CBCS SCHEME

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15AE35

Third Semester B.E. Degree Examination, Aug./Sept.2020
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 80

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. **(08 Marks)**

b. The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 Poise. The shaft is of diameter 0.4m and rotates at 190rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm. **(08 Marks)**

OR

2 a. A pressure gauge consists of two cylindrical bulbs B and C each of 10sq.cm cross sectional area, which are connected by a U-tube with vertical limbs each of 0.25sq.cm c/s area. A red liquid of specific gravity 0.9 is filled into C and clear water is filled into B, the surface of separation being in the limb attached to C. Find the displacement of the surface of separation when the pressure on the surface in C is greater than that is B by an amount equal to 1cm head of water. **(10 Marks)**

b. A pipe line which is 4m in diameter contains a gate valve. The pressure at the centre of the pipe is 19.6N/cm^2. If the pipe is filled with oil of specific gravity 0.87, find the force exerted by the oil upon the gate and position of centre of pressure. **(06 Marks)**

Module-2

3 For a finite control volume fixed in space derive momentum equation in integral and differential form. **(16 Marks)**

OR

4 a. Derive an expression for continuity equation in 3D, in differential form for steady incompressible fluid flow. **(08 Marks)**

b. The velocity components in a two-dimensional flow field for an incompressible fluid are as follows:

$$u = \frac{y^3}{3} + 2x - x^2y \text{ and } v = xy^2 - 2y - x^3/3$$

Obtain an expression for the stream function ψ **(08 Marks)**

Module-3

5 a. The water is flowing through a taper pipe of length 100m having diameters 600mm at the upper end and 300mm at the lower end, at the rate of 50 litres/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62N/cm^2. **(08 Marks)**

b. Obtain the expression for rate of flow through venturimeter. **(08 Marks)**

OR

6 a. The pressure difference 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 on expression for ΔP. **(08 Marks)**

b. Define model analysis. Explain Similitude-types of similarities. **(08 Marks)**

Module-4

7 a. Find the displacement thickness, momentum thickness, energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$, when 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. **(08 Marks)**

b. With a neat sketch explain Laminar, transition and turbulent boundary layer concepts. **(08 Marks)**

OR

8 Obtain the expression for Displacement thickness (δ^*), momentum thickness (θ) and Energy thickness (δ^{**}). **(16 Marks)**

Module-5

9 Derive expression for i) Stagnation pressure (P_s) ii) Stagnation Density (ρ_s) iii) Stagnation temperature (T_s). **(16 Marks)**

OR

10 a. Obtain the expression for velocity of sound wave in a fluid. **(08 Marks)**

b. A kite 0.8m × 0.8m weighing 0.4kgf (3.924N) assumes on angle of 12° to the horizontal. The string attached to the kite makes as angle of 45° to the horizontal. The pull on the string is 2.5kgf (24.525N) when the wind is flowing at a speed of 30km/hour. Find the corresponding coefficient of drag and lift. Density of air is given as 1.25kg/m^3. **(08 Marks)**

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