CBCS SCHEME

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18CV33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: **1.** *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Assume missing data (if any) suitably.*

Module-1

1 a. Define the following and mention their units:
(i) Capillarity (ii) Surface tension (iii) Viscosity **(06 Marks)**

b. Derive an expression for capillary rise/fall of fluid in a tube of small diameter with sketches. **(06 Marks)**

c. A 100 mm diameter cylinder rotates concentrically inside a 105 mm diameter fixed cylinder. The length of both the cylinders is 250 mm. find the viscosity of the liquid that fills the space between the cylinders, if a torque of 1.0 N-m is required to maintain a rotating speed of 120 rpm. **(08 Marks)**

OR

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

b. Derive an expression for difference in pressure between two points using a U-tube differential manometer. **(08 Marks)**

c. Determine the pressure intensity at the bottom of a tank filed with an oil of specific gravity 0.7 to a height of 10 m. **(06 Marks)**

Module-2

3 a. Define: (i) Total pressure (ii) Center of pressure **(04 Marks)**

b. Derive an expression for total pressure and center of pressure for an inclined plane surface submerged in a liquid. **(08 Marks)**

c. A 1200 mm × 1800 mm size rectangular plate is immersed in water with an inclination of 30° to the horizontal. The 1200 mm side of the plate is kept horizontal at a depth of 30 m below the water surface. Compute the total pressure on the surface and the position of center of pressure. **(08 Marks)**

OR

4 a. Differentiate between:
(i) Uniform and non-uniform flow
(ii) Steady and unsteady flow **(04 Marks)**

b. Derive continuity equation for a three dimensional flow in Cartesian coordinates. **(08 Marks)**

c. Evaluate stream function ψ and compute velocity of flow, V, for a two-dimensional flow field given by, $u = 4x^3$ and $v = -12x^2y$ at point (1, 2). Assume $\psi = 0$ at point (0, 0). **(08 Marks)**

Module-3

5 a. State Impulse Momentum principle. Give fields where it is applied. **(04 Marks)**

b. Derive an expression for force exerted by a fluid on a pipe bend. **(08 Marks)**

c. A pipe of 300 mm diameter, carrying 15000 litres per minute of water is bent by 135°. Find the magnitude and direction of resultant force exerted by the flowing fluid on the bend if the pressure of the flowing water is 39.24 N/cm^2. **(08 Marks)**

OR

6 a. What is venture effect? Derive an expression for discharge through a venturimeter. **(08 Marks)**

b. A pitot tube fixed in a pipe of 300 mm diameter is used to measure the velocity and rate of flow. If the stagnation and static pressure heads are 6.0 m and 5.0 m respectively, compute the velocity and rate of flow. Assume $C_V = 0.98$ for the pitot tube. **(06 Marks)**

c. A 20 cm × 10 cm venturimeter is used to measure the flow of water in a horizontal pipe. The pressure at the inlet of venturimeter is 17.658 N/cm^2 and the vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through the venturimeter assuming $C_d = 0.98$. **(06 Marks)**

Module-4

7 a. Define hydraulic coefficients for an orifice and give the relation between them. **(06 Marks)**

b. Give classification of mouth pieces with suitable sketches. **(06 Marks)**

c. A jet of water issuing from an orifice 25 mm diameter under a constant head of 1.50 m, falls 0.915 m vertically before it strikes the ground at a horizontal distance of 2.288 m from vena-contracta. The discharge is found to be 102 litres per minute. Calculate the hydraulic coefficients of the orifice. **(08 Marks)**

OR

8 a. Enumerate advantages of triangular notches over rectangular notches. **(04 Marks)**

b. Derive the expression for discharge through a triangular notch. **(08 Marks)**

c. A river 60 m wide has vertical banks and 1.50 m depth of flow. The velocity of flow is 1.20 m/s. A broad crested weir 2.40 m high is constructed across the river. Find the head on the weir crest considering the velocity of approach. Assume $C_d = 0.90$. **(08 Marks)**

Module-5

9 a. Derive Darcy-Weisbach equation for head loss due to friction in a pipe. **(08 Marks)**

b. List major and minor losses in a pipe flow. **(04 Marks)**

c. Water is required to be supplied to a colony of 4000 residents at a rate of 180 lires per person from a source 3 km away. If half the daily requirement needs to be pumped in 8 hours against a friction head of 18 m, find the size of the main pipe supplying water. Assume friction factor as 0.028. **(08 Marks)**

OR

10 a. What is an equivalent pipe? Derive an expression for diameter of an equivalent pipe. **(08 Marks)**

b. Explain phenomenon of water hammer in pipes. **(04 Marks)**

c. Water is flowing in a pipe of 150 mm diameter with a velocity of 2.5 m/s, when it is suddenly brought to rest by closing the valve. Find the pressure rise in the pipe assuming it to be elastic with E = 206 GN/m^2 and Poisson's ration = 0.25. The bulk modulus of water, K = 206 GN/m^2. Thickness of pipe wall is 5 mm. **(08 Marks)**

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