CBCS SCHEME

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17AE/AS35

Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Define Capillarity and Surface Tension. Obtain an expression for capillary rise. **(10 Marks)**

b. If the velocity profile of a fluid over a plate is parabolic with the vertex 20 cm from the plate, where the velocity is 120 cm/sec. Calculate the velocity gradients and shear stresses at a distance of 0.10 and 20 cm from the plate, if the viscosity of the fluid is 8.5 poise. **(10 Marks)**

2 a. Obtain an expression for inclined plane surface submerged in liquid. **(10 Marks)**

b. The diameters of a small piston and a large piston of a hydraulic jack are 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Find the load lifted by the large piston when (i) The piston are at the same level (ii) Small piston is 40 cm above large piston. **(10 Marks)**

3 a. Explain the source flow and sink flow. Obtain an expression for doubled flow of stream function. **(10 Marks)**

b. Obtain an expression for continuity equation for a three dimensional steady incompressible flow. **(10 Marks)**

4 a. For a finite control volume fixed in space. Derive momentum equation in integral form. **(10 Marks)**

b. The velocity potential function is given $\phi = 2xy$, calculate the velocity components at the point (4, 5). Determine the value of stream formula. **(10 Marks)**

5 a. Obtain an expression for five dimensionless numbers. **(10 Marks)**

b. A pump has a tapering running full of water. The pipe is placed vertically with the diameters at the base and top being 1.2 m and 0.6 m respectively. The pressure at the upper end is 240 mm of Hg vaccum, while the pressure at the lower end is 15 kN/m^2. Assume the head loss to be 20% of difference of velocity head. Calculate the discharge the flow is vertically upwards and difference of elevation 3.9 m. **(10 Marks)**

6 a. Using Buckingham's π-theorem, show that the discharge Q consumed by an oil ring is given by $Q = Nd^3\left[\frac{\mu}{\rho ND^2}, \frac{\sigma}{\rho N^2 d^3}, \frac{W}{\rho N^2 d}\right]$. **(10 Marks)**

b. Obtain an expression for discharge through a orifice meter. Define the orifice meter. **(10 Marks)**

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

b. Derive an expression for displacement thickness, energy thickness. **(10 Marks)**

8 a. Derive an expression for Drag and lift. **(10 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50 km/hr. In a stationary air of density 1.15 kg/m^3. If the co-efficient of drag and lift are 0.15 and 0.75 respectively. Determine (i) Drag force (ii) Lift force (iii) The resultant force and (iv) The power required to keep the plate in motion. **(10 Marks)**

9 a. Derive Bernoulli's equation for adiabatic and Isothermal process. **(10 Marks)**

b. A gas is flowing through a horizontal pipe which is having area of cross section as 40 cm^2, where pressure is 40 N/cm^2 and temperature 15°C. At another section the area of cross-section is 20 cm^2 and pressure is 30 N/cm^2 (gauge). If the mass rate of flow of gas through the pipe is 0.5 kg/s, find the velocities of the gas at these sections, assuming an isothermal change. Take R = 292 N-m/kg°K and atmospheric pressure = 10 N/cm^2. **(10 Marks)**

10 a. Obtain an expression for velocity of sound wave in a compressible fluid in terms of change of pressure and change of density. **(10 Marks)**

b. Sketch the nature of propagation of disturbance in compressible flow when Mach number is more than one, equal to one and less than one. **(10 Marks)**

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