KUMARAGURU college of technology
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Register Number:……..

B.TECH DEGREE EXAMINATION: MAY 2015

(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)

1. Molecular diffusion is due to
   a) Thermal motion of the molecule b) Potential energy of the molecules
   c) Activation energy of the molecules d) Viscosity
2. Diffusivity of vapour with variation of pressure is described by the relation
   a) $D_{AB} \alpha P_T$ b) $D_{AB} = P_T$
   c) $D_{AB} \alpha 1/P_T$ d) $D_{AB} \alpha P_T^2$
3. Absorption factor is defined as
   a) mGL b) G / mL
   c) mG / L d) L / mG
4. Which type of column is used for hydrogen fluoride gas by separation absorption?
   a) Plate column b) Spray column
   c) Packed column d) Bubble cap
5. Relative volatility doesn't change appreciably with change in
   a) Temperature b) Partial pressure
   c) Total pressure d) Vapour pressure of either component
6. An example of a maximum boiling azeotrope is
   a) Ethanol-water system b) Hydrochloric acid-water system
   c) *n*-heptane – *n*-octane system d) Chloroform-water system
7. Selectivity of solvent used in extraction should be
   a) 0 b) 1
   c) <1 d) > 1
8. Which type of extractor would be useful for handling antibiotics?
   a) Treybal extractor b) Podbielniak extractor

c) Schiebel extractor d) Pulsed column

9. Hyper-sorption refers to a _____ process.
   a) Fixed bed absorption b) Fixed bed adsorption
   c) Moving bed absorption d) Moving bed adsorption
10. In leaching operation, for constant under low, y* / x is
   a) greater than one b) less than one
   c) equal to one d) equal to 0.5

PART B (10 x 2 = 20 Marks)

11. State Fick's first law of diffusion.
12. Distinguish molecular diffusion and eddy diffusion.
13. For vacuum operation why packed towers are desirable?
14. What is the significance of HTU and NTU?
15. Define relative volatility.
16. Draw the different type of feed lines for varies feed conditions.
17. What is meant by a solutropic system?
18. Represent the ternary system in a triangular diagram.
19. What do you understand about adsorption hysteresis?
20. Differentiate in-situ and ex-situ leaching.

PART C (5 x 14 = 70 Marks)

21. a) (i) Sulphur dioxide is absorbed from air into water in packed absorption tower. At a certain location in the tower, the mass transfer flux is 0.027 k mol SO_2 / m^2 hr and the liquid phase concentrations in mole fraction are 0.0025 and 0.0003 respectively at the two-phase interface and in the bulk liquid. If the diffusivity of SO_2 in water is 1.7 x 10^{-5} m^2/s, determine the mass transfer coefficient (k_c). (7)

   (ii) Calculate the rate of diffusion. NaCl at 200°C through a stationary film of water 1 mm thickness where the concentration are 20% and 10% by weight respectively on either side of the film. Diffusity is 1.35 x 10^{-5} m^2/sec. (7)

(OR)

   b) (i) Illustrate the theories of mass transfer in detail. (7)

   (ii) Define overall and individual mass transfer coefficient. Deduce the relationship between them. (7)

22. a) Calculate the number of theoretical stages required for a given separation using the Kremser-Brown-Souders Equation.

(OR)

b) (i) A packed tower is designed to recover 98% CO_2 from a gas mixture containing 10% CO_2 and 90% air using water. A relation $y = 14x$ can be used for equilibrium conditions where y = kg of CO_2/kg of dry air and x = kg of CO_2/kg of water. The water to gas rate is kept 30% more than the minimum value. Calculate the height of the tower if height of transfer unit is 1 m. (7)

(ii) Contrast on comparison between packed and tray towers. (7)

23. a) In the distillation column, a saturated liquid mixture of 45 mol percent ethanol in broth, with traces of acetaldehyde and fuel oil, is concentrated to 85 mol percent. The concentration of alcohol in the wastewater is reduced to not less than 5 mol percent. Calculate the number of theoretical trays required for desired separation, for a feed rate of 10,000 kg/hr. Treat the feed as a binary mixture of ethanol and water. Take the feed temperature as 20°C. The column will operate at 1 atmosphere. Reflux is twice the minimum.

x	0.02	0.07	0.12	0.23	0.33	0.51	0.57	0.68	0.75	0.89
y	0.17	0.39	0.47	0.55	0.58	0.66	0.68	0.74	0.78	0.89

(OR)

b) Elaborately discuss about the following:

(i) Azeotropic distillation (5)

(ii) Extractive distillation (5)

(iii) Flash distillation (4)

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24. a) (i) Explain the liquid–liquid equilibrium with reference to triangular graph. (7)

(ii) Outline the factors to be considered in the selection of solvent for extraction. (7)

(OR)

b) (i) Which type of extractor uses centrifugal forces to separate the two liquids? Summarize the working principle and construction in detail with neat diagram. (7)

(ii) Write a brief note on multistage cross current and counter current extraction. (7)

25. a) (i) Discuss the different type of adsorbents preparation and characterization. (7)

(ii) Derive Langmuir isotherm stating suitable assumptions. Give its limitations. (7)

(OR)

b) Which type of leaching equipment is used for leaching of vegetable seeds? Describe the construction, working, merits and demerits.

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