Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. BIOTECHNOLOGY
END SEMESTER EXAMINATION, NOV/DEC 2017
SUBJECT: **SEPARATION TECHNIQUES IN BIOTECHNOLOGY[BIO3103]**
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. 400 k mole/h of a feed gas mixture is subjected to gas absorption by fresh solvent in a tray column containing 10 trays (equilibrium). The equilibrium relationship is Y=0.45X where X and Y are mole ratios in liquid and gas respectively, with usual notations. Feed gas contains 8% (mole) of the solute, and it is desired to remove 90% of the solute from the feed. **2**

(i) Plot equilibrium line and operating line **2**

(ii) Determine the liquid rate to the column, and **1**

(iii) Determine composition of the liquid and gas leaving 7^{th} tray (from bottom).

1B. The following is the X_m (g-water/g-dry solid) vs. t (min) data for convective drying of a biological solid by blowing air at 70^0C. **5**

t	0	10	20	30	40	50	60	70	80	90	100	120	140	160
X_m,	0.19	0.176	0.153	0.13	0.107	0.084	0.064	0.050	0.039	0.031	0.026	0.018	0.014	0.012

Convert the data into rate of drying (g-water/g-dry solid.min) and plot rate (Y axis) vs moisture X_m(X-axis).
Use central difference method to calculate rate.

2 The below table is the weight % of methanol in water vs. enthalpy data at 1 atm pressure. H_V and H_L are the enthalpies of vapour and liquid.

H_V cal/gm	625	525	460	420	385	350	320	295
Weight % in vapour	0	30	48	63	73	83	90	100
H_L cal/gm	100	95	85	80	40	50	50	49
Weight % in liquid	0	5	14	23	37	54	75	100

<table>
<tr><td>2.</td><td>(i) Convert the data to mole fractions (x-y) and plot, provide specimen calculation for one set of data.
(ii) Plot H-xy with tie- lines (keep it above x-y diagram matching the x-axes data). Both the enthalpies (Hv and H_L) should be converted to calories per mole.
(iii) A feed containing 60% mole methanol and rest water is flash distilled at 1 atm. What is the fraction of liquid and vapour obtained if desired vapour composition is 0.75. Use both H-xy and x-y diagram for the calculations. Mol. Wt. of methanol is 32.</td><td>4
3
3</td></tr>
<tr><td>3A.</td><td>The following is the equilibrium data of colour adsorption from sugar solution by active charcoal.
<table><tr><td>$\frac{\text{Colour units}}{\text{kg carbon}}$</td><td>0</td><td>208</td><td>472</td><td>1250</td><td>4416</td></tr><tr><td>$\frac{\text{Colour units}}{\text{kg sugar}}$</td><td>0</td><td>4.16</td><td>7.08</td><td>12.5</td><td>22.05</td></tr></table>A solution of raw cane sugar 48% sucrose is coloured by small quantities of impurities. Decolourization is done by adding small dose of carbon and noting change in equilibrium colour. Original colour = 20 units on arbitrary scale. Assume non-adsorption of water. Convert the data to kg carbon/kg dry sugar (y-axis) vs. % colour removed (x-axis) and plot.</td><td>4
1</td></tr>
<tr><td>3B.</td><td>Explain the Freundlich and Langmuir theory of adsorption.</td><td>2</td></tr>
<tr><td>3C.</td><td>Elucidate the plate theory of chromatography by taking up 5 equilibrium plates and a single component, K=1 and feed concentration is 80 μmol</td><td>3</td></tr>
<tr><td>4A.</td><td>With examples of different charges, explain the principles of Ion Exchange Chromatography.</td><td>2</td></tr>
<tr><td>4B.</td><td>Define K_d in Size Exclusion Chromatography.
Give reasons for three different values of K_d (K_d=0, K_d=1, 0<K_d <1, K_d>1) in size Exclusion Chromatography</td><td>1
2</td></tr>
<tr><td>4C.</td><td>Draw the batch drying rate curves for wet solids, provide reasons for the different behaviors based on hygroscopicity; provide examples
(i) Boundary layer Control drying
(ii) Boundary Layer – Internal Diffusion Control Drying
(iii) Internal Diffusion Control Drying</td><td>3</td></tr>
<tr><td>4D.</td><td>Define the following - Free Moisture, Equilibrium Moisture, Bound and Unbound Moisture Use appropriate diagram.</td><td>2</td></tr>
<tr><td>5A.</td><td>How many grams of seed antibiotic with a size of 0.05 mm are required to produce 160 g/litre of a size of 1mm? Assume that the crystals are nearly uniform and have a density of 1.04 g/litre.</td><td>2</td></tr>
<tr><td>5B.</td><td>What are the four different types of nucleation in crystallization process? Explain their significance.</td><td>3</td></tr>
<tr><td>5C.</td><td>Draw and explain the equilibrium diagrams for leaching (X-Y, N-XY with tie lines)
(a) Solute is infinitely soluble in solvent and solvent gets adsorbed by solids
(b) Solute is partially soluble in solvent and solvent does not get adsorbed by solids
(c) Solute is infinitely soluble in solvent and solvent is not adsorbed by solids</td><td>3</td></tr>
<tr><td>5D.</td><td>Explain tailing and fronting in chromatography</td><td>2</td></tr>
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