



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Under Graduate

Branch: Chemical Engineering (Green Technology and Sustainability Engineering)

Course/Subject Code: BE05044011

Subject Name: Mass Transfer-I

W. E. F. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Core Course

Prerequisite:	Basics of Heat transfer, fluid mechanics, and unit process
Rationale:	The goal of this course is to study the principles of mass transfer and their practical implementations in separation and purification procedures within the chemical industry. The course aims to provide a comprehensive understanding of essential concepts in mass transfer operations, including diffusion, mass transfer coefficients, and Interphase mass transfer. By studying deeply into these fundamentals, students will gain the proficiency to address intricate problems related to various mass transfer operations. Additionally, the course empowers students to comprehend the underlying principles and functionalities of diverse mass transfer equipment.

Course Outcome:

After Completion of the Course, Student will able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Explain the fundamental principles of mass transfer operations, classification of separation processes, and criteria for selecting suitable separation methods.	10
CO-2	Apply molecular diffusion concepts and Fick's law to analyze steady-state diffusion and estimate diffusion coefficients in gases, liquids, and solids.	20
CO-3	Determine mass transfer coefficients and analyze mass transfer processes using film theory, boundary layer theory, and relevant dimensionless correlations.	20
CO-4	Describe the construction and operation of gas-liquid contact equipment such as tray towers, packed towers, spray towers, and venturi scrubbers.	15
CO-5	Analyze and perform basic design calculations for absorption processes in packed and tray towers.	15
CO-6	Explain principles of distillation processes, phase equilibria, and different types of distillation operations used in chemical industries.	20

Teaching and Examination Scheme:

Teaching /Learning Scheme in Hours Per Semester					Total Credits = TH/30	Examination Marks					Total Marks
L	T	P	PBL	TH	04	Theory Marks		Practical Marks			
						ESE (E)	PA (M)	PA (I)	PBL	ES(V)	
45	0	30	45	120		70	30	20	30	50	200



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Course Content:

Sr. No.	Content	Total Hrs
1	Introduction : Definition and aim of mass transfer operations, Classification of mass transfer operation with examples, Direct Vs Indirect Mass transfer operations, choice of separation method, Methods of conducting mass transfer operations, Design principles	4
2	Diffusion Mass transfer : Molecular Diffusion, Fick's Law of Diffusion, Steady state molecular diffusion in fluids, Diffusion coefficient: Measurement and Prediction, and Diffusivity in Solids.	8
3	Mass transfer coefficient : Concept of Mass Transfer Coefficient, Dimensionless Groups and Correlations for Convective, Mass Transfer co-efficient in Laminar Flow Condition, Boundary Layer Theory and Film Theory in Mass Transfer, Mass Transfer Coefficients in Turbulent Flow, Interphase Mass Transfer and Mass Transfer Theories	7
4	Equipments for Gas Liquid Operations : Gas Dispersed: Sparged vessels, Mechanically agitated vessels, Gas-Liquid contact, Tray Tower, Tray tower internals, Different types of trays, Weirs, Down comers and criteria of their selection, Flooding, Loading, Coning, Weeping & dumping in tray tower Liquid Dispersed: Ventury scrubber, Wetted wall towers, spray towers, Packed Towers, Packed tower internals, Different types of packings and their selection criteria, mass transfer coefficient for packed towers, Co-current flow of gas & liquid, End effects and axial mixing, Tray tower vs. Packed tower	8
5	Absorption : Introduction to Absorption and Solvent selection, Packed Tower Design, Mass Transfer Coefficients Correlation and HETP Concept, Tray Tower Design and Introduction to Multicomponent System	8
6	Distillation : Introduction to Distillation and Phase diagrams, Azeotropes and Enthalpy Concentration Diagrams, Flash Distillation, Batch and Steam Distillation, Fractional Distillation, Packed Tower Distillation, Multicomponent Distillation	10

Sustainability alignment:

This course contributes to SDG 6 (Clean Water and Sanitation), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 14 (Life Below Water) through the study of separation processes and mass transfer techniques that are fundamental to efficient, sustainable, and environmentally responsible industrial operations.

Suggested Specification table with Marks (Theory):



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Distribution of Theory Marks

R Level	U Level	A Level	N Level	E Level	C Level
15	20	25	10	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Principles of Mass Transfer and Separation Processes by B.K Dutta
2. Mass Transfer Principles and Operations by A.P. Sinha and P. De
3. Mass Transfer Operations by R. Treybal

Suggested list of experiments

1. To determine the diffusion co-efficient of CCl_4 in air & with varying temperature.
2. To determine the mass transfer coefficient in Wetted wall column.
3. Study of Simple Distillation
4. Study of Fractional Distillation
5. Study of Steam distillation
6. Study of Distillation in packed columns, HETP.
7. Study of Adsorption in packed bed column.
8. To study the heat and mass transfer of cooling tower under different flow and thermodynamic conditions.

Open source software and website:

Students can refer to video lectures available on the websites including NPTEL.

Activities suggested under self learning:

Sl. No.	Name of the activity	No. of hours	Total Hours
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h	10
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h	10
3.	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2h each.	10
4.	Self learning on-line course	Minimum duration of the course should be 10h.	10
5.	Complex problem solving	Maximum 2 problems. Study of the	10



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		problem and solution finding.	
6.	Poster/chart/power point preparation on technical topics		6
7.	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h	10
8.	Group Discussion on emerging/trending technical topics based on subject		1 hr each
