Teaching Scheme					Mass Transfer – I (22PCM211T)					
					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn to evaluate mass transfer rates under laminar and turbulent conditions.
- Learn the principles of adsorption, absorption and distillation operations.
- Provide introduction to physical and thermodynamic principles of mass transfer.
- Learn the design principles of mass transfer equipments.

UNIT I: Introduction to mass transfer **11 Hr.**

Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; Diffusivity measurement and prediction; Multi-component diffusion; Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients; NTU and NTP concepts; Stage-wise and differential contractors.

UNIT II: Absorption operations **10 Hr.**

Principles of absorption; Single and multicomponent absorption; Absorption with chemical reaction, equilibrium and material balance; Limiting gas-liquid ratio; Tray tower absorber design: Calculation of number of theoretical stages, tray efficiency, tower diameter; Packed tower absorber: Rate based approach, determination of height of packing using HTU and NTU calculations; Industrial absorbers.

UNIT III: Adsorption operations **10 Hr.**

Adsorption: Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms; Adsorption operations: Stage wise operations, steady state moving bed and unsteady state fixed bed adsorbers; Break through curves.

UNIT IV: Distillation operations **11 Hr.**

Vapour liquid equilibria; Raoult's law; Vapour-liquid equilibrium diagrams for ideal and non-ideal systems; Enthalpy concentration diagrams; Distillation methods: Flash distillation, differential distillation, steam distillation, azeotropic distillation, extractive distillation and multistage continuous rectification; Number of ideal stages by McCabe Thiele method; Total reflux, minimum reflux ratio and optimum reflux ratio; Industrial distillation equipment.

Max. 42 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Understand the mechanisms and functioning of absorption, adsorption and distillation equipment.
CO2: Acquaint with various gas-liquid, vapour-liquid, solid-liquid and liquid-liquid equilibrium.
CO3: Apply correlations for estimating diffusion and mass transfer coefficients.
CO4: Investigate multi-stage equilibrium separation processes.
CO5: Apply diffusive and convective mass transfer equations and correlations.
CO6: Design absorber, adsorber and distillation column.

TEXT/REFERENCE BOOKS

1. Treybal R.E., "Mass Transfer Operations", 3rd Edition. Mcgraw Hill, (1981).

2. McCabe, W.L., Smith, J.C., and Hariott, P., "Unit Operations of Chemical Engineering", 7th Edition, McGrawHill, (2012).
3. Geankoplis C.J. "Transport Processes and Unit Operations", 3rd Edition, Prentice Hall of India, (2002).
4. Coulson and Richardson's, "Chemical Engineering. Vol I & II", Asian Books Pvt Ltd, (1998).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks