CBCS Scheme

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Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following fluid properties and write their unit:
(i) Density (ii) Specific weight (iii) Specific volume (iv) Specific gravity. **(08 Marks)**

b. Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (i) Water and (ii) Mercury. Take surface Tensions σ = 0.0725 N/m for water and σ = 0.52 N/m, For mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact is 130°. **(08 Marks)**

OR

2 a. State and explain Pascal's law. Derive the equation also. **(06 Marks)**

b. What is total pressure and centre of pressure? **(03 Marks)**

c. Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4 m and altitude 4 m. 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. **(07 Marks)**

Module-2

3 a. Explain the terms:
(i) Buoyancy (ii) Centre of buoyancy (iii) Meta-centre (iv) Meta-centric height **(04 Marks)**

b. Explain conditions of equilibrium of a floating body and a submerged body. **(06 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 $2m \times 1m \times 0.8m$ **(06 Marks)**

OR

4 a. Explain the following:
(i) Steady and unsteady flow.
(ii) Uniform and non-uniform flow.
(iii) Laminar and turbulent flow.
(iv) Rotational and irrotational flow. **(08 Marks)**

b. The stream function for a 2-D flow is given by, $\psi = 8xy$. Calculate the velocity at a point P(4, 5). Find also the velocity potential function. **(08 Marks)**

Module-3

5 a. Derive Euler's equation of motion for one-dimension flow along a stream line. State the assumptions. **(08 Marks)**

b. A horizontal water pipe of diameter 150 mm converges to a diameter of 75 mm. If the pressure at the two sections are 400 kN/m^2 and 150 kN/m^2 respectively. Calculate the flow rate of water. **(08 Marks)**

OR

6 a. What is venturimeter? Derive an expression for discharge through the venturimeter. **(08 Marks)**

b. Water flows over a rectangular notch 1 m wide with a head of 15 cm and afterwards passes through a triangular (V-notch) of 90°. Taking C_d for the rectangular and V-notch as 0.62 and 0.59 respectively. Find the head over the triangular notch. **(08 Marks)**

Module-4

7 a. What is dimensional analysis? State Buckingham π-theorem and explain the procedure to determine π groups. **(08 Marks)**

b. Using Buckingham π-theorem. Show that the velocity through the circular orifice is given by,

$$V = \sqrt{2gH}\phi\left(\frac{D}{H}, \frac{\mu}{\rho VH}\right)$$

where H = head, ρ = mass density, g = Acceleration due to gravity
D = Diameter of orifice, μ = Co-efficient of viscosity **(08 Marks)**

OR

8 a. Derive an expression for the loss of head due to sudden enlargement in pipe flow. **(08 Marks)**

b. A 10 m long water pipe is laid at a slope of 3 in 4. The diameter of the lower end and upper end are 120 mm and 180 mm respectively. Pressure gauges fixed at the lower end and upper end reads 0.2 MPa and 0.3 MPa respectively. Determine the flow rate of water through the pipe. **(08 Marks)**

Module-5

9 a. Starting from basic principle derive an expression for velocity and shear stress distribution for laminar flow between two fixed parallel plates. **(08 Marks)**

b. An oil of viscosity 10 poise flow between two parallel fixed plates which are kept at a distance 50 mm apart. Find the rates of flow of oil between the plates if the drop of pressure in a length of 1.2 m be 0.3 N/cm^2. The width of the plates is 200 mm. **(08 Marks)**

OR

10 a. What is meant by drag and lift? Derive an expression for drag and lift. **(08 Marks)**

b. A man descends to the ground from an aeroplane with the help of a parachute which is hemispherical having a diameter of 4 m against. The resistance of air with a uniform velocity of 25 m/s. Find the weight of the man if the weight of Parachute is 9.81 N. Take $C_D = 0.6$. **(08 Marks)**

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