CBCS SCHEME

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17AE/AS35

Third Semester B.E. Degree Examination, Jan./Feb. 2023
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. Discuss the following properties of fluids :
i) Density
ii) Specific weight
iii) Specific volume
iv) specific gravity
v) Viscosity. **(10 Marks)**

b. If the velocity profile of a fluid over a plate is parabolic with the vertex 20cm form the plate, where the velocity is 120 cm/sec. Calculate the velocity gradients and shear stresses at a distance of 0, 10 and 20cm from the plate, if the viscosity of the fluid is 8.5 poise. **(10 Marks)**

OR

2 a. The diameters of a small piston and a large piston of a hydraulic jack are 3cm and 10cm respectively. A force of 80N is applied on the small piston. Find the load lifted by the large piston when :
i) The pistons are at the same level
ii) Small piston is 40cm above the large piston
iii) The density of the liquid in the jack is given as 1000kg/m^3. **(10 Marks)**

b. A cubical tank has sides of 1.5m. It contains water for the lower 0.6m 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
ii) Position of centre of pressure. **(10 Marks)**

Module-2

3 a. The velocity components in a two-dimensional flow field for an incompressible fluid are as follows : $u = \frac{y^3}{3} + 2x - x^2y$ and $v = xy^2 - 2y - \frac{x^3}{3}$
Obtain an expression for the steam function ψ. **(10 Marks)**

b. In a tow-dimensional incompressible flow, the fluid velocity components are given by $U = x - 4y$ and $v = -y - 4x$
Show that velocity potential exists and determine its form. Find also the stream function. **(10 Marks)**

OR

4 a. Derive the integral and differential form of energy equation using control volume approach. **(10 Marks)**

b. Derive the integral and differential form of momentum equation (Navier – Stales Equation) using control volume approach. **(10 Marks)**

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Module-3

5 a. Obtain the expression for rate of flow through venturimeter. **(10 Marks)**

b. Obtain the expression for rate of flow through orifice meter or orifice plate. **(10 Marks)**

OR

6 a. A partially sub-merged body is towed in water. The resistance R to its motion depends on the density ρ, the viscosity μ of water, length ℓ of body, velocity v of the body and the acceleration due to gravity g, show that the resistance of the motion can be expression in the form : $R = \rho L^2 V^2 \phi\left[\left(\frac{\mu}{\rho VL}\right).\left(\frac{\ell g}{V^2}\right)\right]$. **(08 Marks)**

b. Explain the method of selecting repeating variables and procedure for solving problems by using Buckingham's π - theorem. **(12 Marks)**

Module-4

7 a. Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{v} = \frac{y}{\delta}$, where u is the velocity at a distance y from the plate and u = U at y = δ, where δ = boundary layer thickness. Also calculate the value of δ^*/θ. **(10 Marks)**

b. Find the displacement thickness, the momentum thickness and energy thickness for the velocity distributing 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. Derive the Van Karman momentum integral equation for boundary layer flows. **(14 Marks)**

b. Discuss the total drag on a flat plate due to Laminar and turbulent boundary Layer. **(06 Marks)**

Module-5

9 a. Derive the Bernoullis equation for isothemal process and adiabatic process. **(10 Marks)**

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

OR

10 Derive the expression for stagnation Pressure (P_s), Stagnation density (P_s), and Stagnation temperature (T_s). **(20 Marks)**

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