sem V / mech / 9-12-11 / Fluid mechanics

6361-11. MP–3793

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume **suitable** data if **necessary**.
(4) **Figures** to the **right** indicate marks.

1. Write short notes on: 20
   a. Lift force on circulating cylinder in uniform flow.
   b. Moody's chart
   c. Streamline body and bluff body
   d. Iterative methods in CFD.

2. If a velocity distribution in a laminar boundary layer on a flat plate is –

$$\frac{u}{U} = a + b\eta + c\eta^2 + d\eta^3 \text{ where, } \eta = \frac{y}{\delta}$$

   Evaluate a, b, c, d from the physical boundary conditions and
   Determine; 08
   a. Boundary Layer Thickness 04
   b. Shear stress on one side of plate 06
   c. Coefficient of drag 02
   d. Check whether the flow will separate or not.

3. a. What is meant by total pressure and centre of pressure? Derive its expression for an inclined surface submerged in a fluid? 10
   b. A cylindrical tank 1 m diameter and 3 m high is filled with air at a pressure of 50 kN/m^2 above atmospheric pressure. Determine 10
   a. Total pressure acting on vertical wall of tank and
   b. Distance of centre of pressure from top of tank.
   Draw pressure distribution along height of tank.

4. a. Three pipes with details as following are connected in parallel between two points 10

Pipe	Length	Diameter	f
1	1000 m	20 cm	0.02
2	1200 m	30 cm	0.015
3	800 m	15 cm	0.02

   When the total discharge of 0.30 m^3/sec flows through the system, calculate distribution of discharge and head loss between the junctions.
   b. Derive Euler's equation of motion in rectangular Cartesian Co-ordinate system and from this derive Bernoulli's Equation for liquid. State assumptions made in the derivation of Bernoulli's Equation. 10

5. a. Water flows in a 300 mm pipe. Two pitot tubes are installed in a pipe, one at the centre line and other 75 mm from centerline. If the velocities at the two points are 3 m/sec and 2 m/sec resp. Calculate the reading on differential mercury manometer connected to the two tubes. 10
   b. Two discs are placed in a horizontal plane one over the other. The water enters at the centre of lower disc and flows radially outward from a source of strength 0.628 m^2/sec. The pressure at radius 50 mm is 200 kN/m^2, find 10
   i. Pressure in kN/m^2 at radius of 500 mm and
   ii. Stream function at angle of 30^0 and 60^0 if $\psi = 0$ at $\theta = 0^0$.

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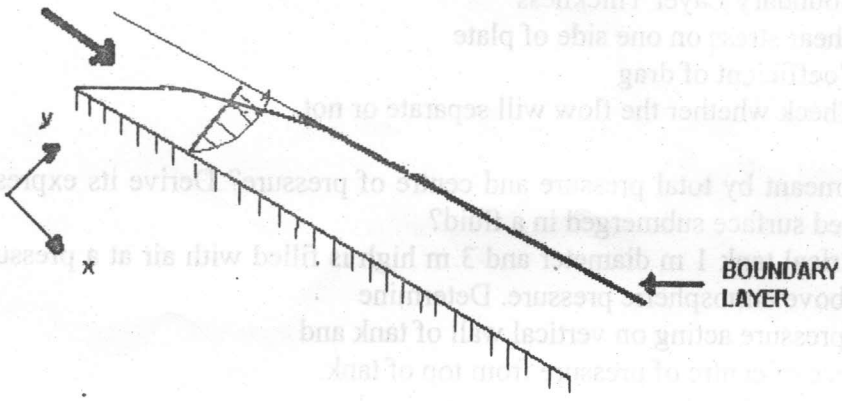
6. a. Explain what is meant by separation of boundary layer and describe in detail the methods to control this? **08**

b. Two fixed parallel plates kept 80 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m/sec. Taking dynamic viscosity of oil to be 19.62 poise, Calculate **12**

i. The discharge per meter width
ii. The shear stress at the plate
iii. The pressure difference between two points 25 m apart
iv. The velocity at 20 mm from the plate and
v. The velocity gradient at the plate end.

7. a. Consider fully developed laminar flow down an inclined plane. Starting with N-S Equation, develop a mathematical model for the case. State the assumptions made. Decide computational domain with the BC and tell reasons for selection of BC. What kind of meshing will you recommend for such flow, Develop a descretize equation for an interia node using Finite Difference Method? **12**



b. The velocity components in a flow are given by $u = 4x$; $v = -4y$. Determine the stream and potential functions. Plot these functions for ψ = 60,120,180, 240 and Φ = 0,-60,-120, -180, +60, +120, ,+180.Check for continuity. **08**