T.E/ Sem VI / mech / Hydraulics Machinery / Oct-09

P4-Exam.-Oct-09-226

Con. 5358–09. **SP–7973**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any four questions out of remaining **six** questions.
(3) Assume any **suitable** data if **required**.

1. Answer the following :– **20**
   (a) Brief the salient features of the bucket of pelton wheel with suitable sketches.
   (b) What is NPSH ? What is difference between NPSH available and NPSH required ?
   (c) What is axial thrust in centrifugal pump ?
   (d) Explain the function of guide vanes in reaction turbine.
   (e) Define slip and co-efficient of discharge of reciprocating pump. Explain negative slip.

2. (a) Show that hydraulic efficiency of pelton turbine is maximum when bucket speed at mean radius is equal to half of velocity of jet. **8**

   (b) A double jet pelton wheel is required to generate 7500 kW when the available head at the base of nozzle is 400 m. The jet is deflected through 165° and the relative velocity of the jet is reduced by 15% in passing over the buckets. Determine – **12**
      (i) the diameter of each jet
      (ii) total flow
      (iii) force exerted by the jet on buckets in tangential direction.

   Assume generator efficiency of 95%, overall efficiency of 60%, $K_V = 0{\cdot}97$ and $K_u = 0{\cdot}46$.

3. (a) A Francis turbine works under a head of 68 m and developes 330 kW at 850 rpm. The flow ratio 0·15. The width to diameter ratio at inlet is 0·1. The ratio of outlet diameter to inlet diameter is 0·5. The vane thickness reduces the flow area by 6%. The overall efficiency is 85% and the hydraulic efficiency is 94%. The velocity of flow remains constant from inlet to outlet. The discharge is radial. **12**
   Determine –
      (i) Guide blade angle
      (ii) Vane angle at inlet and outlet
      (iii) Diameter at inlet and outlet
      (iv) Width of the runner at inlet.

   (b) Explain the different components of a reaction turbine. **8**

4. (a) What is mean by cavitation in turbine ? What is Thomas cavitation factor ? What is the significance for water turbines ? **8**

   (b) A conical draft tube having inlet and outlet diameters 1 m and 1·5 m discharges water at outlet with a velocity of 2·5 m/s. The total length of the draft tube is 6 m and 1·2 m of the length of draft tube is immerged in water. If the atmospheric pressure head is 10·3 m of water and loss of head due to friction in the draft tube is equal to 0·2 x velocity head at outlet of the tube, find – **12**
      (i) Pressure head at inlet
      (ii) Efficiency of the draft tube.

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5. (a) Write short notes on :– **10**
   (i) Selection of turbine
   (ii) Application of C.F.D. in turbine

   (b) The following data refers to a centrifugal pump :– **10**
   a centrifugal pump –

Static head	=	40 m
Diameter of suction, delivery pipes	=	100 mm
Suction height	=	5 m
Loss of head in suction pipe	=	2 m
Loss of head in delivery pipe	=	8 m
Impeller outlet diameter	=	400 mm
Impeller width at outlet	=	25 mm
Rotational speed	=	1200 rpm
Manometric efficiency	=	80%

   Vanes are curved back at an angle of 30° to wheel tangent. Find the power required to drive the pump. What pressure will be indicated by gauges mounted on suction and delivery sides ?

6. (a) Tests on a single stage centrifugal pump running at constant speed gave the following results :– **12**

Discharge (*lpm*)	0	227	454	681	908	1185
Head (m)	12·2	12·5	11·9	10·4	7·3	3·7
Efficiency (%)	0	48	68	76	70	50

   Two such pump are installed to run in parallel with common suction and delivery pipes with a useful static lift of 6·4 m. The friction and other losses external to the pump are calculated as $Q^2 \times 1{\cdot}48 \times 10^{-6}$ m where Q is flow in *l.p.m.*
   Calculate the discharge and power required to drive the pump, when :
   (i) Only one pump is connected
   (ii) Two pumps are working in parallel.

   (b) Tests on model pump showed discharge of 150 *lps* against a head of 25 m at a speed of 1200 rpm. It was found that the model starts cavitating when the NPSH was 4 m. If the actual pump is placed 4 m below the level of water in the pump and is required to give 6 m^3/s against a head of 100 m. Find the maximum permissible speed at which pump can be run without cavitation. **8**

7. (a) A single acting reciprocating pump has a plunger of 80 mm diameter and a stroke of length 150 mm. It takes its supply of water from a pump 3 m below the pump through a pipe 4·5 m long and 30 mm diameter. It delivers water to a tank 12 m above the pump through a pipe 25 mm diameter and 15 mm long. If separation occurs at 78·48 N/m^2 below atmospheric pressure, find the maximum speed at which the pump may be operated without seperation. Assume the plunger to have simple harmonic motion. **10**

   (b) Write short notes on :– **10**
   (i) Self priming of pump
   (ii) Function of Air-vessel in reciprocating pump.
