GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3173519
Semester – VII
Subject Name: Advanced Separation Techniques

Type of course: Professional Elective Course

Prerequisite: None.

Rationale: Separation techniques are integral unit operation in most of the modern chemical, pharmaceutical and other process plants. There are many standard and conventional separation techniques available in the market and these techniques are quite common and the relevant technologies as well as well-developed and well-studied. On the other hand, newer separation processes, like, membrane based techniques, chromatographic separation, super critical fluid extraction, etc., are gaining importance in modern days plants. The present course is designed to emphasize on these novel separation processes. The course is designed for an elective subject of final year undergraduate students.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1.	**Super Critical Extraction** Working Principal, Advantage & Disadvantages of supercritical solvents over conventional liquid solvents, Advantage & Disadvantages of supercritical extraction over liquid- liquid Extraction, Decaffeination, ROSE process, Commercial applications of supercritical extraction. **Short path Distillation:** Concept & working of short path Distillation Unit (SPDU), Difference between short path Distillation & molecular distillation, applications of SPDU.	10

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2.	**Reactive & Catalytic Distillation:** Concept, Advantage & Disadvantages, BALE & KATMAX packing Manufacturing of MTBE and ETBE and it's comparison with conventional techniques **Pressure Swing Distillation:** Concept & Working, Advantage & Disadvantages of PSD over azeotropic and Extractive Distillation, Applications	08
3.	**Membrane separation technique:** Principles, mechanisms, cross flow, membrane materials and various membrane modules used in membrane separation processes, Classification, application & advantages of membrane separation processes. **Pressure Swing Adsorption:** Concept & Working, Advantages & Disadvantages of PSA over cryogenic distillation, four step PSA, six step PSA, Purification of hydrogen, oxygen, Nitrogen & other commercial applications of PSA.	10
4.	**Melt crystallization:** Concept, phase equilibrium, different techniques, commercial applications. **Ultrafiltration and nano filtration:** Concept & working principal ultrafiltration Vs Conventional filtration, Ultrafiltration membranes and modules, Commercial applications of ultrafiltration and nano filtration. **Membrane or Osmotic Distillation:** Working Principal, Various applications, etc.	08

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**21**	**21**	**7**	**7**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

List of Experiments:

1. In the beginning of the academic term, faculties will have to allot their students at least one Open-ended Project / Study Report /Latest outcome in technology.
2. Literature survey including patents and research papers of fundamental process

- Design based small project or
- Study report based on latest scientific development or
- Technology study report/modeling/ simulation/collection report or

- Computer based simulation/web based application/analysis presentations of basic concept field which may help them in chemical engineering.

3. These can be done in a group containing maximum three students in each.
4. Faculties should cultivate problem based project to enhance the basic mental and technical level of students.
5. Evaluation should be done on approach of the student on his/her efforts (not on completion) to study the design module of given task.

Course Outcomes: After learning this course students will be able to:

Sr. No.	CO statement	Weightage
CO-1	Identify separation techniques using reactive distillation.	20
CO-2	Explain separation using membrane modules.	15
CO-3	Assess separation techniques using supercritical extraction	15
CO-4	Classify membrane modules for reverse osmosis.	15
CO-5	Design separation techniques using short path distillation.	20
CO-6	Validate separation techniques using reactive distillation.	15

Text 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

Reference Books:

1. Perry Chemical Engineers Handbook' 7th Edition by R.H Perry and D. Green.
2. Ullman's Encyclopedia of Industrial Chemistry.
3. "Encyclopedia of Chemical Engineering" by Kirk & Othmer.
4. "Natural Extracts using supercritical carbon dioxide" M. Mukhopadhyay

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