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RN-6865

B. E. - III (Sem. V) (Mech.) Examination

May / June – 2010

Hydraulic Machines

Time : **3** Hours] [Total Marks : **100**

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) (Mech.)

Name of the Subject :

☛ Hydraulic Machines

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

Seat No. :

Student's Signature

(2) Attempt **all** questions.

(3) Figures to right indicate full marks.

(4) Draw neat sketches wherever necessary.

(5) Assume suitable data if necessary and indicate same.

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

(i) Explain the term NPSH.

(ii) What are total head and manometric heads of a centrifugal pump ?

(iii) Why should a suction lift of a centrifugal pump not exceed a certain limit ?

(iv) Discuss application of axial thrust pumps.

(v) Draw neat and labelled diagram of different types of impellers.

(b) The discharge of water through a centrifugal pump is 0.05 m^3/sec. The length of pipe is 22m and it raises the height through 15 m. The diameter of pipe is 140 mm, η_0 = 0.72 and coefficient of friction is 0.02. Find the power input to the pump. **5**

(c) With neat sketch explain construction and working of axial flow pump. **5**

2 Attempt any **two** : **16**

(a) A centrifugal pump running at 600 rpm discharges $10m^3$/min against a total head of 15 m. It has an impeller of 50 cm and 25 cm diameter. Vanes are set back at an angle of 45°. The constant velocity of flow is 2m/sec. Determine (i) Monometric efficiency, (ii) Vane angle at inlet (iii) Minimum starting speed of pump.

(b) What do you mean by cavitation? State its effect and explain methods of reducing cavitation in centrifugal pumps.

(c) Write brief note on multi stage pumps.

3 Attempt any **two** :

(a) State and explain effect of vane angle at outlet on manometric efficiency of centrifugal pump.

(b) A centrifugal pump has an impeller of external diameter 60 cm and internal diameter 30 cm. The velocity of flow is 2.5 m/sec and is constant. The vane angles at inlet and outlet are 30° and 45° respectively. Find

(i) Speed in rpm

(ii) Pressure rise through impeller

(iii) Power required to drive pump for unit - flow rate

(c) With neat sketch explain contraction and working of centrifuge pumps.

4 (a) Answer the following : **10**

(i) Define unit speed of turbine.

(ii) Define runaway speed of turbine.

(iii) Define Hydraulic efficiency of turbine.

(iv) Kaplan turbine is an impulse turbine. (True or False)

(v) The angle of deflection in pelton cohed blade is _____ generally.

(vi) In Francis turbine water leaves in _____ direction. (axial, radial, tangential)

(vii) Define Base load plant.

(viii) In a reaction turbine the function of a draft tube is to

(a) provide safety to turbine

(b) prevent air from entering

(c) reconvert the kinetic energy to flow energy

(d) increase the rate of flow

(ix) Cavitation damage in turbine runner occurs near the

(a) inlet of convex side of blade

(b) outlet of convex side of blade

(c) inlet of concave side of blade

(d) outlet of concave side of blade

(x) Governing of turbine is by varying the _____.

(Blade angle, Blade thickness, flow rate)

(b) Derive following expression for pelton wheel : **10**

(i) Work done/unit weight/sec.

(ii) Kinetic Energy

(iii) Maximum Hydraulic Efficiency

5 (a) Answer any **two** : 8

(i) State the method of governing Pelton wheel turbine using neat sketch.

(ii) Explain main characteristic curve for hydraulic turbine.

(iii) Explain constant efficiency curves for hydraulic turbine.

(b) A pelton wheel is to be designed for the following specifications : Shaft power = 11,772 kW, Head = 380 metres, speed = 750 rpm, Overall efficiency = 86%, Jet diameter is not to exceed on sixth of the wheel diameter (d/D = 1/6). Determine (i) The wheel diameter, (ii) The number of jets required, (iii) Diameter of jet. **7**

OR

(b) A Pelton wheel is having a mean diameter of 1 meter and is running at 1000 rpm. The net head on the pelton wheel is 700 metres. If the side clearance angle ϕ is 15^o and discharged through nozzle is 0.1 m^3/sec, find : (i) Power available at the nozzle (ii) Hydraulic efficiency of the turbine. Assume Cv coefficient of velocity is 1. **7**

6 Answer any **two** : **15**

(i) A reaction turbine works at 450 rpm under a head of 120 metres. Its diameter at inlet is 120 cm and the flow rate is 0.4 m^2. The angles made by absolute and relative velocities at inlet are 20^o and 60^o respectively with the tangential velocity. Determine : (i) The volume flow rate (ii) the power developed (iii) Hydraulic efficiency.

(ii) As inward flow reaction turbine has external and internal diameters as 1.0 m and 0.6 m respectively. The hydraulic efficiency of the turbine is 90% when the head on the turbine is 36 m. the velocity of flow at outlet is 2.5 m/sec and discharge at outlet is radial. If the vane angle at outlet is 15^o and width of the wheel is 100 mmm at inlet and outlet, determine (i) the guide blade angle (ii) speed of the turbine (iii) vane angle of the runner at inlet (iv) volume flow rate of turbine and (v) power developed.

(iii) A Kaplan turbine develops 24647.6 kW power at an average head of 39 metres. 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 90%, calculate the diameter, and specific speed of the turbine.

(iv) A propeller reaction turbine of runner diameter 4.5 m is running at 40 rpm. The guide blade angle at inlet is 145^o and runner blade angle at outlet is 25^o to the direction of vane. The axial flow area of water through runner is 25 m^2. If the runner blade angle at inlet is radial determine:

(a) Hydraulic Efficiency of the turbine

(b) Discharge through turbine

(c) Power developed by the runner and

(d) Specific speed of the turbine.