Sem IV / MECH

Paper / Subject Code: 41222 / Fluid Mechanics

(3 Hours) **[Total Marks: 80]**

N.B. : (1) **Question No.1 is Compulsory.**
(2) Attempt any three Questions out of remaining five questions.
(3) Figures to the right indicate full marks.
(4) Assume any suitable data if necessary and justify the same.

Q1 Solve any **FOUR**

A) Explain Streamlined and bluff bodies **5**

B) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm^2 (gauge) and mean velocity of 2.0 m/s. find the total head or total energy per unit weight of the water at a cross section, which is 5m above the datum line. **5**

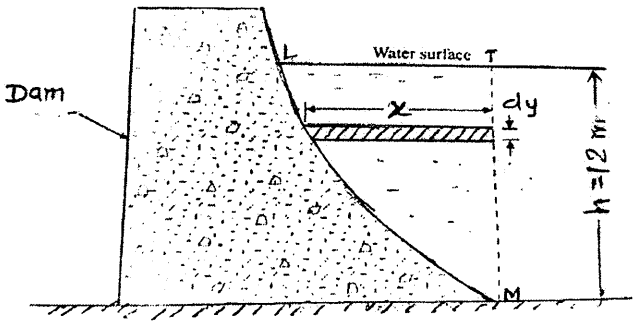
C) Explain Velocity Potential and Stream Function **5**

D) Explain major and minor losses in pipes **5**

E) One litre of crude oil weighs 9.6 N. Calculate its specific weight, density and specific gravity? **5**

Q2 A) Derive Euler equation of motion along a streamline and from that derive Bernoulli's theorem. **10**

B) The curved face of a dam is shaped according to the relation $y = \frac{x^2}{12.25}$ as shown in fig. If the width of the dam is unity and height of water retained by the dam is 12 m. determine the magnitude and direction of the resultant water pressure acting on the curved face of the dam. **10**



Q3 A) A 0.4m x 0.3m, 90° vertical reducing bend carries 0.5 m^3/s oil of specific gravity 0.85 with a pressure of 118 KN/m^2 at inlet to the bend. The volume of bend is 0.1 m^3. Find the magnitude and direction of the force on the bend. Neglect the frictional losses and assume both inlet and outlet sections to be at same horizontal level. Also assume that water enters the bend at 45° to the horizontal. **10**

B) Derive an expression for velocity distribution, discharge per unit width and shear stress when laminar flow between two parallel fixed plates (Plane Poiseuille flow). **10**

Q4 A) Using the laminar boundary layer velocity distribution: **10**

$$\frac{u}{U_\infty} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$$

i) Check if boundary layer separation occurs.

ii) Determine Boundary layer thickness (In terms of Re)

B) Derive the expression for the total pressure force and Centre of pressure when Vertical surface submerge in liquid. **10**

Q5 A) A partially submerged body is towed in water. The resistance R to its motion depend on the density ρ, the viscosity μ of water, length of the body, velocity V of the body and acceleration due to gravity. Show that the resistance to motion can be expressed in the form **10**

$$R = \rho L^2 V^2 \phi\left[\left(\frac{\mu}{\rho LV}\right), \left(\frac{Lg}{V^2}\right)\right]$$

B) The flow field of a fluid is given by V = xyi + 2yzj – (yz + z^2)k **10**

(i) Show that it represent a possible three- dimensional steady incompressible continuous flow.

(ii) Is this flow rotational or irrotational?

If rotational, determine at point A (2, 4, 6)

(a) Angular Velocity

(b) Vorticity

(c) shear strains

Q6 A) Two reservoirs are connected by three pipes in series. **10**

Pipe	Length	Diameter	Coefficient of friction
1	300 m	30 cm	0.02
2	250 m	25cm	0.025
3	200 m	20cm	0.03

Calculate the discharge through them if the elevation difference of the levels is in the reservoirs is 20 m. consider the minor losses.

B) Write short notes (**any TWO**) **10**

I. Classification of fluid flow

II. Importance of Reynolds Transport theorem (RTT).

III. With neat sketch explain any two application of Bernoulli's theorem

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