CBCS SCHEME

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18AE/AS35

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
Mechanics of Fluid

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. Derive expression for capillary rise and capillary fall. **(10 Marks)**

b. An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5 m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100 mm. The thickness oil film is 1.0 mm. **(10 Marks)**

OR

2 a. A cubical tank has sides of 1.5 m. It contains water for the lower 0.6 m depth. The upper remaining part is filled with oil of specific gravity 0.9. Calculate for one vertical side of the tank ; i) Total pressure and ii) Position of centre of pressure. **(10 Marks)**

b. Derive the expression for inclined plane surface submerged in liquid. **(10 Marks)**

Module-2

3 a. Obtain the expression for equation of stream function and equation of potential function for source flow. **(10 Marks)**

b. A point P(0.5, 1) is situated in the flow field of doublet of strength 5 m^2/s. calculate the velocity at this point and also the value of the stream function. **(10 Marks)**

OR

4 a. For a finite control volume fixed in space derive continuity equation in integral and differential form. **(10 Marks)**

b. For a finite control volume fixed in space derive energy equation in integral and different form. **(10 Marks)**

Module-3

5 a. Derive an expression for rate of flow through venturimeter. **(10 Marks)**

b. Find the discharge of water flowing through a pipe 30 cm diameter placed in an inclined position where a venturimenter is inserted, having a throat diameter of 15 cm. The difference of pressure between the main and throat is measured by a liquid of Sp.gr. 0.6 in an inverted U-tube which given a reading of 30 cm. The loss of head between the main and throat is 0.2 times the kinetic head of the pipe. **(10 Marks)**

OR

6 a. Using Buckingham's π-theorem, show that the discharge Q consumed by an oil ring is given by $Q = Nd^3 \phi \left[\frac{\mu}{pNd^2}, \frac{\sigma}{pN^2d^3}, \frac{\omega}{pN^2d}\right]$

Where d is the internal diameter of the ring, N is rotational speed, p is density, μ is viscosity, σ is surface tension and ω is the specific weight of oil. **(10 Marks)**

b. The pressure different Δp in a pipe of diameter D and length ℓ due to viscous flow depends on the velocity V, viscosity μ and density p. Using Buckingham's π-theorem obtain an expression for Δp. **(10 Marks)**

Module-4

7 a. Derive Von Karmon momentum integral equation for a flat plate due to boundary layer. **(10 Marks)**

b. Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U}=2\left(\frac{y}{\delta}\right)-\left(\frac{y}{\delta}\right)^2$. **(10 Marks)**

OR

8 a. A jet plane which weight 29.43 kN and having a wing area of 20 m^2 flies at a velocity of 950 km/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 coefficients of lift and drag for wing. The density of the atmospheric air is 1.21 Kg/m^3. **(10 Marks)**

b. With a neat sketch explain the cambered airfoil nomenclature and its aerodynamics characteristics. **(10 Marks)**

Module-5

9 a. Derive the expression for velocity of sound wave in a fluid. **(10 Marks)**

b. A gas is flowing through a horizontal pipe at a temperature of 4°C. The diameter of the pipe is 8 cm and a section 1-1 in this pipe. The pressure is 30.3 N/cm^3 (gauge). The diameter of the pipe charge from 8 cm to 4 cm at the section 2-2, where pressure is 20.3 N/cm^3 (gauge). Find the velocities of the gas at these sections assuming as isothermal process. Take R = 287.14 Nm/kg K, and atmospheric pressure = 10 N/cm^2. **(10 Marks)**

OR

10 a. Derive Bernoulli's equation for i) Isothermal process ii) Adiabatic process in steady compressible flow. **(10 Marks)**

b. A gas with a velocity of 300 m/s is flowing through a horizontal pipe at a section where pressure is 6×10^4 N/m^2 (absolute) and temperature 40°C. The pipe changes in diameter and at this section the pressure is 9×10^4 N/m^2. Find the velocity of the gas at this section if the flow of the gas is adiabatic. **(10 Marks)**

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