CBCS SCHEME

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18ME43

Fourth Semester B.E. Degree Examination, June/July 2025
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. Differentiate between : (i) Mass density and weight density
(ii) Real fluid and Ideal fluid (iii) Specific weight and specific volume
(iv) Dynamic viscosity and kinematic viscosity. **(08 Marks)**

b. Explain with suitable reasons for variation of viscosity in liquids and gases with respect to temperature. **(04 Marks)**

c. The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine
(i) The dynamic viscosity of the oil in poise.
(ii) The kinematic viscosity of the oil in stokes, if the specific gravity of the oil is 0.95. **(08 Marks)**

OR

2 a. Prove that centre of pressure lies below the centre of gravity of the vertical surface. **(08 Marks)**

b. State (i) Pascal's law (ii) Hydrostatic law **(04 Marks)**

c. A rectangular plane surface is 2 m wide 3 m deep. It lies in vertical plane in water. Determine the total pressure and position of centre of pressure on the plane surface when it's upper edge is horizontal and
(i) Coincides with water surface.
(ii) 2.5 m below the free water surface. **(08 Marks)**

Module-2

3 a. Explain the conditions of equilibrium for floating and submerged bodies. **(06 Marks)**

b. How will you determine the meta-centric height of floating body experimentally? Explain with sketch. **(06 Marks)**

c. A solid cylinder of diameter 4.0 m has a height of 4 m. Find the meta-centric height of the cylinder if the specific gravity of the material of cylinder = 0.6 and it is floating in water with it's axis vertical. State whether the equilibrium is stable or unstable. **(08 Marks)**

OR

4 a. Explain any four types of fluid flows. **(08 Marks)**

b. Define : (i) Stream function (ii) Velocity potential function. **(04 Marks)**

c. If for a two-dimensional potential flow, the velocity potential is given by $\phi = x(2y-1)$. Determine the velocity at point P(4, 5). Determine also the value of stream function (ψ) at the point P. **(08 Marks)**

Module-3

5 a. Derive Euler's equation of motion along a stream line and deduce to Bernoulli's equation. Also state the limitations of Bernoulli's equation. **(10 Marks)**

b. Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and the pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through the pipe is 40 lit/s. **(10 Marks)**

OR

6 a. Derive the expression for the loss of head due to sudden enlargement. **(10 Marks)**

b. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. Assume laminar flow. **(10 Marks)**

Module-4

7 a. Define the following : (i) Drag (ii) Lift (iii) Stream lined body (iv) Bluff body (v) Boundary layer thickness. **(10 Marks)**

b. A man weighing 882.9 N descends to the ground from an aeroplane with the help of a parachute against the resistance of air. The velocity with which the parachute, which is hemispherical in shape, comes down is 20 m/s. Find the diameter of the parachute. Assume $C_D = 0.5$ and density of air = 1.25 kg/m^3 **(10 Marks)**

OR

8 a. Explain the term "dimensionally homogenous equation". **(04 Marks)**

b. What is meant by geometric, kinematic and dynamic similarities? **(06 Marks)**

c. Using Buckingham's π-theorem, show that 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,

$$T = D^5 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho} \right].$$ **(10 Marks)**

Module-5

9 a. What are oblique and normal shocks? **(04 Marks)**

b. Derive velocity of sound interms of bulk modulus. **(06 Marks)**

c. A projectile travels in air of pressure 15 N/cm^2 at 10°C at speed of 1500 km/hr. Find the Mach number and Mach angle. Assume $\gamma = 1.4$ and R = 287 J/kgK **(10 Marks)**

OR

10 a. Explain any five advantages and disadvantages of CFD. **(10 Marks)**

b. Explain the process of computational fluid dynamics (CFD). Also discuss two field application of CFD. **(10 Marks)**

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