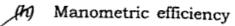## B.Tech 5th Semester Exam., 2015

FLUID MACHINERY

Time : 3 hours

Full Marks : 70

Instructions :

(i) *The marks are indicated in the right-hand margin.*

(ii) *There are* **NINE** *questions in this paper.*

(iii) *Attempt* **FIVE** *questions in all.*

(iv) *Question No.* **1** *is compulsory.*

1. Define the following terms (any *seven*) : 2×7=14

   (a) Gross head

   (b) Net head

   (c) Inward radial flow turbine

   (d) Outward radial flow turbine

   (e) Unit speed

   (f) Unit discharge

   (g) Draft tube

   (h) Manometric efficiency

   (i) Air vessel

   (j) Slip

(Turn Over)

2. (a) Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of jet. 4

(b) A jet of water of diameter 75 mm moving with a velocity of 25 m/s strikes a fixed plate in such a way that the angle between the jet and plate is 60°. Find the force exerted by jet on the plate—
(i) in the direction normal to the plate;
(ii) in the direction of jet.

(c) A jet of water of diameter 10 cm strikes a flat plate normally with a velocity of 15 m/s. The plate is moving with a velocity of 6 m/s in the direction of jet and away from the jet. Find—
(i) force exerted by jet on the plate;
(ii) work done by jet on the plate per second. 5

3. (a) Describe briefly the function of various components of Pelton turbine with neat sketches. 5

(b) A Pelton wheel has mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 l/s under a head of 30 m. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and hydraulic efficiency of the turbine. Assume coefficient of velocity as 0·98. 9

4. (a) How is hydraulic turbine classified? 5

(b) A Francis turbine with an overall efficiency of 75% is required to produce 148·25 kW power. It is working under a head of 7·62 m. The peripheral velocity = $0·26\sqrt{2\,gH}$ and radial velocity of flow at inlet is $0·96\sqrt{2\,gH}$. The wheel runs at 150 r.p.m. and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, determine—

(i) guide blade angle;

(ii) the wheel vane angle at inlet;

(iii) diameter of wheel at inlet;

(iv) width of wheel at inlet. 9

5. (a) Define the term 'unit power'. Also derive the expression for this term. 5

(b) A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 m³/sec. If the efficiency is 90%, determine the performance of the turbine under a head of 20 m. 9

6. (a) Describe the working of a single-acting reciprocating pump with neat sketch. 5

   (b) A single-acting reciprocating pump, running at 50 r.p.m., delivers 0·01 m^3/s of water. The diameter of piston is 200 m~ ~nd stroke length is 400 mm. Deterr

   (i) theoretical discl.~ _

   (ii) coefficient of discharge;

   (iii) slip and the percentage slip of the pump. 9

. (a) Describe multistage centrifugal pump with (i) impellers in parallel and (ii) impellers in series. 5

   (b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 r.p.m., works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2·5 m/s. The vanes are set back at angle of 40° at outlet if the outer diameter of the impeller is 500 mm and width at outlet is 50 mm. Determine—

   (i) vane angle at inlet;

   (ii) work done by impeller on water per second;

   (iii) manometric efficiency. 9

8. (a) Describe the working of a single-stage reciprocating air compressor. 5

   (b) Estimate the work done by a two-stage reciprocating single-acting air compressor to compress 2·8 m^3 of air per min at 1·05 bar and 10 °C to a final pressure of 35 bar. The intermediate receiver cools the air to 30 °C and 5·6 bar pressure. For air, take $n = 1·4$.

9. Write short notes on the following : 7+7=1

   (a) Governing of water turbine

   (b) Indicator diagram

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