CBCS SCHEME

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17AU42

Fourth Semester B.E. Degree Examination, Feb./Mar. 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 and explain the following:
(i) Viscosity (ii) Surface tension (iii) Capillary rise (iv) Vapour pressure **(08 Marks)**

b. Classify the various types of fluids with the help of diagram and briefly explain them. **(06 Marks)**

c. If the velocity distribution over a plate is given by $u = \frac{2}{3}y - y^2$ in which 'u' is the velocity m/s and a distance 'y' meter above the plate. Determine the shear stress at y = 0 and y = 0.15. Take dynamic viscosity of fluid as 8.63 poise. **(06 Marks)**

OR

2 a. Derive the expression for hydrostatic force and depth of centre of pressure for an inclined submerged plan surface. **(10 Marks)**

b. An inverted differential monometer contains an oil of Sp. Gravity 0.9 is connected to the difference of pressure at two points of pipe containing water for the manometer readings shown in Fig.Q2(b). Find the pressure difference between A and B.

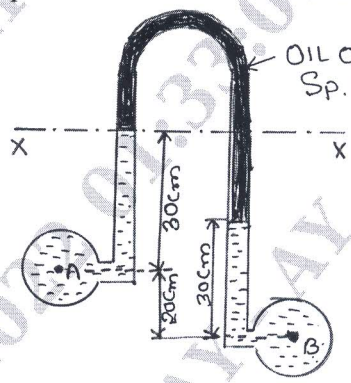

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Define the buoyancy and centre if buoyancy, Meta-centre and Meta centric height. **(06 Marks)**

b. Derive the expression for meta centric height of a floating body using analytical method. **(08 Marks)**

c. A uniform body of size 3m long × 2m wide × 1m deep floats in water. What is the weight of the body? If depth of immersion is 0.8m? Determine the meta-centric height also. **(06 Marks)**

OR

4 a. Distinguish between (i) steady flow and unsteady flow (ii) laminar flow and turbulent flow. **(06 Marks)**

b. Derive the continuity equation in the 3D in the differential form. **(08 Marks)**

c. A fluid flow field is given by $V = x^2yi + y^2zj - (2xyz + yz^2)k$. Prove that it is a case of possible steady incompressible fluid flow. Calculate the resultant velocity at the point (2, 1, 3). **(06 Marks)**

Module-3

5 a. Derive the Euler's equation of motion for a steady flow and deduce the Bernoulli equation of motion. Mention the assumption made. **(10 Marks)**

b. A non-uniform part of a pipe line 5m long is laid at a scope of 2 in 5. Two pressure gauge each fitted at upper and lower ends read 20 N/cm^2 and 12.5 N/cm^2. If the diameters at the upper and lower ends are 15 cm and 10 cm respectively. Determine the quality of water flowing per second. **(10 Marks)**

OR

6 a. Define venturimeter. Prove that rate flow through venturimeter is

$$Q_{act} = C_d \times \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$ **(08 Marks)**

b. States merits and demerits of Orifice meter. **(04 Marks)**

c. Determine the height of rectangular weir of length 6m to be built across a rectangular channel. The minimum depth of water on the upstream side of the weir is 1.8 m and discharge is 2000 liters/s. Take $C_d = 0.6$ and neglect correction. **(08 Marks)**

Module-4

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

b. Define and explain:
(i) Reynold's number (ii) Euler's number (iii) Mach's number
(iv) Geometric similarity (v) Kinematic similarity **(10 Marks)**

OR

8 a. Derive an expression Darcy equation for loss of head due to friction in pipes. **(10 Marks)**

b. Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m through which water is flowing at a velocity of 3 m/s using (i) Darcy formula (ii) Chezy's formula. [Take C = 60] **(08 Marks)**

c. Define HGL and TEL. **(02 Marks)**

Module-5

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

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

c. Determine :
(i) The pressure gradient
(ii) The shear stress at the two horizontal parallel plates
(iii) The discharge per meter width for the laminar flow of oil with a maximum velocity of 2 m/s between two horizontal parallel fixed plates which are 100 mm apart.
[Given μ = 2.4525 NS/m] **(06 Marks)**

OR

10 a. Explain terms:
(i) Lift (ii) Drag (iii) Laminar boundary layer (iv) Turbulent boundary layer **(08 Marks)**

b. Define displacement thickness and momentum thickness. **(06 Marks)**

c. Calculate the Mach Number at a point on a jet propelled air craft which is flying at 1100 km/hr at sea level where air temperature is 20°C. Take K = 1.4 and R = 287 J/kgK. **(06 Marks)**

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