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

Dec.-23-0401

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 : Attempt Five questions in all, selecting one question each from Section A, B, C and D. Question no. 9 is compulsory.

SECTION - A

1. (a) A jet of water of 30 mm diameter strikes a hinged square plate at its centre with a velocity of 20 m/s. The plate is depleted through an angle of 20°C. Find the weight of the plate. If the plate is not allowed, to swing, what will be the force required at the lower edge of the plate to keep the plate in vertical position. (5)

   (b) Discuss in detail the turbine parameters such as gross head, discharge, work done and efficiency. (5)

2. (a) A 147 mm diameter jet of water issuing from a nozzle impinging on the buckets of a Pelton wheel and the jet is deflected through an angle of 165° by the buckets. The head available at the nozzle is 400 m. Assuming co-efficient of velocity as 0.97, speed ratio as 0.46, and reduction in relative velocity while passing through buckets as 15%, find: (i) The force exerted by the jet on the buckets in tangential direction, (ii) the power developed. (5)

   (b) Determine the power given by the jet of water to the runner of a Pelton wheel which is having tangential velocity as 25 m/s. The net head on the turbine is 60 m, and discharge through the jet water is 0.04 m^3/s. The side clearance angle is 15° and take $C_v = 0.975$. (5)

SECTION - B

3. (a) Write in detail, the difference between the Francis and Kaplan turbine. (3)

   (b) The external and internal diameters of an inward flow reaction turbine are 1.13 m and 0.4 m, respectively. The head on the turbine is 22 m and velocity of flow through the runner is constant and equal to 2.5 m/s. The guide blade angle is given as 10° and the runner vanes are radial at inlet. If the discharge at outlet is radial, determine: (i) The speed of the turbine, (ii) The vane angle at outlet of the runner and (iii) Hydraulic efficiency. (7)

4. (a) Explain the reason of occurrence of Cavitations in turbine and present the effects on turbine performance. (5)

   (b) Explain the criteria of determination of safe height of installation for turbine. Why draft tube are used at the exit of reaction turbines? (5)

SECTION - C

5. (a) Derive and explain the head capacity relationship and pump losses. (3)

   (b) The outlet diameter of an impeller of a centrifugal pump is 400 mm and outlet width is 50 mm. The pump is running at 800 r.p.m. and is working against a total head of 15 m. The vanes angle at outlet is 40° and manometric efficiency is 75%. Determine: (i) velocity of flow at outlet, (ii) velocity of water leaving the vane, (iii) angle made by the absolute velocity at outlet with the direction of motion at outlet and (iv) discharge. (7)

6. (a) Write the effect of acceleration and friction on the indicator diagram (pressure-stoke length plot). (5)

(b) A single acting reciprocating pump has a plunger diameter of 250 mm and stroke of 450 mm and it is driven with S.H.M. at 60 r.p.m. The length and diameter of delivery pipe are 60 m and 100 mm respectively. Determine the power saved in overcoming friction in the delivery pipe by fitting an air vessel on the delivery side of the pump. Assume friction factor = 0.01. (5)

SECTION - D

7. (a) Draw and explain the construction details of centrifugal fans. (5)

(b) Explain various slip factors in HS diagram for centrifugal compressor. (5)

8. (a) A single acting two stage air compressor deals with 4 m^3/min of air at 1.013 bar and 15°C with a speed of 250 r.p.m. The delivery pressure is 80 bar. Assuming complete intercooling, find the minimum power required by the compressor and the bore and stroke of the compressor. Assume a piston speed of the 3 m/s, mechanical efficiency of 75% and volumetric efficiency of 80% per stage. Assume the polytropic index of compression in both the stages to be n = 1.25 and neglect clearance. (7)

(b) Air is compressed in a centrifugal compressor (γ = 1.4) from 110 to 300 kPa. The compression efficiency is 0.90. Determine the work done per unit mass of air using the ideal gas law. (3)

SECTION - E (Compulsory Question)

9. Explain the following:

(a) Discuss cavitation in pumps.

(b) Write the applications of reciprocation pumps.

(c) Write different elements of turbine.

(d) What are the design parameters in turbines?

(e) What is the use of draft tube?

(f) Explain the design parameters of centrifugal pump.

(g) Draw sketch of Francis turbine.

(h) Explain difference in centrifugal v/s reciprocating pumps.

(i) What are the different factors of low turbine performance?

(j) Draw characteristic curve of reaction turbine. (10×2=20)