Code No: RR210801 **Set No.1**

II B.Tech. I Semester Supplementary Examinations, May -2005
FLUID MECHANICS
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The pressure drop 'Δ' in a pipe of diameter D and length l, depends on mass density μ of the flowing fluid, mean velocity of flow V and average height K of roughness projections on the pipe surface. Obtain a dimensionless expression for ΔP. Hence show that
   $h_f = f1V^2/2gd$ where h_f is the head loss due to friction $(\Delta P/w)$, w is the specific weight of the fluid and f is coefficient of friction

2. Explain the behavior of non Newtonian fluids with the help of plot and give examples.

3. (a) Differentiate between incompressible and compressible fluids. Give examples
   (b) Write the equations for fanning friction factor and Darcy's friction factor.
   (c) A fluid is flowing though a cylindrical pipe of radius 'R' explain the distribution of velocity and shear stress. What are the force which influences the system.

4. Water at 15^0C is to flow through 500 m of horizontal pipe at the rate of 454 lt/min. A head of 10 m is available. Calculate the pipe diameter if the friction factor is 0.0048.

5. Air enters a convergent divergent nozzle at a temperature of 555^0k and a pressure of 20 atm. The throat area is one half that o the discharge of the divergent section. Assuming the mach number in the throat is 0.8, what are the values of the following quantities at the throat : Pressure , temperature , linear velocity , density, and mass velocity.

6. (a) What are the different forces acting on the particle moving through the fluid.
   (b) Define terminal velocity. Derive the equation for terminal velocity for gravitational settling.

7. Solid particles having a size of 0.2 mm, sphericity is 0.8 and a density of $1000kg/m^3$are to be fluidized using air at 2.5 atm abs and 25^0C. The voidage at minimum fluidization conditions is 0.42. If the cross section of the empty bed is 0.36 m^2 and the bed contains 400 kg of solid , calculate the pressure drop at minimum fluidization conditions.

8. Water flows through an orifice of 25 mm diameter situated in a 75 mm pipe at the rate of 300 cc/sec. What will be the difference in level in a water manometer connected across the meter? Given coefficient of discharge, $C_0 = 0.61$, viscosity of water=1 mNs/m^2.

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1. (a) Define fluid mechanics. Classify fluid mechanics and explain each field.
   (b) Differentiate between static pressure and dynamic pressure.
   (c) What do you understand by barometric pressure, absolute pressure, gauge pressure and vacuum

2. Derive the Bernoulli's equation for a frictional fluid being pumped from a point a to an elevated point B.

3. A small capillary with an inside diameter of 2.22×10^{-3} m and a length 0.317 m is being used to continuously measure the flow rate of a liquid having a density of 875 kg/m^3 and viscosity of 1.13×10^{-3} Pa s. The pressure drop reading across the capillary during flow is 0.0655 m water of density 996 kg/m^3. What is the flow rate in m^3/s if end effect corrections are neglected.

4. A pump delivers water from a holding tank at atmospheric pressure to a process equipment at 450 kpa at a flow rate of 6.2 lt/s. The process equipment is located 10 m higher than the holding tank. Calculate the power requirement for the pump if its efficiency is 70% , the fluid friction and the changes in kinetic energy are negligible. Take density of water as 995 kg/m^3.

5. (a) Define mach number and explain its significance.
   (b) What do you mean by sonic, subsonic and super sonic flow.
   (c) How is the mach number important in establishing the relation between the velocity and the area of cross section for flow through nozzles.

6. Particles of 0.0025 cm diameter rotated in a water suspension by the centrifugal action. The speed of the centrifuge is 600 rpm. The inside diameter of the rotating liquid is 12.5 cm and the out side diameter is 26 cm. Assuming that the particles are at terminal velocity at all times corresponding to location, calculate the time required to separate the particles. Given the density of the particles as 1105 kg/m^3 and that of water is 910 kg/m^3.

7. What are the differences between the particulate and aggregative fluidization. Write atleast five applications of fluidization.

8. Water flows through an orifice of 25 mm diameter situated in a 75 mm pipe at the rate of 300 cc/sec. What will be the difference in level in a water manometer connected across the meter? Given coefficient of discharge, $C_0 = 0.61$, viscosity of water=1 mNs/m^2.

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Code No: RR210801 **Set No.3**

II B.Tech. I Semester Supplementary Examinations, May -2005
FLUID MECHANICS
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define fluid mechanics. Classify fluid mechanics and explain each field.
   (b) Differentiate between static pressure and dynamic pressure.
   (c) What do you understand by barometric pressure, absolute pressure, gauge pressure and vacuum
2. Explain the behavior of non Newtonian fluids with the help of plot and give examples.
3. Prove that the velocity profile of a Newton fluid flowing in laminar flow through a pipe of circular cross section is parabolic.
4. Under conditions of laminar flow , the friction factor is given by 16/ Nre .Derive an expression for the pressure drop per unit length in terms of the pipe diameter, 'd', the average velocity 'u', the density and the viscosity of the fluid.
5. (a) Define mach number and explain its significance.
   (b) What do you mean by sonic, subsonic and super sonic flow.
   (c) How is the mach number important in establishing the relation between the velocity and the area of cross section for flow through nozzles.
6. What is terminal velocity. Derive the equation for terminal velocity under the influence of centrifugal field.
7. Particles having a size of 0.1mm , a shape factor of 0.86 and a density of 1200 kg/m^3 are to be fluidized using air at 25^0C and 202.65kPa abs pressure. The void fraction at minimum fluidizing conditions is 0.43. The bed diameter is 0.6 m and the bed contains 350 kg of solids, Calculate the minimum height of the fluidized bed and pressure drop at minimum fluidization conditions.
8. Explain the principle of operation of the pitot tube and indicate how it can be used in order to measure the total flow rate of fluid in a duct. If a pitot tube is inserted in a pipe of circular cross section in which the fluid is in a stream line flow. Calculate at what point in the cross section it should be inserted so as to give direct reading of the mean velocity of the flow of fluid.

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II B.Tech. I Semester Supplementary Examinations, May -2005
FLUID MECHANICS
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) What is the importance of dimensional analysis?
   (b) Outline the procedure for Rayleigh's method and Buckingham method used in dimension analysis.
2. Define Newton's law of viscosity. Explain the effect of temperature and pressure on viscosity of liquids.
3. (a) Differentiate between incompressible and compressible fluids. Give examples
   (b) Write the equations for fanning friction factor and Darcy's friction factor.
   (c) A fluid is flowing though a cylindrical pipe of radius 'R' explain the distribution of velocity and shear stress. What are the force which influences the system.
4. Carbontetra chloride is to flow through a smooth horizontal circular tube of inner diameter 3cm with a volumetric flow rate of 2 lt /s. at 25^0C. Estimate the pressure loss per cm length of the pipe. Density and viscosity are 1.54g/cc and 0.87 cp respectively.
5. What is the critical pressure for flow through nozzles."A converging nozzle can discharge a fluid at constant flow rate to a region of variable pressure independent of the down stream pressure", Explain.
6. A gas flows in a conduit vertically a t a velocity of 20 cm/s .What is the maximum particle size of density, 1.2 g/cc, that may be carried by it? Gas density is given as 1.15×10^{-3} and the viscosity is given as 2.25×10^{-5} Pa s. Assume Stroke's law region and Check for the validity of Stoke's law.
7. To clean a sand bed filter, it is fluidized at minimum conditions using water at 24^0C the sharp sand particles have density of 2550 kg/m^3 and an average size of 0.2mm. The sand has the following properties: Sphericity= 0.67; void fraction = 0.49. The diameter is 0.4 m and desired height of the bed at these minimum fluidizing conditions is 1.75m, calculate the pressure drop at these conditions and the minimum velocity for fluidization.
8. A pitot tube is used to measure the flow rate of water at 20^0C in the center of a pipe having an inside diameter of 102.3 mm .The manometer reading is 78 mm of carbon tetra chloride at 20^0C. The pitot tube coefficient is 0.98. Calculate the velocity and volumetric flow rate .The density of water is 1 gm/cc and that of carbon tetrachloride is 1.6 gm/cc

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