CBCS SCHEME

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18AU42

Fourth Semester B.E. Degree Examination, June/July 2023
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 fluid properties :
i) Specific weight
ii) Cavitation
iii) Capillarity
iv) Surface tension
v) Vaccum pressure. **(05 Marks)**

b. Derive an expression for capillary rise of a liquid. **(07 Marks)**

c. Two large plane surfaces are 2.8cm apart. The space between the surfaces is filled with fluid. What force is required to drag a very thin plate of surface area 0.5 square meter between the two plane large surfaces at a speed of 0.8m/s, if :
i) The thin plate is in the middle of the two plane surfaces
ii) The plate is at a distance of 1.0cm from one of the plane surface? Take dynamic viscosity of fluid is 8.1 poise. **(08 Marks)**

OR

2 a. State and prove Pascal's law. **(05 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. **(10 Marks)**

c. Determine total pressure and centre of pressure on an isosceles triangular plate of base 4m and latitude 4m, when it is immersed vertically in an oil of specific gravity 0.9. The base of the plate coincides with the free surface of oil. **(05 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 the Euler's equation of motion for a ideal fluid and hence deduce Bernoulli's equation of motion. **(10 Marks)**

b. A pipe of diameter 30cm carries water at a velocity of 20m/s. The pressures at the points 'A' and 'B' are given as 34.34N/cm^2 and 29.43N/cm^2 respectively, while the datum head at 'A' and 'B' are 25m and 28m. Determine the loss of head between 'A' and 'B'. **(10 Marks)**

OR

6 a. Derive an expression for the actual discharge through venturimeter. **(10 Marks)**

b. An orifice meter with orifice diameter 10cm is inserted in a pipe of 20cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62N/cm^2 and 9.81N/cm^2 respectively. Co-efficient of discharge for the meter is given as 0.6. Find the discharge of water through pipe. **(10 Marks)**

Module-4

7 a. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by :

$$T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right].$$

Prove this by using Buckingham's π -theorem. **(10 Marks)**

b. Define :

i) Kinematic similarity

ii) Dynamic similarity. **(04 Marks)**

c. Determine the expression for the power P, developed by a pump, when P depends upon the head H, the discharge Q and specific eight 'ω' of the fluid. **(06 Marks)**

OR

8 a. Derive an expression fro Darcy – Weisback for the loss of head due to friction in a pipe. **(10 Marks)**

b. Determine the head lost due to friction in a pipe of diameter 300mm and length 50m through which water is flowing at a velocity of 3m/s. Using :

i) Darcy formula

ii) Chezy's formula for which c = 60. Take γ for water = 0.01 stoke. **(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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