Code No: **20ME3O01**

R20

II B. TECH I SEMESTER REGULAR EXAMINATIONS, MARCH - 2022
THERMODYNAMICS
(MECHANICAL ENGINEERING)

Time: 3 Hours **Max. Marks: 70**

Note: Answer **ONE** question from each unit **(5 × 14 = 70 Marks)**

~~~~~~

UNIT-I

1. a) What do you understand by path function and point function? What are exact and inexact differentials? [6M]

   b) A mass of 1.5 kg of air is compressed in a quasi-static process from 0.1 MPa to 0.7 MPa for which pv=constant. The initial density of air is 1.16 kg/m^3. Find the work done by the piston to compress the air. [8M]

(OR)

2. a) Determine the work done by the air which enters into an evacuated vessel from atmosphere when the valve is opened. The atmospheric pressure is 1.213 bar and 1.5 m^3 of air at atmospheric condition enters into the vessel. [7M]

   b) Discuss the concept of Thermodynamic equilibrium. [7M]

UNIT-II

3. a) Show that energy is a property of a system. [6M]

   b) During one cycle the working fluid in an engine engages in two work interactions: 15kJ to the fluid and 44 kJ from the fluid, and three heat interactions, two of which are known: 75 kJ to the fluid and 40 kJ from the fluid. Evaluates the magnitude and direction of the third heat transfer. [8M]

(OR)

4. a) Write the steady flow energy equation for a single stream entering and a single stream leaving a control volume and explain the various terms in it. [6M]

   b) In a steam power station, steam flows steadily through a 0.2 m diameter pipeline from the boiler to the turbine. At the boiler end, the steam conditions are found to be: p = 4 MPa, t = 400^0 C, h= 3213.6 kJ/kg, and v = 0.073m^3/kg. At the turbine end, the conditions are found to be: p = 3.5 MPa, t = 392^{0}C, h = 3202.6 kJ/kg, and v = 0.084 m^3/kg. There is a heat loss of 8.5 kJ/kg from the pipeline. Calculate the steam flow rate. [8M]

UNIT-III

5. a) What is a PMM2? Why is it impossible? [6M]

   b) A cyclic heat engine operates between a source temperature of 800^{0}C and a sink temperature of 30^{0}C. What is the least rate of heat rejection per kW net output of the engine? [8M]
~~~~~~

(OR)

6. a) State and prove Clausius theorem. [6M]

   b) 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 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. [8M]

      (a) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40^0C.

      (b) Reconsider (a) given that the efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum possible values.

UNIT-IV

7. a) Draw the phase equilibrium diagram for a pure substance on h-s plot with relevant constant property lines. [7M]

   b) Ten kg of water at 45^0C is heated at a constant pressure of 10 bar until it becomes superheated vapour at 300^0C. Find the change in volume, enthalpy, internal energy and entropy. [7M]

(OR)

8. a) Explain specific Heats, Internal Energy, and Enthalpy of an Ideal Gas and show the relation between them. [7M]

   b) Express the changes in internal energy and enthalpy of an ideal gas in a reversible adiabatic process in terms of the pressure ratio. [7M]

UNIT-V

9. a) Write a short note on [6M]

   (i) Mass and Mole fraction (ii) Dalton's law of partial pressure

   (iii) Amagats' law of additive volumes.

   b) A vessel of 0.35 m^3 capacity contains 0.4 kg of carbon monoxide (molecular weight = 28) and 1 kg of air at 20^0C. Calculate: (i) The partial pressure of each constituent, (ii) The total pressure in the vessel, and The gravimetric analysis of air may be taken as 23.3% oxygen (molecular weight = 32) and 76.7% nitrogen (molecular weight = 28). [8M]

(OR)

10. a) Explain about adiabatic saturation temperature. [7M]

    b) Explain with a neat sketch the constant property lines in a psychrometric chart. [7M]

* * * * *