25 JUL 2023

Reg. No.												

Question Paper Code	12087

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023

Third Semester

Mechanical Engineering

(Common to Mechanical and Automation Engineering)

20MEPC302 - ENGINEERING THERMODYNAMICS

(Regulations 2020)

(Use of approved Steam Table is permitted)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	What is meant by "perpetual Motion machine of First kind?	2,K1,CO1
2.	Write the steady flow energy equation for a compressor.	2,K2,CO1
3.	State Clausius theorem.	2,K1, CO2
4.	Define the term COP for a heat pump.	2,K1,CO2
5.	What is saturated pressure?	2,K1,CO3
6.	Define dryness fraction.	2,K1,CO3
7.	What is the equation of state?	2,K1,CO4
8.	Write down the first T-ds equation.	2,K1,CO4
9.	Define dew point temperature.	2,K1,CO5
10.	State Dalton's law of partial pressure.	2,K1,CO5

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11. a) (i) Considering a system which changes its state, prove that the internal energy is a point function. — 6,K2,CO1

(ii) Derive the suitable expression for the ideal compressor from the steady flow energy equation and specify the assumptions under which such equation is applicable. — 7,K2,CO1

OR

b) Steam enters a nozzle at 400°C and 800 kPa with a velocity of 10 m/s, and leaves at 300°C and 200 kPa while losing heat at a rate of 25 kW. For an inlet area of 800 cm2, determine the velocity and the volume flow rate of the steam at the nozzle exit. — 13,K3,CO1

12. a) A heat engine receives heat from two reservoirs at 900K and 600K and rejects 8 kW of heat to 300K reservoir. The engine develops 12 kW of powers. Determine (a) Efficiency of heat engine (b) Heat supplied by each of the reservoir. — 13,K3,CO2

OR

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

b) Air expands from 11 bar at 55^{0}C 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,CO2*

13\. a) 1.5 kg of steam at 1 bar, 150°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. *13,K3,CO3*

OR

b) Consider a steam power plant operating on the ideal Rankine cycle. Steam enters the turbine at 3 MPa and superheated to 873 K and is condensed in the condenser at a pressure of 10 kPa. Determine the thermal efficiency. *13,K3,CO3*

14\. a) (i) Derive the Joule – Thomson co-efficient equation and draw the inversion curve. *7,K3,CO4*

(ii) State four Gibbs functions and Maxwell's relations. *6,K2,CO4*

OR

b) An insulated rigid tank is divided into two compartments by a partition. One compartment contains 7 kg of oxygen gas at 40°C and 100 kPa, and the other compartment contains 4 kg of nitrogen gas at 20°C and 150 kPa. Now the partition is removed, and the two gases are allowed to mix. Determine (a) the mixture temperature and (b) the mixture pressure after equilibrium has been established. *13,K3,CO4*

15\. a) Air enters a window air conditioner at 1 atm, 30°C, and 80% relative humidity at a rate of 10 m^3/min, and it leaves as saturated air at 14°C. Part of the moisture in the air that condenses during the process is also removed at 14°C. Determine the rates of heat and moisture removal from the air. *13,K3,CO5*

OR

b) Consider a gas mixture that consists of 3 kg of O_2, 5 kg of N_2, and 12 kg of CH_4. Determine (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. *13,K3,CO5*

PART - C (1 × 15 = 15 Marks)

16\. 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 removed by a room cooler, so that a steady state is maintained in the room. *15,K3,CO1*

OR

b) Derive Tds equation when (i) T and V independent (ii) T and P independent (iii) p and v independent. *15,K3,CO4*