Total No. of Questions—12]   [Total No. of Printed Pages—4

Seat No.

[4957]-113

S.E. (Mechanical/Auto.) (First Semester) EXAMINATION, 2016

FLUID MECHANICS

(2008 PATTERN)

Time : Three Hours   Maximum Marks : 100

N.B. :— (*i*) Answer any *three* questions from each Section.

(*ii*) Answers to the two Sections should be written in separate answer books.

(*iii*) Draw diagrams wherever necessary.

(*iv*) Use of scientific calculator is allowed.

(*v*) Assume suitable data wherever necessary.

SECTION I

1. (*a*) Explain the following terms :   [6]

(*i*) Vapour pressure

(*ii*) Bulk modulus of elasticity

(*iii*) Capillarity.

(*b*) Discuss various types of flow.   [8]

(*c*) State and explain Newton's law of viscosity.   [4]

Or

2. (*a*) A body with gravity force of 500 N with a flat surface area of 0.2 m² slides down a lubricated inclined plane making a 30° angle with the horizontal. For viscosity of 0.1 kg./ms and body speed of 1 m/s, determine the lubricant film thickness.   [8]

P.T.O.

(*b*) Explain :

      (*i*)   Vorticity   [6]

      (*ii*) Velocity potential

      (*iii*) Stream function

(*c*) Define :   [4]

Stream lines, path lines and streak lines.

3. (*a*) State and prove Pascal's law.   [8]

      (*b*) Explain with neat sketch the method of determining metacentric height of floating body.   [8]

Or

4. (*a*) An isosceles triangular plate of base 3 m and altitude 3 m is immersed vertically in an oil of specific gravity 0.8. The base of the plate coincides with the free surface of oil.

Determine :

      (*i*)   Total pressure on the plate

      (*ii*) Center of pressure ($\bar{h}$)   [8]

      (*b*) Derive an expression for total pressure and centre of pressure for inclined plane submersed in liquid and hence derive the expression for center of pressure for vertical plane.   [8]

5. (*a*) Derive an expression for Euler's equation along stream line. [8]

      (*b*) A 400 mm × 200 mm venturimeter is provided in a vertical pipeline carrying oil of specific gravity 0.9, flow being upward. The difference in elevation of the throat section and entrance

section of the venturimeter is 200 mm. The differential U-tube mercury manometer shows a gauge deflection of 350 mm. Calculate :

(*i*) The discharge of oil and

(*ii*) The pressure difference between the entrance section and the throat section.

Take C_d = 0.98 and specific gravity of mercury as 13.6. [8]

Or

6. (*a*) Write a short note on 'Notches.' [4]

(*b*) Discuss various arrangements of Pitot tube. [8]

(*c*) List of forces acting on fluid mass. Explain the significance of each term. [4]

SECTION II

7. (*a*) Derive Hagen-Poiseuille equation for laminar flow in the circular pipes. [12]

(*b*) What are repeating variables ? What points are important while selecting repeating variables ? [6]

Or

8. (*a*) Torque T of a propeller depends on density of liquid ρ, viscosity of liquid μ, speed of shaft N r.p.m., linear velocity V, diameter of the propeller shaft D.

Using Buckingham π-theorem, show that : [10]

$$T = \rho N^2 D^5 \phi \left[\frac{ND}{V}, \frac{\rho N D^2}{\mu} \right]$$

(*b*) Derive expression for velocity distribution for flow in fixed parallel plates. [8]

9. (*a*) Derive an expression for the power transmission through the pipes. Find also the condition for maximum transmission of power. [8]

(*b*) Write a short note on Siphon. Draw HGL and THL for flow through siphon. [8]

Or

10. (*a*) A piping system consists of three pipes arranged in series; the lengths of the pipes are 1200 m, 750 m and 600 m and diameters 750 mm, 600 mm and 450 mm respectively :

(*i*) Transform the system to an equivalent 450 mm diameter pipe, and

(*ii*) Determine an equivalent diameter for the pipe, 2550 m long. [6]

(*b*) Derive Dupits equation. [6]

(*c*) Explain minor losses occurred in pipe. [4]

11. (*a*) Discuss boundary layer development over flat plate. [8]

(*b*) Discuss flow around cylinder and airfoil. [8]

Or

12. (*a*) Write a short note on "Separation of boundary layer and its control". [8]

(*b*) Derive an expression for displacement, momentum and energy thickness. [8]