Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Diploma Engineering College
Semester 4 (Diploma)

Subject: Mass Transfer Operations – DETCH14206

Type of course: Major

Prerequisite: Basic knowledge of physical changes

Rationale: Mass transfer operations provide the foundation for understanding and controlling the movement of mass between different phases in chemical processes, enabling engineers to design efficient, effective, and high-quality operations.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI - Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE - Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Sr. No.	Course content	Hrs	Weightage
1	**Introduction** Importance of Mass Transfer Operation Classification of Mass Transfer Operations based on direct contact of two immiscible phases, Choice of separation method, Methods of conducting Mass Transfer Operations, Fundamental design principles, Brief idea about mass transfer separation operations possible by Membrane, Direct and Indirect operations	10	20%
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.	20	25%

3	**Interphase Mass Transfer** Concept of equilibrium, Diffusion between phases (Two resistance concept), 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, Definition Stage & Stage efficiency, Definition and types of Cascades, Explain: Film theory, Penetration theory and Surface renewal theory.	15	25%
4.	**Gas Absorption** Definition of Absorption, Application of absorption, Equilibrium solubility of gases in liquids (Two component system), Effect of temperature & pressure on solubility, Characteristics of ideal liquid solution and Raoult's law, Choice of solvent for absorption, One component transferred, material balances (a) counter current flow (b) co-current flow, Minimum liquid gas ratio for absorbers.	15	30%

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1.	**Mass Transfer Equipments:** Students have to visit a chemical industry and list out all equipments where mass transfer takes place. Students need to write a brief description about each equipment and upload on GMIU web portal.	10
2.	**Problem solving**: Students will be given to solve Numerical problems based on diffusion and mass transfer coefficient calculations. Students have to upload them on GMIU web portal.	10
3.	**Industrial applications:** List out and explain all unit operations of 5 different industries where mass transfer takes place and categorize them as per different sectors. Upload a brief report on GMIU webportal.	10
Total		30

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (**Revised Bloom's Taxonomy**)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	20%	25%	15%	20%	00

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Understand the importance of Mass Transfer Operations in Chemical Industries.
CO2	Apply theoretical knowledge of Diffusion in industrial calculations.
CO3	Relate the knowledge of Interphase Mass Transfer Operations in Chemical Industries.
CO4	Calculate Mass Transfer Efficiencies of various Gas Absorption processes.

Instructional Method:

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.

From the content 10% topics are suggested for flipped mode instruction.

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

LIST OF PRACTICALS:

Sr. No.	Practical	Unit	Hours
1	Find out rate of diffusion (liquid gas diffusion) – 1	2	2
2	Find out rate of diffusion (liquid gas diffusion) - 2	2	2
3	Find out diffusion co-efficient (liquid-liquid diffusion)	2	2
4	Find our molar flux of diffusion (liquid-liquid diffusion)	2	4
5	Find out rate of absorption (Air-Sulphuric acid)	4	2
6	Obtain the ternary diagram (water-acetic acid-benzene)	3	4
7	Find out stage efficiency (liquid-liquid co current extraction)	3	4
8	Find out rate of Absorption in packed column	4	4
9	Find out the rate of leaching (salt-sand-water)	3	2
10	Find out the rate of leaching (solid-liquid)	3	4
Total			30

Reference Books:

[1] Mass Transfer operations, Robert E. Treybal.

[2] Unit operations in Chemical Engineering, McCabe & Smith.

[3] Introduction to Chemical Engineering, Badgers & Bancherow.

[4] Chemical Engineering, Kolsen & Richardson.

[5] Unit operations of Chemical Engineering, P. Chattopadhyay.

[6] Hand book of Chemical Engineering, J. H. Perry.