Course Syllabus
Gyanmanjari Pharmacy College
Semester-1(M.Pharm.)

Subject: Modern Pharmaceutical Analytical Techniques (MPHXX11501)

Type of course: Major

Prerequisite: B.Pharmacy

Rationale: The modern methods of pharmaceutical analysis course aimed to provide knowledge and application on various analytical techniques in process and quality control of pharmaceuticals. It emphasizes on basic principle, instrumentation of various analytical instruments in analysis of drug substance/product. This course covers the use of various modern analytical methods such as spectroscopy, chromatography, electrochemical methods, thermal analysis, electrophoresis, x-ray analysis and scanning microscopy, in pharmaceutical process and research.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	-	-	4	75	25	-	-	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

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Course Content:

Chapter No.	Course content	Hrs	% Weightage
1.	**UV-Visible Spectrophotometry**: Principle and types of molecule interaction with different EMR, Concept of chromophore, electronic transition, λmax, molecular extinction coefficient and their significance. UV-Visible spectrophotometer Instrumentation. UV spectrum characteristics, UV solvents, Beer law and its limit, Woodwards rule, quantification methods for single and multi-component dosage forms. Concept of optical rotator dispersion and circular dichorism and its application in monograph analysis. **IR spectroscopy:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational Frequencies and Applications of IR spectroscopy. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications.	11	18.33
2.	**NMR spectroscopy:** 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 ^{13}C NMR. Applications of NMR spectroscopy.	11	18.33
3.	**Mass Spectroscopy:** 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	11	18.33
4.	**Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography	11	18.33
5.	**Electrophoresis:** Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following:	11	18.33

	a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing b. X ray Crystallography: 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 X ray diffraction.		
6.	**X ray Crystallography:** 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 X- ray diffraction. **Immunological assays:** RIA (Radio immuno assay), ELISA, Bioluminescence assays.	5	8.33

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1.	Faculty will Provide real-world analytical challenges, such as troubleshooting issues in HPLC or FTIR analysis to the students and students will upload on ERP portal.	15
2.	Faculty will assign pre-class videos or readings on topics like UV-Visible Spectroscopy, and hold in-class discussions or quizzes to students and students will upload on ERP portal.	15
3.	Faculty will Provide simulated chromatograms or spectra and ask students to interpret and troubleshoot errors and upload on ERP portal.	20
Total		50

Suggested Specification table with Marks (Theory):75

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	45 %	20%	10%	05 %	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

Modern Pharmaceutical Analytical Techniques (MPHXX11501)

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After learning the course the students should be able to:	
CO1	Explain and discuss the principle of various modern analytical techniques which are suitable for pharmaceutical process and development.
CO2	Perform critical analysis on suitability of analytical technique in quantitative and qualitative analysis of drug substance in products and biological samples.
CO3	Demonstrate appropriate analytical technique based on the type of drug substance or drug products or matrix sample of research interest.
CO4	Evaluate the different analytical techniques for the selected application in Pharmaceutical manufacturing and quality control.

Instructional Method:

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.

From the content 10% topics are suggested for flipped mode instruction.

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

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Spectroscopy by Donald L Pavia, Gary M Lampman, George S Kriz, James A Vyvyan

[2] Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons.

[3] Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore.

[4] Instrumental methods of analysis – Willards, 7th edition, CBS publishers.

[5] Organic Spectroscopy - William Kemp, 3rd edition, ELBS

[6] Vogel's text book of Practical Organic Chemistry

[7] Methods in Biotechnology, Natural Product Isolation by Sarker, Latif, Gray

[8] Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi. 3rd Edition, CBS Publishers, New Delhi.

[9] Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi.

[10] Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series.