 CO1*

OR

b) Derive the general steady flow energy equation for an open system and deduce the energy equation for (a) a nozzle and (b) evaporator. *13 K2 CO1*

12. a) A reversible heat engine operates between two reservoirs at temperatures of 600^0C and 40^0C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40^0C and -20^0C. The heat transfer to the heat engine is 2000kJ and the *13 K3 CO2*

network output for the combined engine refrigerator is 360kJ. Calculate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40^0C.

OR

b) i) State and Prove Clausius inequality. *7 K2 CO2*

ii) Prove Entropy-A property of the system. *6 K2 CO2*

13. a) Air expands from 11 bar at 55^0C to a pressure of 3 bar adiabatically. Determine temperature at the end of expansion and work done. Find also the change in entropy. *13 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 20^0C to a pressure of 17.5 bar. Calculate (i) the final volume and temperature (ii) work done (iii) heat transferred and (iv) change in entropy. *13 K3 CO3*

14. a) Explain the phase transformation that takes place when ice (Solid) is heated continuously till superheated is obtained. Name the different states involved. Sketch the transformation on a temperature vs heat added diagram. *13 K2 CO4*

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. *13 K3 CO4*

15. a) Write down T-ds relations and derive Maxwell's relation from them. *13 K2 CO5*

OR

b) Derive Clausius –Clapeyron equation. What are the assumptions made in this equation? *13 K2 CO5*

PART - C (1 × 15 = 15 Marks)

16. a) An insulated rigid tank is divided into two compartments by a partition. One compartment contains 7kg of oxygen gas at 40°C and 100kpa and the other compartment contains 4kg of nitrogen gas at 20°C and 150kpa. Cv for N_2 = 0.743 kJ/kg K and Cv for O_2 = 0.0658 kJ/kg K. If the partition is removed and the two gases are allowed to mix, determine *15 K3 CO6*

(1) The mixture temperature and

(2) The mixture pressure after equilibrium has been established.

OR

b) The moist air is at 45˚C dry bulb temperature and 30˚C wet bulb temperature. Calculate (i) Vapour pressure, (ii)Dew Point Temperature, (iii) Specific Humidity, (iv) Relative Humidity, (v) Degree of saturation and (vi) Vapour density. *15 K3 CO6*

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create ***12921***