

CHE-354-MJ-T: ANALYTICAL CHEMISTRY III

Course Type: Major Theory

Credits: 2

A. Course Objectives:

1. To introduce principles of spectroscopic and electrochemical analytical techniques.
2. To develop understanding of instrumentation and working of analytical methods.
3. To enable quantitative analysis using spectrophotometric and electrochemical techniques.
4. To familiarize students with sample preparation and interference handling.
5. To enhance analytical and problem-solving skills in chemical analysis

B. Course Outcomes (COs):

CO No.	Course Outcome Statement (COs) <i>After learning the course, the students are able to -</i>
CO-1	Define spectrophotometry, AAS, flame photometry, and electrochemical methods.
CO-2	Explain principles, instrumentation, and interferences in analytical techniques.
CO-3	Solve numerical and analytical problems in spectroscopic and electrochemical methods.
CO-4	Analyze spectral and electrochemical data for quantitative estimation.
CO-5	Justify selection of analytical methods based on accuracy and limitations.
CO-6	Derive relationships and interpretations in analytical measurements.

C. Contents:

Prerequisites	
Basic knowledge of physical chemistry, chemical equilibrium, and solutions is required. Familiarity with fundamental concepts of optics and electrochemistry will aid in understanding analytical techniques.	
Chapter 1: Spectrophotometry	06 Hours
Introduction, Wave properties of electromagnetic radiation, Relation between frequency, velocity and wave number, particle properties of electromagnetic radiation, relation between wavelength and particle properties of electromagnetic radiation, electromagnetic spectrum, interaction of electromagnetic radiation with matter, atomic spectroscopy and molecular spectroscopy, types of molecular spectra, Advantages of spectroscopy. Instrumentation, Applications of spectrophotometry, Molar composition of complexes, Spectrophotometric	

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Ref-1: 351 -357, Ref-2: S-1 to S-21, Ref-3: 2.107-2.148

Chapter 2: Atomic Absorption Spectroscopy**06 Hours**

Introduction, Elementary theory, Instrumentation, flames, the nebulizer-burner system, non flame techniques, (graphite furnace, cold vapour technique), resonance line sources, monochromator, detectors, interferences, chemical interferences, background correction methods, Atomic absorption spectrophotometers, Experimental preliminaries (calibration curve methods, standard addition method) Preparation of sample (wet ashing, fusion, Dry ashing, microwave dissolution, concentration procedures), Detection limits, Estimation of Ca and Mg in water. Key Ref-4: 612- 643

Chapter 3: Flame Emission Spectroscopy**06 Hours**

Introduction, emission spectra, flame emission spectroscopy, flame photometers. Evaluation methods, calibration curve procedure, the standard addition technique, Applications: determination of alkali metals by flame photometry, determination of trace elements in contaminated soil. Numerical, Key Reference-4: 645-649, 655-656.

Chapter 4: Electrochemical Methods- Polarography and Voltammetry**12 Hours**

Polarography: Introduction, Principles, Electrodes, Instrumentations, Dropping Mercury Electrodes, Factors affecting polarographic current, Oxygen removal, Polarographic analysis, AC Polarography, Pulse Polarography, Differential Pulse Polarography, Square Wave Polarography, Numericals. Ref-5: 761-820, Ref-3: 2.523-2.533.

Voltammetry: Principles, Voltammetry at solid electrodes, Hydrodynamic Voltammetry, Triangular Wave Voltammetry, Amperometry, Stripping Voltammetry.

References:

1. A Textbook of Analytical Chemistry – Y. Anjaneyulu, K. Chandrasekhar & Valli Manickam, Pharma Med Press, 2006.
2. Instrumental Methods of Chemical Analysis – B. K. Sharma, Goel Publishing House, 27th Edition, 2011.
3. Instrumental Methods of Chemical Analysis – Gurdeep R. Chatwal & Sham K. Anand, Himalaya Publishing House, 2010.
4. Vogel's Textbook of Inorganic Quantitative Analysis – J. Mendham, R. C. Denney, J. D. Barnes & M. Thomas, Pearson Education, 6th Edition, 2000.
5. Introduction to Instrumental Analysis – R. D. Braun, Pharma Med Press, 2006.