COURSE TITLE	**ADVANCED SEPARATION TECHNIQUES**
COURSE CODE	**01CH0612**
COURSE CREDITS	**3**

Objective:

1 To understand the governing mechanisms and driving forces of various advanced separation processes and to equip process and design parameters for advanced separation processes.

Course Outcomes: After completion of this course, student will be able to:

1 Apply modern separation techniques in various applications

2 Analyze and evaluate novel membranes for intended application

3 Analyze and design pervaporation, chromatography and dialysis-based separation processes

4 Utilize the technological methods in problem solving in process plant.

Pre-requisite of course: Basic concepts of Mass transfer operations.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	**Introduction:** Comparisons of conventional processes and advanced processes,, Classification and choice of separation processes, Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances,, Process steps in Downstream processing in Bioprocess Industry, Process concept, Cross flow filtration- Theory and Equipments	10
2	**Membrane Separation:** Overview of Membrane separation process. Membranes- Types, materials, preparations and characterization., Principles, process, design and working of Reverse Osmosis, Nanofiltration, Ultrafiltration, Microfiltration, Dialysis, Pervaporation, Ion Exchange., Membrane Transport Theory, Solution Diffusion Model, Pore Flow Model.	10
3	**Separation By Adsorption Techniques:** Mechanism, Types and choice of adsorbents, adsorption isotherms and techniques, Affinity Chromatography and Immune Chromatography., Types of Equipments, Relevant techniques - UV-VIS Spectroscopy,, Atomic Absorption Spectrometry	8

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Contents : Unit	Topics	Contact Hours
4	**Ionic Separations:** Controlling factors, Applications,, Types of equipment employed for electrophoresis,, Di-electrophoresis, Ion exchange chromatography and electro Dialysis.	6
5	**Other Techniques:** Separations involving Lyophilisation, and Permeation techniques for solids,, liquids and gases. Advances in crystallization, drying and extraction,, Supercritical fluid extraction, Oil spill Management, Industrial effluent treatment and advances.	6
Total Hours		**40**

Textbook :

1 Membrane separation process, second ed.,, Kaushik Nath,, PHI Learning Pvt. Ltd., 2017

2 Industrial Processing with Membranes, Lacey, R.E. and S. Loaeb, Wiley – InterScience,, 1972

References:

1 Separation Processes, Separation Processes, King, C.J., Tata McGraw - Hill Publishing Co., Ltd.,, 1982

2 New Chemical Engineering Separation Techniques, New Chemical Engineering Separation Techniques, Schoew, H.M., Interscience Publishers,, 1972

3 Handbook of Separation Process Technology, Handbook of Separation Process Technology, Ronald W.Roussel, John Wiley,, 1987

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
10.00	20.00	25.00	25.00	10.00	10.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

3 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

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Supplementary Resources:

1 https://nptel.ac.in/downloads/103105060/

2 https://separationtechniques.chemistryconferences.org/events-list/separation- processes-in-chemical-engineering

3 https://www.nap.edu/read/6388/chapter/4

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