

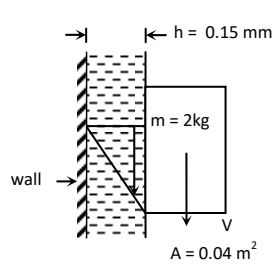
Prelim Paper

Time: 3 Hrs.]

Fluid Mechanics

[Marks : 80

- N.B.** (1) Question No. 1 is compulsory.
(2) Attempt any **THREE** questions out of remaining FIVE questions.
(3) Figure to the right indicates full marks.
(4) Assume any suitable data if necessary and justify the same.

1. Attempt the following (any FOUR) : 20
- (a) What is pitot tube? On what principle does it work?
 - (b) What is boundary layer development and factors that affect growth of boundary layer?
 - (c) Write short note on Drag and lift
 - (d) Explain : (i) Local acceleration (Temporal acceleration)
(ii) Convective acceleration
 - (e) What are the significance of "Mach Number"? On the basis of Mach number define (i) Sonic flow (ii) Subsonic flow (iii) supersonic flow.
2. (a) A Fluid flow field is given by $\vec{u} = xy \mathbf{i} + 2yj - (yz + 2z) \mathbf{k}$ 10
Determine whether this is a possible steady incompressible fluid flow. If so, calculate magnitude of acceleration at the point (1, 2, 3).
- (b) How Bernoulli's equation is based on Euler's theory of fluid flow and is obtained by integrating the Euler's equation of motion? 10
3. (a) A solid block 2 kg mass slides steadily at a velocity 'V' along a vertical wall as shown in fig. below. A thin oil film of thickness $h = 0.15 \text{ mm}$ provides lubrication between the block and wall. The surface area of the face of the block in contact with the oil film is 0.04 m^2 . The velocity distribution within the oil gap is linear as shown in fig. Take dynamic viscosity of oil as $7 \times 10^{-3} \text{ pa-s}$ and acceleration due to gravity as 10 m/s^2 . Neglect weight of the oil the terminal velocity 'V' (m/s) of the block is? 10
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- (b) Define following terms : 10
- (i) streamline (ii) streak line (iii) path line
 - (iv) source (v) sink
4. (a) What is stream function and velocity potential function? Explain relation between both. How equipotential line and streamline are perpendicular to each other? 08
- (b) Three pipes of 400 mm, 200 mm and 300 mm diameters have lengths of 400 m, 200 m and 300 m respectively. They are connected in series to make a compound pipe the ends of this compound pipe are connected with two tanks whose difference of water level is 16m. If co-efficient of friction for these pipe is same & equal to 0.005. Determine the discharge through the compound pipe neglecting the minor losses. 12

5. (a) Find shape factor for the velocity distribution in the boundary layer given by 10

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

Where, u is the velocity at the distance ' y ' from the surface of the flat plate and ' U ' be the free stream velocity at the boundary layer thickness ' δ '.

- (b) An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of specific gravity 0.9 when the coefficient of discharge of the orifice meter = 0.64. 10

6. (a) Explain following terms: 12

- (i) Circulation and vorticity
- (ii) Total pressure and centre of pressure
- (iii) Streamlined body and bluff body
- (iv) Lagrangian and Eulerian method

- (b) Find the density of a metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water. 08

