CBCS SCHEME

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15AU42

Fourth Semester B.E. Degree Examination, June/July 2023
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 capillarity and show that the capillary rise for water in a glass tube is given by $h = \frac{4\sigma}{\rho g d}$, where σ is surface tension and 'd' is glass tube diameter. **(08 Marks)**

b. A glass tube of 2.5mm diameter is immersed vertically in water. Determine the capillary rise in the glass tube, if water has surface tension of 0.0725N/m. **(08 Marks)**

OR

2 a. Sketch and explain the construction of a simple U-tube manometer to measure i) gauge pressure ii) Vacuum pressure. How pressure P at any given datum A-A is measure? **(08 Marks)**

b. It simple U-tube manometer has its right limb containing mercury is open to atmosphere while the left limb is connected to a pipe in which a fluid of 0.9 sp.gr, is flowing. The pipe center is 12cm below the level of mercury in the right limb. The difference of mercury level in the two limbs is 20cm. Find the fluid pressure in the pipe. **(08 Marks)**

Module-2

3 a. Define the following terms :
i) Buoyancy ii) Metacentre ii) Unstable equilibrium of a floating body iv) Stable equilibrium of a sub-merged body. **(08 Marks)**

b. Explain the experimental method of determination of meta centric height. **(08 Marks)**

OR

4 a. Define the following types of flow and represent mathematically. **(08 Marks)**
i) Steady and unsteady flow
ii) Uniform and non-uniform flows

b. For a fluid flow, the velocity potential function ϕ is given by
$$\phi = \frac{x^3 y}{3} - \frac{xy^3}{3} + y^2 - x^2$$
Find the velocity components in x and y direction at (4, 5). **(08 Marks)**

Module-3

5 a. Starting from Euler's equation of motion, derive Bernoulli's equation. State the assumptions made. **(08 Marks)**

b. Water is flowing through a pipe of diameter 20cm and 10cm at cross sections 1 and 2 respectively. If the velocity is 4m/s at section 1, determine :
i) velocity heads at sections 1 and 2 ii) rate of discharge. **(08 Marks)**

OR

6 a. Define : i) Coefficient of discharge ii) Coefficient of contraction iii) Coefficient of velocity. Write the expression for the same **(08 Marks)**

b. Sketch and explain the working of a Pitot tube. Using Bernoulli's equation. Explain how velocity at any point is measured. **(08 Marks)**

Module-4

7 a. Define : i) Reynolds number ii) Euler number
Express them mathematically. Write/mention their significance. **(08 Marks)**

b. Define Similitude. Discuss the three types of similarities. **(08 Marks)**

OR

8 a. Mention various miner losses in a pipe for a sudden contraction pipe show that head loss $h_c = K(V_2^2/2g)$ **(08 Marks)**

b. Determine the difference in the elevations between the water surfaces in two tanks connected by horizontal pipe of 30cm diameter and 400m length. The water flow rate is 300 litres/s. consider all losses and take f = 0.008. **(08 Marks)**

Module-5

9 a. Discuss the flow over a flat plate of a fluid flowing with a free stream velocity U_∞. Sketch and label laminar, turbulent boundary layers and zones. **(08 Marks)**

b. Determine the displacement and momentum thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$, where u is the velocity at distance y and u = U at y = δ, and δ is boundary layer thickness. **(08 Marks)**

OR

10 a. A thin plate is moving in still atmospheric air at 5m/s. The length of the plate is 0.6m and width 0.5. Calculate : i) the thickness of the boundary layer at the end of the plate ii) drag force on the side of the plate. Take air density as 1.24Kg/m^3 and kinematic viscosity as 0.15 stokes. Drag coefficient, $C_D = 1.328/\sqrt{Re_L}$ and Blasius solution is $\delta = 4.91x/\sqrt{Re_x}$ **(08 Marks)**

b. Define : i) Mach number ii) Mach angle. **(04 Marks)**

c. Explain the formation of Mach cone assuming M > 1. **(04 Marks)**

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