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

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

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Assuming that the rate of discharging of a centrifugal pump is dependent upon the mass density r of fluid, pump speed N(rpm) the diameter of the impeller D, the pressure P and the viscosity of fluid μ, show using Buckingham's Π- Theorem that it can be represented by $Q = (ND^3)\phi[(gH/N^2D^2), (v/ND^2)$
   Where H= Head and v= Kinematic viscosity of the fluid. [16]

2. (a) Define Newton's law of viscosity. Explain the effect of temperature and pressure on viscosity of liquids. [10]
   (b) Differentiate Laminar and Turbalent flow. [6]

3. (a) Define fanning friction factor and Darcy's friction factor. [6]
   (b) Show that the velocity distribution of an incompressible fluid flowing through the pipe is $[\tau_w g_c(r_w^2 - r^2)]/(2r_w\mu)$. [10]

4. Glycerine of density 1250 kg/m^3 and viscosity of 0.72 kg/ms flows through a pipe of 80 mm diameter . If the shear stress at the wall is 300 N/m^2 , Calculate the pressure gradient along the flow , the average velocity in the pipe , the ratio of discharge and the Reynold's number. [16]

5. Show that the maximum fluid velocity attainable for flow through a pipe of uniform cross section is equal to the sonic velocity. [16]

6. Calculate the different settling velocities for spherical quartz particles of follwing diameter: 100, 400, 600, 900 m. settling at water at 20^0C .
   Data: Density of quartz = 2650 kg/m3
   Density of water: 1000 kg/m^3
   Viscosity of water = 1cp
   Show graphically how the settling velocity changes with the variation of particles diameter. [16]

7. Calculate the minimum fluidization velocity from the given data: porosity = 0.4; particle diameter = 1.25mm(spherical); density difference between the particle and the fluid = 250 kg/m^3 and the viscosity of the fluid is 0.001 kg/ m s. [16]

8. A sharp edged orifice is connected to a manometer for measuring the flow rate of brine of specific gravity 1.2 flowing through a 7.5 cm ID pipe. The maximum flow rate is not to exceed 750 lt/min. Manometer reading is 400 mm Hg .The manometer reading is 400mm Hg. Calculate the size of the orifice. [16]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: RR210801 **Set No.2**

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

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Determine the dimensionless groups formed from the variables involved in the flow of fluid external to a solid body. The force exerted on the body is a function of v, l, U, and L. [16]

2. Derive the three dimensional equation of continuity. [16]

3. (a) Define fanning friction factor and Darcy's friction factor. [6]
   (b) Show that the velocity distribution of an incompressible fluid flowing through the pipe is $[\tau_w g_c(r_w^2 - r^2)]/(2r_w\mu)$. [10]

4. An oil of specific gravity 0.85 and 1.7 cp viscosity is flowing through a smooth pipe of 150 mm diameter at the rate of 20 lt/min. Determine whether the flow is laminar or turbulent. Calculate pressure drop for 100 m length of the pipe. [16]

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. [4+6+6]

6. Urea pellets are made by spraying drops of molten urea into cold gas at the top of a tall tower and allowing the material to solidify as it falls. Pellets of 6mm in diameter are to be made in a tower 25m high containing air at 20^0C . The density of urea is 1330 kg/m^3. Density of air at 20^0C is 1.02 kg/m^3. What would be the terminal velocity of the pellets, assuming free settling conditions. [16]

7. (a) What are the differences between the particulate and aggregative fluidization. Write atleast five applications of fluidization.
   (b) What are the advantages and disadvantages of fluidization. [6+10]

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. [16]

⋆ ⋆ ⋆ ⋆ ⋆

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

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

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Assuming that the rate of discharging of a centrifugal pump is dependent upon the mass density r of fluid, pump speed N(rpm) the diameter of the impeller D, the pressure P and the viscosity of fluid μ, show using Buckingham's Π- Theorem that it can be represented by $Q = (ND^3)\phi[(gH/N^2D^2), (v/ND^2)$
Where H= Head and v= Kinematic viscosity of the fluid. [16]

2. (a) Describe the process of Boundary layer formation, also descirbe the process of Boundary layer separation [10]
   (b) Define the terms fully developed flow and transition length. [6]

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+4+8]

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. [16]

5. Derive the equation of energy for compressible fluid flow for adiabatic process.

   [16]

6. A particle of 0.01 cm diameter and 2.4 gm/cc at a Reynold's number of 0.1 . What is the viscosity of the oil and the terminal settling velocity at this Reynold's number.

   [16]

7. Explain the conditions for fluidization with the help of a sketch. [16]

8. Water flowing at $1500cm^3/sec$ in a 50mm diameter pipe is metered by means of a simple orifice of diameter 25mm. If the coefficient of discharge of the meter is 0.62, what will be the reading on a mercury manometer connected to the meter. What is the Reynold's number for the flow in the pipe. Density of water is $1000kg/m^3$ viscosity of water=$1mNs/m^2$. [16]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: RR210801 **Set No.4**

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

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Derive the condition for hydrostatic equilibrium and deduce the barometric equation. [10]
   (b) What are the required characteristics of the manometric fluid. [6]

2. In a natural gas pipe line at station 1, the pipe diameter is 0.61m and the velocity is 15m/s and the density is 39 kg/m^3. At station 2, the pipe diameter is 0.914m and the density is $24kg/m^3$. Calculate the velocity at station 2 and the mass flow rate. [16]

3. An incompressible fluid is flowing through a horizontal cylindrical pipe of radius r_w, show that the shear stress distribution is $[\tau_w/r_w] = [\tau/w]$. [16]

4. An oil of specific gravity 0.85 and 1.7 cp viscosity is flowing through a smooth pipe of 150 mm diameter at the rate of 20 lt/min. Determine whether the flow is laminar or turbulent. Calculate pressure drop for 100 m length of the pipe. [16]

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. [16]

6. What is the drag on a 0.012 m diameter sphere that drops at a rate of 0.08m/s in and oil of viscosity $0.1Ns/m^2$ and a specific gravity of 0.85. Assume the drag coefficient to be 5.3. [16]

7. Spherical particles of 1 mm in diameter are to be fluidized with water . The minimum porosity is 0.4 and density of particles is 1.5 g/cm^3. Density and viscosity of water are $1g/cm^3$ and 0.001 kg/m s. Calculate the minimum fluidization velocity.]

   [16]

8. A venture meter of 2 cm throat diameter is connected to a pipe carrying water of 7.5 cm ID. The manometer reading is 50 cm. What is the flow rate of water in the pipe and venture coefficient is 0.98. Density of water is 1000 kg/m . [16]

⋆ ⋆ ⋆ ⋆ ⋆