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Total number of printed pages – 6 **B. Tech**

CPCH 7202

Fourth Semester Examination – 2008

FLUID FLOW AND FLOW MEASUREMENT

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2 ×10

   (a) Define boundary layer thickness. At what condition boundary layer separation occurs.

   (b) Define drag coefficient and fanning's friction factor.

   (c) The SI unit of dynamic viscosity is _____ . Spherical shape of mercury is due to _____ .

   (d) For μ = 2.49 poise, specific gravity = 0.83, what is the value of kinamatic viscosity in stokes.

   (e) What are the assumptions made in the derivation of Bernoulli's equation ?

   (f) Differentiate between Froude number and Euler number.

   (g) For turbulent flow of Newtonian fluid in a pipe, pressure drop can be calculated by _____ and for laminar flow the value of momentum correction factor (β) is _____ .

   (h) Write Ergun's equation. Define porosity.

   (i) What is cavitation ?

   (j) Define piezometric head. Pitot tube is used for measuring _____ .

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2. (a) The pressure difference ΔP in a pipe of diameter D and length L due to turbulent flow depends on the velocity V, viscosity μ, density ρ and the roughness κ. Using Buckingham's π Theorem obtain an expression for ΔP. 5

(b) A thin plate moving in still atmospheric air at a velocity of 5 m/sec. The length of the plate is 0.6 m and width is 0.5 m. Calculate the thickness of the boundary layer at the end of the plate. Density of air =1.24 kg/m^3. Kinematic viscosity = 0.15 stokes. 5

3. (a) An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and length 300 m. The rate of flow of fluid through the pipe is 3.5 lit/sec. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. 5

(b) Differentiate between Orifice meter and Venturimeter. 5

4. (a) Define minimum fluidization velocity. Derive the equation for minimum fluidization velocity. What are the advantages and disadvantages of fluidization ? 5

(b) Define terminal velocity. Differentiate between free settling and hindered settling. 5

5. (a) A pipe of 7.5 cm i.d. is carrying water at 20 °C. In this pipe a venturimeter is fitted which has a throat diameter 2 cm. If the differential mercury manometer shows a reading of 50 cm, what is the flow rate of water in the pipe ? Assuming $C_d = 0.98$. 5

(b) What is the maximum diameter of a spherical particle of dust of density 2.5 gm/cc which will settle in the atmosphere (air

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density 1.225 × 10^{-3} gm/cc, kinematic viscosity 0.149 cm^2/sec) in good agreement with stokes law. 5

6. (a) Differentiate between fan, blower and compressor. 5

   (b) Derive shear stress distribution equation in a cylindrical tube. 5

7. (a) Carbon tetrachloride is to flow through a smooth horizontal circular tube of i.d. 3 cm at a volumetric flow rate of 2 lit/sec at 25 °C. Estimate the pressure loss per cm length of the tube density and viscosity of carbon tetrachloride are 1.54 gm/cc and 0.87 cp respectively. 5

   (b) Calculate the hydraulic mean diameter of the annular space between a 40 mm and a 50 mm tube. 5

8. Write short notes of following (any *two*) : 5×2

   (a) Centrifugal pump

   (b) Hydrostatic equilibrium.

   (c) Heat transfer in isothermal flow

   (d) Notches and Weir.

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