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Total No. of Questions : 09

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B.Tech.(CE) (Sem.–3)
FLUID MECHANICS-I
Subject Code : CE-203
Paper ID : [A0602]

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTION TO CANDIDATES :
1. SECTION-A is COMPULSORY.
2. Attempt any FOUR questions from SECTION-B.
3. Attempt any TWO questions from SECTION-C.

SECTION-A (10 × 2 = 20 Marks)

1. a) If the surface tension of water air interface is 0.073 N/m, what will be the gauge pressure inside a rain drop of diameter 1 *mm*.

b) Express the pressure of 150 *m* of water column in metre of mercury.

c) In a static liquid what will be the horizontal component of pressure force acting on a curved surface.?

d) What is the condition for a floating body to remain in stable equilibrium?

e) Define velocity potential function.

f) Define Reynolds number.

g) In a flow through a pipe the Reynolds number is 100. What will be Darcy-Weisbach friction factor *f* for this flow?

h) What will be the head loss in a sudden expansion of pipe from 6 *cm* diameter to 12 *cm* diameter in terms of velocity V_1 in the 6 *cm* pipe.

i) A pump delivers 50 L/s of water and delivers 7.5 KW of power to the system. Calculate the head developed by the pump.

j) Write the dimension of dynamic viscosity.

SECTION-B (4 × 5 = 20 Marks)

2. A rectangular plate of size 25 *cm* by 50 *cm* and weighing 25 *kgf* slides down a 30° inclined surface at a uniform velocity of 2 *m/s*. If the uniform 2 mm gap between the plate and the inclined surface is filled with oil, determine the dynamic viscosity of oil.

3. The pressure between two points A and B in a pipe conveying oil of specific gravity 0.8 is measured by an inverted U-tube. The column connected to point B stands 1.6 *m* higher than that at the point A. A commercial pressure gauge attached directly to the pipe at A reads 1.125 kgf/cm^2, determine its reading when attached directly to the pipe at B.

4. A pipe of 300 *m* long has a slope of 1 in 100 and tapers from 1.2 *m* diameter at the high end to 0.6 *m* diameter at the low end. Quantity of water flowing is 5400 litres per minute. If the pressure at the high end is 68.67 KP, find the pressure at the low end. Neglect losses.

5. A right angled triangular notch is provided in the vertical side of a tank having plan area of 0.93 m^2. When the head over the notch is 75 *mm*, it is found that the water surface in the tank is falling down at a rate of 2.54 *mm*/second. Calculate the coefficient of discharge of the notch.

6. For laminar flow of an oil having dynamic viscosity μ = 1.766 Pa.s in a 0.3 *m* diameter pipe, the velocity distribution is parabolic with a maximum point velocity of 3 *m/s* at the centre of the pipe. Calculate the shearing stresses at the pipe wall and within the fluid 50 *mm* from the pipe wall.

SECTION-C (2 × 10 = 20 Marks)

7. The velocity components in a two dimensional flow field for an incompressible fluid are expressed as

$$u = \frac{y^3}{3} + 2x - x^2y;\ v = xy^2 - 2y - \frac{x^3}{3}$$

a) Show that these functions represent a possible case of an irrotational flow.

b) Obtain an expression for stream function ψ.

c) Obtain an expression for velocity potential function ϕ. (10)

8. a) Velocity distribution for laminar flow of real fluid in a pipe is given as

$$v = V_{max}[1 - (r^2/R^2)]$$

Where V_{max} is the velocity at the centre of the pipe, R is the pipe radius and v is velocity at radius r from the centre of the pipe. Determine the momentum correction factor. (5)

b) A 1/10 scale model of a submarine moving far below the surface of water is tested in a water tunnel. If the speed of the prototype is 8 *m/s*, determine the corresponding velocity of water in the tunnel. Also determine the ratio of the drag for the model and prototype.

Kinematic viscosity of sea water =1.121 × 10^{-6} m^2/s,
Density of sea water = 1027kg/m^3,
Kinematic viscosity of water = 1.0 × 10^{-6} m^2/s (5)

9. Describe briefly the experimental method of determination of the metacentric height of a floating object. (10)