
First Semester

EC-101: Fundamentals of Quantitative Analysis and Separation Methods

Unit-I: Concepts involved in Analysis

Role of analytical chemistry, classification of analytical methods-classical and instrumental, types of instrumental analysis, selecting analysis method, neatness and cleanliness, laboratory operations and practices, good laboratory practices, techniques of weighing, errors, volumetric glassware-cleaning and calibration of glassware, sample preparation – dissolution and decompositions, selecting and handling reagents, laboratory notebooks, safety in the analytical laboratory, calibration and detection limits, proficiency testing.

Unit-II: Titrimetric and Gravimetric Methods of Analysis

General principles: Solvents in analytical chemistry, buffers, acid-base equilibria, concentration systems, stoichiometric calculation, acid-base titration, titration curves, acid base indicators, applications of acid-base titration, complexometric titration, metal-ion indicators, precipitation titration, Mohr’s titration, Volhard’s titration, adsorption indicators, Fajans’s titration, titration curves in oxidation-reduction titration, redox indicators, applications of redox titrations.

Unit-III: Separation Techniques -I

(A) Solvent Extraction: Fundamental treatment, theoretical principle, classification, and factors favouring extraction, extraction equilibria, applications.

(B) Solid phase extraction and solid phase micro extraction, applications.

(C) Ion- Exchange: Theories, use of synthetic ion exchange in separation, chelating ion exchange resins, liquid ion exchangers, experimental technique.

Unit-IV: Separation Techniques -II

An introduction to chromatographic methods, paper, thin layer and column chromatography, theory of chromatography, classification of chromatographic techniques, retention time, relationship between retention time and partition coefficient, the rate of solute migration, differential migration rates, band broadening & column efficiency, kinetic variables affecting band broadening, Electrophoresis and capillary electrophoresis, HPTLC.

Unit-V: GC and HPLC

Instrumentation of GC and HPLC, applications in qualitative and quantitative analysis, comparison of GC and HPLC, Ion chromatography, pyrolytic gas chromatography, size exclusion chromatography, super critical fluid chromatography, affinity chromatography.


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Books Recommended


EC-102: Stereochemistry and Thermo-analytical Methods

Unit-I: Stereochemistry

(A) Conformational analysis: Conformation of n-butane and cyclohexane, stability of conformers and energy profile diagram.

(B) Optical activity: Criteria for optical activity, stereoisomers, enantiomers and diastereomers, erythro and threo isomers, a general idea of symmetry elements.

(C) Racemic Modifications: Conglomerate, racemate and racemic solid solutions, a general idea of stereo selective synthesis.

(D) Resolution of Racemic modifications: by Chemical separation, chromatography, preferential crystallization and asymmetric transformation (a brief idea only).

Unit-II: Statistical Treatment of Data-I

Types of errors, accuracy and precision, rounding off, significant figures, normal distribution of errors, statistical treatment of finite samples (mean, median, range & average deviation), t-test, confidence interval of the mean, standard error of a mean, test of significance, comparison of two means, F-test, rejection of data, Q-test, bivariate data, Quality control charts, relationship between variables, correlation & regression, principle of least squares.

Unit-III: Statistical Treatment of Data-II

Validation of analytical procedure in pharmaceutical formulation (LOD, LOQ, Robustness, Specificity, Accuracy, Precision, Selectivity, Linearity, Ruggedness, Reproducibility, Repeatability), Recovery analysis, Error bars, Study design.

Unit-IV: Thermo-analytical Methods

Thermogravimetry, factors affecting thermogravimetric curves, derivative thermogravimetry (DTG), thermobalances, applications of thermogravimetry, differential thermal analysis, factors affecting DTA curve, instrumentation, applications of DTA.

Differential scanning calorimetry, theory, instrumentation, applications of DSC, thermometric titration, principle, classification, instrumentation and applications of thermometric titration.

Unit-V: Principles of Gravimetric Analysis

Stoichiometry of gravimetric reactions, formation and properties of precipitates, precipitation from homogeneous solution, nucleation, organic precipitations, applications of gravimetric analysis.
Books Recommended
EC-103: Spectro-analytical Methods of Analysis-I

Unit-I: Colorimetry and Spectrophotometry

An introduction to spectrophotometric methods, a brief idea of wave properties of electromagnetic radiation, theory of spectrophotometry and colorimetry, conjugated dienes, Woodward-Fieser rules for calculating absorption maxima in dienes, transition probability, types of absorption bands, types of electronic transitions, chromophores, auxochromes, limitations of Beer's Law, classification of methods of colour measurement, instrumentation single beam and double beam, photometric error, applications of spectrophotometry to inorganic and organic compounds (quantitative calculations), spectrophotometric titration.

Unit-II: Other Spectro-analytical techniques

(A) Introduction, general principle, instruments for nephelometry and turbidimetry, applications of nephelometry and turbidimetry to analytical chemistry.

(B) Dispersion Refractometry and Flame photometry

(C) Polarometry, circular dichroism (CD) and optical rotatory dispersion (ORD).

Unit-III: Emission Spectroscopy

Elementary idea of emission spectroscopy, introduction, elementary theory, instrumentation, types of flames, interferences, factors affecting flame photometry, applications to qualitative and quantitative analysis, limitations.

Unit-IV: Fluorescence and Phosphorescence Spectrophotometry

Theory of fluorescence and phosphorescence, quantum yield, factors affecting fluorescence and phosphorescence, relation between concentration and intensity, instrumentation, applications, an elementary idea of chemiluminescence.

Unit-V: Kinetic of Slow and Fast reactions (An elementary study keeping in view its applications in analytical chemistry)

(A) Rates of chemical reaction, expression for reaction rate, rate constants, order of reaction, methods for determination of order of reaction, Arrhenius equation, Collision theory, failure of collision theory, Absolute reaction rate theory, unimolecular reactions, mathematical formulation of Lindemann's theory, catalysed reactions, Theory of homogenous catalysed reactions, kinetics of enzyme catalysed reactions, elementary idea of micellar catalysis.

(B) Study of fast reactions by stopped flow method, relaxation methods, flash photolysis method, photochemical reactions, kinetics of photochemical combination of hydrogen and chlorine, branched chain reactions, oscillatory reactions, applications of kinetic methods in finding out optimum conditions for different reactions.

Books Recommended


EC-104: Electro-analytical Methods of Analysis

Unit-I: Fundamentals

Electrochemical cells, solution structure, potential in electroanalytical cells, Nernst equation, electrode potential the ideal polarized and non-polarized electrodes, faradiac reaction, variables in electrochemical cells, factors affecting electrode reaction rate and current, decomposition potential, back potential and voltage.

Unit-II: Potentiometry

Introduction, reference electrodes, indicator electrodes, ion-selective electrodes and their applications in chemical analysis, instrumentation and measurement of cell unit, direct potentiometry, potentiometric titration, applications.

Unit-III: Polarography

Direct current polarography, basic principle, instrumentation, advantages and disadvantages of dropping mercury electrode, different kinds of limiting currents, components of polarographic waves, reversible and irreversible waves, pulse and A.C. polarography, applications of polarography to inorganic and organic compounds, elementary idea of stripping voltammetry, amperometric titrations.

Unit-IV: Conductometry and Coulometry

Conductometry as an analytical tool, applications of direct conductometric measurements, basis of conductometric titrations, applications of conductometry titration, constant current and controlled potential electro-gravimetry, separation of metals, coulometry at controlled potential, coulometry at constant current, applications.

Unit-V: Voltammetry

AC polarography, current sampled (TAST) polarography, normal pulse and differential pulse polarography, stripping voltammetry, linear sweep and cyclic voltammetry, chronopotentiometry, chronoamperometry.

Books Recommended
