T 8241

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Third Semester

Mechanical Engineering

ME 1201 — ENGINEERING THERMODYNAMICS

(Common to Production Engineering and B.E. (Part-Time) – Second Semester – Regulation 2005)

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Standard steam table, Mollier chart, Psychometric-charts are permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the convention for positive and negative work?

2. What are the corollaries to the first law of Thermodynamics?

3. Given Kelvin-Planck statement of the second Law of Thermodynamics.

4. What is a process involved in a Carnot cycle, sketch the same in P-V and T-S diagram.

5. Define critical pressure and temperature for water.

6. Sketch the Rankine cycle on a P-V plane and name the various process.

7. State the Avagodro's law and state its significance.

8. Write the Maxwell's questions and its significance.

9. Explain the terms (a) Specific humidity (b) Dew point temperature.

10. What is adiabatic mixing and write the equation for that?

PART B — (5 × 16 = 80 marks)

11. (a) In an isentropic flow through nozzle, air flows at the rate of 600 kg/hr. At inlet to the nozzle, pressure is 2 MPa and temperature is 127°C. The exit pressure is 0.5 MPa. Initial air velocity is 300 m/s determine (i) Exit velocity of air (ii) Inlet and exit area of nozzle.

Or

(b) A centrifugal pump delivers 2750 kg of water per minute from initial pressure of 0.8 bar absolute to a final pressure of 2.8 bar absolute. The suction is 2 m below and the delivery is 5 m above the centre of pump. If the suction and delivery pipes are of 15 cm and 10 cm diameter respectively, make calculation for power required to run the pump.

12. (a) A heat engine operating between two reservoirs at 100 K and 300 K is used to drive heat pump which extracts heat from the reservoir at 300 K at a rate twice that at which engine rejects heat to it. If the efficiency of the engine is 40% of the maximum possible and the co-efficient of performance of the heat pump is 50% of the maximum possible, make calculations for the temperature of the reservoir to which the heat pump rejects heat. Also work out the rate of heat rejection from the heat pump if the rate of supply of heat to the engine is 50 kW.

Or

(b) One kg of air is contained in a piston cylinder assembly at 10 bar pressure and 500 K temperature. The piston moves outwards and the air expands to 2 bar pressure and 350 K temperature. Determine the maximum work obtainable. Assume the environmental conditions to be 1 bar and 290 K.

Also make calculations for the availability in the initial and final states.

13. (a) 1 kg of steam initially dry saturated at 1.1 MPa expands in a cylinder following the law $PV^{1.13} = C$. The pressure at the end of expansion is 0.1 MPa. Determine

(i) The final volume

(ii) Final dryness fraction

(iii) Work done

(iv) The change in internal energy

(v) The heat transferred.

Or

(b) Steam at a pressure of 2.5 MPa and 500°C is expanded in a steam turbine to a condenser pressure of 0.05 MPa. Determine for Rankine cycle :

(i) The thermal efficiency of Rankine cycle

(ii) Specific steam consumption.

If the steam pressure is reduced to 1 MPa and the temperature is kept same 500°C. Determine the thermal efficiency and the specific steam consumption. Neglect feed pump work.

14. (a) Derive Tds Equation when

(i) T and V independent

(ii) T and P independent

(iii) P and V independent.

Or

(b) Explain and derive the

(i) Jules Thompson co-efficient

(ii) Clausius Clapeyron equation.

15. (a) A room 7 m × 4 m × 4 m is occupied by an air water vapour mixture at 38°C. The atmospheric pressure is 1 bar and the relative humidity is 70%. Determine humidity ratio, dew point temperature mass of dry air and mass of water vapour. If the mixture of air-water vapour is further cooled at constant pressure until the temperature is 10°C. Find the amount of water vapour condensed.

Or

(b) Air at 20°C, 40% RH is mixed adiabatically with air at 40°C 40% RH in the ratio of 1 kg of the former with 2 kg of later. Find the final condition of air. Draw the process in chart also as diagram.