

013303

December 2023

B.Tech.(ME/ME) (Hindi Medium) 3rd Semester
Fluid Mechanics and Machines (PCC-ME-303-21)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

1. It is compulsory to answer all the questions (1.5 marks each) of Part-A in short
2. Answer any four questions from Part-B in detail.
3. Different sub-parts of a question are to be attempted adjacent to each other.

PART-A

1. (a) Define surface tension and viscosity. (1.5)
- (b) Define metacentric height. (1.5)
- (c) Differentiate between laminar flow and turbulent flow. (1.5)
- (d) Write down the applications of Bernoulli theorem. (1.5)
- (e) Write down the reasons for the difference in coefficient of discharge value of orificemeter and venturimeter. (1.5)

013303/000/11/202

[P.T.O.]

- (f) What do you mean by separation of boundary layer? (1.5)
- (g) Explain the term, 'dimensionally homogeneous equation'. (1.5)
- (h) Draw the velocity triangles at entry and exit of Francis Turbines. (1.5)
- (i) Differentiate between impulse and reaction turbines. (1.5)
- (j) Define slip and negative slip of a reciprocating pump. (1.5)

PART-B

2. (a) Derive an expression for the meta-centric height of a floating body. (10)
- (b) What are the conditions of equilibrium of a floating body and a sub-merged body? (5)
3. (a) What is Euler's equation of motion? How will you obtain Bernoulli's equation from it. (5)
- (b) In a 45° bend a rectangular air duct of 1 m² cross-sectional area is gradually reduced to 0.5 m² area. Find the magnitude and direction of the force required to hold the duct in position if the velocity of flow at the 1 m² section is 10 m/s, and pressure is 29430 N/m². Take density of air as 1.16 kg/m³. (10)

013303/000/11/202

2

4. State Buckingham's π -theorem. 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 is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. (15)

5. (a) Show that the difference of pressure head for a given length of the two parallel plates which are fixed and through which viscous fluid is flowing is given by

$$h_f = \frac{12\mu u L}{\rho g t^2}$$

where μ = Viscosity of fluid, u = Average velocity,
 t = Distance between the two parallel plates,
 L = Length of the plates, ' ρ ' is the mass density and
 'g' is the acceleration due to gravity. (10)

- (b) Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The rate of flow of water through the pipe is 250 litres/sec. (5)

6. A 137 mm diameter jet of water issuing from a nozzle impinges on the buckets of a Pelton wheel and the jet is deflected through an angle of 165° by the buckets. The head

available at the nozzle is 400 m. Assuming co-efficient of velocity as 0.97, speed ratio as 0.46, and reduction in relative velocity while passing through buckets as 15%, find :

- (i) The force exerted by the jet on buckets in tangential direction. (15)
- (ii) The power developed. (15)

7. (a) Explain the functions of main parts of a centrifugal pump with neat sketch? (5)
- (b) Define indicator diagram. How will you prove that area of indicator diagram is proportional to the work done by the reciprocating pump? (10)