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V SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: SEPARATION TECHNIQUES [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 kmole per hr of a hydrocarbon oil containing 6mole% propane is stripped using direct superheated steam to reduce the propane content to 1.5 % (mole) in a countercurrent operation. The equilibrium relationship is given by y=2.4x where y & x are mole fraction of propane in vapour & liquid respectively. Determine the minimum steam rate in kg/h and the number of ideal plates if 1.3 times the minimum rate is used.	**6**
1B.	Explain the principle and method for purifying sandalwood oil by using steam distillation.	**2**
1C.	Explain the characteristics of sieve tray and hysteresis of valve trays.	**2**
2A.	Generate y-x data (minimum 10 data of x from 0 to 1.0), and partition coefficient K for α=2.5 assuming constancy of the relative volatility. Provide specimen calculation for any two set of readings. Plot the data on graph.	**2**
2B.	The following is the VLE data for acetone water at 1 atm. x 0 0.01 0.02 0.050 0.100 0.200 0.30 0.40 0.500 0.600 0.700 0.800 0.900 1.0 y 0 0.253 0.425 0.624 0.755 0.798 0.815 0.83 0.839 0.849 0.859 0.874 0.95 1.0 100 moles of Acetone water solution (50% molar acetone) is differentially distilled to evaporate 60% of the liquid (molar basis) . Compute the liquid and vapor compositions.	**5**
2C.	Compute the minimum number of stages if the same input feed of acetone –water (in problem 2B) is to be fractionated to overhead product of 0.95 mole fraction and 0.05 mole fraction at the bottom. Assume stage efficiency to be 80% and compute minimum reflux ratio for liquid feed at saturated condition.	**3**
3A.	Show that for two stage Cross Current adsorption to reduce the concentration of a solute in a feed liquid from Y_0 to a concentration Y_2 (both fixed), the minimum amount of adsorbent results, when adsorption isotherm is linear and when the quantity of adsorbent used in each stage is equal (i.e., $S_1=S_2$). In other words, it is equivalent to proving that slopes of the operating lines are equal. In this case the feed solvent liquid flow rate is also constant at L_s (pure solvent), i.e., solvent is not adsorbed by the adsorbent.	**5**
3B.	Explain and distinguish between primary and secondary nucleation.	**2**
3C.	A saturated solution of $MgSO_4$ at 80^{o}C is cooled to 30^{o}C in a crystallizer. During the cooling, mass equivalent to 4% of solution is lost by evaporation of water. Calculate the quantity of original	**3**

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	saturated solution to be fed to the crystallizer per 1000 kg crystals of MgSO4.7H2O. Solubility of MgSO4 at 30°C and 80°C are 40.8 and 64.2 kg/100 kg water resp. Take your basis as 100 kg free water in the original solution and then scale up for 1000 kg crystals.	
4A.	The following is the drying rate [kg/(kg.h)] data for a meat sample. Compute the amount of water removed by drying for a sample with 20 kg dry meat. Use graphical integration approach.	**5**

Time, min	0	5	10	15	20	30	40	50	60	70	80
Rate , kg/(kg.h)	0	0.25	0.45	0.6	0.7	0.8	0.85	0.82	0.8	0.79	0.75

4B.	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	**3**
4C.	Explain Ostwald's ripening by taking up the example of $MgSO_4$.	**2**
5A.	A chromatographic separation of a two component samples on a 50 cm column gave the retention times for the solutes A and B as 2.5 and 3.1 minutes with base widths of the two chromatographic peaks being 0.24 and 0.3 resp. Calculate the (a) Number of theoretical plates (b) Average plate height and (c) Resolution of the two peaks (d) Will the resolution increase if the column length is increased? Give reasons.	**3**
5B.	What are the significances of the each of the parameters of Van Deemter equation? With this equation, explain how to obtain optimum flow rate (u_{opt}) in the case of a chromatographic column.	**3**
5C.	Distinguish between the following (a) free moisture, (b) bound moisture (c) unbound moisture (d) equilibrium moisture (e) critical moisture. Use appropriate diagrams for your explanation.	**2**
5D.	For size exclusion chromatography, briefly explain the various volume based parameters.	**2**