

**III B.Tech II Semester Supplementary Examinations,  
November/December 2005  
MASS TRANSFER OPERATIONS-II  
(Chemical Engineering)**

Time: 3 hours

Max Marks: 80

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

\*\*\*\*\*

1. (a) A binary Mixture of A and B components have the following temperature and vapour pressure characteristics (vapour pressure in mm Hg)

$T^{\circ}\text{C}$	38.5	42	46	50	54	58	62
Vapour pressure A	400	458	532	615	708	812	948
Vapour pressure B	160	185	217	254	295	342	400

- (b) Explain the p-x-y characteristics of binary liquid system with a neat schematic diagram. [10+6]
2. Derive the relationship for the intersection of the operating lines corresponding to the rectifying and stripping sections of distillation column for various thermal conditions of the feed. [16]
3. (a) What is an azeotrope? Give few examples.  
(b) What is the importance of extractive distillation.  
(c) With neat figure explain the process of extractive distillation. Mention its application in the industries. [4+4+8]
4. (a) Discuss about the applications of liquid extraction.  
(b) Write about the notation scheme used to describe the concentration and amounts of ternary mixtures for the purpose of discussing both equilibrium and material balances. [6+10]
5. (a) Briefly describe the various towers used for liquid extraction operation.  
(b)  $160 \text{ cm}^3/\text{s}$  of a solvent S is used to treat  $400 \text{ cm}^3/\text{s}$  of a 10% by weight solution of A in B, in a three stage counter current multiple contact liquid-liquid extraction plant. The densities of A, B and C respectively are 1200, 100 and  $800 \text{ kg}/\text{m}^3$ . What is the composition of the final raffinate?  
Using the same total amount of solvent, evenly distributed between the three stages, what would be the composition of the final raffinate if the equipment were used in a simple multiple contact arrangement?  
Equilibrium data:

kg A/kg B	0.05	0.10	0.15
kg A/kg S	0.069	0.159	0.258

[8+8]

6. A countercurrent extraction battery is used to extract the sludge for the reaction



The quantity of solution retained by the calcium carbonate sludge varies with concentration as follows:

Kg of solution retained	0.082	0.801	0.930	1.200	1.640
Mass percent of NaOH	0	5	10	15	20

The products from the reaction chamber enter the first unit with no excess reactant but contains 6.5 kg of water per kg of calcium carbonate. It is desired to produce a 10 percent solution of NaOH and 98 percent of NaOH is to be recovered. Estimate

- (a) the number of stages required and  
 (b) wash water to be used per kg of calcium carbonate. [16]
7. (a) Discuss the properties of a good adsorbent.  
 (b) Raw sugar solution containing 48% by weight is colored by impurities. The impurities are to be removed by activated carbon in a contact filtration unit. The equilibrium data are as follows:

kg carbon/g of dry sugar:	0	0.005	0.01	0.015	0.02	0.03
% color removed :	0	47	70	83	90	95

The original solution has a color concentration of 20% and it has to be reduced to 2%. Calculate the amount of carbon required to treat 500kg of solution in a single stage operation. [12+4]

8. (a) Derive the rate of adsorption in fixed beds?  
 (b) What are the factors determining rate of ion exchange? [10+6]

\*\*\*\*\*