

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) : $2 \times 7 = 14$

- ~~(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

(7)

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. 5
- (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

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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 = $0.26\sqrt{2gH}$ and radial velocity of flow at inlet is $0.96\sqrt{2gH}$. 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

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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 $0.01 \text{ m}^3/\text{s}$ of water. The diameter of piston is 200 mm and stroke length is 400 mm. Determine—

- (i) theoretical discharge;
- (ii) coefficient of discharge;
- (iii) slip and the percentage slip of the pump. 9

7. (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

9. Write short notes on the following : 7+7=14

- (a) Governing of water turbine
- (b) Indicator diagram
