R09

II B.Tech I Semester Examinations, MAY 2011 PROCESS ENGINEERING PRINCIPLES **Bio-Technology**

Time: 3 hours

Code No: A109212303

Max Marks: 75

4 + 4 + 4 + 3

[7+8]

[15]

Answer any FIVE Questions All Questions carry equal marks *****

1. Write short notes on :

- (a) Streamlines
- (b) Streamtubes
- (c) Potential flow
- (d) Fully developed flow.
- 2. (a) Differentiate between pitot tube and venturi meter.
 - (b) Explain the stuffing box and Mechanical seal.
- 3. By taking an example Discuss the various unit operations you encounter in the bioprocess industry. $\left[15\right]$
- 4. What is the relation between c_p and c_v derive it?
- 5. The following rheological data were obtained with a fermentation broth in the very initial stages of fermentation. Find out whether the fluid is Newtonian or non-Newtonian. If it a Newtonian fluid, find the rheological constants. It is a Newtonian fluid, find the viscosity of the fluid. [15]Rheological data:

$\frac{d\mu}{d\gamma}(\sec^{-1})$	5	10	15	20	32	50
$T(N/m^2)$	1×10^{-2}	2.1×10^{-2}	2.96×10^{-2}	4.1×10^{-2}	6.2×10^{-2}	0.1

- 6. Write briefly on the following :
 - (a) Friction factor chart
 - (b) Velocity distribution in laminar flow
 - (c) Velocity distribution in turbulent flow
 - (d) Indicate the difference between skin friction and form friction. |3+4+4+4|
- 7. Catalyst pellets 5mm in diameter are to be fluidized with 45000 kg/h of air at 1atm and 800C in a vertical cylindrical vessel. The density of the catalyst particles is 960 kg/m³ their sphericity is 0.86. If the given quantity of air is just sufficient to fluidize the solids, what is the vessel diameter? $\left[15\right]$
- 8. (a) Draw the characteristic curves for a centrifugal pump.
 - (b) What is a positive displacement pump? Describe the working of any one type with neat sketch. [7+8]

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- 1. Explain drag and drag coefficient giving all equations and relations. [15]
- 2. (a) An open tank contains 5.7 m of water covered with 2.8 m of kerosene ($\rho = 8.0$ kN/m^3). Find the pressure at the interface and at the bottom of the tank.
 - (b) If air had a constant specific weight of 0.076 lb/ft^3 and were incompressible, what would be the height of the atmosphere if sea level pressure were 14.92psia. [8+7]
- 3. With a neat diagram derive an equation to measure the mass flow rate using the Rotameter? $\left[15\right]$
- 4. The capillary tube of diameter 2 mm and length 100mm is used for measuring viscosity of liquid. The difference of pressure between the two ends of the tube is 0.6867 N/cm^2 and the viscosity of the liquids is 0.25 poise. Find the rate of flow of the fluid through the tube [15]
- 5. (a) What is Mach number, Subsonic and supersonic?
 - (b) Derive equation for Mach number of an ideal gas in terms of its acoustic velocity. [10+5]
- 6. (a) Define and explain briefly volumetric efficiency?
 - (b) Write the working procedure of peristaltic pumps. [5+10]
- 7. (a) What is momentum balance equation? Explain about the driving force for momeutum balance.
 - (b) Why heat transfer take place from one point to the another point? Explain. [8+7]
- 8. (a) Explain how ideal gas law is used to evaluate PVT data.
 - (b) Define "Force" [11+4]

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- 1. Sulfuric acid is pumped at 3 kg/sec through a pipeline of 25 mm diameter and 60 m length. Calculate the drop in pressure. If the pressure drop falls one half, what will be the new flow rate? [15]2. What are the applications of fluidization? Explain. [15]3. Explain in detail about the unit operation and unit processes. [15]4. (a) How does a U-tube manometer function? Derive an expression for $(P_1 - P_2)$ in terms of measurable quantities. (b) What are the importance of check valves in process industries and explain its working? [7+8]5. Discuss about the compressibility factor for ideal gas. [15]6. Derive the relations between skin friction, Wall shear, Pressure drop and friction factor and give the equations? Explain the terms involved in it. $\left[15\right]$ 7. (a) Describe the working of an Airlift pump and explain on what factors its efficiency dependent. (b) Write short notes on Selection of pumps for handling of liquids. [7+8]8. Write short notes on (a) Newton's law of Viscosity
 - (b) Power law of fluids
 - (c) Effect of temperature on viscosity. [5+5+5]

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- (a) Differentiate between venture and orifice meters. 1.
 - (b) Explain how pressure is recovered in the both meters? Explain. |7+8|
- 2. 6 liters per min. of volume are flowing through a pipe of 1.2 cm I.D. pipe. If the density of volume is 0.87 gm/cm^3 . calculate
 - (a) Volumetric flow rate cm^3 / sec
 - (b) Mass flow rate gm / sec
 - (c) Average velocity cm / sec and
 - (d) Mass velocity $gm / sec cm^2$.
- 3. For turbulent flow in packed beds derive the pressure drop equation with suitable assumptions? 15
- 4. Discuss in detail about the virial equations of state and virial coefficients. [15]
- 5. Write in detail about the various unit operations that are widely used in biotech industry. $\left[15\right]$
- 6. An oil of density 917 kg/m³ is being pumped in a pipe of diameter 15cm. The discharge is measured as 850L/min. The drop in the pressure in a stretch of 800m pipe line, both end of which are at the same elevation, is measured as 95kPa.Estimate the absolute viscosity of oil. 15
- 7. Find an expression for eddy viscosity from the formula for the logarithmic velocity profile in the turbulent core. Is the quantity, a function of R_e or position? [15]
- 8. It is proposed to pump 10,000kg/hr of toluene at 1140C and 1.1 atm absolute pressure from the re-boiler of a distillation tower to a second distillation unit without cooling the toluene before it enters the pump. If the friction loss in the line between reboiler and pump is 7kN/m^2 and the density of toluene is 866kg/m^3 , how far above the pump must the liquid level in the reboiler be maintained to give a net positive suction head of 2.5m? [15]
