**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(MID SEMESTER EXAMINATION)**

**CLASS: B.TECH** **SEMESTER: IV**
**BRANCH: CHEM & CP** **SESSION : SP/2020**

**SUBJECT: CL209 MASS TRANSFER OPERATION - I**

**TIME: 2 HOURS** **FULL MARKS: 25**

**INSTRUCTIONS:**
1. The total marks of the questions are 25.
2. Candidates may attempt for all 25 marks.
3. Before attempting the question paper, be sure that you have got the correct question paper.
4. The missing data, if any, may be assumed suitably.

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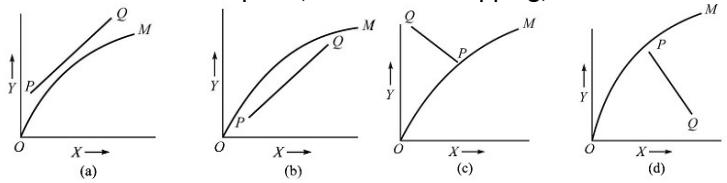
|---|---|---|---|---|---|
| Q1 | (a) | List the practical examples of i) equimolar counter diffusion and ii) solute diffusing through non diffusing medium. | [2] | 1 | 1 |
| Q1 | (b) | Briefly describe Knudsen diffusion and surface diffusion. | [3] | 1 | 2 |
| Q2 | | Hydrochloric acid (A) diffuses through a thin film of water (B) 4.0 mm apart at 298 K. The concentration of HCl on boundary of the film is 12 wt% (density = 1060.7 kg/m$^3$) and on the other boundary is 4 wt% (density = 1020.15 kg/m$^3$). The diffusivity of HCl in water is $2.5\times10^{-9}$ m$^2$/s. Calculate the molar flux of HCl considering water to be stagnant. Molecular wt. of water is 18.0 and that of HCl is 36.5. | [5] | 1 | 3 |
| Q3 | | Air at a velocity of 2 m/s is flowing over the tray. The temperature of water and air is 25°C. The width of the tray is 45 cm and its length along the direction of air flow is 20 cm. The diffusivity of water vapor in air is $0.26\times10^{-4}$ m$^2$/s. The relative humidity of air is 50%. The Kinematic viscosity of air at 25 °C is 16.14 $\times10^{-6}$ m$^2$/s. The mass concentration of water the interphase is 0.02298 kg/m$^3$. The relative humidity of air is 50%. Calculate the rate of water evaporation. Use the following correlation of mass transfer: $Sh_x = 0.664\, Re_x^{1/2} Sc^{1/3}$ | [5] | 2 | 3 |
| Q4 | (a) | The operating line (PQ) and the equilibrium line (OM) for four gas-liquid systems are given below. Identify them as cases representing co-current absorption, counter current absorption, co-current stripping, counter current stripping. | [2] | 3 | 4 |

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| Q4 | (b) | What are the drawbacks of film theory? Briefly explain the effect of weeping and entrainment for gas-liquid contact in tray tower. | [3] | 2,3 | 1,2 |
| Q5 | (a) | In agas liquid contact operation in a tray column, the feed gas contained 50 mole % solute. It is expected that the exit gas should contain 4.762 mole % solute. The solute free gas flow rate is 72 kmol/hr. The fresh liquid is introduced at the top. Derive the minimum liquid flowrate. The equilibrium data in mole ratio unit is given as follow: | [5] | 3 | 6 |

| X | 0 | 0.05 | 0.07 | 0.1 | 0.15 | 0.2 | 0.22 | 0.25 | 0.27 | 0.3 | 0.35 | 0.4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y | 0 | 0.01 | 0.02 | 0.042 | 0.085 | 0.15 | 0.19 | 0.25 | 0.29 | 0.31 | 0.33 | 0.35 |

**:::::: 03/03/2020 ::::::E**