

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL TECHNOLOGY (36)

BASICS OF MASS TRANSFER

SUBJECT CODE: 2163609

B.E. 6th SEMESTER

Type of course: Chemical Technology

Prerequisite: Studied departmental fundamental chemical engineering subjects in previous semesters. Basic knowledge of chemical engineering is required

Rationale: The objective of this course is to provide a means to teach undergraduate chemical technology students the basic principles of mass transfer and to apply these principles. The aim of this subject is to study mass transfer in unit operations in chemical Industries and different theories of mass transfer in chemical industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	Basics of Mass Transfer : Classification of mass transfer operation, direct contact of two immiscible phases, direct contact of miscible phases unit system	10	20
2	Diffusion: Definition of molecular and eddy diffusivity , Ficks first law, Concept of N & J Flux, Steady state molecular diffusion in fluids at rest and in laminar flow, Diffusivity of gases, Diffusivity of liquids , Applications of molecular diffusion	15	30
3	Inter Phase Mass Transfer: Concept of overall mass transfer coefficient, Concept of effective diffusivity. Film, penetration and surface renewal theory.	15	30
4	Mass transfer operations in process industries: Introduction and types of distillation, absorption, adsorption drying, crystallisation, extraction, humidification and dehumidification.	10	20

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
60	10	10	10	10	00

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

Reference Books:

1. Mass Transfer Operations, R E Treybal, Mc Graw Hill, 1980
2. Unit Operations of Chemical Engineering, Warren McCabe, Jubian Smith and Peter Harriot, Mc Graw Hill, 7th Ed., 2004 .
3. Principles of Mass Transfer and Separation Processes: B. K. Dutta, Prentice-Hall of India Private Ltd., 2007.
4. Transport Processes & Unit Operations in Chemical Engineering, Gean Koplis, Prentice Hall, 2003.
5. Coulson and Richardson's Chemical Engineering Volume 1 - Fluid Flow, Heat Transfer and Mass Transfer , Coulson, J.M.; Richardson, J.F.; Backhurst, J.R.; Harker, J.H. Elsevier, 6th Ed., 1999
6. Coulson and Richardson's Chemical Engineering Volume 2 – Particle Technology and Separation Processes, B J Blackhurst & J H Harker, Elsevier, 5th Ed., 2002
7. Coulson and Richardson's Chemical Engineering Volume 3 – Biochemical Reactors & Process Control, B J Blackhurst & J H Harker, Elsevier, 3rd Ed., 1994
8. Coulson and Richardson's Chemical Engineering Volume 4 – Solutions to the Problems in Chemical Engineering from Vol - 1, B J Blackhurst & J H Harker, Elsevier, 2001
9. Coulson and Richardson's Chemical Engineering Volume 5 – Solutions to the Problems in Chemical Engineering from Vol - 2 and Vol-3, B J Blackhurst & J H Harker, Elsevier, 2001
10. Chemical Engineering Design Volume 6, R K Sinnott, Coulson and Richardson's Chemical Engineering Elsevier, 4th Ed, 2005

Course Outcome:

1. This course on mass transfer introduces the fundamental concepts, principles and applications of mass transfer processes.
2. The course covers mass transfer fundamentals such as diffusion, film and penetration theory and mass transfer coefficients

List of Experiments:

1. Determine diffusion coefficient, or diffusivity
2. Determine the Mass Transfer Coefficient (K_r) **with** Chemical Reaction
3. Determine the Mass Transfer Coefficient (K_r) **without** Chemical Reaction
4. Determine the Mass Transfer Coefficient and flux (N_A) in Gas-Liquid System by Evaporation.
5. Determine the Mass Transfer Coefficient for the gas flowing through the pipe
6. Determine the percentage efficiency for stage wise extraction
7. Determine the efficiency of single stage leaching operation for leaching
8. Determine the yield of crystals in batch crystallizer
9. Carry out differential distillation for binary liquid-liquid system
10. Tray dryer

Design based Problems (DP)/Open Ended Problem:

Students are free to select any area of science and technology based on chemical technology applications to define Projects.

1. To design distillation column
2. To design absorption column

3. To design crystallizer or extractor

Major Equipment:

1. Air-vapor diffusion
2. Mass transfer with/without chemical reaction.
3. Wetted Wall Column
4. Batch Crystallization
5. Tray dryer
6. Vapor liquid equilibrium

List of Open Source Software/learning website:

1. NPTEL Lectures
2. Literature available on internet
3. Literature available under R&D of chemical Industries
4. Research articles
5. Delnet

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.