CBCS SCHEME

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18AU42

Fourth Semester B.E. Degree Examination, July/August 2022
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. Define terms: (i) Buoyancy (ii) Centre of Buoyancy (iii) Meta centre
(iv) Meta-centric height (v) Stability of floating body **(10 Marks)**

b. A ship 70 m long and 10 m broad has a displacement of 19620 kN. A weight of 343.35 kN is moved across the deck through a distance of 6m. The ship is tilted through 6°. The moment of inertia of the ship at waterline about its fore and aft axis is 75% of M.O.I of the circumscribing rectangle. The centre of buoyancy is 2.25 m below water-line. Find the metacentric height and position of centre of gravity of ship. Specific weight of sea water is 10104 N/m^3. **(10 Marks)**

OR

4 a. Derive the equation of continuity. Obtain an expression for continuity equation for a 3-dimensional flow. **(10 Marks)**

b. The following cases represent the two velocity components, determine the third component of velocity such that they satisfy the continuity equation:

(i) $u = x^2 + y^2 + z^2$, $v = xy^2 - yz^2 + xy$

(ii) $v = 2y^2$, $w = 2xyz$ **(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. Using the Buckingham's π theorem, show that the discharge 'Q' consumed by an oil ring is given by $Q = Nd^3\phi\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{\rho N^2 d^3}, \frac{w}{\rho N^2 d}\right]$ where 'd' is the internal diameter of ring, N is rotational speed, ρ is density, μ is viscosity, σ is surface tension and w is specific weight of oil. **(10 Marks)**

b. What is similitude? Explain the three types of similitudes. **(10 Marks)**

OR

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

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

(i) Darcy's formula

(ii) Chezy's formula for which C = 60. **(10 Marks)**

Module-5

9 a. Define Reynold's number. What is its significance? **(04 Marks)**

b. Derive Hagen Poisoulle's equation for viscous flow through a circular pipe. **(10 Marks)**

c. An oil of viscosity 0.1 NS/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and length 300 m. The rate of flow of fluid through the pipe is 3.5 liters/s. Find the pressure drop in a length of 300 m. **(06 Marks)**

OR

10 a. Explain terms:

(i) Lift

(ii) Drag

(iii) Displacement thickness (δ*)

(iv) Momentum thickness (θ)

(v) Energy thickness (δ**) **(10 Marks)**

b. A flat plate 1.5 m × 1.5 m moves at 50 km/hr in stationary air of density 1.15 kg/m^3. If the coefficients of drag and lift are 0.15 and 0.75 respectively, determine:

(i) The lift force

(ii) The drag force

(iii) The resultant force

(iv) The power required to keep the plate in motion **(10 Marks)**

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