Time: 3 hours **Marks: 80**

NB:

1. **Question No.1 is compulsory.**
2. **Attempt any three questions from remaining questions.**
3. **Neat diagram must be drawn wherever necessary.**
4. **Assume suitable data if necessary and state clearly.**

1 Answer any four from the following

a. State the phenomenon of surface tension on fluid. 5

b. State Reynold Transport Theorem 5

c. State the Bernoulli's Theorem and assumptions made in deriving the Bernoulli's Theorem 5

d. Distinguish between the hydrodynamically rough surface and hydrodynamically smooth surface with neat sketches 5

e. Explain the phenomenon of vapor pressure and method to avoid it. 5

2 a. If the velocity distribution in laminar boundary layer over a flat plate 10

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

determine the velocity distribution form using necessary boundary conditions and find

i. Boundary Layer Thickness

ii. Check whether the flow is attached or not.

b. Air has a velocity of 1000 km/h at a pressure of 9.81 kN/m^2 vacuum and temperature of 47^{0}C. Take atmospheric pressure is 98.1 kN/m^2, R=287 J/kg K and $\gamma = 1.4$.Determine the following 10

i. Local Mach Number

ii. Stagnation Pressure

iii. Stagnation Temperature, and

iv. Stagnation Density

3 a. Use the appropriate form of Navier-stokes equation to derive an equation of velocity profile Couette flow State assumptions made at each stage. Plot the velocity distribution curve. 10

b. If the expression for velocity potential function is described as $\emptyset = 3xy$; determine x and y components of velocity at(1,3) and (3,3).Determine the discharge passing between stream lines passing through these points. 10

4 a. An isosceles triangle of base 3 m and altitude 6 m is immersed vertically in water, with its axis of symmetry horizontal. If the head of water on it is 9 m from axis of symmetry, determine. 10

i. Total pressure on the plate

ii. The position of center of pressure

b. Derive the expression for total pressure and center of pressure for the inclined immersed plane lamina in water. 10

5 Using Reynold's Transport Theorem derive the mass flow rate equation and momentum equation to solve the following 06

The angle of reducing bend is 60^0 deviating from initial direction to final direction Its initial diameter is 300 mm and final diameter is 150 mm and is fitted in a pipeline carrying a discharge of 360 litres/sec. The pressure at the commencement of the bend is 2.943 bar. The friction loss in the pipe bend may be assumed as 10 percent of kinetic energy at exit of the bend. Determine the magnitude and direction of force exerted by the reducing bend. 14

6 Write short note for the following

a. Pressure Drag 5

b. Streamlined and bluff bodies 5

c. Boundary layer separation and methods to avoid it. 5

d. Conditions of equilibrium for floating and submerged bodies. 5

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