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Question Paper Code : 71547

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Third Semester

Civil Engineering

CE 6303 – MECHANICS OF FLUIDS

(Common to Environmental Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the S.I. units of Dynamic viscosity and Kinematic viscosity.
2. Define meta-centre.
3. What is a flownet?
4. What is venturimeter? Write the main parts of venturimeter.
5. What is hydraulic gradient line and total energy line?
6. What is Moody's diagram and its importance in pipe flow?
7. Define displacement thickness.
8. Write Von Karman's momentum integral equation for boundary layer flow.
9. What is dimensional homogeneity?
10. List the types of similarities between model and prototype.

PART B — (5 × 13 = 65 marks)

11. (a) A sliding fit cylindrical body of diameter 399 mm, length 200 mm and mass 3.5 kg drops vertically down inside a hollow cylinder of 400 mm internal diameter at a constant velocity of 0.05 m/s. Calculate the viscosity of oil filled in the space between the cylinders. (13)

Or

(b) Find the total pressure and position of centre of pressure on a triangular plate of base 2 m and height 3 m which is immersed in water in such a way that the plane of the plate makes an angle of 60° with the free surface of the water. The base of the plate is parallel to water surface and at a depth of 2.5 m from water surface. (13)

12. (a) In a two dimensional incompressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and also obtain an expression for velocity potential function. (13)

Or

(b) Derive Euler's equation of motion along a stream line and obtain Bernoulli's equation by its integration. State all assumptions made. (13)

13. (a) A fluid of viscosity 0.7 Ns/m² and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m², find (i) the pressure gradient (ii) the average velocity and (iii) Reynolds number of the given laminar flow. (13)

Or

(b) The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300 m, 170 m and 210 m and of diameters 300 mm, 200 mm and 400 mm respectively, is 12 m. Determine the rate of flow of water if co-efficient of frictions are 0.005, 0.0052 and 0.0048 respectively. Consider minor losses also. (13)

14. (a) The velocity distribution in laminar boundary layer is given by $u/U = 3(y/\delta) - 2(y/\delta)^2$ where u = velocity at distance 'y' from the boundary and U = velocity at a distance 'δ', the thickness of the boundary layer. Calculate:

(i) The ratio of displacement thickness to boundary layer thickness (δ^* / δ)

(ii) The ratio of momentum thickness to boundary layer thickness (θ / δ). (13)

Or

(b) A flat plate 1.5 m × 1.5 m moves at 13.89 m/s in stationary air of density 1.15 kg/m³. If the coefficient of drag and lift are 0.15 and 0.75 respectively, determine the lift force, drag force, resultant force and the power required to keep the plate in motion. (13)

15. (a) The frictional torque 'T' of a disc of diameter 'D' rotating at a speed 'N' in a fluid of viscosity 'μ' and density 'ρ' in a turbulent flow is given by $T = D^5 N^2 \rho \phi\left[\mu/(D^2 N \rho)\right]$. Prove this by Buckingham's π — theorem. (13)

Or

(b) (i) Explain about Reynold's number and Froude's number. (8)

(ii) Write short notes on Euler's model law. (5)

PART C — (1 × 15 = 15 marks)

16. (a) Determine the rate of flow of water through the pipe of 300 mm diameter placed in an inclined position where a venturimeter is inserted having a throat diameter of 150 mm. The difference of pressure between the main and throat is measured by a liquid of specific gravity 0.7 in an inverted U-tube manometer which gives a reading of 260 mm. The loss of head between the main and throat is 0.3 times the kinetic head of the pipe. (15)

Or

(b) The pressure drop in an aeroplane model of size '1/40' of its prototype is 80×10^4 N/m². The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air as 1.24 kg/m³. The viscosity of water is 0.01poise and viscosity of air is 0.00018 poise. (15)