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Question Paper Code: 1033190

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024
Third Semester
Civil Engineering
U20CE302 – FLUID MECHANICS
(Regulation 2020)

Time: Three Hours Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. Calculate the mass density and specific volume of one liter of a liquid which weighs 7N.
2. Define compressibility of fluid.
3. State the Pascal's Law.
4. Differentiate between stream and potential function.
5. How occur turbulent flow?
6. Write the any two uses moody diagram.
7. What is boundary layer? Give a sketch of a boundary-layer region over a flat plate.
8. Differentiate between 'Drag' and 'Lift'.
9. What is meant by kinematic similarity?
10. State Froude's model law.

PART – B (5 x 16 = 80 Marks)

11. (a) The thin plate of Area 'A' is placed midway in a gap of height 'h' filled with a liquid of viscosity 'μ_1'. The same gap is now filled with another liquid of viscosity 'μ_2' and the same plate is placed asymmetrically in the gab but parallel to the walls. Experiments indicated that for the same velocity u, the force required was same. Prove that, $\mu_1 = \mu_2 h^2 / 4y (h-y)$. (16)

(OR)

(b) The dynamic viscosity of oil used for lubrication between a shaft and sleeve is 6 poise. The shaft diameter is 0.4m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm the thickness of oil film is 1.5mm. (16)

12. (a) A pipe (1) 450 mm in diameter branches into two pipes (2) and (3) of diameters 300 mm and 200 mm respectively. If the average velocity in 450 mm diameter pipe is 3m/s. Find, (i) Discharge through 450 mm diameter pipe (ii) Velocity in 200 mm diameter pipe if the average velocity in 300 mm pipe is 2.5 m/s. (16)

(OR)

(b) (i) Write the short note on neat sketch of Laser Doppler velocimetry. (8)

(ii) Explain the working principles of Hot Wire Anemometer. (8)

13. (a) (a) A cylindrical water tower of diameter 3.0 m supplies water to a house. The level of water in the water tower is 35 m above the point where the water enters the house through a pipe that has an inside diameter 5.1cm. The intake pipe delivers water at a maximum rate of $2.0 \times 10{-}3\ m^3 \cdot s^{-1}$. The pipe is connected to a narrower pipe leading to the second floor that has an inside diameter 2.5 cm. What is the pressure and speed of the water in the narrower pipe at a point that is a height 5.0 m above the level where the pipe enters the house? (16)

(OR)

(b) Derive Darcys Weisbach equation for calculating loss of head due to friction in pipes. (16)

14. (a) Determine the displacement thickness, momentum thickness and energy thickness in terms of boundary layer thickness δ for the velocity profile in the boundary layer on a flat plate given by $u/U= 2(y/\delta)-(y/\delta)^2$. (16)

(OR)

(b) A horizontal pipe line 50m long is connected to a water tank at one end discharges likely into the atmosphere at the other end. For the first 30 m of its length from the tank, the pipe is 15 cm diameter and its diameter is suddenly enlarged to 30 cm. the height of water level in the tank is 8m above the centre of pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for the sections of the pipe. (16)

15. (a) The frictional torque T of a disc diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\rho\phi\ (\mu/D^2N\rho)$. Prove it by Buckingham's π-theorem. (16)

(OR)

(b) A ship 500 m long moves in sea-water whose density is 1030 kg/m^3. A 1:75 model of this ship is to be tested in a wind tunnel. The velocity of air in the wind tunnel around model is 40 m/s and the resistance of the model is 50 N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea water. The density of air is given a 1.24 kg/m^2. Assume the kinematic viscosity of sea-water and air as 0.012 stokes a 0.018 stokes respectively. (16)

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