19CH205 MASS TRANSFER OPERATIONS - I

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	60	-	-	5	5

Source:
-http://www.hitekengineers.com/absorption-system.html

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with mass transfer phenomena and its usage for engineering application. The general objectives of this course are to discuss the fundamental concepts of mass transfer principles such as diffusion phenomena, absorption, stripping, humidification, drying and design of various mass transfer equipments and to apply those concepts towards real problems in process industry.

COURSE OUTCOMES :

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Articulate equation to estimate diffusivities in fluids & solids using the principles of engineering sciences along with the estimation of mass transfer coefficients for gas –liquid contacting systems.	1,2
2	Apply mass transfer fundamentals and correlate their theoretical knowledge to determine rates of mass transfer and design the system components for various operations.	3
3	Apply of the principles of novel separation process to evaluate societal, health and safety by subsequent responsibilities.	2
4	Conduct experiments in teams related to various mass transfer operations and design various prototype or pilot plant setup for mass transfer.	3,9
5	Interpret experimental data to estimate mass transfer co-efficient and provide valid conclusions on suitability of the process.	4

SKILLS:

- ✓ *Estimate the diffusion coefficients for binary and ternary mixture.*
- ✓ *Specification and design of various mass transfer equipment.*
- ✓ *Estimate the correlation of mass transfer coefficients in packed and fluidized bed absorption column.*
- ✓ *Design specifications of cooling tower.*
- ✓ *Design calculation of rotary dryer.*

UNIT - I **L-9**

DIFFUSION AND MASS TRANSFER : Mass transfer operations; Molecular diffusion in fluids and in binary solutions; Fick's Law; Steady state equimolar counter current diffusion; Application of molecular diffusion; Theories of mass transfer; Diffusion in fluids; Mass transfer coefficients in laminar and turbulent flow; Diffusion through solids; Dimensionless groups in mass transfer; Mass transfer coefficients in wetted wall column.

UNIT - II **L-9**

INTERPHASE MASS TRANSFER : Concept of equilibrium; Diffusion between phases; Material balance in- steady state, co–current and counter current stage processes; Sparged vessels; Agitated vessels; Venturi scrubbers; Sieve tray design for absorption tray tower verses packed tower; Loading and flooding in a packed column.

UNIT - III **L-9**

ABSORPTION AND STRIPPING : Introduction; Counter and co–current absorption; Isothermal absorption and stripping of single component; Operating lines; Minimum flow rate; Determination of number of transfer units and height of continuous absorber; Determination of number of plates; Absorption factor; Kremser-Brown equations.

UNIT - IV **L-9**

HUMIDIFICATION : Introduction; Vapor pressure curve; Definitions; Psychometric charts; Enthalpy of vapor gas mixtures; Humidification and dehumidification; Cooling towers.

UNIT - V **L-9**

DRYING : Introduction; Definitions of various moisture contents; Drying conditions; Rate of batch drying under constant drying conditions; Mechanism of batch drying; Drying time through circulation drying; Batch and continuous drying.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Estimation of diffusivity in gas phase.
2. Estimation of diffusivity in liquid phase.
3. Determination of batch drying characteristics using tray dryer.
4. Determination of batch drying characteristics using vacuum dryer.
5. Determine the pressure drop and flooding characteristics in a packed column.
6. Determination of hydrodynamic characteristics of a packed column.
7. Verification of Himus equation through surface evaporation.
8. Estimation of solid diffusion coefficient.
9. Estimation of distribution coefficient.
10. Determination of solubility of a ternary system.
11. Oil extraction by soxhelet apparatus.
12. Determination of the mass transfer coefficient for absorption of CO_2 in NaOH solution in packed Column.
13. Estimate the drying characteristics curve under constant drying condition in the rotary dryer.
14. Study the design and operating principles of spray dryer.
15. Study the characteristics of cooling tower experiment.

TEXT BOOKS:

1. Treybal R. E., "Mass Transfer Operations", 3rd edition, McGraw-Hill, 2005.
2. Binay. K. Dutta, "Principles of Mass Transfer and Separation Processes", 2nd edition, Prentice Hall of India, New Delhi, 2009.

REFERENCE BOOKS:

1. Christie J. Geankoplis., "Transport Processes and Separation Process Principles", 4th edition, Prentice Hall India Pvt. Ltd., 2003.
2. Judson King C., "Separation Processes", 2nd edition, McGraw-Hill, 2005.
3. J. D. Seader, Ernest J. Henley and D. Keith Roper, "Separation Process Principles-chemical and Biochemical Operations", 3rd edition, John Wiley& Sons, Inc, 2011.