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Question Paper Code : 77054

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Third Semester

Civil Engineering

CE 6303 — MECHANICS OF FLUIDS

(Common to Environmental Engineering)

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine the specific gravity of a fluid having viscosity 0.005 Ns/m^2 and kinematic viscosity 0.035 × 10^{-4} m^2/s.

2. State the concept of pressure measurement used in mechanical gauges.

3. Write the continuity equation in three dimensional differential form for compressible fluids.

4. State the impulse-momentum principle.

5. Distinguish between hydraulic gradient and energy gradient.

6. What are the causes of major and minor losses in pipes?

7. For a given velocity profile, how to determine whether the flow has separated or not?

8. How the drag and lift acting on a body moving in a fluid of density ρ at a uniform velocity U are calculated mathematically?

9. Examine whether the equation $V = \sqrt{2gH}$ is dimensionally homogeneous?

10. What are the advantages of distorted models?

PART B — ($5 \times 16 = 80$ marks)

11. (a) A 150 mm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 151 mm. Both the cylinders are 250 mm high. If the torque of 12 Nm is required to rotate the inner cylinder at 100 r.p.m. determine the Viscosity of the fluid filled in the space between the above two cylinders.

Or

(b) Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the centre of the plate is 3 m below the free surface of water. Also find the position of centre of pressure.

12. (a) If for a two-dimensional potential flow, the velocity potential function is given by $\Phi = x(2y-1)$, determine the velocity at the point P(2,3). Determine also the value of stream function at the point P.

Or

(b) An oil of specific gravity 0.8 is flowing through a horizontal venturimeter having a inlet diameter 200 mm and throat diameter 100 mm. The oil-mercury differential manometer shows a reading of 250 mm, calculate the discharge of oil through the venturimeter. Take $C_d = 0.98$.

13. (a) An oil of viscosity 0.1 Ns/m^2 and specific gravity 0.9 is flowing through a circular pipe of diameter 50 mm and of length 300 m. The rate of flow of fluid through the pipe is 3.5 litres per second. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall.

Or

(b) Three pipes of the same length L, diameter D, and friction factor f are connected in parallel. Determine the diameter of the pipe of length L and friction factor f which will carry the same discharge for the same head loss. Use the Darcy's formula for head loss due to friction.

14. (a) Find the displacement thickness and the momentum thickness for the velocity distribution in the boundary layer given by $u/U = 2(y/\delta) - (y/\delta)^2$.

Or

(b) A thin plate is moving in still atmospheric air at a velocity of 5 m/s. The length of the plate is 0.6 m and width is 0.5 m. Show that the boundary layer is laminar over the plate. Also calculate the thickness of the boundary layer at the end of the plate and the drag force on one side of the plate. Take density of air as 1.24 kg/m^3 and kinematic viscosity as 0.15×10^{-4} m^2/s.

15. (a) The efficiency η of a fan depends on density ρ, dynamic viscosity μ, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters using Buckingham's π method.

Or

(b) Explain briefly the steps involved in Rayleigh's method of dimensional analysis and also brief the types of similarities existing between the prototype and its model.

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