CBCS SCHEME

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18CV33

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define following terms with their units :
(i) Specific weight
(ii) Kinematic viscosity
(iii) Surface tension
(iv) Capillarity
(v) Bulk modulus **(10 Marks)**

b. Calculate the pressure in excess of outside pressure for a water droplet of 4 mm diameter and for a water jet of 5 mm diameter. Assume surface tension of water as 0.073 N/m. **(10 Marks)**

OR

2 a. State and prove Pascal's law. **(04 Marks)**

b. Establish a relationship among absolute, gauge and atmospheric pressure with simple sketch. **(06 Marks)**

c. A simple u-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the Two limbs is 40 cm and height of Fluid in left from the centre of pipe is 15 cm below. **(10 Marks)**

Module-2

3 a. Define the terms : (i) Total pressure
(ii) Centre of pressure **(04 Marks)**

b. Obtain an expression for the force exerted and centre of pressure for a completely submerged inclined plane surface. **(06 Marks)**

c. A circular plate 3.0 m diameter is immersed in a water in such a way that its greatest and least depth below the Free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **(10 Marks)**

OR

4 a. Differentiate between :
(i) Steady flow and uniform flow.
(ii) Rotational flow and irrotational flow. **(04 Marks)**

b. Derive continuity equation for a 3-dimensional fluid flow in Cartesian co-ordinates. **(08 Marks)**

c. The velocity potential function (ϕ) is given by an expression,

$$\phi = -\frac{xy^3}{3} - x^2 + \frac{x^3y}{3} + y^2$$

(i) Find the velocity component in x and y direction
(ii) Show that ϕ represents a possible case of flow. **(08 Marks)**

Module-3

5 a. Obtain an expression for Euler's equation of motion along a stream line and obtain Bernoulli's equation. **(08 Marks)**

b. State and explain impulse momentum equation. **(04 Marks)**

c. Water is flowing from a tapered pipe having diameters 350 mm and 200 mm at section 1 and 2 respectively. The flow rate through the pipe is 0.05 m^3/sec. The section 1 is 10 m above the datum and section 2 is 5 m above the datum. If the intensity of pressure at section 1 is 0.5×10^6 pascals. Find the intensity of pressure at section 2. **(08 Marks)**

OR

6 a. Derive the equation for discharge through venturimeter. **(10 Marks)**

b. An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. **(10 Marks)**

Module-4

7 a. Explain Hydraulic coefficients of an orifice and obtain relation between them. **(06 Marks)**

b. Explain the classification of orifice and mouth pieces. **(04 Marks)**

c. A rectangular orifice 1.5 m wide and 1.0 meter deep is discharging water from a tank. If the water level in the tank is 3.0 m above the top edge of the orifice. Find the discharge through the orifice. Take the co-efficient of discharging for orifice = 0.6. **(10 Marks)**

OR

8 a. Derive an expression for discharge over a rectangular notch. **(10 Marks)**

b. Water flows over a rectangular weir 1 m wide at depth of 150 mm and afterwards passes through a triangular Right angled weir. Taking C_d for the rectangular and triangular weir as 0.62 and 0.59 respectively. Find the depth over the triangular weir. **(10 Marks)**

Module-5

9 a. Derive Darcy's equation for loss of head due to friction between two sections of pipe. **(10 Marks)**

b. The rate of flow of water through a horizontal pipe is 0.25 m^3/sec. The diameter of pipe which 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine

(i) Loss of head due to sudden enlargement. (ii) Pressure intensity in large pipe

(iii) Power lost due to enlargement. **(10 Marks)**

OR

10 a. Explain the terms :

(i) Hydraulic gradient line.

(ii) Total energy line with the help of sketch. **(06 Marks)**

b. Explain the different types of Minor loss of energy due to change of velocity in the pipes. **(06 Marks)**

c. Calculate the discharge through a pipe of diameter 200 mm. When the difference of pressure between the two ends of a pipe 500 m apart is 4 m of water. Take the value of f = 0.009 in the formula $h_f = \frac{4fLV^2}{2gd}$ **(08 Marks)**

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