

GUJARAT TECHNOLOGICAL UNIVERSITY

Diploma in Chemical Engineering

Semester: 4

Subject Name: MASS TRANSFER -I

Sr No.	Course Content
1	Introduction 1.1.Importance of Mass Transfer Operation 1.2.Classification of Mass Transfer Operations based on direct contact of two immiscible phases 1.3.Choice of separation method 1.4.Methods of conducting Mass Transfer Operations 1.5.Fundamental design principles 1.6.Brief idea about mass transfer separation operations possible by membrane 1.7.Direct and Indirect operations
2	Molecular Diffusion in Fluids 2.1.Definition of diffusion (a) Molecular diffusion (b) Eddy diffusion 2.2.Difference between molecular & turbulent /Eddy diffusion. 2.3.Rate of diffusion in Mass Transfer 2.4.Statement of Fick's first law for diffusivity 2.5.Definition of molar flux 2.6.Definition of diffusivity and concentration gradient 2.7.Effect of temperature / pressure & concentration on diffusivity 2.8.General equation for steady state molecular diffusion in fluids (Laminar flow only) 2.9.Molecular diffusion in gases 2.10.Steady state diffusion of following (a) Component A through non diffusing B and derive relation between N_A & P_A and numerical based on this relation (b) Equimolar counter current diffusion A and B & derive relation between N_A & P_A and numerical based on this relation 2.11.Thermal diffusion and its application 2.12.Derivation of diffusivity equation ($D_{AB}=D_{BA}$)
3	Interphase Mass Transfer 3.1.Concept of equilibrium 3.2.Diffusion between phases (Two resistance concept) 3.3.Local two phase mass transfer 3.4.Local overall mass transfer co-efficient 3.5.Use of local and overall mass transfer co-efficient 3.6.Average overall mass transfer co-efficient 3.7.Definition Stage & Stage efficiency 3.8.Definition and types of Cascades 3.9.Explain: Film theory, Penetration theory and Surface renewal theory

4	Gas Absorption 4.1. Definition of Absorption 4.2. Application of absorption 4.3. Equilibrium solubility of gases in liquids (Two component system) 4.4. Effect of temperature & pressure on solubility 4.5. Characteristics of ideal liquid solution and Raoult's law 4.6. Choice of solvent for absorption 4.7. One component transferred, material balances (a) counter current flow (b) co-current flow 4.8. Minimum liquid gas ratio for absorbers 4.9. Counter current multistage operation (One component transferred) 4.10. Definition of Real tray & Tray efficiency- point efficiency, Murphy efficiency, overall tray efficiency 4.11. Gas absorption equipments (a) mechanically agitated vessel (b) packed towers 4.12. H E T P 4.13. Calculation (a) based on Raoult's law (b) material balance
5	Liquid Extraction 5.1. Definition 5.2. Industrial Application 5.3. Liquid equilibrium (three component system) 5.4. Equilateral triangular co-ordinates and representation of composition of liquid mixture on it 5.5. System of three liquids-one pair partially soluble 5.6. Effect of temperature & pressure on solubility curve 5.7. Choice of solvent 5.8. Representation of single stage extraction and multistage cross current extraction on ternary diagram in brief 5.9. Problems solving by use of direct formula 5.10. Equipment (a) single stage extraction (b) agitated vessel (c) flow mixer & settler (d) spray tower (e) packed tower (f) sieve tower (g) centrifugal extractor 5.11. Material balance for single stage, multistage, cross current / counter current system
6	Leaching 6.1. Definition of leaching 6.2. Industrial Application 6.3. Preparation of Solid 6.4. Temperature of leaching 6.5. Methods of operation and equipment

	(a) Unsteady state operation (i) In place (in situ) leaching (ii) Heap leaching (iii) Percolation tanks (iv) Filter press leaching (v) Agitated vessel (vi) leaching by Shanks system (b) Steady state operation (i) leaching during grinding (ii) leaching in door type of agitators (iii) leaching in door balanced tray thickener (iv) continuous counter current decantation with flow sheets (v) leaching of vegetable seeds 1. Rotacel 2. Kennedy extractor 3. Boll man extractor 4. Continuous horizontal extractor 6.6..Material balance for single stage, multi-stage, cross current / counter current system
--	---

Laboratory Experiences:

1. Find out rate of diffusion (liquid gas diffusion)
2. Find out diffusion co-efficient (liquid -liquid diffusion)
3. Find our molar flux of diffusion (liquid -liquid diffusion)
4. Find out rate of absorption (Air- Sulphuric acid)
5. Find out stage efficiency (liquid-liquid counter current extraction)
6. Find out stage efficiency (liquid-liquid co current extraction)
7. Find out rate of Absorption in packed column
8. Find out rate of Absorption in tray column
9. Obtain the ternary diagram (water-acetic acid-benzene)
10. Find out tie line (water-acetic acid-benzene)
11. Find out the rate of leaching (salt-sand-water)
12. Find out the leaching efficiency by Shanks system

Reference Books:

1. Mass Transfer operations Robert E Trey bal
2. Unit operations in Chemical Engineering McCabe & Smith
3. Introduction to Chemical Engineering Badgers & Bancherow
4. Chemical Engineering Kolsen & Richardson
5. Unit operations of Chemical Engineering P. Chattopadhyay
6. Hand book of Chemical Engineering J H Penny