

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30) ADVANCED SEPARATION PROCESSES SUBJECT CODE: 2733004 M.E. 3rd SEMESTER

Type of course: Chemical Engineering (MAJOR ELECTIVE - IV)

Prerequisite: Mass transfer operations and separation fundamentals at undergraduate level

Rationale: The advanced separation processes allows students to undertake advanced study of separation processes involved in chemical industries coupled with new technological innovations. In present scenario, industries are advancing by approaching these techniques for complex systems and for that purpose this subject is introduced in post graduation course to provide firm foundation the same.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topic	Teaching Hours	Module Weightage (%)
1.	Introduction: Separation factors and it's dependence on different variables. mechanism of separation, separation by phase addition or creation, separation by barrier, separation by solid agent, separation by external field or gradient, component recoveries and product purities, separation power, selection of feasible separation processes.	8	14
2.	Advances in Adsorption Types and choice of adsorptions, Ion exchangers, sorbents for chromatography, equilibria in chromatography, Chromatographic techniques, adsorption chromatography, Retention theory mechanism for slurry adsorption, Fixed bed adsorption (Percolations), thermal swing adsorption, pressure swing adsorption, continuous counter current adsorption systems.	11	21
3.	Supercritical fluid extraction: Supercritical fluids, phase equilibria, industrial application, important supercritical processes- decaffination of coffee, extraction of oil from seeds, Residuum Oil Supercritical Extraction (ROSE), supercritical fluid reactions ,etc.	8	15
4.	Reactive and catalytic distillation : Concept and History, advantages and disadvantages, Various methods of applications, manufacturing of MTBE and ETBE and other commercial applications.	8	15
5.	Advances in crystallization : Melt crystallization, Fractional crystallization, zone melting, freeze crystallization, etc.	6	11
6.	Advances in distillation: Soft path distillation, Molecular distillation, Extractive and	8	15

	Azeotropic distillation, Pressure swing distillation, Salt distillation, Osmotic distillation, etc.		
7.	Membrane Reactor: Working of Membrane reactor, Various modules of membrane used for membrane reactor, advantages & disadvantages, application under research.	5	9

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. "Handbook of separation techniques for Chemical Engineers", Schweitzer P.A. (Ed.), 3rd Edition, McGraw-Hill, New York, 1997.
5. "Reactive Distillation", John Wiley & Sons, New York, 2000.
6. "Separation processes" by C.J King, Tata McGraw Hill, New Delhi, 1982.
7. "Mass Transfer" by T.K. Sherwood, R.L. Pigford and C.R. Wilke, McGraw-Hill, New York (1975).
8. "Mass transfer operations", R.E. Treybal, McGraw-Hill, New York (1980).
9. New Chemical Engineering separation Techniques' by H.M. Schoen, Wiley Interscience, New York, 1972.
10. "Handbook of separation process Technology" by Ronald W. Roussel, John Wiley, New York, 1987.
11. "Reactive separation processes" by Kulprathipanja S., Taylor and Francis, New York, 2002

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

1. To built advanced concepts of separation processes carried out in chemical industries.
2. To understand the designing and functioning of equipments required for the separations in chemical engineering
3. To utilize the innovative technological methods in problem solving of separation in industries.
4. To understand the applications of advanced separative equipments.
5. To recognize the selection criteria between conventional separation techniques and advanced separation techniques.

List of Experiments and major equipments:

Any five practicals performance of advanced separation processes viz.

1. Perform separation processes using Chromatography
2. Perform separation processes using reactive distillation
3. Perform separation processes using extraction or azeotropic distillation
4. Perform separation processes using Ion exchangers
5. Perform separation processes using Supercritical fluid extraction

Open Ended Project:

The practical work at masters must be largely consisting of OEP. In each case a sample set may be provided and the faculty member may be empowered to select appropriate problems for practical work. At the end of semester before submission of marks of PA and term work, the faculty member will upload the three best problems done by the students during the practical hours. The title area of project with practical problems along with the complete details and names of the students and name of the supervisor, branch and name of the college be specified so that this information can be published from GTU website.

Open Ended projects in Advanced separation processes may include:

1. Review chart of application of advanced separation processes in process industry.
2. Fabrication of reactive/ catalytic distillation unit.
3. Fabrication of packed bed for adsorption.
4. Fabrication and performance evaluation of any advanced distillation system.

List of Open Source Software/learning website:

- Students can refer to video lectures available on various websites including NPTEL
- Students can refer to the CDs which are available with some reference books for the solutions of problems using softwares. Students can develop their own programs for the solutions using excel, Chemical and other simulation softwares.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. Every student or a group of students shall critically study two paper, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.