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Total No. of Pages : 02

Total No. of Questions : 09

B.Tech (Civil) (Sem.–4)

FLUID MECHANICS-II

Subject Code : CE-204

Paper ID : [A0607]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS 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 have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Q1. Answer briefly :

a) What are the applications of Navier-Stokes equations?

b) Explain different stages of transition from laminar to turbulent state.

c) Define scale of turbulence.

d) Cite some examples of boundary layer formation.

e) What are the coefficients of drag and lift?

f) Define hydraulic gradient line and energy gradient line.

g) What information is revealed from the inspection and analysis of hydraulic jump equation?

h) Define surge.

i) Define critical depth as applied to flow in an open channel.

j) What do you understand by the term buffer zone?

SECTION-B

Q2. A container full of oil has a horizontal parallel crack in its end wall which is 500 mm wide and 50 mm thick in the direction of flow. The pressure difference between two faces of the crack is 10 kPa and the crack forms a gap of 0.4 mm between the parallel surfaces. Calculate :

a) Volume of oil leakage per hour through the crack
b) Maximum leakage velocity
c) Shear stress and velocity gradient at the boundary.

Q3. A flat plate was positioned at zero incidence in a uniform flow stream of air. Assuming boundary layer to be turbulent over the entire plate, work out the ration of skin friction drag forces on the front and rear half part of the plate.

Q4. A 2mm diameter spherical metallic ball (specific weight 117.5 kN/m^3) is dropped in a large mass of fluid of viscosity 15 poise and specific gravity 0.95. Proceeding from first principles, make calculations for the drag force exerted by fluid on metallic ball, pressure drag and skin friction drag and the terminal velocity of ball in fluid.

Q5. State the Manning formula and the Bazin formula for the Chezy coefficient C. An irrigation canal of trapezoidal section has bed width of 3.5 m and bed slope of 1 in 1600. If the depth of flow is 1.5 m and the side slopes of the channel are 1 vertical to 2 horizontal, determine the average flow velocity and the discharge carried by the channel. Use Bazin formula with roughness factor K = 1.54. Also compute the average shear stress at the channel boundary.

Q6. Water is flowing in a stream which may be assumed rectangular in section with width 10 m and depth of water 1 m. The bed of channel slope is 1 in 2000 and this is constant for at least 2 km upstream. Taking Chezy constant C= 60 $m^{1/2}$ /s, calculate the steady flow in the channel. A dam is placed across the channel, increasing the depth at the dam to 2m. Determine, making reasonable approximations, the depth of flow at 500m upstream of the dam.

SECTION-C

Q7. For turbulent flow in a pipe of 25 cm diameter, the centre line velocity is 2.25 m/s and the velocity at a point 8 cm from the centre as measured by a pitot tube is 1.95 m/s. Make calculations for :

a) Friction velocity and wall shearing stress.
b) Average velocity and discharge through the pipe.
c) Friction factor and
d) Pipe roughness.

Q8. Determine the displacement thickness and momentum thickness in terms of the nominal boundary layer thickness δ in respect of the following velocity profiles in the boundary layer on a flat plate

a) $u/Uo = 2(y/\delta) - (y/\delta)^2$

b) $u/Uo = (y/\delta)^{1/m}$

Where u is the velocity at a height y above the surface and Uo is the free stream velocity.

Q9. A 3m wide rectangular channel conveys 7.5 m^3/s of water with a velocity of 5m/s. Is there a condition for hydraulic jump to occur? If so, calculate the height, length and strength of the jump. Also determine the loss of energy per kg of water.