



University of Kerala

Discipline	CHEMISTRY				
Course Code	UK5DSECHE304				
Course Title	ANALYTICAL CHEMISTRY -III				
Type of Course	DSE				
Semester	5				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	1. Foundational understanding of chemistry principles, including chemical bonding, molecular structure, and chemical reactions. 2. Prior knowledge of basic analytical chemistry principles, such as the interaction of analytes with different separation techniques.				
Course Summary	This course provides students with an in-depth understanding of various analytical chemistry techniques, including spectroscopic methods, thermal analysis, and Chromatographic techniques.				

Detailed Syllabus:

Module	Unit	Content	Hrs
		ANALYTICAL CHEMISTRY -III	60
I		THERMAL METHODS OF ANALYSIS	9
	1.1	Thermal Methods of Analysis: Introduction, Thermogravimetric Analysis: Principle, Instrumentation, Sources of Error in TGA, Interpretation of TG Curve, Factors Affecting TG measurements: Instrumental factors and Sample characteristics, Differential Thermal Analysis (DTA), Applications of TGA.	4
	1.2	Differential Scanning Calorimetry (DSC)-Principle, Instrumentation, Applications of DSC.	2
	1.3	Thermomechanical Analysis (TMA) and Dynamic Mechanical Analysis (DMA), Principle and Applications of TMA, DMA.	3
II		SPECTROSCOPIC METHODS OF ANALYSIS I	9
	2.1	Overview of Spectroscopy: EMR and its Interaction with Matter	1
	2.2	Basic Components of Spectroscopic Instrumentation: Sources of Energy, Wavelength Selection, Sample cells, Detectors, Slit width, Instrumental wavelength (for visible, UV, IR, fluorescence)	2

	2.3	Spectroscopy Based on Absorption: Absorbance and Transmittance, Beer-Lambert's Law, Its limitations	1
	2.4	Ultraviolet-visible Spectroscopy: Principle, Instrumentation, molecular structure (transitions, absorption by isolated, conjugated & aromatic chromophores), Applications	3
	2.5	Infrared Spectroscopy: Principle, Instrumentation, Fingerprint regions Molecular Vibrations, Vibrational Frequency, Vibrational Modes, Absorption by functional groups ((i) n-hexane, (ii) benzene, (iii) phenol, (iv) hexanol), Applications	2
III	CHROMATOGRAPHIC TECHNIQUES I		9
	3.1	General description of chromatography, Principles of Chromatographic separations, Classification of chromatography: Adsorption, Partition, Ion exchange and Size exclusion chromatography	2
	3.2	General Theory of Column Chromatography, Theory of Column Efficiency, Chromatographic Resolution, Capacity Factor, Column Selectivity, Column Efficiency, Optimizing Chromatographic Separations	4
	3.3	Gas Chromatography, Principle, Instrumentation, Applications, Introduction to GC-MS.	3
IV	CHROMATOGRAPHIC TECHNIQUES II		18
	4.1	Liquid Chromatography: High-Performance Liquid Chromatography, Stationary Phases in HPLC, Chiral Stationary Phases	3
	4.2	Equipment for HPLC, Detectors (Universal detectors, refractive index detectors, Viscosity and light scattering detectors, UV-Visible detectors)	3
	4.3	Ion chromatography: Ion exchange separation of amino acids and PCR	3
	4.4	Thin-layer chromatography (TLC), R _f values, TLC stationary and mobile phases, TLC sample application, HPTLC: development, gradient elution, spot visualization	3
	4.5	Paper chromatography: principle, solvent systems, mechanism of paper chromatography, different development methods: ascending, descending, horizontal, circular spreading	3
	4.6	Electrophoresis, CZE, Slab gel and Capillary gel electrophoresis	3
V	Open Ended Module: Learning through problem-solving, seminars, open discussions, assignment discussions, Quizzes, Open book exams etc.		15
	1	Provide a detailed interpretation of the TG curve of Calcium oxalate monohydrate, and discuss the factors influencing the curve.	
	2	Write a report on the applications of near-infrared (NIR) spectroscopy in non-destructive testing in a specific industry of your choice.	
	3	Measure the absorption spectra of known compounds and calculate the concentration using Beer-Lambert's Law.	
	4	Discuss the principles of NIR absorption and its advantages in quality control and product analysis.	
	5	Compare and contrast gas chromatography (GC) and liquid chromatography (LC) in terms of their applications and advantages/disadvantages. Provide examples of real-world scenarios where each technique would be most suitable.	

6	Design an experiment to separate and analyze specific biomolecules using capillary gel electrophoresis.
7	Explore recent advancements in thermal analysis methods and their applications in materials science, pharmaceuticals, and environmental analysis.
8	Present case studies on the use of chromatographic techniques in forensic science, food safety, and drug discovery, highlighting novel approaches and challenges faced in real-world scenarios.

References

1. S.M. Khopkar, *Basic Concepts of Analytical Chemistry*, New Academic Science Limited, 3rd edition, 2012.
2. James W. Robinson, Eileen M. Skelly Frame, George M. Frame II, *Undergraduate Instrumental Analysis*, Marcel Dekker. Taylor & Francis e-Library, 6th edition, 2005.
3. B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, *Vogel's Text Book of Practical Organic Analysis*, Longman, 5th edition, 1989.
4. D. A. Skoog, D. M. West and F. J. Holler, *Fundamentals of Analytical Chemistry*, Saunders College Publishing, 7th edition, 1996.
5. J. R. Dyer, *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice 2, Hall, 1974.
6. D. H. Williams and I. Fleming, *Spectroscopic methods in organic chemistry*, 6th Edition, Tata McGraw Hill, 2011.
7. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. A. Vyvyan, *Introduction to Spectroscopy*, 4th Edition, Brooks Cole, 2008.
8. Y. R. Sharma, *Elementary Organic Spectroscopy*, S. Chand Publishing, 2010.
9. D. J. Holme and H. Perk, *Analytical Biochemistry*, 3rd edition, Prentice Hall, 1998.
10. B. K. Sharma, *Analytical Chemistry*, Krishna Prakashan Media (P) Ltd., 2nd Edition, 2006
11. Gary D. Christian, Purnendu K. Dasgupta, Kevin A. Schug, *Analytical Chemistry* –, Wiley, 7th edition, 2013.
12. D. A. Skoog and D. M. West, *Principles of Instrumental Analysis*, Saunders College Publishing, 5th edition, 1998.
13. Gurdeep R. Chatwal, Sham K. Anand, *Instrumental Methods of Chemical Analysis*, Himalaya Publishing House.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understanding of various thermal analysis techniques and their instrumentation.	An	PSO-1
CO-2	Proficiency in UV-visible and Infrared Spectrophotometry, including quantitative and qualitative applications.	An	PSO-1 & 2

CO-3	Proficiency in the theory of column chromatography and gas chromatography techniques including instrumentation and quantitative measurements.	C	PSO-1 &2
CO-4	Familiarity with thin-layer chromatography, Paper Chromatography and electrophoresis techniques & competency in liquid chromatography	E	PSO-1 &2
CO-5	Applies the knowledge obtained from the course to relevant situations	Ap	PSO- 3 & 5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ANALYTICAL CHEMISTRY III

Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	1	An	F	L	
2	CO-2	PO-1 & 2 PSO-1&2	An	C	L	
3	CO-3	PO-1 & 2 PSO-1 &2	C	C	L	
4	CO-4	PO-1 & 2 PSO-1 &2	E	C	L	
5	CO-5	PO-2,3, & 4 PSO- 3 & 5	Ap	M	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	-	-	-	2	-	-	-	-	-
CO 2	2	2	-	-	-	-	2	2	-	-	-	-
CO 3	2	2	-	-	-	-	2	2	-	-	-	-
CO 4	2	2	-	-	-	-	2	2	-	-	-	-

CO 5	-	-	3	3	-	-	-	3	3	2	-	-
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Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	√			√
CO 2	√			√
CO 3	√	√		√
CO 4	√			√
CO 5		√	√	