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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.
2. Attempt any FOUR questions from SECTION-B.
3. Attempt any TWO questions from SECTION-C.

SECTION-A (10 × 2 = 20 Marks)

1. (a) How is the transition of flow from laminar to turbulent demonstrated by Reynolds?

   (b) What are Prandtl's boundary layer equations and why these equations are difficult to solve?

   (c) Explain the phenomenon of boundary layer separation?

   (d) Show that the difference of local velocity and average velocity is same for smooth and rough pipes.

   (e) What is drag and what are its types?

   (f) How can a lift force be developed on a rotating cylinder placed in uniform flow field?

   (g) How do you determine average velocity of flow in open channels?

   (h) What is critical flow and what are its characteristics?

   (i) What is momentum equation as applied to flow in open channels?

   (j) Differentiate between hydraulic jump and surge.

SECTION-B (4 × 5 = 20 Marks)

2. Oil of specific gravity 0.92 and viscosity 1.05 Poise flows between two horizontal parallel plates kept 12 mm apart. If the average velocity is 1.4m/s, determine boundary shear stress, shear stress and velocity at 5 mm from the bottom plate and head loss in a distance of 25 m.

3. A 300 mm diameter water supply pipe had a friction factor of 0.02 when freshly laid. After 10 years of service, the friction factor was found to be 0.025. What friction factor can be expected after another 15 years? Assume the pipe to be in rough turbulent flow regime.

4. A flat plate 500 mm x 200 mm is placed longitudinally in a stream of oil flowing with a free stream velocity of 6 m/s. Calculate boundary layer thickness and shear stress at the middle of plate. Also, calculate friction drag on one side of the plate. The specific gravity and viscosity of oil are 0.9 and 1 stoke, respectively.

5. A lined rectangular channel is 5 m wide and has a depth of 2 m with bed slope of 1 in 1600. Retaining the same section and area of lining, to what maximum extent the discharge can be increased without changing the slope? Given, Manning's coefficient as 0.015.

6. In a trapezoidal channel of bottom width 3.5 m and sides slope 2 horizontal to 1 vertical, the critical depth is found to be 0.9 m. What is the minimum specific energy corresponding to this critical depth?

SECTION-C (2 × 10 = 20 Marks)

7. Uniform flow occurs in a rectangular channel 3.5 m wide at a depth of 2 m, laid at a slope of 0.0036. Find how high a hump can be raised on the channel bed without causing a change in the upstream depth. If upstream depth is to be raised to 2.4 m, what should be the height of hump? Take Manning's coefficient as 0.015.

8. Derive the differential equation of gradually varied flow in open channels. Deduce this equation for a wide rectangular channel.

9. An overflow spillway has its crest at elevation 136 m and a horizontal apron at elevation of 102 m on the downstream side. The elevation of energy line just upstream of the spillway crest is 138 m. Determine the tail water elevation required to form a hydraulic jump. Take coefficient of discharge as 0.72 for the spillway.