Code No: R050210801 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2006
FLUID MECHANICS FOR CHEMICAL ENGINEERING
(Chemical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Prove that , for static fluid, pressure turns out to be independent of the orientation of any internal surface on which the pressure is assumed to act, ($P = P_x = P_y = P_z$). [16]

2. (a) A 20 cm dia pipe divides into a 15cm branch and a 10 cm branch. If the total flow is 0.5 m^3/sec and if the same average velocity occurs in each branch, What is the discharge rate in each branch.
   (b) write notes on "Reynold Stress" and "Eddy viscosity". [10+6]

3. (a) Define 'Equivalent diameter' for fluid flow through ducts of noncircular diameter.
   (b) Calculate the hydraulic mean diameter of the annular space between a 4 cm and 6 cm tubes.
   (c) Draw velocity profile for laminar flow in a circular pipe. [5+5+6]

4. (a) Define the terms Mach number and sonic velocity.
   (b) Explain about convergent -divergent nozzle. [8+8]

5. Give a short notes on:
   (a) Drag Coefficient
   (b) Superficial Velocity
   (c) Sphericity
   (d) Criteria for settling regime. [16]

6. (a) Discuss about various types of fluidization.
   (b) Explain the phenomena of fluidization with the help of a neat sketch. [8+8]

7. (a) A centrifugal pump with an efficiency of 65% is driven by an electric motor with an efficiency of 90%. The pump delivers 250 kg of water per minute against a total head of 25m. What is the work accomplished by the pump? What is the power delivered by the motor to the pump, and what is the power taken by the motor? ρ_{water}= 1000kg/m^3.
   (b) For an ideal centrifugal pump, if the rpm is doubled, what is the effect on capacity of the pump, head developed, and power consumed? [10+6]

8. (a) Describe the working of a magnetic flow meter.

(b) Explain the working of a reciprocating pump with the help of neat sketch. [6+10]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: R050210801 **Set No. 2**

II B.Tech I Semester Regular Examinations, November 2006
FLUID MECHANICS FOR CHEMICAL ENGINEERING
(Chemical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Derive an expression for the estimation of pressure drop in a centrifuge.
   (b) A centrifuge bowl 250-mm ID (internal diameter) is turning at 4000 r/min. It contains a layer of chlorobenzene 50 mm thick. If the density of the chlorobenzene is 1109 kg/m^3 and the pressure at the liquid surface is atmospheric, what gauge pressure is exerted on the wall of the centrifuge bowl? [8+8]

2. Water at 20°C is pumped at a constant rate of 9 m^3/h from a large reservoir resting on the floor to the open top of an experimental absorption tower. The point of discharge is 5 m above the floor and frictional losses in the 50mm pipe from the reservoir to the tower amount to 2.5 J/kg. At what height in the reservoir must the water level to be kept if the pump can develop only 0.1kW. [16]

3. (a) Define 'Equivalent diameter' for fluid flow through ducts of noncircular diameter.
   (b) Calculate the hydraulic mean diameter of the annular space between a 4 cm and 6 cm tubes.
   (c) Draw velocity profile for laminar flow in a circular pipe. [5+5+6]

4. (a) Derive an expression for area velocity relationship for a compressible fluid.
   (b) An air plane is flying at a Mach number of 0.65 at an altitude where the temperature is -40^0C. Determine the velocity of the air plane at this altitude. (γ_{air}= 1.4, R = 287J/kg − m − K). [10+6]

5. (a) Explain about Drag and Drag Coefficient.
   (b) Air at 37.8^{0}C and 101.3 KPa abs pressure flows past a sphere having a diameter of 42mm at a velocity of 23m/s.What is the force on the sphere? (μ_{mair}= 1.90× 10^{-5}pa − sec, CD = 0.47at$\text{N}_{\text{Re,p,}}6 \times 10^4$). [10+6]

6. (a) Discuss about various types of fluidization.
   (b) Explain the phenomena of fluidization with the help of a neat sketch. [8+8]

7. Describe the following with the help of neat sketches.
   (a) swing check valve
   (b) simple stuffing box
   (c) liquid flow through a centrifugal pump
   (d) efficiency curve for an ideal and actual centrifugal pump. [4+4+4+4]

8. A single stage compressor is to compress 7.56x10^{-3} kg mol/s of methane gas at 26.7°C and 137.9 kPa, abs to 551.6 kPa abs. Υ= 1.31 for methane.

   (a) Calculate the power required if the mechanical efficiency is 80% and the compression is adiabatic.

   (b) Calculate the same for isothermal compression. [16]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: R050210801 **Set No. 3**

II B.Tech I Semester Regular Examinations, November 2006
FLUID MECHANICS FOR CHEMICAL ENGINEERING
(Chemical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Write short notes on the following:
   (a) Simple manometer
   (b) inclined manometer
   (c) gauge pressure
   (d) Absolute pressure
   (e) vacuum. [5+5+2+2+2]

2. (a) A 20 cm dia pipe divides into a 15cm branch and a 10 cm branch. If the total flow is 0.5 m^3/sec and if the same average velocity occurs in each branch, What is the discharge rate in each branch.
   (b) write notes on "Reynold Stress" and "Eddy viscosity". [10+6]

3. (a) Define Fanning's friction factor. How is it related to the pressure drop?
   (b) Prove for laminar flow of Newtonian fluids through a pipe, $u/u_{max} = 1 - (r/r_w)^2$. [8+8]

4. Methane gas is being pumped through a 305m length of 52.5mm diameter steel pipe at a rate of 41 kg/m^2s. The inlet pressure is 345kPa abs. Assume isothermal flow at 288.8K. ($\mu_{methane} = 1.045 \times 10^{-5} pa - sec, f = 0.0014$). Calculate the pressure at the end of the pipe. [16]

5. Discuss in detail the determination of pressure drop for flow through bed of solids. [16]

6. What is meant by fluidization? Explain the phenomena of fluidization. Give the advantage and disadvantages of fluidization. [16]

7. (a) Draw the characteristic curves for a centrifugal pump and explain them.
   (b) Describe the purpose of employing multistage centrifugal pumps. [12+4]

8. (a) What is venacontracta? Why is it formed?
   (b) Orifice coefficients are more empirical than those for venturi. Explain. [6+10]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: R050210801 **Set No. 4**

II B.Tech I Semester Regular Examinations, November 2006
FLUID MECHANICS FOR CHEMICAL ENGINEERING
(Chemical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. A continuous gravity decanter is to separate chlorobenzene, with a density of 1109 kg/m^3, from an aqueous wash liquid having a density of 1020 kg/m^3. If the total depth in the separator is 1 m and the interface is to be 0.6 m from the vessel floor,
   (a) what should the height of the heavy-liquid overflow leg be;
   (b) how much would an error of 50 mm in this height affect the position of the interface? [10+6]

2. Define the following:
   (a) Steady and Unsteady flow
   (b) Uniform and Non-Uniform flow
   (c) Laminar and Turbulent flow
   (d) Stream lines and stream tube. [4+4+4+4]

3. (a) Define 'Equivalent diameter' for fluid flow through ducts of noncircular diameter.
   (b) Calculate the hydraulic mean diameter of the annular space between a 4 cm and 6 cm tubes.
   (c) Draw velocity profile for laminar flow in a circular pipe. [5+5+6]

4. (a) What is a compressible fluid? Differentiate between compressible fluid and incompressible fluid.
   (b) Discuss about maximum attainable velocity in isothermal flow. [10+6]

5. (a) Calculate the terminal settling velocity of dust particles having a diameter of $60\mu m$ in air at 294.3K and 101.32KPa.The dust particles can be considered spherical with a density of 1280Kg/m^3. (μ_{air}= 1.78×10^{-5}pa.sec)
   (b) Describe in detail about free settling and hindered settling. [6+10]

6. (a) Explain about pressure drop in fluidized bed.
   (b) A bed of diameter 0.60m contains 350Kg of solid particles diameter 0.10mm, shape factor of 0.86 and a density of 1200Kg/m^3. They are to be fluidized using air at25^0C and 202.65kPa abs pressure. The minimum velocity is 0.004374m/s.Estimate the porosity of the bed, when the velocity is 4.0 times the minimum fluidizing velocity. (μ_{air}= 1.845×10^{-5}pa $-$ sec). [8+8]

7. Discuss the working, merits and demerits of any four common types of valves used in process industry. [16]

8. (a) Explain the construction of an orifice meter with a neat sketch.
   (b) Discuss the pressure recovery in an orifice meter and venturi meter. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆