GUJARAT TECHNOLOGICAL UNIVERSITY
CHEMICAL ENGINEERING (Computer Aided Process Design) (16)

SUBJECT CODE: 3711610
Novel Separation Techniques
SEMESTER: I

Type of course: Program Elective - I

Prerequisite: A course on Separation Techniques

Rationale: In this subject emphasis is given on Novel Separation Techniques that can be used in real industrial problems. It includes membrane separation techniques, advanced distillation techniques and some other techniques. With understanding of this subject, student can find solution of difficult separation problems, otherwise.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Contents:

Sr. No.	Content	Total Hrs	% Weightage
1.	**Chromatographic method of separation** Gel, Solvent, Ion and High performance Liquid Chromatography	3	6
2.	**Membrane Distillation** Working principles, Membrane Characteristics and Membrane Distillation mechanism, Membrane Distillation configurations (arrangements), Factors affecting Membrane Distillation, Effect of operating parameters, Advantages and disadvantages, Applications.	5	10
3.	**Membrane Reactor** Concept & working, Various modules of membrane used for membrane reactor, Advantages & Disadvantages, Industrial applications.	4	7
4.	**Membrane separation technique** Principles, mechanisms, cross flow, membrane materials and various membrane modules used in membrane separation processes, Reverse Osmosis, different types of membrane materials and modules used for R.O., Membrane Reactor,	6	11
5.	**Electroextraction** Working principles of mass transfer under the action of electric field, Effects of electric field on interface of two liquid phases, Criteria for selecting other liquid phase, difficulties involved in the process like effect of pH, electro osmosis etc., Applicable fields, design of batch flow and continuous flow apparatus.	5	10
6.	**Reactive & Catalytic Distillation** Principles, commercial packing, Industrial applications like	5	10

	Etherification process, Esterification Processes, Alkylation Processes and Advantages.		
7.	**Super Critical Extraction** Working Principle, Decaffeination, ROSE process, Commercial applications of supercritical extraction, Advantages and disadvantages.	4	7
8.	**Ultrafiltration and nano filtration** Concept & working principal ultrafiltration Vs Conventional filtration, Ultrafiltration membranes and modules, Commercial applications of ultrafiltration and nano filtration.	4	7
9.	**Pressure Swing Operations** Concept & Working of Pressure Swing Distillation and Pressure Swing Adsorption, Advantage & Disadvantages, Industrial applications.	6	11
10.	**Short path Distillation** Concept & working of short path Distillation Unit (SPDU), Difference between short path Distillation & molecular distillation, applications of SPDU.	4	7
11.	**Pervaporization** Working principle, Advantages, Commercial applications.	4	7
12.	**Melt crystallization** Concept, Phase equilibrium, Different techniques, Commercial applications	4	7

Reference Books:

1. "Membrane separation Processes" by Kaushik Nath, PHI pvt. Ltd., 2008
2. "Introduction to process Engineering & Design" by S.B. Thakore & B.I Bhatt, Tata McGraw-Hill Ltd.,2007
3. Perry Chemical Engineers Handbook' 7th Edition by R.H Perry and D. Green.
4. Ullman's Encyclopedia of Industrial Chemistry.
5. "Encyclopedia of Chemical Engineering" by Kirk & Othmer.
6. "Natural Extracts using supercritical carbon dioxide" M. Mukhopadhyay

Course Outcome: After learning the course the students should be able:

1. To built advanced concepts of separation techniques used in chemical industries.
2. To understand the principles and functioning advanced separation techniques.
3. To utilize the advanced separation technique in problem solving where conventional techniques are not fruitful and require replacement.
4. To understand the applications of advanced separation techniques as per industrial requirement.
5. To recognize the selection criteria between advanced separation techniques and conventional separation techniques.

List of Open Source Software/learning website:

- NPTEL lecture series
- Literature available on Process Control and automation
- MIT Open course lecture on Process Dynamics