

# GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. SEMESTER: V

BIO-TECHNOLOGY

Subject Name: **Principles of Process Engineering -II**

Subject Code: **150404**

Teaching Scheme				Evaluation Scheme		
Theory	Tutorial	Practical	Total	University Exam (Theory) (E)	Mid Sem Exam (Theory) (M)	Internal Assessment (I)
3	0	3	6	70	30	50

Sr. No.	Course content
1.	<b>Introduction to mass transfer operations.</b>
2.	<b>Molecular and Eddy Diffusion in Fluids:</b>  Estimation of diffusivities and mass transfer coefficient in laminar flow and turbulent flow, Their co-relations, Analogies in transfer process, Simultaneous heat and mass transfer, Phase relationship for absorption, Distillation, Drying & crystallization, Applications of diffusion.
3.	<b>Inter Phase Mass Transfer:</b>  Concept of overall mass transfer coefficient, Mass transfer in packed bed, Fluidized bed concept of effective diffusivity, Film penetration and surface renewal theory, equilibrium.
4.	<b>Diffusion Through Solids.</b>
5.	<b>Gas Absorption:</b>  Solubility of gasses in liquids, Ideal and non-ideal solution, Choice of solvent for absorption, Material balance and liquid gas ratio for absorption and stripping counter, Current multi stage operation (isothermal), Continuous contact equipment, Introduction to multi component adsorption, Concept of HETP and jh factor, Industrial absorbers.
6.	<b>Liquid Liquid Extraction and Leaching:</b>  Ternary liquid liquid equilibrium and tie line data choice of solvent solvent, Single stage & multistage extraction, Co- current and cross current extraction, Continuous counter current multistage extraction with and without reflux theory & performance of continuous contact equipments, Single stage & multistage equipments, Introduction to extraction with two solvents, Applications of liquid extraction, Steady state and unsteady state leaching equipments, Single stage leaching, Multistage cross current and counter

	current leaching, Rate of leaching recovery of solvent vapours, Application of leaching.
7.	<b>Mass Transfer with Chemical Reactions:</b>  Mass transfer with chemical reaction in case of adsorption, Extraction leaching, Introduction to back mixing in various contacting devices.

### List of Experiments:

1. To determine the % extraction for the benzoic acid from dilute aqueous solution using toluene as solvent.
2. To determine the diffusion co-efficient of  $\text{CCl}_4$  in air & it's variation with temperature.
3. To determine mass transfer co-efficient of liquid evaporation to atmospheric air at different temperatures.
4. To determine the efficiency of single stage leaching operation for leaching of NaOH aqueous solution &  $\text{CaCO}_3$ .
5. To find out the liquid side mass transfer coefficient  $K_L a$  for the absorption of  $\text{CO}_2$  in NaOH in the packed column.
6. To determine the mass transfer co-efficient for dissolution of benzoic acid with and without chemical reaction.
7. To determine ternary phase diagram for Benzene (A), Water(B), Acetic acid(C) system.
8. To study the (cross current) liquid-liquid extraction for extracting acetic acid from benzene using water as solvent.
9. To determine the mass transfer coefficient in a stirred cell.
10. To determine the stage efficiency and the overall recovery of NaOH for multistage cross current leaching operation for leaching NaOH from mixture of NaOH and  $\text{CaCO}_3$  using water as a solvent.
11. To determine the mass transfer co-efficient of vaporization of Naphthalene ( $\text{C}_{10}\text{H}_8$ ) to air.

### Reference Books:

1. "Mass transfer operation" by R. E Treybal, Mc-Graw Hill, Kogakushs Ltd.
2. "Mass transfer with Chemical reaction" by G Astavita Elsevier Co.
3. "Fundamentals of Mass Transfer" by V. Katarov, Mir publishers.