CBCS SCHEME

USN | | | | | | | | | | 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 136×10^4N. 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 30^0 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 w, 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 $20m^2$ 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/m^3. **(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 Bernoullis 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

$$Ps = P_1\left(1+\frac{K-1}{2}M_1^2\right)^{\left(\frac{K}{K-1}\right)}.$$ **(10 Marks)**

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