

ANALYTICAL CHEMISTRY

Semester	Subject Code	Category	Lecture Hours		Theory hours		Practical hours		Credits
			Per week	Per sem.	Per week	Per sem.	Per week	Per sem.	
V	21CCH5D	Elective-I (Option-1)	3	45	3	45	-	-	3

COURSE OBJECTIVES:

The students will be able to

- Gain knowledge about Data analysis, Principles of gravimetric analysis, Thermal analysis, Purification methods of solids and liquids and the various Separation techniques.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Know about the terms and methods of finding error analysis and can able to determine the sources of errors and its effects towards analytical results.	K4
CO2	Acquire knowledge about the methods of gravimetric analysis; can able to know the concepts and methods of Thermal Gravimetric Analysis and Differential thermal analysis.	K3
CO3	Understand about the principles and methods of separation techniques and their applications.	K3
CO4	Gain knowledge about the most common chromatographic separation techniques.	K3
CO5	Learn about the idea of electroanalytical methods like amperometry and cyclic voltammetry.	K3

*CO – Course Outcomes

Knowledge Level: K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze.

MAPPING WITH PROGRAMME OUTCOMES:

COS	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	S	S	S	S
CO2	M	M	S	S	M	S
CO3	S	S	S	S	M	S
CO4	S	S	M	S	S	S
CO5	S	M	M	S	S	S

(S – Strong; M – Medium; L – Low)

UNIT-I: Basic Concepts of Analytical Chemistry

9 Hours

- 1.1 Data Analysis – Definition of error – Classification of errors – Determinate errors and indeterminate errors – Error analysis – Correction of determinate errors – Minimizing errors – Precision (definition and explanation with an example) – Methods of expressing precision – Accuracy (definition and explanation with an example) – Methods of expressing accuracy – Significant figures and its importance with examples – Mean, median, average deviation and standard deviation – Confidence limit.
- 1.2 Principles of Gravimetric analysis – Gravimetric factor (formula) – Characteristics of Precipitating agents – Choice of precipitants – Specific and Selective precipitants (definition and explanation with example) – Conditions of precipitation – Co-precipitation and Post-precipitation (definition, explanation, mechanism and methods to minimize) – Differences between Co-precipitation and Post-precipitation – Gravimetric experiments – Estimation of Barium as Barium sulphate and estimation of Barium as Barium Chromate.

UNIT-II: Thermoanalytical Methods

9 Hours

- 2.1 Thermogravimetric analysis – Principles involved in TGA– Characteristics of TGA thermograms – TGA of calcium oxalate monohydrate and copper sulphate pentahydrate – Factors affecting TGA curves – Sample characteristics and instrumental factors– Discussion of various components of the instrument with block diagrams – Applications.
- 2.2 Differential thermal analysis – Principles involved in differential thermal analysis – DTA thermograms – DTA of calcium oxalate monohydrate – Factors affecting DTA curves– Sample characteristics and instrumental factors – Discussion of various components of the instrument with block diagram – Applications of DTA – Thermometric titrations – Principle, advantages, conditions, instrumentation, titration of HCl vs NaOH and applications.

UNIT-III: Basic Separation Techniques

9 Hours

- 3.1 Solvent extraction – Electrophoresis – Purification of solid organic compounds – Soxhlet extraction– Principle, experimental technique, and applications– Crystallization– Fractional crystallization – Sublimation – Extraction – Uses of immiscible solvents.

- 3.3 Purification of organic liquids – Experimental techniques of distillation – Distillation under reduced pressure – Fractional distillation – Azeotropic distillation – Vacuum distillation – Steam distillation – Principle, experimental technique and applications – Tests for purity – Chromatography, melting point and boiling point.

UNIT-IV: Chromatographic Systems

9 Hours

- 4.1 Chromatographic techniques – Principle of adsorption and partition chromatography – Column chromatography – Properties of good adsorbents, classification of adsorbents, adsorbents used, preparation of column, adsorption, development, elution, requirements of eluents, recovery of substances and its applications – Thin layer chromatography – Principle, choice of adsorbents and solvents, preparation of chromatogram, development, location of the compound in the chromatogram – Applications of TLC in Organic and Inorganic Chemistry (Ni and Co).
- 4.2 Paper chromatography – Solvents used, principle, stationary phase, mobile phase – R_f value – Factors influencing R_f value – Applications – Separation of amino acid mixture – Choice of the filter paper, preparation of the solution, application of the sample to the paper, choice of solvents, development of the chromatogram, drying the paper – Radial paper chromatography (PC) – PC and TLC – Superiority of TLC over PC – Ion exchange chromatography – Principle, types of resins, experimental techniques, applications and advantages – Gas Chromatography (GC) – High Performance Liquid Chromatography (HPLC) – Principle, experimental techniques, instrumentation and applications – Gas Chromatography Mass spectrometry (GCMS).

UNIT-V: Electroanalytical Methods

9 Hours

- 5.1 Polarography – Principle – Concentration polarization – Dropping mercury electrode – Advantages and disadvantages – Convection, Migration and Diffusion currents – Ilkovic equation (derivation not required) and significance – Experimental assembly – electrodes – Capillary – Experimental solution – Current voltage curve – Oxygen wave – Influence of temperature and agitation on diffusion layer.
- 5.2 Polarography as an analytical tool in quantitative and qualitative analysis – Amperometry and Cyclic voltammetry – Basic principles, instrumentation and uses – Applications – Amperometric titrations – Principle – Difference between Amperometric titrations and Potentiometric titrations.

TEXT BOOKS:

S. No.	Authors	Title	Publishers	Year of publication
1.	R. Gopalan	Elements of Analytical Chemistry	Sultan Chand and Sons	2002
2.	V. Veeraiyan	Textbook of Analytical Chemistry	Highmount Publishing House	2006
3.	B. K. Sharma	Instrumental Methods of Chemical Analysis	Goel Publishing House	1996

REFERENCE BOOKS:

S. No.	Authors	Title	Publishers	Year of publication
1.	Douglas A. Skoog, Donald M. West, Stanley R. Crouch and F. James Holler	Fundamentals of Analytical Chemistry	Thomson-Brooks/Cole	2004
2.	J. Mendham, R. C. Denney, J. D. Barnes and M. J. K. Thomas	Vogel's Textbook of Quantitative Chemical Analysis	Pearson Education Limited	2008
3.	S. M. Khopkar	Basic Concepts of Analytical Chemistry	New Age International.	1998
4.	V. K. Srivastava and K. K. Srivastava	Introduction to Chromatography	S. Chand and Co. Ltd.	1990
5.	R. P. Budhiraja	Separation Chemistry	New Age International Publishers	2004
6.	John Kenkel	Analytical Chemistry for Technician	CRC Press	2014
7.	Frank A. Settle	Handbook of Instrumental Techniques for Analytical Chemistry	Prentice Hall PTR	1997
8.	S. M. Khopkar	Basic Concepts of Analytical Chemistry	New Academic Science	2008
9.	R. A. Day and A. L. Underwood	Quantitative Analysis	Prentice Hall	1991
10.	S. A. Iqbal and M. S. Setii	An Introduction to Analytical Chemistry	Discovery Publishing House	1994

TEACHING METHODOLOGY:

- Conventional chalk and board teaching
- Power Point Presentations
- Assignments
- Animated videos
- Chalk and Board
- Interactive sessions
- To get recent information through the internet.

SYLLABUS DESIGNER:

- Dr. S. Sashikala, Assistant Professor of Chemistry.