01543

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

December, 2012

BIME-013 : TURBO MACHINES

Time : 3 hours   *Maximum Marks : 70*

Note :   Answer **any five** questions. Assume any missing data suitably.

1. (a)   Deduce an expression for the specific speed   8
            of a hydrodynamic machine and point out
            how the classification of hydrodynamic
            runners is based on specific speed ?

    (b)   A turbine is to operate under a head of   6
            25 m at 200rpm. The discharge is 9m³/sec.
            If the turbine efficiency is 90% determine :

            (i)   Specific speed of the turbine

            (ii)   Power generated

            (iii) Discharge under a head of 20m.

2. (a) Give the classification of hydraulic turbines.   **8**
In the case of a pelton wheel, two hemispherical cups are joined together and water is directed at the junction. What are the advantages of the arrangement ?

(b) A double jet pelton wheel has a specific   **6**
speed of 16 and is required to deliver 1000 kW. The supply of water to the turbine is through a pipeline from a reservoir whose level is 350 m above the nozzles. Allowing 5% for friction loss in the pipe, calculate speed, diameter of jets and mean diameter of bucket circle. Take velocity coefficient = 0.98, speed ratio=0.46 and overall efficiency = 85%.

3. (a) What are the important component parts   **8**
of a reaction turbine? Explain their functions. Give the differences between impulse and reaction turbines.

(b) A Francis turbine has inlet wheel diameter   **6**
of 2m and an outlet diametert of 1.2m. The runner speed is 250rpm and water flow rate is 8m³/sec. The blades have a constant breadth of 0.2m. If the vanes are radial at inlet and the discharge is radially outwards at exit, calculate the angle of guide vane at inlet and the blade angle at outlet.

BIME-013   2

4. (a) How does a centrifugal pump impart 8
pressure energy to the fluid? Indicate the
mechanism involved. Explain the terms
manometric efficiency, mechanical
efficiency and overall efficiency on
applicable to centrifugal pumps.

 (b) A centrifugal pump is running at 1000rpm. 6
The outlet vane angle of the impeller is 45°
and the velocity of flow at outlet is
2.5m/sec. The discharge through the pump
is 200 litres per second when the pump is
working against a total head of 20m. If the
manometric efficiency of the pump is 80%.
Determine :

 (i) diameter of impeller.

 (ii) the width of the impeller at outlet.

5. (a) Discuss in detail the performance 7
characteristics of centrifugal pump.

 (b) With neat figure explain the working of axial 7
flow pump.

6. (a) Define slip factor and power input factor 7
of centrifugal compressor. Derive an
expression for total pressure ratio in term
of slip factor, power input factor,
insentropic efficiency, blade velocity at
outlet, temperature and specific heat ratio.

(b) The following data are given for a centrifugal compressor and it is required to find the impeller tip diameter. 7

Speed = 15,000rpm, flow rate = 22.5kg/sec, ambient temperature and pressure = 21°C and 1 bar, inlet and exit flow velocity = 140m/sec, pressure ratio = 4, adiabetic efficiency = 0.76, Double sided impeller, slip factor = 0.9, work input factor = 1.04, C_p = 1.005 kJ/kgK.

7. (a) Explain degree of reaction. Explain the 8 working of single stage reaction turbine. Describe the pressure and velocity variations along the axis of the turbine.

(b) In a single stage impline turbine the mean 6 diameter of blades is 1m. Speed = 3000rpm, The steam issues from the nozzle at a velocity of 350m/sec, nozzle angle = 20°. Blades are symmetrical, blade friction factor = 0.86. Determine power developed if axial thrust on the end bearing of a rotor is 120N.

8. Write short notes on *any two* of the followings :
    2x7=14
    (a) Gas turbine
    (b) Cavitation
    (c) Turbine governing

———