CH311	MASS TRANSFER OPERATIONS-I	L	T	P	C	Int	Ext
		2	1	-	3.0	30	70

Semester V [Third Year]

COURSE OBJECTIVES:

1. To impart the principles of mass transfer.
2. To learn the concepts of mass transfer coefficient and its estimation.
3. To understand the principles of various mass transfer equipment.
4. To describe the drying and humidification processes.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Estimate the rate of material transfer in different mass transfer operations.
2. Calculate mass transfer coefficients at interfaces of multiphase mass transfer systems.
3. Appraise different types of equipment and their operation for gas-liquid separations and design of the absorption tower.
4. Design the drying and humidification.

UNIT I [CO:1] **(12)**

Molecular Diffusion: Steady state diffusion into fluids at rest and in laminar flow, continuity equation, Fickâ€™s law, diffusion coefficient, diffusion in binary gas mixtures, one component stagnant.

Diffusion in binary gas mixtures, equimolar counter diffusion, non-equimolar counter diffusion, estimation of diffusivities in liquids and gases, diffusion in solids.

UNIT II [CO:2] **(12)**

Mass transfer coefficient: Mass transfer into a single phase: notation for mass transfer coefficients for liquids and gases, mass transfer from gas into a flat falling liquid film, Sherwood number, Peclet number, Schmidt number, Reynolds number, mass transfer coefficient correlations for laminar and turbulent flow in circular pipes.

Theories of Mass Transfer: film theory, penetration theory, surface renewal theory, Boundary Layer theory. Analogy between mass, heat and momentum transfer

Interphase Mass Transfer: Diffusion on both sides of an interface, relationship of overall mass transfer coefficient with either side mass transfer coefficient. Material Balances (theoretical only): Steady state co current process, Steady state counter current process, Cross flow cascades and Countercurrent cascades.

UNIT III [CO:3] **(12)**

Equipment for Gas Liquid Operations: Gas dispersed: Sparged vessels, diameter of gas bubbles, gas hold up, specific interfacial area, mass transfer coefficient, Tray towers: bubble cap trays. Liquid dispersed: Venturi scrubbers, wetted wall tower, spray tower, packed tower, types of packing, mass transfer coefficient in packed tower.

Gas Absorption: Solubility of gases in liquids, ideal liquid solutions, non-ideal liquid solutions, choice of solvent for absorption. Single component absorption material balance counter current multi stage operations in plate tower, absorption of one component in packed tower, HETP concept.

UNIT IV [CO:4] **(12)**

Humidification: Vapor-gas mixtures, absolute humidity, dry bulb temperature, relative saturation, percentage saturation, dew point, enthalpy, psychrometric charts, air water system, wet bulb temperature, Lewis relation, Adiabatic operation â€“ design of water cooling with air, Non-adiabatic operation evaporative cooling.

Drying: Batch drying, rate of batch drying, time of drying, mechanism of batch drying, equipment for batch and continuous drying operations.

LEARNING RESOURCES:

TEXT BOOK:

Mass Transfer Operations, Robert E. Treybal, 3rd edition, International Edition, McGraw Hill (1981).

REFERENCE BOOK(s):

1. Principles of Mass Transfer and Separation Processes, Binay K. Dutta, 2nd edition, Prentice Hall of India, 2007
2. Mass Transfer: Theory and Applications, KV Narayanan, B Lakshmikutty, 2nd Edition, CBS Publishers And Distributors Pvt Ltd.
3. Transport process and separation process principles, Christie John Geankoplis, 4th edition, PHI (2009).
4. Separation Process Principles, J D Seader and E J Henly, 2nd Edition, John Wiley & sons (2006).
5. Diffusion - Mass Transfer in Fluid Systems, E.D. Cussler, Cambridge University Press, Cambridge 1984.
6. Principles of Unit Operations, S. Foust, 2nd Edition, Wiley, New York, 1980.