

# LJ UNIVERSITY

## LJ INSTITUTE OF PHARMACY

SEMESTER: I

**Subject Name: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES**

**Subject Code: MAT101T**

**Scope:** This course is designed to convey the knowledge necessary to understand issues related to different kinds of hazard and their management. Basic theoretical and practical discussions integrate the proficiency to handle the emergency situation in the pharmaceutical product development process and provides the principle-based approach to solve the complex tribulations.

**Objectives:** Upon completion of this course the student should be able to

1. Understand the principles, theory, and instrumentation of UV-Visible, IR, and fluorescence spectroscopy, and their applications in pharmaceutical analysis. Attributes the concept of various spectroscopy, its instrumentation and application in pharmaceutical field.
2. Comprehend the principles, instrumentation, and applications of NMR and Mass Spectroscopy in the identification and characterization of pharmaceutical compounds.
3. Demonstrate knowledge of various chromatographic techniques, including HPLC, GC, and their pharmaceutical applications.
4. Explain the principles and applications of potentiometry, conductometry, and thermal analysis in pharmaceutical analysis.
5. Apply the principles of electrophoresis, X-ray crystallography, and immunological assays in the analysis of pharmaceutical compounds.

**Teaching scheme and examination scheme:**

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
4	--	----	4	75	25	---	-----

Sr. No.	Course Contents	Hours
1	<p><b>(A) UV-Visible spectroscopy:</b> Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible spectroscopy. Multicomponent analysis using UV-visible spectroscopy- Simultaneous equation method (Vierotd's method) , Absorbance ratio method ( Q-Absorbance method) , Derivative Spectrophotometric method, Multiwavelength UV-Spectrophotometry, Dual wavelength method, Area Under Curve Method., Difference Spectroscopy.</p> <p><b>(B)IR spectroscopy:</b> Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy</p>	11

	<p><b>(C) Spectrofluorimetry:</b> Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.</p> <p><b>(D) Flame emission spectroscopy and Atomic absorption spectroscopy:</b> Principle, Instrumentation, Interferences and Applications.</p>	
2	<p><b>NMR spectroscopy:</b> Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and <sup>13</sup>C NMR. Applications of NMR spectroscopy. Other Advance Techniques.</p>	11
3	<p><b>Mass Spectroscopy:</b> Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy, LC-MS, LC-MS-MS</p>	11
4	<p><b>Chromatography:</b> Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following:</p> <p>a) Paper chromatography b) Thin Layer chromatography</p> <p>c) Ion exchange chromatography d) Column chromatography</p> <p>e) Gas chromatography f) Affinity chromatography</p> <p><b>HPLC:</b> Principle, instrumentation, pharmaceutical applications, 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, New developments in HPLC-role and principles of ultra, nano liquid chromatography in pharmaceutical analysis. Immobilized polysaccharide CSP's: Advancement in enantiomeric separations, revised phase Chiral method development and HILIC approaches. HPLC in Chiral analysis of pharmaceuticals. Preparative HPLC, practical aspects of preparative HPLC.</p> <p><b>Fundamentals of HPTLC</b></p>	11
5	<p><b>(A) Potentiometry and Conductometry:</b> Principle, working, Electrodes and Application of Potentiometry and Conductometry .</p> <p><b>(B) Thermal Techniques:</b> Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. Differential Thermal Analysis (DTA): Principle, instrumentation and advantage</p>	08

	and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA).  TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.	
6	<p><b>(A) Electrophoresis:</b> Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following:</p> <p>a) Paper electrophoresis</p> <p>b) Gel electrophoresis</p> <p>c) Capillary electrophoresis</p> <p>d) Zone electrophoresis</p> <p>e) Moving boundary electrophoresis</p> <p>f) Iso electric focusing</p> <p><b>(B) X ray Crystallography:</b> Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of Xray diffraction.</p> <p><b>(C) Immunological assays:</b> RIA (Radio immuno assay), ELISA, Bioluminescence assays and other advancement</p>	08
<b>Total Hours</b>		60

## Recommended Books:

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series
8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.
9. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley & Sons, 198