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Question Paper Code : 70276

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Third Semester

Civil Engineering

CE 6303 — MECHANICS OF FLUIDS

(Common to Environmental Engineering)

(Regulations 2013)

(Also common to PTCE 6303 – Mechanics of Fluids for B.E. Part Time – Second Semester – Civil Engineering – Regulations 2014)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define specific volume and specific gravity.

2. Define surface tension and capillarity.

3. What do you understand by Continuity Equation?

4. Give the assumptions made in the derivation of Bernoulli's equation.

5. Sketch the typical hydraulic gradient and total energy gradients, when one end of the horizontal pipe is connected to the reservoir and the other end is open to the atmosphere.

6. Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The discharge of water through the pipe is 250 litres/sec.

7. Define displacement thickness.

8. Write Von Karman's momentum integral equation for boundary layer flow.

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

10. What are the advantages of distorted models?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive an expression for the capillary rise of a liquid having surface tension a and contact angle 0 between two vertical parallel plates at a distance W apart. If the plates are of glass, what will be the capillary raise of water? Assume σ = 0.0773 N/m, θ = 0° take W = 1 mm (7)

(ii) Calculate the dynamic viscosity of oil which is used for lubrication between a square plate of size 0.8 m × 0.8 m and an inclined plane with angle of inclination 30°. The weight of the square plate is 330 N and it slide down the inclined plane with uniform velocity of 0.3 m/s The thickness of the oil film is 1.5 mm. (Fig. 11(a)(ii)) (6)

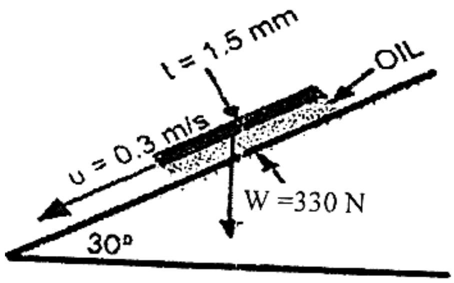

Fig. 11(a)(ii)

Or

(b) If the velocity distribution of a fluid over a plate is given by $v = ay^2 + by + c$ with the vertex 0.2 m from the plate, where the velocity is 1.2 m/s and shear stress = 0 calculate the velocity gradient and shear stresses at a distance of 0 m, 0.1 m, 0.2 m from the plate, if the Viscosity of the fluid is 0.85 Ns/m^2.

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) 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, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $u/U = y/\delta$, where u is the velocity at a distance y from the plate and $u = U$ at $y = \delta$ where δ = boundary layer thickness.

Or

(b) A thin plate is moving in still atmospheric air at a velocity of 7 m/s. The length of the plate is 0.7 m and width 0.6m. Calculate the thickness of the boundary layer at the end of the plate and the drag force on one side of the plate. Take the density of air as 1.25 kg/me and kinematic viscosity as $0.15 \times 10^{-4} m^2/s$.

15. (a) The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft *l*, velocity *V*, air viscosity μ, air density ρ and bulk modulus of air *K*. Express the functional relationship between these variables and the resisting force. (13)

Or

(b) A 1:64 model is constructed of an open channel in concrete which has Manning's $N = 0.014$. Find the value of *N* for the model. (13)

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/m^2. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air as 1.24 kg/m^3. The viscosity of water is 0.01 poise and viscosity of air is 0.00018 poise. (15)

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