(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) Define Boundary layer and explain briefly boundary layer formation. 5

B) Explain the concept of control volume, control surface and importance of Reynolds Transport theorem (RTT) 5

C) What is dimensional analysis? State the uses and advantages of dimensional analysis? 5

D) A wooden block of 4 m x 1 m x 0.5 m in size and its specific gravity 0.75 is floating in water. Find the weight of concrete of specific weight 24 kN/m^3 that may be placed on the wooden block, which will immerse the wooden block completely. 5

E) Explain Newton Law of Viscosity? Define Poise and stoke? 5

Q2 A) A square aperture in the vertical side of a tank has one diagonal vertical and is completely covered by a plane plate hinged along one of the upper sides of the aperture. The diagonals of the aperture are 2 m long and the tank contains a liquid of specific gravity 1.15. The centre of aperture is 1.5 m below the free surface. Calculated the thrust exerted on the plate by the liquid and position of its centre of pressure. 10

B) Find the velocity and acceleration at the point (1, 2, 1) for t = 2 sec for a three – dimensional flow field given by (u = 3 + yz + t), (v = xz - t -1), (w = xy + 1). 10

Q3 A) A pipeline carrying oil of relative density 0.8 changes its diameter from 200 mm to 400 mm, which is 5 m at a higher level. If the pressures at these two points are 100 kN/m^2 and 50 kN/m^2 respectively and the discharge is 250 liter/sec, determine direction of flow and loss of head. 10

B) Derive Darcy Weisbach equation and state its utility? 10

Q4 A) The velocity distribution in the boundary layer is given by 10

$$\frac{u}{U} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$$

Calculate:
(i) Displacement thickness (ii) Momentum thickness (iii) Shape factor
(iv) Energy thickness

B) Derive the continuity equation for three dimensional, steady and incompressible flow. 10

Q5 A) A converging pipe bend with its centreline in a horizontal plane, changes the direction of pipeline by 60^o in the clockwise direction and reduces the pipeline diameter from 30 cm to 20 cm in the direction of flow. If the pressure indicate by Bourdon gauge at the centre line of the 30 cm diameter entrance to the bend is 140 kN/m^2 and the flow of water through the pipeline is 0.10 m^3/sec. Determine the magnitude and direction of force on the bend due to moving water. 10

B) Two parallel plate kept 100 mm apart have laminar flow of oil between them, maximum velocity of flow is 1.5 m/s. Assume viscosity of oil 24.5 poise. 10

Calculate :

(i) Discharge per metre width

(ii) Shear Stress at the plate

(iii) The difference in pressure between two points 20 m apart

(iv)Velocity gradient of plates

(v) Velocity at 20 mm from the plate

Q6 A) Determine the rate of flow of water through a pipe diameter 20 cm and length 50 m when one end of pipe is connected to a tank and other end of pipe is open to atmosphere. The pipe is horizontal and height of water in the tank is 4 m above the center of pipe. Consider all minor losses. Take friction factor f = 0.04. Draw TEL and HGL 10

Solve any **TWO**

B) (i) Define Reynold's number, its significance and application 10

(ii) Streamlined and Bluff body.

(iii)State and prove Pascal Law and give some application