LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Chemical Engineering (708)

Bachelor of Engineering (B.E.) - Semester – VI

Course Code:	**017084601**
Course Name:	**Advanced Separation Techniques**
Category of Course:	Professional Elective Course (PEC)
Prerequisite Course:	Mass Transfer I, Mass Transfer II, Thermodynamics II

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
4	**0**	**0**	**4**	**40**

Syllabus

Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Introduction to Advanced Separation Techniques & Super Critical Extraction**			**5 (12.5%)**
	1.1 Introduction to Advanced Separation Techniques	Methods of Conducting Mass Transfer Operations	---	
	1.2 Working principle of super critical extraction	Liquid- Liquid Equilibrium		
	1.3 Advantages and disadvantages of super critical solvents over conventional liquid solvents	---	---	
	1.4 Advantages and disadvantages of super critical extraction over liquid-liquid extraction	---	---	
	1.5 Decaffeination	---	---	
	1.6 ROSE process	---	---	
	1.7 Application of SCE	---	---	
02	**Short Path Distillation**			**5 (12.5%)**
	2.1 Principle of Short Path Distillation	Vapor-liquid Equilibria	---	
	2.2 Design and Working of Short Path Distillation Unit	---	---	
	2.3 Molecular Distillation	---	---	
	2.4 Application of Short Path Distillation	---	---	
03	**Reactive and Catalytic Distillation**			**5 (12.5%)**
	3.1 Principle of reactive and catalytic distillation	Packed bed Tower	---	
	3.2 Advantages and Disadvantages	---	---	
	3.3 BALE & KATMAX packings	---	---	
	3.4 Manufacturing of MTBE	---	---	
	3.5 Manufacturing of ETBE	---	---	
04	**Pressure Swing Distillation**			**5 (12.5%)**
	4.1 Concept & Working of PSD	Minimum and maximum boiling azeotropic mixtures	---	
	4.2 Advantage & Disadvantages of PSD Over Azeotropic	Azeotropic Distillation	---	
	4.3 Advantage & Disadvantages of PSD Over Extractive Distillation	Extractive Distillation	---	
	4.4 Applications	---	---	
05	**Membrane Separation Technique**			**4 (10%)**
	5.1 Mechanisms of membrane separation technique	Molecular Diffusion in Fluids	---	
	5.2 Membrane materials and various membrane modules	---	---	
	5.3 Classification of membrane separation processes	---	---	
	5.4 Advantages of membrane separation processes	---	---	
06	**Reverse Osmosis**			**3 (7.5%)**
	6.1 Concept of osmosis and reverse osmosis	The Chemical Potential as a Criterion for Phase Equilibria	---	
	6.2 Different types of membrane module and membrane materials for RO	---	---	
	6.3 Advantages and disadvantages of RO	---	---	
	6.4 Application of RO	---	---	
07	**Ultrafiltration and Nano filtration**			**3 (7.5%)**
	7.1 Working principle of ultrafiltration	Diffusion Between Phases	---	
	7.2 Ultrafiltration membranes and modules	---	---	
	7.3 Applications of ultrafiltration and nano filtration	---	---	
08	**Pervaporization**			**3 (7.5%)**
	8.1 Basic Principle of Pervaporization	Equilibrium Solubility of Gases in Liquids	---	
	8.2 Advantages of Pervaporization	---	---	
	8.3 Production of absolute alcohol and other application of Pervaporization	---	---	
09	**Membrane Reactor**			**3 (7.5%)**
	9.1 Concept of membrane reactor	---	---	
	9.2 Various modules of membrane used in membrane reactor	---	---	

	9.3 Advantages and disadvantages	---	---	
	9.4 Application of membrane reactor	---	---	
10	**Pressure Swing Adsorption**			**4 (10%)**
	10.1 Concept of PSA	---	---	
	10.2 Working of PSA	---	---	
	10.3 Advantages & Disadvantages of PSA over cryogenic distillation	---	---	
	10.4 Commercial application of PSA	---	---	

Proposed Theory + Practical Evaluation Scheme by Academicians
(% Weightage Category Wise and it's Marks Distribution)

L:	4	T:	0	P:	0

Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.
Each Test will be of 25 Marks.
Each Test Syllabus Weightage: Range should be 20% - 30%

Group (Theory or Practical)	Group (Theory or Practical) Credit	Total Subject Credit	Category	% Weightage	Marks Weightage
Theory	4	4	MCQ	40%	40
Theory			Theory Descriptive	60%	60
Theory			Formulas and Derivation	00%	00
Theory			Numerical	00%	00
Expected Theory %	**100%**		**Calculated Theory %**	**100%**	**100**
Practical	0		Individual Project	0%	0
Practical			Group Project	0%	0
Practical			Internal Practical Evaluation (IPE)	0%	0
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical %	**0%**		**Calculated Practical %**	**0%**	**100**
Overall %	**100%**			**100%**	**100**

Course Outcome	
1	To develop proficiency in advanced separation techniques including supercritical extraction and short path distillation for practical application in diverse industries.
2	To understand, apply, and optimize reactive and catalytic distillation techniques, as well as pressure swing distillation methods, for enhanced separation efficiency and process optimization in chemical engineering applications.
3	To optimize membrane separation techniques across various industries by developing a deep understanding of membrane materials, module designs, transport mechanisms, and their applications in separation processes.
4	To apply the advanced separation techniques in industrial settings by comprehending their principles, optimizing process parameters, and addressing challenges for enhanced efficiency and sustainability.
Suggested Reference Books	
1	Membrane separation Processes, Kaushik Nath, PHI pvt. Ltd
2	Introduction to process Engineering & Design, S.B. Thakore & B.I Bhatt, Tata Mc Graw Hill Ltd.
3	Perry Chemical Engineers Handbook, R.H Perry and D. Green, Mc Graw Hill Ltd
4	Kirk-Othmer Concise Encyclopedia of Chemical Technology, Kirk-Othmer, John Wiley And Sons

List of Open Source Software/Learning Website	
1	https://onlinecourses.nptel.ac.in/noc24_ch18/preview