



Semester – 1

BRANCH	Subject Title	Subject Code
B.Sc. (Chemistry– Minor/ Generic Elective Course)	ANALYTICAL CHEMISTRY	CHM2/CH

Course Learning Outcomes (CLO)

By the end of this course students will learn the following aspects of laboratory exercises in chemistry:

1. Basic concepts of Mathematics for Chemists.
2. Fundamentals of analytical chemistry and steps involved in analysis.
3. Basic knowledge of Computer for chemists.
4. Basic Concepts of Chemical equilibrium.
5. Principles of Chromatography and chromatographic techniques.
6. Various techniques of Spectroscopic Analysis.

CONTENT

Unit - 1

Mathematics for Chemists

Straight line equation, Logarithmic relations, curve sketching, linear graphs & calculation of slopes. Differentiation, differentiation of functions like $\sin x$, $\log x$. maxima & minima. partial differentiation. Integration of some useful relevant functions.

Unit - 2

Basic Analytical Chemistry: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures. statistical terms: mean, mean deviation, median, standard deviation, Numerical Problems.

Calculations used in Analytical Chemistry

Some Important units of measurements- SI Units, distinction between mass and weight, mole, milli mole and Numerical Problems.

Solution and their concentrations- Concept of Molarity, molality and normality. Expressing the concentration in parts per million (ppm), parts per billion (ppb). Numerical Problems.

Chemical Stoichiometry- Empirical and Molecular Formulas, Stoichiometric Calculations, Numerical Problems.



Unit - 3

Computer for Chemists

Introduction to computer. Introduction to operating systems like -DOS. Windows, Linux and Ubuntu

Use of computer programs

Running of standard programs & packages such as MS-word, MS-excel. PowerPoint, Execution of linear regression x-y Plot. Use of softwares for drawing structures and molecular formulae.

Unit - 4

Chemical Equilibrium: Equilibrium constant and free energy, concept of chemical potential. Thermodynamic derivation of law of chemical equilibrium. Temperature dependence of equilibrium constant; Van't Hoff reaction isochore, Van't Hoff reaction isotherm. Le-Chatelier's principle and its applications.

Unit - 5

Chromatography

Introduction. Principle and Classification. Mechanism of separation: adsorption, partition & ion-exchange.

Development of chromatograms: frontal. elution and displacement methods.

Paper Chromatography, (ascending, descending and circular). Thin Layer Chromatography (TLC) and Column Chromatography (CC). Gas Chromatography (GC) and High Pressure Liquid Chromatography (HPLC), types of column and column selection, applications, limitations.

Principle and Applications of:

Flash chromatography, Ion-exchange chromatography and Chiral chromatography.

Unit - 6

Spectral techniques of analysis

Basics of absorption spectroscopy: Electromagnetic radiation Spectral range. Absorbance. Absorptivity. Molar Absorptivity. Fundamental Laws of Absorption. Lambert-Beer Law and its limitations.

Constitution & working of photometer, spectrometer, colorimeter.

Ultraviolet (UV) absorption spectroscopy-



Presentation and analysis of UV spectra. Types of electronic transitions. Effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, Hyperchromic and hypochromic shifts. UV spectra of conjugated polyenes and enones.

Infra-red (IR) absorption spectroscopy-

Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, Measurement of IR spectrum, finger print region, characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds.

Practical

1 Basic analytical exercises

Calibration of different weights and glass apparatus (measuring cylinder, burette, pipette, volumetric flasks).

- Preparation of solutions of different molarity/normality by weighing and dilution.

2. Quantitative Analysis

Titrimetric Analysis

- Standardization of NaOH with Oxalic acid.
- Determination of carbonate and hydroxide present in mixture.
- Determination of carbonate and bicarbonate present in a mixture.
- Determination of free alkali present in different soaps/detergents.

3. Quantitative Analysis by Colorimetry

- Verification of Lambert-Beer Law
- Determination of concentration of coloured compounds (e.g., CuSO₄, KMnO₄)

4. Qualitative Analysis

- Systematic identification of organic compound by qualitative analysis.
- Chromatography:

Identification by determination of the R_f values of the given organic/ inorganic compounds by paper/ thin layer chromatography.