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Question Paper Code : 23245

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Third Semester

Civil Engineering

CE 2202 — MECHANICS OF FLUIDS

(Regulations 2008)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed with proper justifications.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define weight density of a liquid.

2. State Pascal's law.

3. With the help of a sketch, show the relationship between absolute pressure and gauge pressure.

4. Can there be flow across a streamline? Why?

5. Define meta centre.

6. State momentum principle.

7. Define momentum Thickness and Energy Thickness.

8. What is meant by Total Energy line and Hydraulic Gradient line in pipe flow?

9. Define the term dimensional homogeneity. How is it attained in a fluid equation?

10. Define the terms geometric similarity and kinematics similarity.

PART B — (5 × 16 = 80 marks)

11. (a) At a depth of 3 km in the ocean the pressure is 80000 kN/m². The specific weight at the surface is 10.055 kN/m³. The bulk modulus of elasticity is 2.35×10^9 N/m². Find the change in the specific volume, specific volume at that depth and the specific weight at that depth. (16)

Or

(b) Explain the following terms with neat sketches :
(i) Surface tension. (4)
(ii) Continuum concept of system. (4)
(iii) Newtonian fluid and non Newtonian fluid. (4)
(iv) Convective acceleration. (4)

12. (a) (i) An equilateral triangular plate of 3 m side is immersed vertically in water. If one side of the plate coincides with free water surface, determine the total pressure acting on the plate and the position of centre of pressure. (8)

(ii) Explain the applications of U-tube differential manometers (8)

Or

(b) (i) The velocity potential function for a two-dimensional flow is given by $\phi = x(2y-1)$. Obtain the stream function ψ at origin. (8)

(ii) List various devices used for velocity measurement of fluid. Explain the working of any one device briefly. (8)

13. (a) The following date related to an inclined venturimeter.
Diameter of the pipe line = 400 mm
Inclination of the pipe line with the horizontal = 30°
Throat diameter = 200 mm
The distance between the inlet and throat of the meter = 600 mm
Sp. gravity of oil flowing through the pipe line = 0.70
Sp. gravity of heavy U-tube liquid = 13.6
Reading (deflection) of the differential manometer = 50 mm
Determine the rate of flow in the pipe line. (16)

Or

(b) Two parallel plates kept 100 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m / Sec. Calculate,
(i) The discharge per metre width (3)
(ii) The shear stress at the plates (3)
(iii) The difference in pressure between two points 20 m apart (3)
(iv) The velocity gradient at the plates and (3)
(v) The velocity at 20 mm from the plate. Assume viscosity of oil to be 24.5 poise. (4)

14. (a) (i) With the aid of a neat sketch explain the charactersitics of the boundary layer by considering a free stream approaching parallel to a sharp-edged, thin, smooth, flat plate under zero pressure gradient. (10)

(ii) A free stream of water has a velocity of 4 m/s and a smooth flat plate with a sharp leading edge is placed in it. Find the distance from the leading edge where the boundary layer transition from laminar to turbulent flow occurs. Find also the thickness of the boundary layer at that point. Take ρ for water = 1000 $kg\ m^{-3}$ and $\mu = 1$ centipoise. (6)

Or

(b) (i) Consider a simple pipeline taking-off from a reservoir. The pipe has a sharp-edged entrance at the reservoir end. It has a nozzle at the discharge end. Draw neatly the HGL and TEL for the system described. (6)

(ii) Two reservoirs 1 km apart are connected by two pipes in parallel. One is 300 mm in diameter and the other is 200 mm in diameter. If the combined flow is $1\ m^3 s^{-1}$, find the velocity of flow in each pipe. Assume friction factor to be the same for both pipes. (10)

15. (a) (i) State and explain detail about Buckingham's π - theorem. (8)

(ii) Check the dimensional homogeneity of the following common equations in the field of hydranhics

(1) $Q = Cd.a.\sqrt{2gH}$ and

(2) $v = C\sqrt{m.i}$. (8)

Or

(b) (i) What is a distorted model? How does it differ from are undistored model? Mention the advantages and disadvantages of distorted models. (8)

(ii) A spill way model built up to a scale of 1/10 is discharging water with a velocity of 1 m/sec under a head of 100 mm. Find the velocity of water of the proto type, if the head of water over the prototype is 5.5 meters. (8)