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Question Paper Code : 73245

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

Third Semester

Civil Engineering

CE 2202/080100015/10111 CE 305/CE 1203/CE 35 — MECHANICS OF FLUIDS

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed with proper justification.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between a real fluid and an ideal fluid.

2. The surface tension of water in contact with air is 0.0725 N/m. The difference in pressure between inside and outside of water droplet is 250 N/m^2. What is the diameter of the droplet?

3. What is meant by total pressure and centre of pressure?

4. Define steam line, streak line, path line and stream tube.

5. Sketch a pitot tube and explain briefly how it is used to measure the velocity of a flowing liquid.

6. Two horizontal plates are placed 15 mm apart, the space between then being filled with oil of velocity 15 poise. Calculate the sheer stress in the oil if the upper plate is moved with a velocity of 3.0 m/sec.

7. Differentiate between pipes in parallel and pipes in series.

8. Define boundary layer.

9. How are repeating variables selected in Buckingham's π – method?

10. State the reasons for constructing distorted models for rivers.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Show the rheological classification of fluids and define each type of fluid giving an example. (6)

(ii) Two large vertical plates parallel to each other are 2 mm apart. A thin flat plate 1 mm thick, 0.6 m × 0.6 m size and 25 N weight is towed vertically up between the two large plates with a velocity of 0.2 m/s. The inner plate is equidistant from the two stationary plates. The gap between the large plates is filled with oil of viscosity 1.6 poise. Calculate the vertical force required. (6)

(iii) The capillary rise in a glass tube is to be restricted to 3 mm. What should be the size of the tube if the surface tension of water in contact with the air is 0.0725 N/m. (4)

Or

(b) (i) In a pipe of diameter 300 mm, the velocity distribution is parabolic and is given as $v = ay^2 + by + c$, where v is the velocity at a distance y from the wall of the pipe. The maximum velocity of flow is 1.2 m/s. Calculate the velocity gradients and shear stresses at y = 50 mm and y = 100 mm. Take dynamic viscosity of fluid as 8.5 poise. (Hint : To find the coefficients a, b and c, use the boundary conditions v = 0 at y = 0; v = 1.2 m/s at y = 150 mm and $\frac{dv}{dy} = 0$ at $y = 150$ mm.)

(ii) Explain the phenomena responsible for the viscosity of a fluid. Discuss the influence of temperature and pressure on the viscosity of fluids.

12. (a) An opening in a dam is covered by the use of a vertical shice gate. The opening is 2m wide and 1.2 m, high on the upstream side of the gate the liquid of specific granty 1.45 lies upto a height of 1.5 m. abore the top of the gate whereas on the downstream side the water is available upto a height touching the top of the gate. Find

(i) The resultant force acting on the gate and position of the centre of pressure.

(ii) The force acting horizontally at the top of gate which is capable of opening the gate. Assume that gate is hinged at the bottom. (16)

Or

(b) Given that

$u = -4ax(x^2 - 3y^2)$

$u = 4ay(3x^2 - y^2)$

Examine whether these velocity components represent a physically possible two-dimensional flow, if so whether the flow is rotational (or) irrotational. (16)

13. (a) Derive an expression for the velocity distribution for the viscous flow through a circular pipe and sketch the shear stress, distribution and velocity distribution across the section of the pipe. (16)

Or

(b) Derive the Euler's equation of motion for steady flow of an ideal fluid. Using Euler's equation, derive the Bernouli's equation and also write down the assumption made in the derviation of the above equation. (16)

14. (a) A plate of length 750 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 5 m/sec. If the oil has a sp. gravity of 0.8 and kinematics viscosity of 1 stoke, calculate

(i) Boundary layer thickness at the middle of the plate

(ii) Shear stress at the middle of the plate and

(iii) Friction drag on the side of the plate. (16)

Or

(b) The pipes of diameter 400 mm and 200 mm are each 300 mm long. When the pipes are connected in series the discharge through the pipe line is 0.1 m^3/sec, find the loss of head incurred. What would be the loss of head of the system to pass the same total discharge when the pipes are connected in parallel. Take friction factor = 0.0075 for each pipe.

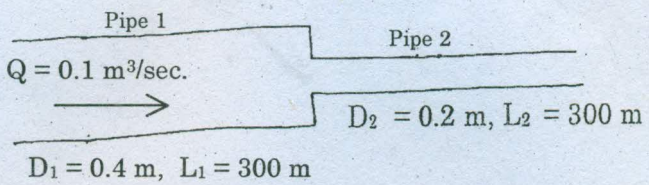

Fig. 14 (b)

15. (a) The efficiency η of a fan depends on density ρ, the dynamic viscosity μ, the angular velocity w, diameter D of rotor and the discharge Q. Show that $\eta = \phi\left[\left(\frac{\mu}{\rho w D^2}\right), \left(\frac{Q}{wD^3}\right)\right]$ using any one method of dimensional analysis. (16)

Or

(b) (i) Explain scale effect in model testing. How is it found? (8)

(ii) Explain briefly the significance of Reynold's number and Froude's number in fluid flow problems. (8)