TRANSFER OPERATION II
(BIOT 3104)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The process of heating a liquid mixture to form vapours and then cooling the vapours to get pure component is called _____
(a) Crystallisation (b) Distillation
(c) Chromatography (d) Sublimation

(ii) For estimating the drier size it is necessary to know _____
(a) Time of drying (b) Heat of drying
(c) Speed of drying (d) All of the mentioned

(iii) Which of the following is not an adsorbent?
(a) Carbon (b) Polymers and resins
(c) Clay (d) Dry sponge.

(iv) Solvent extraction is more effective when the extraction is repeated with
(a) Extra solvent (b) Large solvent
(c) Small solvent (d) No solvent.

(v) With increase in pressure, the relative volatility for a binary system
(a) increases
(b) decreases
(c) remains same
(d) either (a) or (b), depends on the system.

(vi) The solubility of a gas in a liquid generally
(a) Increases with temperature
(b) Decreases with temperature
(c) Decreases with pressure
(d) Not affected by temperature and pressure.

(vii) NTU = the number of theoretical stages when
(a) The operating line and the equilibrium line are straight and parallel
(b) The operating line and the equilibrium line intersect each other
(c) The minimum operating line is parallel to equilibrium line
(d) None of the above.

(viii) Which of the following is not a membrane separation process?
(a) Reverse osmosis (b) Diffusion
(c) Ultrafiltration (d) Dialysis.

(ix) Concentration polarization occurs when
(a) Concentration of the solute (C_M) is more on the membrane surface than in the bulk feed solution(C_B)
(b) $C_M<C_B$
(c) $C_M= C_B$
(d) None of the above.

(x) The driving force for molecular diffusion is
(a) Temperature gradient (b) Concentration gradient
(c) EMF (d) None of the above.

Group – B

2. (a) Derive an expression for diffusivity in a pseudo-steady state one way diffusion process.

(b) Prove that $D_{AB}= D_{BA}$.

6 + 6 = 12

3. A tray tower is to be designed to absorb SO_2 from an air stream by using pure water at 293K. The entering gas contains 20 mol% SO_2 and that leaving 2 mol% at a total pressure of 101.3 kPa. The inert air flow rate is 150 kg air/h.m^2, and the entering water flow rate is 6000 kg water/h.m^2. Assuming an overall tray efficiency of 25%, how many theoretical trays are needed? What should be the number of trays actually to be employed? Assume the tower to operate at 293K and equilibrium relationship is given by $y^*= 20x$

12

Group – C

4. An enriching column is fed with a feed consisting of 40 mol% benzene and 60 mol% toluene at 101.3 KPa. The feed enters at a rate 100 kmol/hr as a saturated vapour and it is desired to produce a distillate containing 90 mol% benzene. Assume that a total condenser is used and reflux ratio is 4.0 mol per mol of distillate. Determine:

(i) Molar rate of production of distillate and residue.
(ii) Composition of residue
(iii) Number of theoretical plates.

Equilibrium Data:

x	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.95	1
y	0	0.205	0.369	0.502	0.618	0.706	0.789	0.849	0.907	0.955	0.978	1

3 + 3 + 6 = 12

5. (a) State the principle of Batch Distillation with diagram.

   (b) Derive the Rayleigh equation for Batch Distillation.

   (c) Define relative volatility.

6 + 4 + 2= 12

Group – D

6. (a) Derive the working formula for calculation of drying time under constant rate of drying.

   (b) Explain the primary and secondary nucleation theory for crystallisation.

   (c) Describe the liquid- liquid extraction process . State two major application of extraction.

4 + 4 + (2 + 2) = 12

7. (a) State the equation and assumptions of Langmuir isotherm for adsorption.

   (b) What is extraction factor? How is this parameter related to composition of inflow solution and composition of raffinate?

6 + (2 + 4) = 12

Group – E

8. Write short notes on:
   (i) Electrodialysis
   (ii) Reverse osmosis.

6 + 6 = 12

9. In a cross flow ultra filtration system used for filtration of proteins from a fermentation broth, gel resistance increases with protein concentration according to the following equation:

   $R_G = 0.5+0.01C$, where C is in mg/L.
   Pressure at the entrance system is P_i =6atm and at the exit is P_0 = 2atm. The shell side of the filter is open to the atmosphere, resulting in P_f =1atm. The membrane resistance is R_M = 0.5 atm/(mg/m^2 .h), and the protein concentration in the broth is C= 100mg/L. Determine:

(i) The pressure drop across the membrane
(ii) Filtration flux
(iii) Rejection coefficient of the membrane for effluent protein concentration of C_i =5mg/L.

4 + 4 + 4 = 12

Department & Section	Submission Link
BT	https://classroom.google.com/c/Mjc4ODUxMzE0OTc3/a/Mjc1OTEyMjE1NDY4/details