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15CV33

Third Semester B.E. Degree Examination, Feb./Mar. 2022
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following as applied to fluids:
i) Surface tension ii) Viscosity iii) Capillarity. **(03 Marks)**

b. Explain classification of fluids based on Newton's law of viscosity. **(05 Marks)**

c. A cylinder of 100mm diameter rotates concentrically inside a fixed cylinder of diameter 105mm. Both the cylinders are 250mm long. Find the viscosity of the liquid that fills the space between the cylinders if a torque of 1.0N-m is required for maintaining a speed of 120rpm. **(08 Marks)**

OR

2 a. State and prove Pascal's law for intensity of pressure at a point in a static fluid. **(06 Marks)**

b. A U-tube mercury manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. Its left leg is connected to the pipe and the right end is open to atmosphere. The centre of the pipe is 100mm below the level of mercury in the right limb. If the difference of mercury levels in the two limbs is 160mm, determine the absolute pressure in the pipe. (Sp. gravity of mercury = 13.6, atmospheric pressure = 101.3 kN/m^2. **(06 Marks)**

c. Find the pressure intensity at the bottom of the water reservoir 800m deep. Assume suitable data. **(04 Marks)**

Module-2

3 a. Define total pressure and centre of pressure. **(04 Marks)**

b. A rectangular gate closes a horizontal tunnel of 5m height and 3m width running full with water. The pressure at the bottom of the gate is 196.2kN/m^2. Determine the total pressure on the gate and the centre of pressure. **(06 Marks)**

c. Derive an expression for total pressure and centre of pressure on a vertically immersed plane surface in a static fluid. **(06 Marks)**

OR

4 a. Explain Lagrangian and Eulerian methods of describing a fluid flow. **(04 Marks)**

b. Differentiate between:
i) Steady and unsteady flow
ii) Laminar and turbulent flow
iii) Stream line and path line. **(06 Marks)**

c. Derive the three dimensional continuity equation in Cartesian co-ordinates. **(06 Marks)**

Module-3

5 a. State and prove Bernoulli's theorem for motion of fluid along a stream line. **(06 Marks)**

b. A pipe of 300mm diameter conveying 0.30m^3/s of water has a right angled bend in horizontal plane. Find the resultant force exerted on the bend if the pressures at inlet and outlet of the bend are 24.525×10^4 Pa and 23.544×10^4 Pa respectively. **(06 Marks)**

c. Define vortex motion and give its classification. **(04 Marks)**

OR

6 a. Derive an expression for discharge through an orifice meter. **(06 Marks)**

b. A horizontal venturimeter 300 × 150mm is used to measure the flow of oil of specific gravity 0.80. The oil-mercury differential manometer shows a reading of 2.48m. Find the discharge of oil through the pipe. Assume $C_d = 0.98$. **(07 Marks)**

c. Draw a neat labeled sketch of a venturimeter. **(03 Marks)**

Module-4

7 a. What are orifices and how are they classified? **(04 Marks)**

b. Define hydraulic coefficients C_c, C_v and C_d and give the relation between them. **(04 Marks)**

c. A tank has two identical orifices on one of its vertical sides. The upper orifice is 4.0m below the water surface and the lower one is 6.0m below the water surface. If the value of C_v for each of the orifices is 0.98, find the point of intersection of the two jets. **(08 Marks)**

OR

8 a. Differentiate between a notch and a weir. **(04 Marks)**

b. Derive an expression for the discharge through a rectangular notch. **(06 Marks)**

c. A broad crested weir of 50.0m length has 50cm height of water above the crest. Find the maximum discharge through the weir if the cross section area of channel on the upstream of weir is $50.0m^2$, consider the velocity of approach. Take $C_d = 0.6$ for the weir. **(06 Marks)**

Module-5

9 a. Derive Darcy-Weisbach equation for headloss due to friction in pipe. **(06 Marks)**

b. Distinguish between:
   i) Hydraulic gradient line and total energy line
   ii) Pipes in series and pipes in parallel. **(04 Marks)**

c. A pipeline 225mm in diameter and 1580m long has a slope of 1 in 200 for the first 790m and 1 in 100 for the remaining 790m. The pressure at the upper end of the pipeline is 107.91kPa and at the lower end it is 53.955kPa. Taking f = 0.032, determine the discharge through the pipe. **(06 Marks)**

OR

10 a. What is surge and what are the factors affecting its magnitude? **(04 Marks)**

b. Derive an expression for increase in pressure inside a pipe due to gradual closure of valve. **(06 Marks)**

c. Water is flowing in a pipe of 150mm diameter with a velocity of 2.50m/s, when it is suddenly brought to rest by closing a valve. Find the pressure rise in the pipe having wall thickness of 5mm, made up of material with elastic modulus (E) = 206 GN/m^2, Poisson's ratio = 0.25. Assume bulk modulus of water (K) = $206GN/m^2$. **(06 Marks)**

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