[03 – 3112]

III/IV B.E. DEGREE EXAMINATION.

First Semester

Mechanical Engineering

ENGINEERING THERMO DYNAMICS – II

(Common with Dual Degree Program in Mechanical Engineering)

(Effective from the admitted batch of 2006–2007)

Time : Three hours   Maximum : 70 marks

Question No. 1 is compulsory.

Answer any FOUR from the remaining.

Use the Steam Tables Refrigeration Tables, Mollier and P-h charts is permitted.

1.   Answer the following :

(a)   What is the use of steam tables?

(b)   Define Gibbs-Daltor law.

(c)   Classify steam nozzles.

(d)   What is meant by compounding in steam turbines?

(e) What are the sources of air leakage in condenser?

(f) Draw the Bell-Coleman cycle on T-S diagram.

(g) Define degree of saturation

2. (a) Derive the equation for dryness fraction using bucket Calorimeter.

(b) Steam at a pressure of 5-4 bar and dryness fraction 0.8 expands in a cylinder reversibly and isothermally to a pressure of 1 bar. Find

   (i) final condition of steam

   (ii) charge in internal energy

   (iii) charge of entropy

   (iv) heat transferred and

   (v) work done per kg of steam

3. (a) Explain the principle of regenerative cycle and derive the equation for work done.

(b) A vessel contains at 1 bar and 20°C, a mixture of 1 mole of CO_2 and 4 moles of air. Calculate for the mixture

    (i)   the masses of CO_2, O_2 and N_2 and the total mass

    (ii)   the percentage carbon content by mass

    (iii) the apparent molecular weight and the gas constant for the mixture and

    (iv) the specific volume of the mixture.

    The volumetric analysis of air can be taken as 21% oxygen and 79% nitrogen.

4.   (a)   Derive the equation for mass of steam discharged through a steam nozzle.

    (b)   Steam at a pressure of 10 bar and 0.9 dry discharges through a nozzle having throat area of 450 mm². If the back pressure is 1 bar, find

       (i)   final velocity of the steam and

      (ii) cross-sectional area of the nozzle at exit for maximum discharge.

5. (a) With a neat sketch, explain the working of Parson's reaction turbine.

   (b) The velocity of steam at inlet to a simple impulse turbine is 1000 m/s and the nozzle angle is 20°. The mean blade speed is 400 m/s and the blades are symmetrical. The mass flow rate of steam is 0.75 kg/s. The friction effects on the blades are negligible. Estimate

      (i) the blade angles

      (ii) the tangential force on the blades

      (iii) the axial thrust

      (iv) the diagram power and

      (v) the diagram efficiency.

6. (a) Explain the working of a parallel flow low level jet condenser.

   (b) The air leakage into a surface condenser operating with a steam turbine is estimated as 84 kg/hr. The vacuum near the inlet of air pump is 700 mm of Hg when barometer reads 760 mm of Hg. The temperature at inlet of vacuum pump is 20°C. Calculate

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(i) the minimum capacity of the air pump in M³/hr

(ii) the dimensions of the reciprocating air pump to remove the air if it runs at 200 r.p.m Take L/D ratio = 1.5 and volumetric efficiency = 100% and

(iii) the mass of vapour extracted per minute.

7. (a) Describe the working of electrolux refrigerator.

(b) In a standard vapour compression refrigeration cycle, operating between evaporator temperature of −10°C and a condenser temperature of 40°C, the enthalpy of the refrigerant, Freon-12 at the end of compression is 220 kJ/kg. Calculate

(i) the COP of the cycle and

(ii) the refrigerating capacity and the compressor power assuming a refrigerant flow rate of 1 kg/min.

8. (a) Explain the working of central air conditioning system.

(b) The sling psychrometer in a laboratory test recorded as dry bulb temperature = 35°C and wet bulb temperature = 25°C. Calculate the following:

  (i) Specific humidity

  (ii) relative humidity

  (iii) vapour density in air

  (iv) dew point temperature and

  (v) enthalpy of mixute per kg of dry air.