[Total No. of Questions - 9] [Total No. of Printed Pages - 4]

Dec-22-0155

ME-404 (Turbo Machines)

B.Tech-4th (CBCS)

Time : 3 Hours **Max. Marks : 60**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note: Candidates are required to attempt five questions in all, selecting one question from each of sections A, B, C and D of the question paper. However, Section E is compulsory and attempts all the subparts of the questions in section E.

SECTION-A

1. (a) A jet of data 75mm diameter has a velocity of 30m/s. It strikes a flat plate inclined at 450 to the axis of jet. Find the force on the plate when.
   (i) The plate is stationary
   (ii) The plate is moving with a velocity of 15 m/s along and away from the jet. [5]

   (b) A Pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 litres/sec under a head of 30m. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. [5]

or

2. (a) A jet of velocity of 5 m/s strikes a flat plate inclined at 300 with the axis of jet. If the cross sectional area of the jet is 5 cm^2, find the force exerted by the jet on the plate. Also, calculate the components of the force in the direction normal to the jet. Find also the ratio in which the discharge gets divided after striking the plate. [5]

   (b) Derive an expression for the power developed by a Pelton wheel turbine. [5]

SECTION-B

3. (a) A turbine is to operate under a head of 30m at 300 rpm. The discharge is 10 m^3/s. If the efficiency is 90%, determine:
   (i) specific speed of the machine,
   (ii) power generated and
   (iii) types of turbine. [5]

   (b) State the relation between Thoma's cavitation coefficient and critical Thoma's cavitation coefficient for cavitation not to occur in hydraulic turbines. [5]

or

4. (a) The following data is given for a Francis turbine. Net head H = 60 m, speed N = 700 rpm, shaft power = 294.3 kW, overall efficiency = 84%, hydraulic efficiency = 93%, flow ratio = 0.20, breadth ratio n = 0:1, Outer diameter of the runner is twice of the inner diameter of runner. The thickness of vanes occupies 5% of circumferential area of the runner, velocity of flow is constant at the inlet and outlet and discharge is radial at outlet. Draw the required velocity diagram and determine the following:
   (i) Guide blade angle,
   (ii) Runner vane angles at inlet and outlet,
   (iii) Diameters of the runner at inlet and outlet,
   (iv) Width of wheel at inlet. [7]

   (b) What is the purpose of a draft tube in a reaction turbine? [3]

[P.T.O.]

SECTION-C

5. (a) Differentiate between a single acting reciprocating pump and double acting reciprocating pump. [5]

   (b) A centrifugal pump runs at 1000 rpm and delivers water against a head of 15m, The impeller diameter and width at the outlet are 0.3m and 0.05m respectively. The vanes are curved back at an angle of 30° with the periphery at the outlet. If the maximum efficiency is 92%, find the discharge. [5]

or

6. (a) Derive an expression for the minimum starting speed of a centrifugal pump. [5]

   (b) For a pump, discuss the difference between brake horsepower and water horsepower, and also define pump efficiency in terms of these quantities. [5]

SECTION-D

7. (a) Determine the pressure ratio developed and the power required to drive a centrifugal air compressor (impeller diameter =45 cm) running at 7200 rpm. Assume zero swirl at the entry and T_{01}=288K. [5]

   (b) Define the degree of reaction, rotor and stage pressure coefficients and stage efficiency for fans and blowers. [5]

or

8. (a) Draw an illustrative diagram of a centrifugal compressor stage indicating the names of its principal parts. [5]

   (b) What are the primary differences between fans, blowers, and compressors? Discuss in terms of pressure rise and volume flow rate. [5]

Section -E (Compulsory Question)

9. Write short answers of the following.. (2×10=20)

   a. Differentiate between turbines and pumps.

   b. Define the term: Speed ratio, flow ratio and jet ratio.

   c. What are unit quantities?

   d. What is a draft tube?

   e. Define the term governing of turbine.

   f. Give at least two reasons why turbines often have greater efficiencies than pumps do.

   g. What is cavitation?

   h. Define specific speed of a turbine.

   i. What are the main advantages and disadvantages of supersonic stages compared to the subsonic stages?

   j. List two common examples of fans, of blowers, and of compressors.