

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCYD538	Modern Separation Techniques	3	0	0	3

Course Objective
<ul style="list-style-type: none"> Introduction to different separation methods use in pharmaceutical industry
Learning Outcomes
<ul style="list-style-type: none"> Knowledge about the purification techniques of Active Pharmaceutical Ingredients (API)

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Separation Techniques: Need for learning separation techniques, separation techniques in natural product research and drug discovery, extraction techniques.	8L	At the end of this course, the student will have a deep knowledge of various separation techniques and how they can be implemented to separate different organic and drug molecules.
2	<p>Chromatography: General principles, classification of chromatographic techniques, normal and reverse phase, bonded phase chromatography, stationary phases, activity of stationary phases, elutropic series, and separation mechanisms.</p> <p>Column Chromatography and Short Column Chromatography: Column packing, sample loading, column development, detection</p> <p>Flash Chromatography and Vacuum Liquid Chromatography: Objectives, optimization studies, selecting column and stationary phases, selecting suitable mobile phases, automated flash chromatography, and reverse phase flash chromatography.</p>	10L	Upon completing this course, the student will learn about various stationary phases used in column chromatography, the difference between normal and reverse phase columns, and the proper choice of choosing the appropriate mobile phase for good and effective separation.
3	High Performance Liquid Chromatography: Principles, instrumentation, peak shapes, capacity factor, selectivity, plate number, plate height, resolution, band broadening, pumps, injector, detectors, columns, column problems, gradient HPLC, HPLC solvents, trouble shooting, sample preparation, method development.	8L	Upon successful completion, the student will learn about plate theory. The different stationary and mobile phases factors can influence the effectiveness of separation of a mixture of substances and resolution factor for a chromatographic separation.

	Planar Chromatography - TLC/HPTLC/OPLC: Basic principles, sample application, development of plates, visualization of plates, 2D TLC, densitometry, Over pressure layer chromatography.		
4	Counter Current Chromatography: Basic principles, droplet counter current chromatography, centrifugal partition chromatography, choice of solvents for SP and MP. Gas Chromatography: Principles, instrumentation, split-splitless injector, head space sampling, columns for GC, detectors, quantification.	7L	Numerous aspects of counter-current chromatography and gas chromatography, their limitations, where they can be applied. Different kinds of detectors for detecting substances after separation.
5	Biochromatography: Size exclusion chromatography, ion exchange chromatography, ion pair chromatography, affinity chromatography general principles, stationary phases and mobile phases. Hyphenated Techniques: Introduction to GC-MS and LC-MS techniques and their applications in natural products.	9L	Different delicate chromatographic techniques used for the separation of biomolecules and the principles of separation. Vast knowledge of GC-MS and LC-MS and their applications in natural products.
TOTAL		42	

Text Books:

- 1) Various Reviews and Research Papers.

Reference Books:

- 1) Methods in Biotechnology, Natural Product Isolation, Sarker, Latif, Gray, Humana Press, 2nd Ed. (2005).
- 2) Methods in Biotechnology, Natural Product Isolation, Richard Canell, Humana Press, 1998.