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

II B.Tech I Semester Supplementary Examinations, November 2006
FLUID MECHANICS
(Chemical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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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. An incompressible fluid flows steadily through two pipes of diameter 0.15m and 0.2m which combine to discharge in a pipe of 0.3 diameter. If the average velocities in the 0.15m and 0.2m dia. Pipes are 2m/s and 3m/s respectively, find the average velocity in the 0.3m diameter pipe. [16]

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. [16]

4. The maximum velocity is measured as 3 m/s in a 0.1 m diameter tube. If the fluid flowing has a density of 1260 kg/m^3 and a viscosity of 0.9 Ns/m^2 , determine whether the flow is laminar or turbulent and determine the pressure gradient. [16]

5. Carbondioxide at one bar and 300^0K is to be compressed to a pressure of 10 bar in a single stage compressor at a rate of 100 m^3/h. Assuming that the carbondioxide behaves as an ideal gas, calculate the temperature of the gas after compression and the work required. Take $C_p/C_v = 1.3$. [16]

6. Derive the expression for the terminal velocity of the spherical particles in the Stroke's law region. [16]

7. What is Pneumatic conveying. Explain. [16]

8. A pitot tube having a coefficient of 0.95 is inserted in the central line of a long pipe of 250mm diameter in which crude oil of density 0.9 gm/cc and viscosity 16.3 cp is flowing. Calculate the maximum velocity of the oil in the pipe if the differential pressure in the manometer is 5cm of water. [16]

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

II B.Tech I Semester Supplementary Examinations, November 2006
FLUID MECHANICS
(Chemical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the function of a two fluid manometer and derive the equation for pressure drop. [16]

2. An incompressible fluid flows steadily through two pipes of diameter 0.15m and 0.2m which combine to discharge in a pipe of 0.3 diameter. If the average velocities in the 0.15m and 0.2m dia. Pipes are 2m/s and 3m/s respectively, find the average velocity in the 0.3m diameter pipe. [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. (a) Define hydraulic radius and equivalent diameter. Why equivalent diameter is calculated? [8]
   (b) Calculate the hydraulic radius for a circular tube and for an annular flow between two concentric pipes. [8]

5. Derive the equation of energy for compressible fluid flow for adiabatic process. [16]

6. (a) Define drag force
   (b) Define drag coefficient and write the expression to calculate drag coefficient.
   (c) Explain frictional drag, deformation drag and form drag. [4+6+6]

7. What are the types of fluidization. Write the equations used to calculate pressure drop in fluidized beds. [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]

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

II B.Tech I Semester Supplementary Examinations, November 2006
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) Differentiate among manometers and mechanical gauges and give examples for each. [6]
   (b) Derive the equation for differential U-Tube manometer, ignoring the reservoir and tube areas. [10]
2. Water is flowing in a pipe. At point 1, the inside diameter is 0.25m and the velocity is 2m/s. Calculate the mass flow rate, volumetric flow rate and the mass velocity. What is the velocity at point 2, where the inside diameter is 0.125m. [16]
3. Derive Hagen Poiseuille equation. [16]
4. Compute the head loss per kilo meter length of the pipe designed to carry oil of specific gravity 0.85 and kinematic viscosity $0.6 \times 10^{-3} m^2/s$ in a 15 cm diameter pipe at a rate of 0.03 m^3/s. [16]
5. Saturated steam at 100 kpa is compressed adiabatically to 500 kpa . The compression efficiency is 80%. Determine the work required to run the compressor and the temperature of the exhaust steam. The steam is entering the compressor at a temperature of $372.8^0 k$,an enthalpy of 2675 kJ/kg and entropy is $7.3594 kJ/kg^0 k$. [16]
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. [6+10]
7. Write short notes on the following :
   (a) Particulate fluidization
   (b) Bubbling fluidization
   (c) Spouted bed fluidization
   (d) Slugging. [4+4+4+4]
8. It is desired to use 28.32 m^3/min of air (metered at a pressure of 101.3 kPa and 294.1K) in a process. This amount of air, which is at rest, enters the fan suction at a pressure of 741.7 mm Hg and a temperature of 366.3K and is discharged at a pressure of 769.6 mm Hg and a velocity of 45.7 m/s. A centrifugal fan having a fan efficiency of 60% is to be used. Calculate the brake-kW power needed. [16]

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

II B.Tech I Semester Supplementary Examinations, November 2006
FLUID MECHANICS
(Chemical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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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 Bernoulli's equation for a frictional fluid being pumped from a point a to an elevated point B. [16]

3. Prove that the kinetic energy correction factor,$\alpha = \int u^3 ds/v^3 S$, where u is the local velocity; 'S' is the cross sectional area and 'V' is the average velocity. [16]

4. (a) Define hydraulic radius and equivalent diameter. Why equivalent diameter is calculated? [8]
   (b) Calculate the hydraulic radius for a circular tube and for an annular flow between two concentric pipes. [8]

5. Air enters a convergent divergent nozzle at a temperature of $555^0 k$ 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. Derive the expression for the terminal velocity of the spherical particles in the Stroke's law region. [16]

7. Write short notes on the following :
   (a) Particulate fluidization
   (b) Bubbling fluidization
   (c) Spouted bed fluidization
   (d) Slugging. [4+4+4+4]

8. A pitot tube with a discharge coefficient of 0.9, is connected to manometer containing water. A light oil with specific gravity of 0.8 is flowing through a pipe line of 8 cm ID. When the pitot tube is kept at the center of the pipe, the manometer reads 9 cm. Calculate the flow rate of oil if the average velocity is 80% of the maximum. [16]

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