Roll No. ..... Total Pages : 03

BT-3/D-14 **8322**

THERMODYNAMICS

ME-201-E

Time : Three Hours] [Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks. Use of only scientific calculator allowed. Use of steam table and Moliere charts allowed.

Unit I

1. (a) Define and explain thermodynamic systems, surrounding and boundary. 10
   (b) Explain the concept of thermodynamic equilibrium. 10

2. (a) Explain the concept of an ideal gas. 8
   (b) The average skin temperature of a person standing in a room is 35°C. The walls of this room are at 25°C. What is the rate of radiation energy flux from this person if the emissivity of the skin is assumed to be 0.96 ? 12

Unit II

3. A heat exchanger is to be designed for cooling oil flowing at a rate of 0.7 kg/s from 170°C to 110°C. The air at inlet temperature of 25°C enters into the heat exchanger and leaves at 100°C. The heat exchanger is well insulated. Assuming no change in kinetic and potential energy across both hot and cold streams, determine the mass flow rate of air. Assume $C_{p,oil}$ = 1.8 kJ/kg-K, $C_{p,air}$ = 1.005 kJ/kg-K. 20

4. (a) Explain the limitations of First Law. 8
   (b) An inventor claims to have been designed and developed a new engine that can produce 45 kW of power by absorbing 52 kW of heat from a thermal reservoir at 700 K while rejecting heat to another thermal reservoir at 300 K. Ascertain validity of this claim. 12

Unit III

5. (a) Explain the principle of Entropy. 10
   (b) Explain third law of thermodynamics. 10

6. In a power plant, 1 kg/s of superheated steam enters into steam turbine at 3MPa and 300°C and leaves it after getting expanded with saturated vapour at 10 kPa. Assuming the flow to be steady, determine (i) actual power output, (ii) maximum posible output, (iii) second law efficiency, (iv) availability of steam at inlet condition, and (v) isentropic efficiency (first law efficiency). The surrounding air is at 100 kPa and 298 K. Assume negligible changes in kinetic and potential energies. **20**

Unit IV

7. (a) Write a note on Saturated Super-heated Steam. **10**

   (b) Explain P-V and P-T plots during steam formation. **10**

8. (a). State and explain T-ds relations. **10**

   (b) Derive thermodynamic relation known as Clapeyron equation. **10**