

Course code	Course Name	L-T-P-Credits	Year of Introduction
CH371	NOVEL SEPARATION PROCESS	3-0-0 3	2016
<b>Prerequisite: Nil</b>			
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>• To identify the multiple factors influencing the choice of separation techniques.</li> <li>• To be able to qualitatively and quantitatively address the fundamental aspects of separation processes.</li> </ul>			
<b>Syllabus</b>			
<p>Overview of Separation Processes - Characteristics and selection- Membrane processes - Type and choice of membranes- Membrane filtration- Reverse Osmosis- Dialysis- Models for membrane separations – Surfactant based separation techniques - Microemulsion / Macroemulsions- Hydrotopes - Solvent ablation- Adsorption - Adsorbents, Adsorption equilibrium- Interacting Adsorption systems - Adsorption-Desorption operations - Basics of Ion exchange- Ion movement theory- Applications - Mass transfer in ion exchange systems. Chromatographic separations - selective adsorption of biological macromolecules- Simulated countercurrent techniques - Comparison with other separation methods.</p>			
<b>Expected Outcome</b>			
<p>On successful completion of the course, the student will be able to</p> <ol style="list-style-type: none"> <li>i. Explain the separation by Membrane process</li> <li>ii. Explain the separation by adsorption and select suitable adsorbent for recovery of solute and solve the related problems.</li> <li>iii. Explain the treatment of process liquids by ion exchange process and it's applications.</li> <li>iv. Explain the treatment of process liquids by Chromatographic Separations and it's applications.</li> </ol>			
<b>Text Books</b>			
<ol style="list-style-type: none"> <li>1. Seader, J D, and Ernest J Henley. <i>Separation Process Principles</i>. New York, Wiley, 1998.</li> <li>2. Marcel Mulder, "Basic Principles of Membrane Technology", 2 Ed., Springer Publications, 2007</li> <li>3. King C. J.; "Separation Processes"; Tata McGraw–Hill Publishing Co. Ltd., 1982.</li> <li>4. Wankat, P. C. "Rate- Controlled Separations", Springer, 1994.</li> </ol>			
<b>References</b>			
<ol style="list-style-type: none"> <li>1. Nunes S P, Peinemann K V, "Membrane Technology in the chemical industry", 2nd Edition, Wiley-VCH, 2006.</li> <li>2. Rautanbach and Albrecht R., "Membrane Process", John Wiley and Sons.1989.</li> <li>3. Crespo. J G, Bodekes K W, "Membrane Processes in separation and Purification", Kluwer Academic Publications, Netherland, 1994.</li> <li>4. Geankopolis C J "Transport processes and Unit Operations", 4th Edition, PHI, New Delhi, 2006.</li> <li>5. Philip Schweitzer; "Handbook of Separation Techniques for Chemical Engineers", Third Edition, Tata McGraw Hill New York, 1997.</li> </ol>			

<b>Course Plan</b>			
<b>Module</b>	<b>Contents</b>	<b>Hours</b>	<b>Sem. exam marks</b>
I	<b>Overview of Separation Processes and their Selection :</b> Characteristics and selection of separation process: Importance and variety of separation, economic significance, inherent separation factor, selection, factors influencing the choice of separation process, solvent selection , selection of equipment. Recent advances in separation techniques based on size, surface proper ties, ionic properties and other special characteristics of substances, Rate based versus equilibrium separation processes, Selection of separation process, Energy requirements of separation processes.	7	15%
II	<b>Membrane processes:</b> Introduction, Type and choice of membranes, Plate and frame, tubular, spiral wound and hollow fibre membrane reactors and their relative merits, Membrane filtration, Microfiltration, Ultrafiltration, Reverse Osmosis, Dialysis, Models for membrane separations.	7	15%
<b>FIRST INTERNAL EXAMINATION</b>			
III	<b>Surfactant Based Separation Techniques:</b> Basic principles, classifications, Surfactants at Inter phases and in bulk, Foam fractionation, Foam flotation, Adsorptive bubble separations, Ion flotation, Micro emulsion /Macro emulsions, Hydrotopes, Solvent ablation.	7	15%
IV	<b>Adsorption:</b> Adsorbents, Adsorption equilibrium, Interacting Adsorption systems: Interacting solutes, Adiabatic adsorbers, velocity effects. Adsorption-Desorption operations: Thermal desorption of gases, Activated carbon solute recovery, Processing liquid using thermal regeneration, Pressure swing and vacuum swing adsorption, Regeneration with purge and desorbent.	7	15%
<b>SECOND INTERNAL EXAMINATION</b>			
V	<b>ION EXCHANGE:</b> Basics of Ion exchange, Ion exchange resins, Binary ion exchange equilibrium, Ion movement theory, Applications, Applications without exchange: Ion exclusion, Mass transfer in ion exchange systems.	7	20%
VI	<b>Chromatographic Separations:</b> Introduction, types of chromatography, Elution chromatography: Principles and Retention theory, Band broadening and separation efficiency, Types of chromatography, Large scale elution (cyclic/batch) chromatography, Selective adsorption of biological macromolecules, Simulated countercurrent techniques, Comparison with other separation methods.	7	20%
<b>END SEMESTER EXAMINATION</b>			

## Question Paper Pattern

Maximum Marks: 100

Exam Duration: 3 Hours

**Part A:** There shall be **Three questions** uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in each main question with a total of 15 marks for all the subdivisions put together. (2 x15= 30 Marks)

**Part B:** There shall be **Three questions** uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in each main question with a total of 15 marks for all the subdivisions put together. (2 x15= 30 Marks)

**Part C:** There shall be **Three questions** uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in each main question with a total of 20 marks for all the subdivisions put together. (2 x20= 40 Marks)

