

**B.TECH DEGREE EXAMINATIONS: NOV/DEC 2014**

(Regulation 2009)

Fifth Semester

**BIOTECHNOLOGY**

BTY115: Mass Transfer Operations

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

- According to Fick's first law of diffusion for liquids,
  - $D_{AB} < D_{BA}$
  - $D_{AB} = D_{BA}$
  - $D_{AB} > D_{BA}$
  - $D_{AB} \neq D_{BA}$
- According to film theory
  - $k_C \propto N_{AB}$
  - $k_C \propto (D_{AB})^{0.5}$
  - $k_C \propto D_{AB}$
  - $k_C \propto (D_{AB} S)^{0.5}$
- The absorption factor is defined as
  - $G/(m L)$
  - $L/(m G)$
  - $m L/G$
  - $LG/m$
- The expression for height of packing based on gas phase is given by
  - $Z = (HTU)_G \times (NTU)_G$
  - $Z \neq (HTU)_G (NTU)_G$
  - $Z = (HTU)_G + (NTU)_G$
  - $Z = (HTU)_G - (NTU)_G$
- Separation of vitamins from animal and fish oils is done by
  - Simple distillation
  - Azeotropic distillation
  - Steam distillation
  - Flash distillation
- Minimum number of ideal stages are required in a fractionating column when the reflux ratio is equal to
  - Minimum reflux ratio
  - Optimum reflux ratio
  - Infinity
  - Zero
- Distribution coefficient is defined as
  - $K = y_i \times x_i$
  - $K = y_i/x_i$
  - $K = x_i/y_i$
  - $K = y_i - x_i$



(ii) Derive an expression for flux of equimolar counter diffusing component at steady state. (7)

22. a) (i) Compare and contrast packed and plate tower. (4)

(ii) Derive an expression for estimating theoretical number of stages or transfer units in absorbers. (10)

(OR)

b) (i) Acetone is to be recovered from an air mixture containing 0.015 mole fraction of acetone in an absorption tower. Water enters the tower counter-current to air mixture. The air mixture enters the absorber at a flow rate of  $2 \text{ kg/m}^2\text{sec}$  and the rate of water is  $3.2 \text{ kg/m}^2\text{sec}$ . Assuming  $y_e = 1.75x$ . Determine the number of overall transfer units, if the outlet air mixture has a mole fraction of 0.00015. where  $x$  and  $y$  are in the units of mole fraction. (10)

(ii) What is the physical significance of NTU? (4)

23. a) (i) Briefly discuss about the azeotropic and extractive distillation. (4)

(ii) A liquid mixture containing 50% mole heptane (A) and 50% mole octane (B) is to be continuously flash vaporized at 1 standard atmosphere pressure to vaporize 60 mole percent of the feed. What will be the composition of the vapour and liquid in the separator for an equilibrium stage? (10)

T, °C	98.5	105	110	115	120	125.5
Vapour Pressure of A mm Hg	760	940	1050	1200	1350	1540
Vapour Pressure of B mm Hg	333	417	484	561	650	760

(OR)

b) (i) A liquid containing 0.4 mole fraction methyl alcohol and 0.6 mole fraction water is fed to an intermediate point on a continuous distillation column containing eight actual sieve trays. The distillation composition is 0.93 mole fraction methyl alcohol and the bottom composition is 0.10 mole fraction methyl alcohol when the reflux ratio is 2.0. The column is operated at atmospheric pressure and the feed enters at its boiling temperature. If the Mc/Cabe-Thiele simplifying assumptions may be made, what is the overall plate efficiency? (7)

(ii) A liquid mixture containing 50 mole percent n-heptane and 50 mole percent n-octane is subjected to a differential distillation at atmospheric pressure until the residual liquid contains 35 mole percent n-heptane. Using the equilibrium data determine the percentage of feed that is left over as residue. (7)

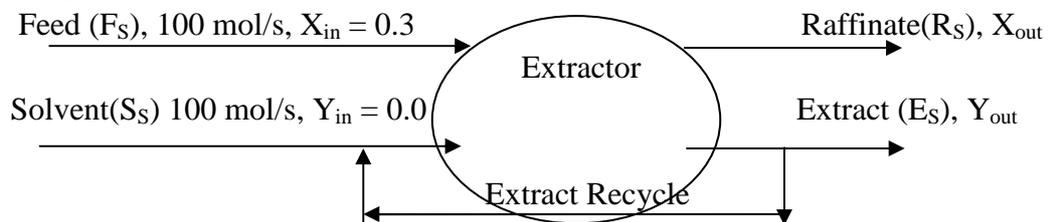
$x$	0.50	0.46	0.42	0.38	0.34	0.32
$y$	0.689	0.648	0.608	0.567	0.523	0.49

(where  $x$  = mole fraction n-heptane in liquid and  $y$  = mole fraction n-heptane in vapour)

24. a) (i) Explain the criterion to be considered for choosing a solvent for extraction? (10)
- (ii) Why is liquid extraction considered more scientific compared with other operations? (4)

(OR)

- b) (i) Which type of extractor is used nuclear power stations? Explain its principle construction and working with a neat diagram. (7)
- (ii) A feed containing a solute is contacted with a solvent in an ideal stage as shown in the diagram below. Only the solute transfer into the solvent. The flow rates of all the streams are shown on a solute free basis and indicated by the subscript S. The compositions of the streams are expressed on a mole ratio basis. The extract leaving the solvent contractor is divided into two equal parts, one part collected as the product and the other stream is recycled to join the solvent. The equilibrium relationship is  $Y^* = 2X$ . Calculate the product flow rate and composition. (7)



25. a) (i) Discuss in detail about preparation, characterization and applications of different type of adsorbents in industries. (7)
- (ii) At equilibrium, the concentration of water in vapour phase ( $C^*$ ) in  $\text{kg/m}^3$  of air space and the amount of water ( $m$ ) adsorbed per kg of dry silica gel are related by  $C^* = 0.0667 m$ . To maintain dry conditions in a room of air space  $100 \text{ m}^3$  containing  $2.2 \text{ kg}$  of water vapour initially,  $10 \text{ kg}$  of dry silica gel is kept in the room. Calculate the fraction of initial water remaining in the air space after a long time. (7)

(OR)

- b) (i) Write short notes on: (4)
- A. Solid leaching
  - B. Lixiviation
  - C. Elutriation
  - D. Decoction
- (ii) Elaborate the CCD of gold mining leaching equipment working and its disadvantages. (10)

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