



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 filled 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/cm². (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 \times 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/cm² 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 litres 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 $E = 206 \text{ GN/m}^2$ and Poisson's ratio = 0.25. The bulk modulus of water, $K = 206 \text{ GN/m}^2$. Thickness of pipe wall is 5 mm. (08 Marks)

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