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**Question Paper Code: U5D03**

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

Fifth Semester

Biotechnology

**21UBT503 - MASS TRANSFER OPERATIONS**

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer All Questions

PART A - (10x 2 = 20 Marks)

1. State Fick's law of diffusion. CO1- U
2. Does transfer of mass between mixtures of gases occurs only in a natural way? Justify your answer. CO2-App
3. Differentiate absorption and chemisorption CO1 -U
4. The Viscosity of the solvent selected for absorption is higher. Predict all possible ill effects in the process. CO2-App
5. Define Relative volatility. CO1-U
6. You are in need to separate ethanol and water from its mixture. Which method will you adopt and why? CO2-App
7. Sketch the solid-liquid equilibria curve. CO1-U
8. Identify the significance of leaching. CO2-App
9. List 3 different adsorption isotherms. CO1-U
10. 100 kg of salt has to be retrieved from sea water. Predict the steps that has to be followed in obtaining the same. CO2-App

PART – B (5 x 16= 80Marks)

11. (a) In an oxygen-nitrogen gas mixture at 101.3 kPa and 298 K, the concentrations of oxygen at two planes 2 mm apart are 20 and 10% by volume respectively. Calculate the flux of diffusion of oxygen for the cases where:  
(i) nitrogen is non-diffusing  
(ii) there is equimolar counter diffusion of the two gases.  
Diffusivity of O<sub>2</sub> in N<sub>2</sub> is  $1.81 \times 10^{-5}$  m<sup>2</sup>/s. CO2 -App (16)
- Or
- (b) Hydrochloric acid (A) at 283 K diffuses through a thin film of water (B). The film is 4 mm thick. The concentration of A at location 1, on one boundary of the film, is 12 weight % (density  $\rho_1 = 1060.7$  kg/m<sup>3</sup>) and at location 2, on the other boundary, is 4 weight % (density  $\rho_2 = 1020.15$  kg/m<sup>3</sup>). The diffusivity of HCl in water is  $2.5 \times 10^{-9}$  m<sup>2</sup>/s. Calculate the flux of diffusion of A assuming water to be stagnant (i.e., non-diffusing). CO2- App (16)
12. (a) Elucidate the common methods used in separating components in a solution. CO4- E (16)
- Or
- (b) Describe in detail about single component absorption with a neat sketch. CO4- E (16)
13. (a) A mixture of benzene and toluene containing 40 mole % benzene is to be separated to give a product of 90 mole % benzene from the top and a bottom product with not more than 10 mole % benzene. Using an average value of 2.4 for the volatility of benzene relative to toluene, calculate the number of theoretical plates required at total reflux. CO2-App (16)
- Or
- (b) A mixture containing 35 mole % A and 64 mole % B is to be separated in a distillation column. The concentration of A in the distillate is 93 mole % and 96 mole % of all A is in distillate. The feed is half vapor and reflux ratio is 4:1. The relative volatility is 2.5. Find the equilibrium stages that are required in the column. CO2-App (16)

14. (a) Explain the principle and working of Ballman Extractor with a neat sketch. CO3- Ana (16)

Or

(b) Explain in detail about S-L extraction considering any extractor of your choice. CO3- Ana (16)

15. (a) Explain the mechanism of drying using drying rate curves and outline the principle of a dryer for drying of coconut for extraction of oil in industries. CO1-U (16)

Or

(b) Explain in detail the principle, mechanism and application of adsorption. CO1-U (16)

