CBCS SCHEME

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21ME43

Fourth Semester B.E. Degree Examination, June/July 2023
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. Explain the following terms:
(i) Total pressure (ii) Centre of pressure
(iii) Gauge pressure (iv) Buoyancy **(08 Marks)**

b. Derive expression for total pressure force and centre of pressure act on a vertical surface immersed in static fluid. **(08 Marks)**

c. Discuss on fluid pressure measuring devices. **(04 Marks)**

OR

2 a. Explain the Eulerian and Langragian method of fluid flow analysis with suitable example. **(08 Marks)**

b. Derive the 3-dimensional flow continuity equation in cartesian coordinates. **(08 Marks)**

c. Calculate the velocity of fluid flow at a point (2, 3) if its 2-D flow stream function is given by $\psi = 2xy$. **(04 Marks)**

Module-2

3 a. Derive the Euler's equation of fluid motion and hence deduce Bernoulli's equation. **(10 Marks)**

b. Derive an expression for discharge through venturimeter. **(10 Marks)**

OR

4 a. Derive expression for discharge through a triangular notch. **(10 Marks)**

b. A horizontal venturimeter of 20 cm inlet diameter and 10 cm throat diameter is used to measure an oil flow. The discharge of oil through venturimeter is 60 lit/s. Calculate the reading of oil-mercury differential manometer. Take $C_d = 0.98$ and specific gravity = 0.8. **(10 Marks)**

Module-3

5 a. Derive Hagen Poiseulle equation for laminar flow through a circular pipe. **(10 Marks)**

b. A crude oil flowing through a horizontal circular pipe of 10 cm diameter and 100 cm length. Assume laminar flow and calculate pressure drop if 100 kg oil collected in a tank in 30 seconds. Take viscosity = 0.97 N-S/m^2 and specific gravity = 0.9. **(10 Marks)**

OR

6 a. Discuss the energy losses that occur in pipe flow. **(10 Marks)**

b. Derive Darcy-Weisbach equation for determining loss of head due to friction. **(10 Marks)**

Module-4

7 a. Explain the following terms:
(i) Boundary layer thickness (ii) Streamline body (iii) Bluff body
(iv) Lift (v) Drag **(10 Marks)**

b. Deduce an expression for pressure drop (dp) in a pipe flow using Buckingham's π - theorem if fluid has velocity (V), viscosity (μ) and density (ρ). Consider pipe diameter (D) and length (L). **(10 Marks)**

OR

8 a. Explain the following terms:
(i) Reynold's number (ii) Froude's number (iii) Euler's number
(iv) Weber's number (v) Mach number **(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. The coefficients of drag and lift are 0.15 and 0.75 respectively. Compute:
(i) Lift force
(ii) Drag force
(iii) Resultant force
(iv) Power required to keep the plate in motion. **(10 Marks)**

Module-5

9 a. Show that velocity of elastic wave propagation in an adiabatic medium is given by $C = \sqrt{\gamma RT}$. **(10 Marks)**

b. A projectile travels in air of pressure 100 kPa at 10°C with a speed of 1500 km/hr. Compute the Mach number and Mach angle. Take $\gamma = 1.4$ and R = 287 J/kg-K. **(10 Marks)**

OR

10 a. Explain the necessity, applications and limitations of CFD. **(10 Marks)**

b. A projectile travels with a speed of 1500 km/hr at 20°C temperature and 0.1 MPa air pressure. Calculate the Mach number and Mach angle. Take $\gamma = 1.4$ and R = 287 J/kg-K. **(10 Marks)**

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