Dr Raj Singh 22/11/2023 (80)

Roll No....................

National Institute of Technology Hamirpur (H.P.)-177005
Department of Civil Engineering
B.Tech, 3rd Semester
End Semester Theory Examination, Nov/Dec-2023

Course Name: Fluid Mechanics **Course Code: CE-212**
Duration: 3 Hours **Max. Marks: 50**

Instructions:

- Attempt all questions.
- Assume any other suitable data if required.

Q.1. A cube 50 cm side is inserted in a two-layer fluid with specific gravity 1.2 and 0.9 respectively. The upper and lower halves of the cube are composed of materials with specific gravity 0.6 and 1.4 respectively. What is the distance of the top of cube above interface? [07]

Q.2. A pipe 200 m long slopes down at 1 in 100 and tapers from 600 mm diameter at the higher end to 300 mm diameter at the lower end and carries 100 litres/sec of oil (sp. Gravity 0.8). If the pressure gauge at the higher end reads 60 kN/m^2, determine: (i) Velocities at the two ends; (ii) Pressure at the lower end. Neglect all losses. [07]

Q.3. A pipe 50 mm diameter is 6 m long and the velocity of flow of water in the pipe is 2.4 m/s. What loss of head and the corresponding power would be saved if the central 2 m length of pipe was replaced by 75 mm diameter pipe, the change of section being sudden? Take $f = 0.04$ for the pipes of both diameters. [07]

Q.4. An oil of viscosity 9 poise and specific gravity 0.9 is flowing through a horizontal pipe of 60 mm diameter. If the pressure drop in 100 m length of the pipe is 1800 kN/m^2, determine: (i) The rate of flow of oil (ii) The centerline velocity (iii) The total frictional drag over 100 m length (iv) The power required to maintain the flow (v) The velocity gradient at the pipe wall (vi) The velocity and shear stress at 8 mm from the wall. [07]

Q.5. The resisting force F of a plane during flight can be considered as dependent upon the length of aircraft l, velocity υ, air viscosity μ, air density ρ, and bulk modulus of air K. Express the functional relationship between these variables and the resisting force using dimensional analysis. Explain the physical meaning of the dimensionless groups. [07]

Q.6. What do you mean by 'Most-economical section' of an open channel? How is it determined? Determine the most economical section of a rectangular channel carrying water at the rate of 0.5 m^3/s; the bed slope of the channels being 1 in 2000. Take Chezy's constant $C = 50$. [07]

Q.7. Write short notes on: [08]

(i) Total Pressure and Centre of Pressure
(ii) Metacentre and Metacentric Height
(iii) Continuity Equation
(iv) Dimensional Homogeneity
(v) Prandtl's mixing length theory
(vi) Boundary layer thickness (δ)
(vii) Hydraulic Gradient and Total Energy Lines
(viii) Specific Energy and Specific Energy Curve

End of Paper