

CBCS SCHEME

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18AE/AS35

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020 Mechanics of Fluids

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Define Capillarity. Obtain an expression for capillary rise of a liquid. (06 Marks)
- b. 10m^3 of mercury weighs $136 \times 10^4\text{N}$. Calculate its specific weight, mass density, specific volume and specific gravity. (04 Marks)
- c. A vertical cylinder of diameter 180mm rotates concentrically inside another cylinder of diameter 181.2mm. Both the cylinders are 300mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of the fluid if a torque of 20Nm is required to rotate the inner cylinder at 120 r.p.m. (10 Marks)

OR

- 2 a. State and prove Hydrostatic law. (06 Marks)
- b. Derive an expression for Vertical Single Column Manometer. (06 Marks)
- c. A rectangular plane surface 3m wide and 4m deep lies in water in such a way that its plane makes an angle of 30° with the free surface of water. Determine the total pressure force and position of centre of pressure, when the upper edge is 2m below the free surface. (08 Marks)

Module-2

- 3 a. Explain different types of fluid particle motion. (10 Marks)
- b. Prove that for potential flow, both the stream function and velocity potential function satisfy the Laplace equation. (10 Marks)

OR

- 4 a. Define the Equation of Continuity. Obtain an expression for continuity equation for a three – dimensional steady incompressible flow. (10 Marks)
- b. Derive Navier Stokes equation for Control Volume approach. (10 Marks)

Module-3

- 5 a. A non – uniform part of a pile line 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20N/cm^2 and 12.5N/cm^2 . If the diameters at the upper and lower ends are 15cm and 10cm respectively, determine the quantity of water flowing per second. (10 Marks)
- b. Explain the principle of Orifice – meter. Derive an expression for the discharge of fluid through it. (10 Marks)

OR

- 6 a. Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity ω , speed of advance V, diameter D, dynamic viscosity μ , mass density ρ , elasticity of fluid medium which can be denoted by the speed of sound in the medium C. (14 Marks)
- b. Briefly explain geometric, kinematic and dynamic similarities. (06 Marks)

Module-4

- 7 a. Derive on the expression for drag and lift. (10 Marks)
 b. A jet plane which weighs 29.43kN and having a wing area of 20m² flies at a velocity of 950km/hour, when the engine delivers 7357.5 kW power, 65% of the power is used to overcome the drag resistance of the wing. Calculate the co-efficients of lift and drag for the wing. The density of the atmospheric air is 1.21 kg/m³. (10 Marks)

OR

- 8 a. Define displacement thickness. Derive an expression for the displacement thickness. (08 Marks)
 b. Obtain an expression for Von Karman Momentum Integral equation. (12 Marks)

Module-5

- 9 a. Define Compressible and Incompressible flow. Derive an expression for Bernoulli's equation when the process is adiabatic. (10 Marks)
 b. Derive an expression for velocity of sound wave in a fluid. (10 Marks)

OR

- 10 a. Explain propagation of pressure waves in a compressible fluid. (10 Marks)
 b. For frictionless adiabatic flow, show that the stagnation pressure at a given point is given by

$$P_s = P_1 \left(1 + \frac{K-1}{2} M_1^2 \right)^{\frac{K}{K-1}}$$

(10 Marks)
