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SE-6865

B. E. III (Sem. V) (Mechanical) Examination

April / May – 2011

Hydrulic Machines

Time : Hours] [Total Marks :

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ B. E. 3 (Sem. 5) (Mechanical)

Name of the Subject :

☛ Hydrulic Machines

☛ Subject Code No. : 6 8 6 5 ☛ Section No. (1, 2,.....) : Nil

Seat No. :

Student's Signature

(2) Attempt all questions.
(3) Use of calculator is permitted.
(4) Figure to the right indicates full marks.
(5) Assume suitable data if required.

1 (a) Attempt following : **10**

(1) Define - specific speed of pump.
(2) What is slip ?
(3) Define manometric efficiency of centrifugal pump.
(4) Draw velocity diagram for the centrifugal pump.
(5) Draw schematic diagram of a reciprocating pump.

(b) Attempt multiple choice questions : **10**

(1) The drag produced by end effects due to finite length of an airfoil is -
  (a) Form drag
  (b) Profile drag
  (c) Induced drag
  (d) Boundary drag

(2) The circulation around an airfoil, required for the lift, for the lift, is produced -
  (a) Due to tip vortices
  (b) By the rotation of airfoil
  (c) When the airfoil is kept inclined to the flow direction
  (d) Because of surface discontinuity formed at its trailing edge

(3) In general, the vanes of a centrifugal pump are -
  (a) Curved forward
  (b) Curved backward
  (c) Radial
  (d) Twisted

(4) The slip in case of reciprocating pump is -
  (a) +ve
  (b) –ve
  (c) +ve or -ve
  (d) Zero

(5) The pump to be used for pumping highly viscous fluids belongs to the category of -
  (a) Screw pump
  (b) Turbine pump
  (c) Plunger pump
  (d) Centrifugal pump

2 (a) A centrifugal pump impeller runs at 1400 rpm, and vanes angle at exit is 25^o. The impeller has an external diameter of 0.4m and an internal diameter of 0.2m. Assuming a contant radial flow through the impeller at 2.6 m/s, calculate (1) the angle made by the absolute velocity of water at exit with the tangent, (2) the inlet vane angle, and (3) the work done per kg of water. **15**

(b) Explain - "Performance characteristics of a centrifugal pump."

OR

2 (a) A centrifugal pump delivers water at the rate of 8.5 m^3/min against a head of 10m. It has an impeller of 50 cm outer diameter and 25 cm inner diameter. Vanes are set back at outlet at an angle of 45^o, and impeller is running at 500 rpm. The constant velocity of flow is 2m/s. Determine (1) Manometric efficiency, (2) vane angle at inlet, and (3) minimum starting speed of the pump. **15**

(b) Classify pumps. Draw schemetic diagram of Vane pump and Lobe pump. **8**

3 Answer any **two** : **15**

(a) Write comparison between Reciprocating and Centrifugal Pump.

(b) An axial flow pump discharges water at the rate of 1.30 m^3/s and runs at 550 rpm. The total head is 10m. Assume blade velocity 22m/s, the flow velocity 4.5 m/s, hydraulic efficiency 0.87, and the overall pump efficiency 0.83, find (1) the power delivered to the water, and power input, (2) the impeller hub diameter and tip diameter, and (3) the inlet and outlet blade angles for the rotor.

(c) The specific speed of an axial flow pump impeller is 1150 and velocity of flow is 2.5m/s. The outer and inner diameters of the impeller are 0.90m and 0.45m , respectively. Calculate the suitable speed of the pump to give a head of 5.5m. Also, calculate vane angle at the entry of the pump.

4 Answer the following questions : **10**

(1) Define unit discharge of Turbine.

(2) Differentiate between suction and delivery head.

(3) Define peak load plant.

(4) Define degree of reaction for turbine.

(5) The area of casing of reaction turbine _____ in order the flow over the periphery, (Increases, Reduces, Remains same).

(6) Define Hydraulic efficiency.

(7) Define Mechanical efficiency.

(8) Define gross and neat head.

(9) Define Volumetric efficiency.

(10) Explain Jet propulsion.

5 Answer the following questions : (any **three**) **20**

(1) Explain characteristics curves for Hydrulic Turbine with neat sketch.

(2) What is draft tubes. Explain its function and also derive draft tube.

(3) Explain with neat sketch working of fransis turbine and list its component.

(4) Explain with neat sketch working of hydroelectric power plant.

(5) Derive and expression for force on series of Vane of flat moving plate and prove that maximum efficiency $\eta_{max} = 50\%$.

6 Ansewer the following questions : (any **three**) **20**

(1) A jet of water of diameter 75 mm moving with a velocity of 20 m/sec strikes a fixed plate in such a way that the angle between the jet and plate is 60^o. Find the force exerted by a jet on the plate [a] in the direction normal to the plane and [b] in the direction of jet.

(2) A wheel having radial blades has 1 m diameter inlet and 70 cm diameter at outlet. Water enters the wheel at a velocity of 40 m/sec at an angle of 30^o with tangent of vane tip velocity and leaves with velocity of flow 5 m/sec. If the blade angles at inlet and outlet are 35^o and 40^o respectively. Find [a] the speed of wheel [b] the work done per kg of water [3] efficiency.

(3) A pelton wheel has a mean bucket speed of 10 meter per second with a jet of water flowing at the rate of 700 litre/sec under a head of 30 m. The bucket deflects the jet through an angle of 160^o. Calculate the power given by water to the runner and the hydrulic efficiency of the turbine. Assume coefficient of velocity as 0.98.

(4) An inward flow reaction turbine is running of 200 rpm and width of the turbine at inlet is 200 mm. the turbine has external and internal diameter as 0.9 m and 0.45 m respectively. The velocity of flow through the runner is constant and is equal to 1.8 m/sec. The guide blade makes an angle of 10^o to the tangent of wheel and discharge and at the outlet of the turbine is radial. Draw the inlet and outlet velocity triangles and determine [1] the absolute velocity of water [2] the velocity of whirl at inlet [3] the velocity relative at inlet [4] mass of water flowing through runner per second. [5] efficiency and power developed.
