COURSE TITLE	**MASS TRANSFER-II**
COURSE CODE	**01CH1507**
COURSE CREDITS	**4**

Objective:

1 To apply the basics of mass transfer to build the allied mechanisms and operations those are essential for process industries.

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

1 Understand the phenomenon of mass transfer in various operations using advanced techniques.

2 Analyse mass transfer operation.

3 Select a suitable mass transfer operation for a given separation.

4 Determine the use and implication of distillation process with suitable number of stages and desired type.

5 Determine number of stages and height of packed column in distillation and extraction operation.

Pre-requisite of course: Mass Transfer operation- I

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Absorption** Absorption & Equipments for Gas-Liquid Operations Gas Absorption - Equilibrium solubilities of gases., Material balance for transfer of one component. Counter current multistage operations for binary and multi component systems., Continuous contactors, absorption with chemical reaction. Concept of HTU and NTU. Industrial Absorbers. Sparged vessels (bubble columns),, mechanically agitated vessels for a single phase and gas liquid contact. Liquid dispersed scrubbers,, venturi scrubbers, wetted towers packed towers., Mass transfer coefficients for packed towers concurrent flow of gas and liquid end effect and axial mixing.	12
2	**Distillation** Introduction, Vapor liquid equilibrium, methods of distillation two component mixtures,, The fractionating column, Conditions for varying overflow in non-ideal binary systems,, Batch Distillation, Multicomponent Mixtures, Azeotropic and Extractive distillation,, Steam Distillation, Plate columns, Packed column for distillation	10

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Contents : Unit	Topics	Contact Hours
3	**Leaching & Liquid-liquid Extraction** Introduction & Mass transfer in leaching Operation, Equipment for leaching, Countercurrent washing of solids,, Determination of number of stages, Graphical methods to determine number of stages., Introduction to Extraction Processes, Equilibrium data, Determination of number of theoretical stages,, Classification of extraction equipment, Stage-wise equipment for extraction.	8
4	**Adsorption:** Theories of adsorption, Isotherms,, Application of the Freundlich equation, Industrial adsorbents,, Equilibrium adsorption of vapours, Equipment of adsorption,, Rotating fixed bed adsorption,, Batch & continuous multistage Adsorption.	10
Total Hours		**40**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment 1** To study absorption rate in physical absorption of gas in liquid	2
2	**Experiment 2** To study absorption rate in chemical absorption of gas in liquid	2
3	**experiment 3** To perform separation of Benzene-Water mixture by using Batch Distillation.	2
4	**Experiment 4** To study distillation column operation to find out number of stages.	2
5	**Experiment 5** To verify Rayleigh's equation for differential distillation.	4
6	**Experiment 6** To verify Henry's law for steam distillation.	4
7	**Experiment 7** To Plot the Vapour-Liquid Equilibrium Curve for Carbon Tetrachloride- Toluene mixture.	2
8	**Experiment 8** To study the operation of adsorption in single stage batch operation.	2
9	**Experiment 9** To study the operation of adsorption in continuous operation.	2
10	**Experiment 10** Determine distribution coefficient for liquid-liquid extraction	2
Total Hours		**24**

Textbook :

1 Chemical Engineering, Volume 2, Particle Technology & separation Processes, , Coulson and Richardson, Butterworth Heinemann Publications, 2002

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Textbook :

2 Mass Transfer Operations, 3rd Edition., Treybal R.E, McGraw Hill, 1981

References:

1 "Unit Operation in Chemical Engineering", 5th ed. , "Unit Operation in Chemical Engineering", 5th ed. , McCabe Smith,, McGraw Hill, 1985

2 Multicomponent Mass Transfer: 2 , Multicomponent Mass Transfer: 2 , Ross Taylor and R. Krishna , Wiley-Interscience, 1993

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					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
10.00	20.00	25.00	25.00	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.

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://nptel.ac.in/courses/103104046/

2 https://nptel.ac.in/courses/103103034/

3 https://nptel.ac.in/courses/103103035/

4 https://archive.nptel.ac.in/courses/103/103/103103145/

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