6E3053

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B.Tech. VIth Semester (Main/Back) Examination, June - 2010
Mechanical Engineering
6ME5 Hydraulic Machines & Hydroelectric Power Plant

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five questions** selecting **one question** from **each unit**. All questions carry **equal marks**. (Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)*

Unit - I

1. a) Prove that for a curved radial vane the efficiency is given by

$$\eta = \frac{2\left(V_{w_1 u_1} + V_{w_2 u_2}\right)}{V_1^2} .$$ (8)

   b) A Francis turbine of diameter 3m develops 6750 kw at 300 rpm under a net head of 45m. A geometrically similar model of scale ratio 1 : 8 is to be tested at a head of 9m. Estimate the size, speed, discharge and power developed by model. What is the specific speed of the model?

   (Assume overall efficiency of 0.82 for both the prototype and model). (8)

2. a) A jet of water having a velocity of 18 m/s strikes a curved vane which is moving with a velocity of 6 m/s. The vane is symmetrical and so shaped that the jet is deflected through 120°. Determine : (8)

   i) The angle of the jet at inlet of the vane so that there is no shock.

   ii) The absolute velocity of the jet at outlet in magnitude and direction.

   iii) The work done per N of water.

   b) A jet of water 60 mm diameter strikes a curved vane at its centre with a velocity of 18 m/s. The curved vane as moving with a velocity of 6 m/s in the direction of the jet. The jet is deflected through an angle of 165°. Assuming the plane to be smooth, find :

i) Thrust on the plate in the direction of jet.

ii) Power of the jet and

iii) Efficiency of the jet. (8)

Unit - II

3. a) Give comparison between Impulse and Reaction turbine. (6)

b) The propeller reaction turbine of runner diameter 4.5 m is running at 48 r.p.m. The guide blade angle at inlet is 145° and the runner blade angle at outlet is 25° to the direction of vane. The axial flow area of water through the runner is 30 m². If the runner blade angle at inlet is radial. Determine : (10)

i) Hydraulic efficiency of the turbine,

ii) Discharge through the turbine, and

iii) Power developed by the runner.

4. a) Derive an expression for hydraulic efficiency of a Pelton wheel. (8)

b) Describe with a neat sketch the governing of impulse turbine. (8)

Unit - III

5. a) Draw a schematic diagram of a Francis Turbine and explain briefly its construction and working. (8)

b) A kaplan turbine develops 22000 kw at an average head of 35 m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of the boss equal to 0.35 times the diameter of the runner and an overall efficiency of 88 percent. Calculate the diameter, speed and specific speed of the turbine. (8)

6. a) What are characteristic curves and what are their uses. Draw the main characteristic and operating characteristics for different types of turbine. (8)

b) Explain the theory and function of Draft tube. Derive an expression for draft tube efficiency. (8)

Unit - IV

7. a) Obtain an expression for the pressure head due to acceleration on the reaction and delivery pipe for reciprocating pump. (8)

b) The diameter and stroke length of a single acting reciprocating pump are 75 mm and 150 mm respectively. It takes it supply of water from a sump 3m below the pump through a pipe 5 m long and 40 mm in diameter. It delivers water to a tank 12 m above the pump through a pipe 30 mm in diameter and

15 m long. If separation occurs 75 kN/m² below the atmospheric pressure, find the maximum speed at which pump may be operated without separation. Assume that the piston has a simple harmonic motion. **(8)**

8. Write short notes on any two : **(16)**

   a) Hydraulic Lift.

   b) Hydraulic Ram.

   c) Hydraulic Torque converter.

Unit - V

9. a) Explain the importance of hydrographs and flow duration curve for the installation of Hydro Electric Power Plant. **(8)**

   b) Write short note on Surge Tank. **(8)**

10. a) Write note on Hydro Power development in India. **(8)**

    b) How is the selection of Turbine made. **(8)**

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