



CBCS SCHEME

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 Lagrangian 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 (Δp) 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 $1.5 \text{ m} \times 1.5 \text{ m}$ 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)

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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 $R = 287 \text{ J/kg-K}$. (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 $R = 287 \text{ J/kg-K}$. (10 Marks)
