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Question Paper Code : 52755

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Third Semester.

Civil Engineering

CE 6303 — MECHANICS OF FLUIDS

(Regulation 2013)

(Common to PTCE 6303 – Mechanics of Fluids for B.E. (Part-Time) – Second Semester – Civil Engineering – Regulation – 2014)

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 are the types of fluid flow?

4. What are the assumptions made in deriving Bernoullis equation?

5. What does Haigen-Poiseulle equation refer to? Also write its equation.

6. Compare H.G.L. and T.E.L.

7. For a given velocity profile, how to determine whether the boundary layer 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. Show that the equation $v = \sqrt{2gh}$ is dimensionally homogeneous.

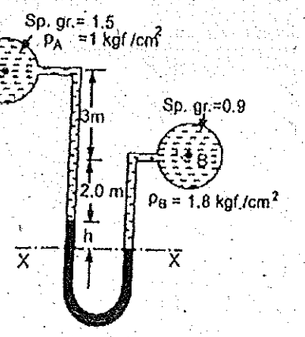
10. What are the advantages of distorted models?

PART B — (5 × 13 = 65 marks)

11. (a) A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10 cm. Both cylinders are 25cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12.0 Nm is required to rotate the inner cylinder at 100 r.p.m. determine the viscosity of the fluid. (13)

Or

(b) A differential manometer is connected at the two points A and B of two pipes as shown in Fig. The pipe A contains a liquid of sp. gr. = 1.5 while pipe B contains a liquid of sp. gr. = 0.09. The pressures at A and B are 1 kgf/cm² and 1.80 kgf/cm² respectively. Find the difference in mercury level in the differential manometer.



12. (a) The stream function for a two-dimensional flow is given by $\psi = 2xy$. Calculate the resultant velocity at $P(3, 4)$. Also find the velocity potential function ϕ.

Or

(b) A horizontal venturimeter with inlet diameter 250 mm and throat diameter 120 mm is used to measure the flow of oil of specific gravity 0.85. The discharge of oil through the venturimeter is 80 litres/s. Find the reading of oil-mercury differential manometer. Take $C_d = 0.97$.

13. (a) Derive the expression for shear stress and velocity distribution for the flow through circular pipe and using that derive the Hagen Poiseuille formula.

Or

(b) Water flows at the rate of 200 l/s upwards through a tapered vertical pipe. The diameter at the bottom is 240 mm and at the top 200 mm and the length is 5 m. The pressure at the bottom is 8 bar, and the pressure at the topside is 7.3 bar. Determine the head loss through the pipe. Express it as a function of exit velocity head.

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 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.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Draw stress strain curve for mild steel and explain the salient points on it. (7)

(ii) Derive a relation for change in length of a circular bar with uniformly varying diameter, subjected to an axial tensile load 'W'. (8)

Or

(b) A water main of 500 mm internal diameter and 20 mm thick is full. The water main is of cast iron and is supported at two points 10 m apart. Find the maximum stress in the metal. The cast iron and water weigh 72000 N/m³ and 10000 N/m³ respectively.

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