CEPC2004 MASS TRANSFER – I (3-0-0)

Overall course Objective: The objective of course is to teach the concepts of various of mass transfer operations like diffusion, absorption, distillation, and humidification. The students will learn about various mass transfer laws and methods like Fick's law, Stefan-Maxwell equation, McCabe-Thiele method and Ponchon-Savarit method.

Course Outcomes

On completion of the course, the students would have

CO1: Familiar with the basic phenomenon of mass transfer involving phases.
CO2: Applying the mathematical and design concepts of mass transfer in gas-liquid systems like diffusion, absorption, humidification, distillation
CO3: Gaining good knowledge of required optimum condition for a gas-liquid system.

Course Articulation Matrix

COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	-	-	-	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2
CO3	3	3	3	2	2	-	-	-	-	-	-	2

Module I: (07 hrs)
Introduction to Mass transfer operations, molecular diffusion in fluids, binary solutions, Fick's law, equation of continuity, steady state equimolar counter current diffusion, Stefan-Maxwell equation.

Module II: (08 hrs)
Diffusivity of gases and liquids, application of molecular diffusion, mass transfer coefficients, in laminar and turbulent flow, Interphase mass transfer, Film theory, Penetration theory, surface-renewal theories, analogy between mass, heat and momentum transfer.

Module III: (10 hrs)
Absorption : Solubility of gases in liquids, two components system, multi component system, ideal and non - ideal solutions, choice of solvent for absorption, single component absorption material balance, counter current multistage operations, dilute gas mixtures, non - isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single component absorption.

Module IV: (10 hrs)
Principle of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation,

differential distillation steam distillation, azeotropic and extractive distillation. Continuous distillation: McCabe - Thiele method, Ponchon - Savarit method, Tray efficiencies, introduction to multi component distillation.

Module V: (10 hrs)

Humidification operations: Definition of fundamental terms, Psychometric charts, theory of adiabatic saturation and wet bulb temperature, Lewis relation, Gas liquid contact, Dehumidification, Adiabatic Humidification. Equipments: Natural Circulation, Natural draft, Mechanical draft, Spray tower, Spray chamber, Spray pond. Humidity Measurement: Direct chemical method, Hygrometer method, Sling psychrometer, Dew point method, Mirror method.

Books:

1. Mass Transfer Operations by R E Treybal, McGraw Hill.
2. Principles of Mass Transfer and Separation Processes by B K Dutta, PHI.

Reference books:

1. Unit Operations of Chemical Engineering, 7th ed. by W L McCabe, J C Smith, and P Harriott, McGraw-Hill.
2. Design of Equilibrium Stage Processes by B D Smith, McGraw-Hill.
3. Mass Transfer Operations by A Suryanarayana, New Age International

Web Learning Reference:

1. Mass Transfer Operations I by Dr. Chandan Das and Dr. S.K. Majumder, Department of Chemical Engineering, IIT Guwahati (Link: https://nptel.ac.in/courses/103/103/103103035/)
2. Mass Transfer Operations I by Dr. B. Mandal, Department of Chemical Engineering, IIT Guwahati (Link: https://nptel.ac.in/courses/103/103/103103034/)