Code: R7102306

R07

B. Tech I Year (R07) Supplementary Examinations, May 2012
PROCESS ENGINEERING PRINCIPLES
(Biotechnology)

Time: 3 hours   Max Marks: 80

Answer any FIVE questions
All questions carry equal marks
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1 (a) Define unit operations and unit processes, giving examples from field of biotechnology.
   (b) Give any four applications of momentum transfer in bioprocessing.

2 (a) What are standard conditions? State ideal gas law and give the range of its applicability.
   (b) Calculate the average molecular weight of a gas having the following composition by volume. CO_2 13.1 O_2 7.7 and rest N_2.

3 (a) Write mechanical energy balance for fluid flow through pipes and derive the Bernoulli's equation. State the assumptions made.
   (b) A pump draws a solution of specific gravity 1.5 from a storage tank through a 75 mm schedule 40 steel pipe. The efficiency of the pump is 70 percent. The velocity in the suction line is 0.9 m/s. The pump discharges through a 50 mm schedule 40 pipe to an overhead tank. The end of the discharge pipe is 24 m above the level of the solution in the feed tank. Friction losses in the entire piping are 24 J/kg. What pressure must the pump develop? What is the power delivered to the fluid by the pump? The cross sectional areas of 75 mm and 50 mm pipes are 4765 mm^2 and 2165 mm^2.

4 (a) Discuss different types of time independent non Newtonian fluids with examples.
   (b) Write about the construction and working principle of any one viscometer with the help of a schematic diagram.

5 (a) What are skin and form frictions? Write the pressure drop equations for skin and form frictions.
   (b) Discuss friction factor chart with the help of schematic diagram. Give its applications.

6 (a) Obtain the expression for the terminal velocity of a single particle assuming Stoke's law to be valid.
   (b) Air at 37.8 ºC and 101.3 kPa absolute pressure flows past a sphere having a diameter of 42 mm at a velocity of 23 m/s. What are the drag coefficient and the force on the sphere? Properties of air at 37.8 ºC:
        $\mu = 1.9 \times 10^{-5}$ Pa.s.
        $\rho = 1.137$ kg/m^3.

7 (a) Describe the construction and working of a rotameter with the help of a schematic diagram.
   (b) A heavy oil at 20 ºC having a density of 900 kg/m^3 and a viscosity of 6 cp is flowing in a 4 inch schedule 40 steel pipe (OD 114.3 m, wall thickness 6.02 mm). When the flow rate is 0.0174 m^3/s, it is desired to have a pressure drop reading across the manometer equivalent to 0.93 $\times 10^5$ Pa? What size orifice should be used if the orifice coefficient is assumed as 0.61? What is the permanent pressure loss?

8 (a) What are characteristic curves? Explain them with the help of a schematic diagram. Give the applications of the curves in bioprocessing.
   (b) Write short notes on:
        (i) Diaphragm pumps.   (ii) Reciprocating pumps.
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