

Subject Code: 09CH0401

Subject Name: Unit Operation - III

Semester: 4th

Objective: To introduce the basic fundamentals of several Mass Transfer operations carried out in the industry.

Credits Earned: 6 Credits

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, mass fraction mole fraction, material balance.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Marks	Practical	Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	VIVA	Term work	
2	0	4	6	50	30	20	25	25	150

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.	02
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) Equimolal counter current diffusion A and B	07

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.	05
4	Humidification: Importance of Humidification operation in Chemical Industry, Definitions: Absolute Humidity, Relative Humidity, % Humidity, Wet Bulb, Dry Bulb, Dew Point, Humid Heat, Humid Volume, Psychrometric Chart, Cooling Towers: Natural Cooling Tower, Forced Cooling Tower.	05
5	Drying: Importance of Drying in processes, principles of drying, equilibrium and free moisture, bound and unbound water, Classification of dryers, solids handling in dryers, equipments for batch and continuous drying processes: working principle of tray driers, tower driers, rotary driers, spray driers. Concept of Freeze drying.	05
6	Equipments for Gas-Liquid Operations: Tray Towers, Different types of Trays, weirs, criteria for selection of trays, Flooding, Loading in Tray Tower, spray Towers, Packed Towers, different types of Packings, Venturi Scrubber.	04
	Total Hours	28

References:

- **Text Book:**

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

- **Reference Book:**

1. Unit operations in chemical engineering - McCabe & Smith.
2. Introduction to chemical engineering -Badger & Banchemo.
3. Chemical engineering vol. 2 -Coulson & Richardson.

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	Understand	Apply	Analyse	Evaluate	Create
20%	40%	20%	20%	-	-

List of Experiments: Any Five experiments to be performed

1. To study for finding out rate of diffusion (liquid gas diffusion)
2. To study for finding out diffusion co-efficient (liquid -liquid diffusion)
3. To study for Calculation the M.T. coefficient of vaporization of Water in Air.
4. To Study the construction and working of Tray Dryer.
5. To Study the construction and working of Rotary Dryer.
6. To Study the construction and working of Spray Dryer.
7. To Study the construction and working of Cooling tower.
8. To Study the construction and working of Tray Tower for Gas liquid Operation.
9. To Study the construction and working of Packed Tower.
10. To Study the construction and working of Venturi Scrubber.

Instructional Method:

- a. 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.
 - b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
 - c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
 - d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory