[Total No. of Questions - 9] [Total No. of Printed Pages - 4] (2125)

15135

B. Tech 5th Semester Examination

Fluid Machines (OS)

ME-5003

Time : 3 Hours **Max. Marks : 100**

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 at least one question from each Section A, B, C & D. Section E is compulsory.

SECTION - A

1. (a) Give complete design procedure for Pelton wheel. Also, mention different components of a power plant working with Pelton wheel. (12)

   (b) Following data refers to a Pelton turbine, it drives a 15MW generator. The effective head is 310m. The generator and turbine efficiencies are 95% and 86% respectively. The speed ratio is 0.46, jet ratio is 12. Nozzle velocity coefficient is 0.98. Determine the jet and runner diameters, the speed and specific speed of runner. (8)

2. (a) Derive an expression for face exerted work done and hydraulic efficiency for water jet striking tangentially to series of curved buckets mounted on the periphery of the wheel. (12)

   (b) A water jet with velocity 30m/s impinges on series of vanes moving at 12 m/s at 30º to the direction of motor. The vane angle of the outlet is 162º to the direction of motor. Compute (a) Vane angle at inlet for shock free entry (b) the efficiency of power transmission. (8)

[P.T.O.]

SECTION - B

3. (a) Draw the constructional details of Francis turbine installation. Mention the function of each component. (10)

   (b) The outer diameter of Francis runner is 1.4m. The flow velocity at the inlet is 9.5 m/s. The absolute velocity at the exit is 7m/s. The speed of operation is 430 rpm. The power developed is 12.25 MW with the flow rate of 12 m^3/s. Total head is 115m. For shock free entry determine the angle of inlet guide vane also find the absolute velocity at the entrance, the runner blade angle at the inlet and loss of head in the unit. Assume zero whirl at exit, Also, find the specific speed. (10)

4. (a) What is function of draft tube? Derive an expression for draft tube efficiency. (10)

   (b) A Kaplan turbine delivering 40MW works under the head of 35m and runs at 167rpm. The hub diameter is 2.5m and runner tip diameter is 5m. The overall efficiency is 87%. Determine the blade angles at hub and tap and also at diameter of 3.75m. Also find the speed ratio and flow ratio based on tip velocity. Assume η_h=90%. (10)

SECTION - C

5. (a) It is required to transmit 50 metric HP from an accumulator through pipe line 10cm in diameter and 1500m long. The ram is loaded with a weight of 125 tonnes and friction loss in the pipe line equals 2.5% of total power being transmitted. Workout the diameter of the ram. If the friction factor is 0.01 for the pipe line. (10)

   (b) Explain with a neat sketch the construction, operation and utility of following hydraulic devices (i) hydraulic intensifier (ii) hydraulic press. (10)

6. (a) Derive an expression for specific speed of the turbine. (6)

(b) Describe the steps involved in developing non-dimensional relations with Buchingham π-theorem. (6)

(c) What is cavitation? How is it quantified? Find an expression for Thoma's cavitation number for turbines. (8)

SECTION - D

7. (a) What is priming of centrifugal pump? Explain clearly why primings is essential before starting the centrifugal pump. (6)

(b) A centrifugal pump has an impeller with inner and outer diameters of 15 & 25cm respectively. It delivers 50 litres of water/sec at 1500 rpm. The velocity of flow through the impeller is constant at 2.5m/s. The blades are curved back at an angle of 30º to the tangent at exit. The diameters of suction and delivery pipes are 15cm & 40cm respectively. The pressure head at the suction is 4m below and that at delivery is 18m above atmosphere. The power required to drive the pump is 25HP. Find (a) The vane angle at inlet (b) The overall efficiency (c) the manometric efficiency. (14)

8. (a) Explain the term manometric efficiency, mechanical efficiency and overall efficiency as applied to centrifugal pumps. (6)

(b) A centrifugal pump is running at 100rpm. The outlet vane angle of the impeller 45º and the velocity of flow at the outlet is 2.5m/s. The discharge through the pump is 200 litres/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) Width of impeller at the outlet. (8)

[P.T.O.]

(c) Explain the double suction impeller, shut-off head and net positive suction head as applied to centrifugal pump. (6)

SECTION - E

9. (a) What is water wheel?

(b) What is difference between impulse & reaction turbine?

(c) What is the need of governing of turbines?

(d) Why there are two cup-shaped buckets in the Pelton wheel?

(e) Why Pelton wheel is used at high heads?

(f) What is difference between propeller & Kaplan turbine?

(g) "Draft tube does shape function in hydraulic turbines as condensee does in steam turbines", Justify this statement.

(h) What is the need of model testing?

(i) What is the significance of studying chapter on dimensional analysis?

(j) What is minimum speed of centrifugal pump? (10×2=20)