CBCS SCHEME

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15CV33

Third Semester B.E. Degree Examination, July/August 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 with units and dimensions : i) Mass density ii) Specific gravity iii) Dynamic viscosity iv) Surface tension. **(06 Marks)**

b. Prove that the relationship between Surface tension and pressure inside the droplet of liquid in excess of outside pressure is given by $P = \frac{4\sigma}{d}$. **(04 Marks)**

c. The space between two square flat plates of 800mm side is filled with an oil film of 20mm thickness. Lower plate is stationery and upper plate moves at a speed of 3.2 m/s when 50N force is applied. Calculate i) Shear stress ii) Dynamic viscosity of oil in poise iii) Kinematic viscosity of oil if – Sp Gr G = 0.90. **(06 Marks)**

OR

2 a. Differentiate between : i) Pressure intensity and Pressure head ii) Simple and differential manometers iii) Absolute and Gauge pressure. **(06 Marks)**

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

c. An U – tube differential manometer connects two pipes A and B. Pipe A contains $CC\ell_4$ (G = 1.59) under 130 KN/m^2 gauge pressure. Pipe B contains oil (G = 0.82) under 200kN/m^2 gauge pressure. Pipe A is 2.5m above pipe B. The manometer contains mercury. Calculate the difference in mercury levels. Draw neat sketch. The level of mercury connected to pipe A is in level with center of pipe B. **(06 Marks)**

Module-2

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

b. Obtain an expression for total pressure and center of pressure for inclined surface submerged in liquid. **(06 Marks)**

c. A trapezoidal channel 02m wide at the bottom and 1m deep has side slopes 1:1. Determine i) Total pressure ii) Center of pressure, when it is full of water. **(06 Marks)**

OR

4 a. Define the terms Velocity potential function and Stream function. **(04 Marks)**

b. Derive an expression for continuity equation for a three dimensional flow. **(06 Marks)**

c. A stream function in a two dimensional flow is $\psi = 2xy$. Show that the flow is irrotational and determine the corresponding velocity potential ϕ. **(06 Marks)**

Module-3

5 a. What is Pitot Tube? How will you determine velocity using Pitot tube? **(04 Marks)**

b. State and prove Bernoulli's theorem for steady flow of an incompressible fluid. **(06 Marks)**

c. Water is flowing through a taper pipe of length 100m having diameters 600mm at the upper end and 300mm at the lower end at the rate of 50 litres/s. The pipe has a slope of 1m 30. Find the pressure at the lower end if the pressure at the higher end is 196.2 KPa. **(06 Marks)**

OR

6 a. Define the terms : i) Forced vertex flow and ii) Free vertex flow. **(04 Marks)**

b. What is Venturimeter? Derive an expression for discharge through a Veturimeter. **(06 Marks)**

c. A 300mm diameter pipe carries water under a head of 20m with a velocity of 3.5m/s. If the axis of the pipe turns through 45°, find the magnitude and direction of resultant force on the bend. **(06 Marks)**

Module-4

7 a. Explain different Hydraulic coefficients of an orifice and establish the relation between them. **(04 Marks)**

b. Derive an expression for discharge over a triangular notch. **(06 Marks)**

c. The head of water over an orifice of diameter 100mm is 5m. The water coming out from the orifice is collected in a circular tank of diameter 2m. The rise of water level in a circular tank is 450mm in 30 seconds. Also the coordinates at a certain point on the jet , measured from Vena – contracta are 1000mm horizontal and 52mm vertical. Find the Hydraulic coefficient C_v, C_d and C_c. **(06 Marks)**

OR

8 a. Explain the terms : i) Velocity of approach ii) Effect of en contractions in notches. **(04 Marks)**

b. What is Broad Crested Weir? Show that under maximum discharge conditions h = 2/3 H with usual notations for a broad crested weir. **(06 Marks)**

c. Find the discharge over a Cipalletti Weir of length 2m when the head over the Weir is 1m. Take $C_d = 0.62$. **(06 Marks)**

Module-5

9 a. Derive Darcy's equation for head loss due to friction through pipes. **(06 Marks)**

b. Explain briefly i) Hydraulic gradient line and ii) Energy gradient line. **(04 Marks)**

c. The rate of flow through a horizontal pipe is $0.03 m^3/s$. Length of pipe is 1km. Diameter of pipe for first half of length is 20cm and suddenly enlarges to 40cm for the remaining length. Find the difference in water surface elevation in the two reservoirs connected to either side of pipe. Take f = 0.01 in equation $\frac{fLV^2}{2gD}$. Consider minor losses. **(06 Marks)**

OR

10 a. Explain briefly the phenomenon of Water Hammer. **(04 Marks)**

b. Derive the expression for pressure loss due to sudden closure of the valve when the pipe is elastic. **(06 Marks)**

c. The water is flowing with a velocity of 1.25m/s in a pipe of 2km length and 250mm diameter. The valve at the end of pipe is closed in 27sec. Find the rise in pressure. Take C = 1400 m/s. **(06 Marks)**

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