CBCS SCHEME

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18AU42

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 the following terms and mention their S.I. units:
(i) Specific weight (ii) Specific gravity
(iii) Surface tension (iv) Viscosity **(08 Marks)**

b. Write classifications of liquids with brief explanations. **(08 Marks)**

c. Define capillarity. Obtain an expression for capillarity rise of a liquid. **(04 Marks)**

OR

2 a. State and prove Pascal's law. **(06 Marks)**

b. Derive an expression for the total pressure for an inclined force and depth of centre of pressure for an inclined surface submerged in water. **(08 Marks)**

c. The right limb of simple U-tube manometer containing mercury is open to the atmosphere while left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb, find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm. **(06 Marks)**

Module-2

3 a. Explain the method to find metacentric height experimentally. **(08 Marks)**

b. Determine the conditions of equilibrium for a floating body with neat sketches. **(04 Marks)**

c. A block of wood of specific gravity 0.7 floats in water. Determine the meta centric height of the block if its size is 2m × 1m × 0.8m. **(08 Marks)**

OR

4 a. Derive an expression for continuity equation for three dimensional flow in carterian co-ordinates. **(10 Marks)**

b. The stream function for a two dimensional flow is given by $\psi = 2xy$, calculate the velocity at the point P(2, 3). Find the velocity potential function. **(10 Marks)**

Module-3

5 a. Derive Euler's equation of motion for ideal fluids and hence deduce Bernoulli's equation of motion. State the assumption made. **(12 Marks)**

b. A pipe, through which water is flowing, is having diameters 20 cm and 10 cm at the cross sections 1 and 2 respectively. The velocity of water at section 1 is given 4.0 m/s. Find the velocity head at sections 1 and 2 also rate of discharge. **(08 Marks)**

OR

6 a. Derive an expression for rate of flow through venturimeter. **(10 Marks)**

b. An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential monometer on the two sides of the orifice meter gives reading of 50 cm of mercury. Find the rate of flow of oil of specific gravity 0.9 when the coefficient of discharge of the meter = 0.64. **(10 Marks)**

Module-4

7 a. Explain Buckingham's π Theorem. **(10 Marks)**

b. A fluid having density ρ and dynamic viscosity μ flows through a pipe of diameter d with velocity v. Find the expression for force causing the flow by Rayleigh's method. **(10 Marks)**

OR

8 a. Derive Darcy Weisbach equation for head loss due to friction in pipe. **(10 Marks)**

b. Water is flowing through a pipe of diameter 200mm with velocity 3m/s. A circular solid plate of diameter 150mm placed in the pipe to obstruct the flow. Find the head loss due to contraction if coefficient of contraction is 0.62. **(10 Marks)**

Module-5

9 a. Derive an expression for shear stress distribution and velocity distribution for laminar flow through circular pipe. **(10 Marks)**

b. Water at 15°C flows between two large parallel plates at distance of 1.6mm apart. Determine

i) The maximum velocity

ii) The pressure drop per unit length

iii) The stress at the walls of the plates if the average velocity is 0.2m/s. The viscosity of water at 15°C is given as 0.01 poise. **(10 Marks)**

OR

10 a. Define displacement thickness and derive an expression for displacement thickness. **(10 Marks)**

b. A projectile is traveling in air having pressure and temperature as 8.829N/cm^2 and –2°C. If the Mach angle is 40°, find the velocity of the projectile. Take K = 1.4 and R = 287 J/kg°K. **(06 Marks)**

c. Explain Mach Angle and Mach Cone. **(04 Marks)**

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