

Total Pages—4 IV—Sem/MECH/2017(S)(New)

FLUID MECHANICS AND HYDRAULIC MACHINES

(Code : MET-404)

Full Marks : 70

Time : 3 hours

Answer any five questions

Figures in the right-hand margin indicate marks

1. (a) Define density. 2
(b) State the different principles of measurement of pressure. 5
(c) Describe the different types of manometers. 7
2. (a) Define metacentre. 2
(b) Derive an equation for the total pressure on a vertical immersed surface. 5
(c) A hollow circular plate of 3 m external diameter and 1 m internal diameter is

(Turn Over)

immersed in water such that its centre is at a depth of 2.5 m from the water surface. Find the total pressure and the point where it acts. 7

3. (a) What is the function of venturi meter? 2

(b) Derive Bernoulli's equation and state some practical applications. 5

(c) What is an orifice metre? Derive an expression for the discharge through an orifice metre. 7

4. (a) Define hydraulic gradient. 2

(b) Water is flowing through a pipe 1200 m long with a velocity of 0.7 m/s. What should be the diameter of the pipe, if the loss of head due to friction is 8.7 m. Take f for the pipe as 0.01. 5

(c) Water is flowing through a pipe 1500 m long and 400 mm diameter with a velocity of 1 m/s. Find the loss of head by using (i) Darcy's equation with $f=0.006$ (ii) Chezy's equation with $C=60$. 7

5. (a) Define the term “jet of water”. 2
- (b) Derive an expression for the force of jet on a fixed plate. 5
- (c) A 150 mm diameter jet of water moving at 30 m/s impinges on a series of vanes moving at 15 m/s in the direction of the jet and leaves at 60° with the direction of motion of the jet. Calculate (i) force exerted by the jet in the direction of motion of the vanes; and (ii) work done by the jet. 7
6. (a) Define hydraulic turbine. 2
- (b) Explain the layout and features of hydro-electric power plant. 5
- (c) An inward flow reaction turbine is supplied water at the rate of 500 litres/second with a velocity of flow of 5 m/s. The velocity of periphery and velocity of whirl at inlet is 24 m/s and 18 m/s respectively. Assuming the discharge to be radial at outlet and the velocity of flow to be constant, find (i) vane angle at inlet (ii) head of water on the wheel. 7

7. (a) Define Pump. 2
- (b) Explain the working principle of reciprocating pump with sketches. 5
- (c) Find the minimum speed at which a centrifugal pump will start functioning against a head of 7.5 m, if the diameters of the impeller at outlet and inlet are 1 m and 0.5 m respectively. 7