NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	2CH204CC23
Course Title:	Mass Transfer Operations-I
Course Type:	Core
Year of introduction:	2023-2024

L	**T**	**Practical component**				**C**
		LPW	**PW**	**W**	**S**	
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. interpret the concepts of mass transfer operations (BL2)
2. apply the fundamentals of mass transfer operations (BL3)
3. elaborate construction and working mechanism of mass transfer equipment (BL4)
4. solve the problems pertaining to various mass transfer operations like diffusion, gas absorption, liquid-liquid extraction and leaching (BL5)

Syllabus: **Total Teaching hours: 30**

Unit	**Syllabus**	**Teaching hours**
Unit I	**Introduction, Molecular Diffusion and Interphase Mass Transfer:** Molecular diffusion in fluids, Fick's law, Diffusivity of gases and liquids, Mass transfer coefficient, Concept of equilibrium, diffusion between phases.	06
Unit II	**Gas Absorption:** Equilibrium, Choice of solvent for absorption, Material balance for co-current and counter current multistage operation, Minimum liquid-gas ratio for absorption and stripping, Absorption and stripping factor, Equipment for gas absorption.	08
Unit III	**Liquid-Liquid Extraction:** Equilibrium and equilateral-triangular coordinates, Choice of solvent for extraction, Single-stage extraction, Multistage crosscurrent extraction, insoluble liquids, Continuous counter current multistage extraction, Equipment for extraction: Single-stage and multistage mixer-settler cascades and multistage towers.	10
Unit IV	**Leaching:** Equilibrium, Single-stage leaching, Multistage crosscurrent leaching, Multistage counter current leaching, Equipment for leaching: Batch, semi-batch and continuous.	06

Self-Study:
Self-study contents will be declared at the commencement of the semester. Around 10 % of the questions will be asked from the self-study contents.

Laboratory Works:
Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings/ References:

1. Treybal, R. E., Mass transfer operations, McGraw Hill, New York.
2. Coulson, J. M., Richardson, J. F., Backhurst, J. R., & Harker, J. H., Fluid flow, heat transfer and mass transfer, Butterworth-Heinemann.
3. Dutta, B. K., Principles of mass transfer and separation processes, PHI Learning Pvt. Ltd.
4. Cussler, E. L., Diffusion: mass transfer in fluid systems, Cambridge university press.
5. Foust, A. S., Wenzel, L. A., Clump, C. W., Maus, L., & Andersen, L. B., Principles of unit operations, John Wiley & Sons.
6. Geankoplis, C. J., Transport processes and separation process principles, Prentice Hall Professional Technical Reference.

Suggested List of Practical (not restricted to the following) only for information

Sr.	Practical	No. of Hours
1	To determine diffusion coefficient or diffusivity of CCl_4 in air at ambient conditions using Arnold Diffusion Cell (Stefan Tube).	02
2	To determine diffusion coefficient or diffusivity of CCl_4 air at elevated temperature using Arnold's cell. Compare the results for room temperature and elevated temperature.	02
3	To determine the mass transfer coefficient of water and air.	02
4	To evaluate efficiency for single-stage liquid-liquid extraction of acetic acid from the mixture of acetic acid and water.	02
5	To evaluate efficiency for multi-stage liquid-liquid extraction of acetic acid from the mixture of acetic acid and water. Compare and analyse the results of single-stage and multi-stage operation.	02
6	To determine percentage recovery of NaOH from mixture of NaOH and calcium carbonate using water as a solvent for single-stage leaching operation.	02
7	To evaluate the stage efficiency and overall recovery of NaOH for multistage cross-current leaching operation for leaching NaOH from mixture of NaOH and $CaCO_3$ using water as solvent. Compare and analyse the results of single-stage and multi-stage operation.	02
8	To study spray tower for liquid-liquid extraction.	02
9	To evaluate mass transfer coefficient of the given gas absorption system.	02
10	Virtual Lab experiment	02