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CBCS SCHEME

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15AU42

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Explain the phenomenon of capillarity. Derive an expression for capillary rise and capillary fall of a liquid. **(08 Marks)**

b. A vertical gap 2.2cm wide of infinite extent contains a fluid of viscosity 2.0Ns/m^2 and specific gravity 0.9. A metallic plate 1.2m × 1.2m × 0.2cm is to be lifted up with a constant velocity of 0.15m/sec, through the gap. If the plate is in the middle of the gap, find the force required. The weight of plate is 40N. **(08 Marks)**

OR

2 a. Explain U-tube differential manometer with neat sketch. **(08 Marks)**

b. Derive an expression for the force exerted on a submerged vertical plane surface by the static liquid and locate the position of centre of pressure. **(08 Marks)**

Module-2

3 a. Derive an expression for metacentric height of a floating body analytically. **(08 Marks)**

b. A circular plate 3 meter diameter is submerged in water in such a way that it's greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **(08 Marks)**

OR

4 a. Obtain an expression for continuity equation for a three-dimensional steady incompressible flow. **(08 Marks)**

b. Prove that for potential flow both the stream function and velocity potential function satisfy the Laplace equation. **(08 Marks)**

Module-3

5 a. Derive an expression for Bernoulli's equation from first principle and state the assumptions made. **(08 Marks)**

b. The 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 lires/sec. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62N/cm^2. **(08 Marks)**

OR

6 a. Explain the principle of venturimeter with a neat sketch. Derive an expression for the rate of flow of fluid through it. **(08 Marks)**

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

Module-4

7 a. Define similitude. Explain types of similarities. **(08 Marks)**

b. The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity w, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. **(08 Marks)**

OR

8 a. Derive Darcy's formula to calculate the frictional head loss in a pipe. **(08 Marks)**

b. A horizontal pipe of diameter 500mm is suddenly contracted to a diameter of 250mm. The pressure intensities in the large and smaller pipe is given as 13.734N/cm^2 and 11.772N/cm^2 respectively. Find the loss of head due to contraction if $C_C = 0.62$. Also determine the rate of flow of water. **(08 Marks)**

Module-5

9 a. Prove that maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. **(08 Marks)**

b. Prove that the velocity distribution for viscous flow between two parallel plates when both plate are fixed across a section is parabolic in nature. **(08 Marks)**

OR

10 a. Define displacement thickness. Derive an expression for the displacement thickness. **(08 Marks)**

b. Derive an expression for velocity of sound wave in a fluid. **(08 Marks)**

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