C 61577 (Pages 2) Name...............................

Reg. No...............................

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, APRIL 2014

(2009 Scheme)

ME 09 406/PTME 09 405—THERMODYNAMICS

Time : Three Hours Maximum : 70 Marks

Use of steam tables and Psychometric charts are permitted.

Part A

*Answer **all** questions.*

1. State zeroth law of thermdynamics.

2. Differentiate point and path functions.

3. Define enthalpy of a gas.

4. State Dalton's law of partial pressure.

5. Define dew point temperature.

(5 × 2 = 10 marks)

Part B

*Answer any **four** questions.*

1. Explain the concept of thermodynamic equilibrium.

2. Briefly explain Carnot's theorem.

3. Show that energy is a property of the system.

4. Define triple point of water. Give its value.

5. Explain the terms sensible heat, latent heat and degree of superheat.

6. Write a brief note on Maxwell relations.

(4 × 5 = 20 marks)

Part C

*Answer **all** questions.*

MODULE I

1. (a) Show that work is a path function, and not a property.

   (b) A mass of 1.5kg 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 1.16kg/m³. Find the work done by the piston to compress air.

Or

Turn over

2. (a) Write the steady flow energy equation as applied to a nozzle and turbine.

    (b) A gas flows through a turbine at the rate of 45kg/min. At inlet the pressure, specific volume and internal energy are 12.5 bar, 0.2 m³/kg and 2,400 kJ/kg. At the exit the corresponding values are 0.06 bar, 20 m³/ kg and l,700 kJ/kg respectively. Calculate the power developed by the turbine assuming adiabatic flow.

MODULE II

3. (a) What is a PMM2 ? Why is it impossible ?

    (b) Air is compressed in a reversible isothermal steady flow process from 1 bar 40°C to 10 bar. Determine the work done on the gas per kg and the heat transferred. Also determine the change of entropy per kg of the mass flow. Assume R = 0.287 kJ/kg°K.

Or

4. (a) All spontaneous processes are irreversible, explain.

    (b) A reversible heat engine operates between two reservoirs at temperature of 6000 C and 400 C. The engine drives a reversible refrigerator which operates between temperatures of 400 C and 200 C. The heat transfer to the heat engine is 2000 kJ and the net work output of engine refrigerator plant is 360 kJ. (a) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 400 C (b) Evaluate the same if the efficiency of the heat engine and COP of the refrigerator are each equal to 40% of their maximum possible values.

MODULE III

5   (a) What is the critical state ? Explain the terms critical pressure, critical temperature and critical volume of water.

    (b) A drum of 1.85 m³ is to be completely filled with dry saturated steam at 7 bar. First the drum is evacuated, and then the necessary amount of water is placed inside and subsequently completely evaporated by heating. What mass of water will be required and what will be the resulting temperature of the vapour ?

Or

6. (a) How is the partial pressure in a gas mixture related to the mole fraction ?

    (b) A certain gas has C_p = 0.913 kJ/kg°K and C_V = 0653 kJ/kg°K. Find the molecular weight and the gas constant R of the gas.

MODULE IV

7. Using Clausius - Claypeyron equation estimate the value of enthalpy of vaporization of water at 50°C and compare it with tabulated values

Or

8. A sling psychrometer reads 40° C DBT and 30° C WBT Find the humidity ratio, relative humidty, dew point temperature, specific volume and enthalpy of air.

(4 × 10 = 40 marks)