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15CV33

Third Semester B.E. Degree Examination, Aug./Sept.2020
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 : Mass density , Specific gravity , Specific weight. Give the relationship between them. Also write their units and dimensions. **(08 Marks)**

b. A closed tank contains 0.5m depth of mercury, 2m of water and 3m of oil (S = 0.6) with air above the oil. If the gauge pressure at the bottom of the tank is 196.2kPa, what is the pressure of air at top of the tank? Also find absolute pressure if P_{atm} = 101.043kPa. **(08 Marks)**

OR

2 a. Define Absolute , Gauge and Atmospheric pressure. Give relationship between them through sketch. **(04 Marks)**

b. One litre of crude oil weighs 9.6N. Calculate specific weight, density and specific gravity. **(06 Marks)**

c. A cube of 25cm sides slides down on incline plane of 2V : 3H with a velocity of 20m/s. The inclined surface is covered by 0.02mm thick oil film of viscosity 2.2×10^{-3} Pas. What is the weight of the cube? **(06 Marks)**

Module-2

3 a. Distinguish between : i) Center of pressure and Center of gravity ii) Stream line and Path line iii) Convective acceleration and temporal acceleration. **(06 Marks)**

b. A circular disc of diameter 0.75m is immersed in a liquid of S = 0.8 with its plane making 30^0 with horizontal. The centre of plate is at 1.5m below free surface. Calculate the total pressure and center of pressure. **(04 Marks)**

c. The velocity vector for a 2D flow is given by :

$$\vec{V} = \left[\frac{y^3}{3} + 2x - x^2y\right]i + \left[xy^2 - 2y - \frac{x^3}{3}\right].$$ Obtain the expression for stream function. **(06 Marks)**

OR

4 a. Derive the continuity equation for a 3D flow using Cartesian coordinate system for steady incompressible flow. **(08 Marks)**

b. The velocity vector in a fluid flow is $\vec{V} = 4x^3\ i - 10x^2y\ j + 2t\ k$. Find velocity and acceleration components at point (2, 1, 3) when t = 1. **(08 Marks)**

Module-3

5 a. Derive an expression for discharge through horizontal venturimeter carrying water. **(06 Marks)**

b. List the assumptions made during derivation of Bernoulli's equation. **(04 Marks)**

c. Water is flowing through a tapering pipe having diameters 300mm and 150mm at section 1 and 2 which are 10m above and 6m below datum respectively. If the pressure at section 1 is 400 kPa and discharge is 40 ℓps determine velocity and pressure at section 2. What is velocity at section 1? Neglect losses. **(06 Marks)**

OR

6 a. Derive an equation for velocity of flow at a point using pitot tube. **(04 Marks)**

b. 300 ℓps of water is flowing in a pipe of 30cm diameter with a gauge pressure of 400kN/m^2. If the pipe is bent by 90^0, find the magnitude and direction of force on the bend. **(07 Marks)**

c. A horizontal venturimeter with inlet and throat diameter 25cm and 15cm respectively is used to measure discharge of water in a pipe. C_d = 0.98. If the U – tube mercury manometer connected to it reads 30cm level difference, find the discharge. **(05 Marks)**

Module-4

7 a. Derive the expression $C_V = \frac{x}{2\sqrt{yH}}$ with usual notations. **(06 Marks)**

b. The head over rectangular notch is 90cm and discharge is 300ℓps. Find the length of crest. C_d = 0.62. **(04 Marks)**

c. Give classification of orifices and mouth pieces. **(06 Marks)**

OR

8 a. Derive an equation for discharge over a rectangular sharp crested weir. **(08 Marks)**

b. A 25mm diameter orifice discharges 22m^3 of water per minute when the head is 6m. The diameter of jet at Vena – Contracta is 22.5mm. Determine C_c , C_d and C_v. **(08 Marks)**

Module-5

9 a. Derive Darcy – Weisbach equation for head loss through a pipe. **(08 Marks)**

b. A 0.5m diameter and 100m long pipeline carrying 0.5m^3/s of water is fitted with a valve at downstream end. Calculate the rise in pressure caused due to closure of valve in time :
i) 0.1 sec and ii) 1 sec. Take sonic velocity = 1430m/s. **(08 Marks)**

OR

10 a. A pipe of 40m length is connected to water tank at one end and discharges freely into the atmosphere at other end. For the first 25m length from the tank the pipe is 15cm in diameter and for remaining part, its diameter is 30cm. The pipe is horizontal and water level in tank is 8m above the center of pipe. Taking f = 0.01 in $h_f = \frac{FLV^2}{2gD}$ and considering all losses, determine the discharge through pipe. Also sketch HGL and TEL. **(12 Marks)**

b. Derive an expression for instantaneous pressure in the pipe due to gradual closure of value fitted at the end. **(04 Marks)**

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