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Total No. of Questions : 09

B.Tech.(CE) (Sem.–4)

Fluid Mechanics-II

Subject Code : CE-204

Paper ID : [A0607]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTION TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students has to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students has to attempt any TWO questions.

SECTION-A

1. **Write briefly :**

   a. Write the boundary conditions for Plane Poiseuille flow.

   b. Define nominal thickness of boundary layer.

   c. Calculate the nominal thickness of turbulent boundary layer over a flat plate at a distance 10 m from the leading edge, if the free steam velocity is 10 m/s and viscosity is $1\times10^{-6}m^2/s$.

   d. Find out the drag force on a sphere of diameter 1 cm falling with uniform velocity of 1 cm/s in a fluid with viscosity 0.1 N-s/m^2.

   e. What is the concept behind Karman similarity hypothesis in a turbulent flow?

   f. Why the laminar flow separates much early than the turbulent flow?

   g. Define critical, subcritical and supercritical flow.

   h. Write names of four methods to calculate the length of water surface profile in a gradually varied flow.

   i. On what condition the hydraulic jumps take place?

   j. What is normal depth?

SECTION-B

2. Derive the equation for generalized Couette flow from the Navier-Stokes equation.

3. A rough pipe of 50 cm diameter and 300 m in length is carrying water with a velocity of 4 m/s. The surface has an absolute roughness of 0.25 mm. Determine whether the flow is laminar or turbulent? Find out the head loss due to friction.

4. A trapezoidal channel with side slopes 1:1 has to be designed to convey a discharge of 30 cumec at an average velocity of 2 m/s. Find out the minimum area of the concrete lining per unit length for the sides and bed.

5. A rectangular channel of 2 m width has a discharge of 0.4 m^3/s. Find the height of the sudden rise of the channel spanning full width so that the upstream flow depth can be maintained at 0.85 m.

6. Find out the energy loss expression for the hydraulic jump in an open channel flow.

SECTION-C

7. The velocity distribution in the boundary layer over the face of a high spillway is in the following form :

$$\frac{u}{U_\infty}=\left(\frac{y}{\delta}\right)^{0.22}$$

The free stream velocity (U_∞) at a certain section is 20 m/s and a boundary layer thickness of 5 cm is estimated from the velocity distribution measured at the section. The discharge passing over the spillway is 5 m^3/s per meter length of the spillway. Calculate the displacement thickness, energy thickness, and the loss of energy upto the section under consideration.

8. A sluice across a channel 6 m wide discharges 1 m deep stream. Calculate the flow rate when the upstream flow depth is 7 m. At downstream, floor has been raised locally to form the hydraulic jump. Find out the force on the concrete block if the depth of flow after jump is 3 m.

9. Discuss the various flow profiles in a open channel for mild, steep and horizontal slopes.