MODEL QUESTION PAPER

FIFTH SEMESTER B.TECH. DEGREE EXAMINATION

(2013 Scheme)

BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING

13.502. MASS TRANSFER OPERATIONS (B)

PART-A

Answer all questions .Each question carries two marks

1. Explain molecular and eddy diffusion citing the differences between the two.
2. Differentiate Flash and simple distillation.
3. Discuss film theory of mass transfer.
4. Explain the thermal conditions of feed in a fractionating column.
5. Explain relevance of absorpition factor in gas absorption.
6. Define plait point and binodal solubility curve.
7. What are the various factors affecting the rate of leaching operation.
8. Discuss the various types of adsorption.
9. Discuss Freundlich equation for adsorption.
10. Discuss the principle of ion exchange.

PART - B
Answer one question from each module

MODULE - I

11 (a) Derive an expression for flux N_A in equimolar counter diffusion and show the graphical representation.

(b) Arnold cell is used to measure the diffusivity of chloroform in air at 25 ^{0} C and 1 atm pressure. The Liquid density of chloroform at 25^0 C is 1.485 g/cc and its vapour pressure is 200 mm Hg. At time t=0, the liquid chloroform surface is 7.4 cm from the top of the tube and after 10 hours the liquid surface was dropped by 0.44 cm. If the concentration of chloroform is zero at the top of the tube, what will be the diffusion coefficient of chloroform in air? (8 +12)

OR

12 (a) Discuss loading and flooding in packed towers.

(b) It is desired to absorb 90 % of acetone from a gas containing 1 mol% acetone in air in a counter curren stage tower. The total inlet gas to the tower is 30kmol/h and the

total inlet pure water flow to be used to absorb acetone is 90 kmol/h. The process is to operate isothermally at 300K and a total pressure of 1 atm. The equilibrium relation is y= 2.53 x, Where x and y denote the molfractions of acetone in liquid and vapour phases. Determine the number of theoretical stages required for this operation both graphically and analytically. (5+15)

MODULE-II

13 (a) A mixture of A & B is to be distilled, the feed composition is 0.5 mol fraction of A. The concentration of A in the distillate is 90% and 95 % of B is there in the residue. The feed is half vapour and average relative volatility of the mixture is 2.5. Determine minimum reflux ratio, the number of ideal stages if optimum reflux ratio is twice the minimum value and the minimum number of theoretical plates for this separation.
(b) Discuss azeotropic and extractive distillation (15+5)

OR

14 (a) A liquid mixture containing 50%m n-heptane and 50%m n-octane is o be continuously Flash vapourised at 1 std atm pressure to vapourise 60 mol% of the feed. What will be the composition of the vapour and liquid for an equilibrium stage?
The x-y data is given as:

x:	1	0.67	0.49	0.31	0.16	0
Y:	1	0.81	0.67	0.49	0.13	0

(b) Explain principle and applications of steam distillation. (12 +8)

MODULE III

15. (a)A solution containing 18 wt% acetone in water is to be extracted with monochloro benzene (MCB) containing 0.5 % by wt acetone by counter current extraction operation, MCB and water are immiscible in the operating condition . Inorder to obtain a raffinate with 1% acetone content, determine the number of stages required if solvent used is 1.2 times the minimum. Given X & Y as follows

X (kg acetone/ kg water):	0.0258	0.0739	0.1605	0.267
Y (kg acetone/ kg MCB) :	0.0288	0.0704	0.1560	0.237

(12)

(b) Discuss the effect of temperature on binodal solubility curve and working of mixer settler cascade. (8)

OR

16. (a) Explain solid liquid equilibrium in leaching operation.

(b) 2000 kg/h of soybean meal containing 45% by weight edible oil is to be treated in a multiple stage counter current leaching equipment using 3000 kg/h of n-hexane containing 3% oil by weight. The insoluble solids retain 1 kg solution per kg of its weight in each stage, How many ideal stages are required if 90 % recovery of the oil is desired. (5+15)

MODULE - IV

17. (a) Explain the applications of ion exchange process and ion exchange techniques.

(b)What are the various parameters necessary for selection of adsorbents? (14+6)

OR

18. (a) Discuss with sketches the construction and operation of a steady state moving bed adsorber.

(b) An aqueous solution is coloured by small amounts of an impurity and the colour is to be removed by adsorption on decolourising carbon. The original colour intensity is measured to be 9.6 units/kg solution. Determine the quantity of fresh carbon required per 1000 kg solution to reduce the colour to 10 % of its original value in a single stage operation. The equilibrium relation is given by $\mathbf{Y} = 8.99 \times 10^{-5} \mathbf{X}^{1.66}$, Where **Y** is colour units per kg solution and **X** colour units per kg carbon (8 +12)