Subject Code: 09CH1501

Subject Name: Unit Operation - IV

Semester: 5th

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

Credits Earned: 5 Credits

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

1) Classify various Mass Transfer operations being carried out in theindustry.
2) Appreciate the importance of various M.T.operations.
3) Predict the kind of M.T. operation required for a particularseparation.

Pre-requisite of course: MTO-I, Stoichiometry, Fluid flow, Heat Transfer.

Teaching and Examination Scheme

Teaching Scheme (Hours)			**Credits**	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid SemM)	Internal (CSE)	Practical Exam (V)	Term work (TW)	
3	0	4	5	50	30	20	25	25	**150**

Contents:

Unit	Topics	Contact Hours
1	**Distillation:** Introduction & Definition, Types of Industries using Distillation, Significance and uses of Distillation process in industries; Types of Distillation: Batch, Continuous, Flash, Rectification, Steam, Azeotropic. Vapour-Liquid Equilibrium, Raoult's Law, Volatility & Relative Volatility (α), Reflux operation in column & its significance, Reflux Ratio: Minimum, Optimum, and Infinite, Determination of number of stages by McCabe-Thiele method,Introduction of Feed andLocation of the feed tray Physical aspects of Column: Partial & Total Reboiler, Partial &totalCondenser, Plates, Feed Valve. Types of Plates used in Column.	10
2	**Adsorption:** Definition and Industrial application, Types of Adsorption, various equipments for adsorption, commonly used Adsorbents in Chemical Industries, Effect of Temperature on Adsorption, Hysteresis, Freundlich Equation.	06

3	**Gas Absorption:** Definition and application of absorption, equilibrium solubility of gases in liquids, effect of temperature and pressure on solubility, characteristics of ideal liquid solutions of Raoult's law, choice of solvents, and material balance for the component transfer in counter current and concurrent flow, concept of HETP and simple problems onabsorption.	06
4	**Crystallization:** Concept and application, methods for super saturation, classification of crystallizer, Meir's theory, concept of nucleation and crystal growth, effect of seeding and simple calculations for percentage yield, construction and working of Swenson Walker, tank, DTB, Krystal and Vacuum crystallizes.	06
5	**Liquid-Liquid Extraction:** Definition and application of liquid extraction, liquid equilibrium for three component system, equilibrium triangular coordinates, 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.	08
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 Ballomanextractor.	06
	Total Hours	**42**

References:

- **Text Book:**

1. Mass transfer operation" by R.E.Treybal, Mc-Graw Hill international,3rdedition.
2. Mass Transfer- II , K.A. Gavhane, NiraliPrakashan, 16th edition.

- **ReferenceBook:**

1. Unit operations in chemical engineering - McCabe &Smith.
2. Introduction to chemical engineering -Badger&Banchero.
3. Chemical engineering vol. 2 -Coulson &Richardson.
4. Unit Operations of Chemical Engineering,Volume-IP. ChattopadhyayKhanna Publishers, New Delhi, 1995

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**
40%	40%	10%	10%	-	-

List of Experiments: Any Five experiments to be performed

1. Carry out simple distillation in glassassembly.
2. To perform separation of Benzene-Toluene mixture using BatchDistillation.
3. To study and verify Freundlich Adsorption Isotherm adsorbing Oxalic Acid over Charcoal.
4. To study &perform Crystallization operation using Batch Crystallizer and to calculate the crystalyield.
5. To perform caffeine extraction from Tea leaves.
6. To study Leaching process by shankssystem.

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, MOOCsetc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory andclass-room.

c. Practical examination will be conducted at the end of semester for evaluation of performance of students inlaboratory.

d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, VirtualLaboratory.