Syllabus for Bachelor of Technology
Chemical Engineering

Subject Code:01CH1406

Subject Name: Mass Transfer-I

B.Tech. Year: 2 (Semester IV)

Objective: The objective of this course is to impart knowledge about basic principles of mass transfer and its application in solving engineering problems involving different mass transfer operations.

Credits Earned: 4 Credits

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

1. Understand basic principles of mass transfer in various operations.
2. Apply the concept of mass transfer theories to the concept of species movement between two phases due to diffusion.
3. Evaluate diffusivity of gases by using empirical equation
4. Analyze the basic parameter to improve the working of crystallizer and dryer.

Pre-requisite of course: None

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (I)	CSE (C)	Viva (V)	Term work (TW)	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Diffusion** Introduction to Mass transfer operation, Concentration, Mass & Molar Average, Velocity, Mass & Molar Flux, N & J flux, Fick's law of diffusion, Steady state molecular diffusion in fluids under stagnant and laminar flow conditions, steady state diffusion: of A through non-diffusing B, equimolar counter diffusion, Effect of Temperature and Pressure on diffusivity, Diffusion coefficient measurement and prediction.	**8**

2	**Interphase Mass Transfer** Concept of Equilibrium, Diffusion between two phases, Modes of Convective Mass transfers. Introduction to Mass transfer coefficients, Gas Phase & Liquid Phase Mass Transfer coefficients, Local & Overall Mass Transfer coefficients, Dimensionless Numbers in Mass transfer, Simultaneous Heat & Mass Transfer, Steady state co-current & counter-current processes. Theories of Mass Transfer	**10**
3	**Crystallization and Humidification** Principles of Crystallization, Super saturation, Nucleation, Crystal growth, Material & Energy Balance applied to Crystallizers, Types of Crystallizers used in practice. Principles of Humidification, Wet Bulb Temperature & Adiabatic Saturation Temperatures, Air/Water System psychrometric, Dehumidification, Cooling Towers, Types of cooling tower, Design calculations of cooling tower	**10**
4	**Drying** Importance of drying in processes, principles of drying, equilibrium and free moisture, bound and unbound water, constant drying conditions, constant-rate period, critical moisture content and falling-rate period, calculation of drying time under constant drying conditions. 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.	**10**
	Total Hours	**38**

List of Experiments:

1. To determine the rate of diffusion and diffusivity coefficient of vapors of organic liquid in atmosphere.
2. To determine mass transfer coefficient of liquid (water) evaporation to atmospheric air at elevated temperature.
3. To determine the rate of drying of wet sand and saw dust in the natural draft tray dryer.
4. To determine the rate of drying of filter cake in the natural draft tray dryer.
5. To determine the yield and percentage recovery of $MgSO_4.7H_2O$ crystal in the batch crystallizer.
6. To determine the wet bulb and dry bulb temperature.
7. To study the colling tower characteristics of water at different air flow rate.

References:

1. "Mass transfer operation" by R. E. Treybal, Mc-Graw Hill international, 3rd edition, 1980.
2. "Principles of Mass transfer & Separation Processes", Binary K. Dutta, PHI Publication, 3rd edition, 2007.
3. "Unit Operations in Chemical Engineering", Warren L. McCabe, Smith, McGraw Hill

Publications, 7th edition, 2005.

4. "Chemical Engineering" Vol. 1 & 2 – Fluid flow, Heat Transfer and Mass Transfer; Coulson & Richardson's, Butterworth – Heinemann Publication, 6th Edition.

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	Analyze	Evaluate	Create
20%	25%	25%	20%	10%	-

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

Design Based Problems (DP)/ Open Ended project (OEP) :

In the beginning of the session, subject faculty will allot an OEP / DP to the students. Students will be free to choose a topic of their choice which will be relevant to the syllabus and they will either prepare a working model/ report / presentation / poster on their topic.

Web Resources:

a. https://nptel.ac.in/courses/103103145
b. https://nptel.ac.in/courses/103103035