CBCS SCHEME

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18PC55

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Mass Transfer Operations

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. State Fick's law of Diffusion. Derive the expression for steady state Equimolar counter Diffusion. **(10 Marks)**

b. In an oxygen-nitrogen gas mixture at 101.3kPa and 298K, the concentrations of oxygen at two planes 2mm 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) Equimolar diffusion of two gases
Diffusivity of O_2 in N_2 is $1.81 \times 10^{-5} m^2/s$. **(10 Marks)**

OR

2 a. A mixture of Nitrogen-acetone vapour at 800mHg and 25°C has % saturation of 80. Calculate:
i) Absolute Humidity
ii) Partial pressure of acetone
iii) Absolute molar Humidity
iv) Volume percent of acetone. **(10 Marks)**

b. Explain the concept of Wet Bulb Temperature and derive the expression for Wet bulb depression. **(10 Marks)**

Module-2

3 a. Define the following:
i) Bound Moisture Content
ii) Equilibrium Moisture
iii) Falling rate period
iv) Relative Humidity
v) Critical moisture. **(10 Marks)**

b. A batch of wet solids is to be dried from 35% to 10% moisture under constant drying conditions in five hours. If the equilibrium moisture content is 4% and the critical moisture content is 14%. Estimate the time required to dry solids to 6% moisture under the same drying conditions. All moisture content are on wet bases. **(10 Marks)**

OR

4 a. Explain any five industrial adsorbents along with applications. **(08 Marks)**

b. Explain Adsorption isotherms in detail. **(12 Marks)**

Module-3

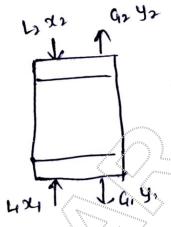
5 a. Explain the characteristics of solvent for Absorption. **(08 Marks)**

b. Carbon di-sulphide is to be adsorbed from a dilute gas mixture of CS_2 and N_2 into a pure non-volatile oil at atmospheric pressure in a counter current absorber. The mole fraction of CS_2 in inlet gas stream is 0.05 and flow rate of gas stream G = 1500kmol/hr. The equilibrium relation is Y = 0.5x. It is desired to reduce the mole fraction of CS_2 in exit gas stream to 0.005.

i) Calculate the minimum value of L/G where L is liquid flow rate in kmol/hr.

ii) Derive equation of operating line if L/G is equal to 1.5 times the minimum value.

(12 Marks)



OR

6 a. Define Solubility. Explain the solubility curve with example. **(05 Marks)**

b. Find the yield of $Na_2S_2O_3$ $5H_2O$ crystals when 100kg of 48% $Na_2S_2O_3$ solution is cooled to 293K. Also calculate the % yield of hydrated crystals. Solubility of $Na_2S_2O_3$ is 70 parts per 100 parts water at 20°C. **(15 Marks)**

Module-4

7 a. Derive Rayleigh's equation from basics when the relative volatility is constant. **(12 Marks)**

b. A liquid mixture containing 40% mole methane 60mole % of water is fed to a simple distillation at atmospheric pressure with 60mole % of liquid distilled. Find the composition of distillate and residue. **(08 Marks)**

x	0.05	0.1	0.2	0.3	0.4	0.5
y	0.27	0.42	0.57	0.66	0.73	0.78

OR

8 a. Explain about Flash or Equilibrium distillation with neat diagram. **(08 Marks)**

b. A mixture of benzene and toluene containing 40% benzene and 60% toluene is to be separated in a fractionating column to give a product containing 96% benzene and a bottom product containing 96% toluene. The feed is a mixture of two third vapour and one third liquid. Find the number of theoretical stages required if reflux ration of 1.5 times the minimum is used and if relative volatility is 2.5. **(12 Marks)**

Module-5

9 a. List the factors to be considered during selection of solvent for extraction. **(08 Marks)**

b. Explain the construction and working of Mixer settler for batch and continuous operation. **(12 Marks)**

OR

10 a. Define Leaching. Also discuss the factors influencing leaching. **(08 Marks)**

b. Explain the construction and working of Dorr agitator and Rotating Disk Contactor. **(12 Marks)**

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