

Roll No.

Total Pages : 04

BT-5/D-18
FLUID MACHINES
ME-303-E

35035

Time : Three Hours]

[Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. Assume any missing data suitably.

Unit I

1. Establish the expression $F = \frac{\rho A (V \cos \theta - u)^2}{\cos \theta}$ for the

force F exerted by a jet of area A which strikes a plate at an angle θ to the normal to the plate with velocity V . The plate itself is moving with velocity u in the direction of normal to the plate surface.

If a 4 cm jet having a velocity of 20 m/s strikes a flat plate the normal of which is inclined at 30° to the axis of jet. If plate the itself is moving with a velocity of 8 m/s parallel to itself and in the direction of normal to its surface, calculate :

- (a) Normal force exerted on the plate
- (b) Work done per second
- (c) Efficiency of the jet.

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P.T.O.

2. Using Buckingham's π -theorem, show that the velocity through a circular orifice is given by :

$$V = \sqrt{2gH} \phi \left[\frac{D}{H}, \frac{\mu}{\rho V H} \right]$$

where, H = Head causing flow, D = Diameter of the orifice, μ = Coefficient of viscosity, ρ = Mass density, and g = Acceleration due to gravity. **20**

Unit II

3. (a) Derive an expression for the hydraulic efficiency of a Pelton wheel. **10**
- (b) The water available for a Pelton wheel is $4 \text{ m}^3/\text{s}$ and the total head from the reservoir to the nozzle is 250 m. The turbine has two runners with two jets per runner. All the four jet have the same diameters. The pipe is 3 km long. The efficiency of transmission through the pipeline and the nozzle is 91% and efficiency of each runner is 90%. The velocity coefficient of each nozzle is 0.975 and coefficient of friction ' $4f$ ' for the pipe is 0.0045. Determine :
- (i) The power developed by the turbine
 - (ii) The diameter of the jet
 - (iii) The diameter of the pipeline. **10**

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4. (a) How do losses in the draft tube effect the pressure at runner exit ? 5
- (b) An inward flow reaction turbine has an external diameter of 1 m and its breadth at inlet is 250 mm. If the velocity of flow at inlet is 2 m/s, find weight of water passing through the turbine per second. Assume 10 per cent of the area of flow is blocked by blade thickness. If the speed of the runner is 210 r.p.m. and guide blades make an angle of 10° to the wheel tangent, draw the inlet velocity triangle and find :
- The runner vane angle at inlet
 - The velocity of wheel at inlet
 - The absolute velocity of water leaving the guide vanes. <http://www.kuonline.in>
 - The relative velocity of water entering the runner blade. 15

Unit III

5. (a) Derive an expression for the minimum starting speed for a centrifugal pump. 10
- (b) A centrifugal pump impeller has diameters at inlet and outlet as 360 mm and 720 mm respectively. The flow velocity at outlet is 2.4m/s and the vane are set back at an angle of 45° at the outlet. If the manometric efficiency is 70 per cent, calculate the minimum starting speed of the pump. 10

6. The diameter and stroke of a single acting reciprocating pump are 300 mm and 500 mm respectively. The pump takes its supply of water from sump 3.2 m below the pump axis through a pipe 9 m long and 200 mm diameter. If separation occurs at 2.4 m of water absolute, determine :

- The speed at which separation are take palce at the beginning of suction stroke
- The speed of the pump if an air vessel is fitted on the suction side 2.4 m above the sump water level.

Take atmospheric pressure head = 10.3 m of water and friction co-efficient, $f = 0.01$. 20

Unit IV

7. (a) What is cavitation ? What are the effects of cavitation ? Give the necessary precautions against cavitation. 10
- (b) Explain with the help of a neat sketch the construction and working of a jet pump. 10
8. Write short notes on any *two* of the following : 10,10
- Hydraulic lift
 - Hydraulic torque converter
 - Hydraulic press.

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