Total No. of Questions—8] [Total No. of Printed Pages—4

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S.E. (Mechanical/Auto) (Sem. II) EXAMINATION, 2018

FLUID MECHANICS

(2015 PATTERN)

Time : Two Hours **Maximum Marks : 50**

***N.B.* :—** (*i*) Answer Q. **1** *or* Q. **2**, Q. **3** *or* Q. **4**, Q. **5** *or* Q. **6**, Q. **7** *or* Q. **8**.

(*ii*) Draw a neat diagram wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of calculator is allowed.

(*v*) Assume suitable data, if necessary.

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

(1) Fluid as continuum.

(2) Surface tension.

(3) Vapour pressure.

(*b*) A shaft 70.0 mm in diameter is being pushed at a speed of 400 mm/s through a bearing sleeve 70.2 mm in diameter and 250 mm long. The clearance which is assumed uniform is filled with oil of kinematic viscosity is 0.005 m^2/s and specific gravity 0.9. Find the force exerted by the oil on the shaft. [6]

P.T.O.

Or

2. (*a*) Show that the pressure at a point in a fluid at rest is the same in all directions. [6]

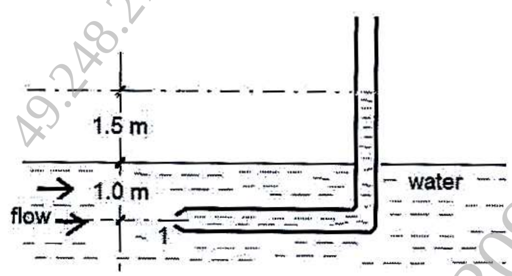
(*b*) A circular plate of 4.0 m diameter is immersed in water of density 1000 kg/m^3 in such a way that the plate's greatest and least depth below free surface are 6 m and 3 m respectively. Find the total pressure on the face of the plate and the position of center of pressure. [6]

3. (*a*) Explain the conditions of equilibrium of submerged bodies. [6]

(*b*) For the flow of an incompressible fluid the velocity component in the x-direction is $u = ax^2 + by$ and the velocity component if the z-direction is zero. Find the velocity component v in the y-direction such that $v = 9$ at $y = 0$. [6]

Or

4. (*a*)



A Pitot tube is inserted in flow of water having density 1000 kg/m^3 as shown in figure. Assuming the coefficient of Pitot tube as 0.98; determine the following at point 1 :

(1) Flow velocity.

(2) Stagnation pressure. [4]

(*b*) Derive the equation :

$$\frac{dp}{\rho} + \mathrm{V}\,d\mathrm{V} + g\,dz = 0$$

where, p is the pressure, ρ is the density, V is the velocity of a fluid particle along a stream line, g is the acceleration due to gravity and z is difference in datum. [8]

5. (*a*) What is coefficient of velocity coefficient of contraction and coefficient of discharge for an orifice ? [6]

(*b*) An orifice of 100 mm diameter discharges water under a constant head of 4.2 m. The diameter of jet at vena contracta is 8.2 cm. If the discharge through the orifice is 40 lps, determine the hydraulic coefficients of orifice. [7]

Or

6. (*a*) Explain the following with a neat sketch : [4]

(1) Hydrodynamically smooth and rough boundaries.

(2) Reynolds shear stress.

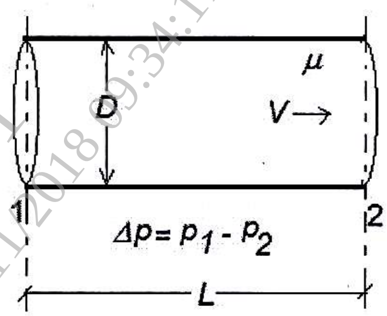
(*b*) For a viscous flow through circular pipe derive the expression : [9]

$$u = \left(\frac{-dp}{dx}\right)\frac{1}{4\mu}(\mathrm{R}^2 - r^2)$$

where, u is velocity, p is the pressure, μ is the fluid viscosity, R is the outer radius of the pipe and r is the inner radius at which the velocity distribution is obtained.

7. (*a*) What are the factors affecting the growth of boundary layer ? [4]

(*b*)



The pressure drop, Δp along a straight pipe of diameter D has been experimentally studied. It is observed for laminar flow of a given fluid and pipe, Δp varies with distance between the two points 1 and 2 as shown in figure. Assume Δp as the function of D, length L, velocity V and fluid viscosity μ. Use dimensional analysis to deduce how pressure drop, Δp varies with pipe diameter D. [9]

Or

8. (*a*) Derive an expression for displacement, momentum and energy thickness with a neat sketch. [9]

(*b*) A solid sphere of 400 mm diameter is completely immersed in a flow of sea water. The velocity of flow is 1.2 m/s and specific gravity 1.025. Calculate the drag force on the sphere assuming C_D = 0.6. [4]