

INSTITUTE	DIPLOMA STUDIES
PROGRAM	DIPLOMA ENGINEERING (CHEMICAL ENGINEERING)
SEMESTER	4
COURSE TITLE	UNIT OPERATION – III
COURSE CODE	09CH2401
COURSE CREDITS	4

Objective:

- 1 To introduce the basic fundamentals of several Mass Transfer operations carried out in the industry.

Course Outcomes: After completion of this course, student will be able to:

- 1 Classify various Mass Transfer operations being carried out in the industry.
- 2 Appreciate the importance of various M.T. operations.
- 3 Predict the kind of M.T. operation required for a particular separation.

Pre-requisite of course: Basic concepts of units and dimensions, basic knowledge of fluid flow, mass fraction & mole fraction, and material balance.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	0	4	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Introduction to Mass Transfer Operation Importance of Mass Transfer Operation, Classification of Mass Transfer Operations, Choice of separation method, Methods of conducting Mass Transfer Operations.	2
2	Molecular Diffusion in Fluids Definition of Diffusion (a) Molecular diffusion (b) Eddy diffusion, Difference between molecular & turbulent /Eddy diffusion, Rate of diffusion in Mass Transfer, Statement of Fick's first law for diffusivity, Definition of molar flux, Definition of diffusivity and concentration gradient, Effect of temperature / pressure & concentration on diffusivity, General equation for steady state molecular diffusion in fluids (Laminar flow only), Molecular diffusion in gases, Steady state diffusion of following (a) Component A through non diffusing B (b) Equimolar counter current diffusion A and B	7

Contents : Unit	Topics	Contact Hours
3	Interphase Mass Transfer Concept of Equilibrium, Diffusion between phases, Local two phase mass transfer, Local overall mass transfer co-efficient, Use of local and overall mass transfer co-efficient, Average overall mass transfer co-efficient, Co-current & Counter current processes.	5
4	Gas – Absorption Definition and application of absorption, equilibrium solubility of gases in liquids, effect of temperature and pressure on solubility, choice of solvents, and material balance for the component transfer in counter current and concurrent flow, concept of HETP and simple problems on absorption.	5
5	Liquid – Liquid Extraction Definition and application of liquid extraction, liquid equilibrium for three component system, system of three liquids one pair partially soluble, effect of temperature and pressure on the solubility curve, choice of solvents for the operation, simple problems using direct formula, various equipments for liq-liq extraction	5
6	Leaching Definition and industrial application of leaching, preparation of solid, methods of operations and equipment for inplace leaching and heap leaching, shanks system, filterpress leaching and equipment like Rotacel, Kennedy extractor and Balloman extractor.	4
Total Hours		28

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiment 1 To study for finding out rate of diffusion (liquid gas diffusion)	4
2	Experiment 2 To study for finding out diffusion co-efficient (liquid -liquid diffusion)	4
3	Experiment 3 To study for Calculation the M.T. coefficient of vaporization of Water in Air.	4
4	Experiment 4 To study the construction and working of Spray Tower.	4
5	Experiment 5 To Study for gas absorption in Tray Tower	4
6	Experiment 6 To Study about different types of tray for tray tower.	4
7	Experiment 7 To Study for gas absorption in Packed Tower.	4
8	Experiment 8 To Study about classification and type of packings for packed	4

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
9	Experiment 9 To determine the efficiency of single stage extraction.	4
10	Experiment 10 To Study the liquid liquid extraction for acetic acid.	4
11	Experiment 11 To perform caffeine extraction from Tea leaves.	4
12	Experiment 12 To study Leaching process by shanks system.	4
13	Experiment 13 To Study the construction and working of Ballman extractor.	4
14	Experiment 14 To Study the construction and working of Rotacel extractor.	4
Total Hours		56

Textbook :

- 1 Mass Transfer Operations, Robert E. Treybal, Mc-Graw Hill Publications, 1980

References:

- 1 Unit operations in chemical engineering, Unit operations in chemical engineering, McCabe & Smith. , Mc-Graw Hill Publications, 2005
- 2 Introduction to chemical engineering, Introduction to chemical engineering, Badger & Banchero, Mc-Graw Hill Publications, 1955
- 3 Coulson and Richardson's CHEMICAL ENGINEERING VOLUME 2, Coulson and Richardson's CHEMICAL ENGINEERING VOLUME 2, J. M. COULSON & J. F. RICHARDSON, Elsevier Science, 1991

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking
40.00	40.00	10.00	10.00		

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

Instructional Method:

- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Supplementary Resources:

- 1 <https://archive.nptel.ac.in/courses/103/103/103103145/>
- 2 <https://ocw.mit.edu/courses/2-51-intermediate-heat-and-mass-transfer-fall-2008/>