

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Analytical Methods in Chemistry	04	02	--	02	Class 12th with Physics, Chemistry, Mathematics	NA

Learning Objectives

The Learning Objectives of this course are as follows:

- To make the students aware of the concept of sampling, accuracy, precision, statistical test data-F, Q and t test.
- To learn the laws of spectroscopy and selection rules governing the possible transitions in the different regions of the electromagnetic spectrum, Thermal and electroanalytical methods of analysis.
- To learn important separation methods like solvent extraction and chromatography. The practical exposure to the latest instrumentation and to detect analytes in a mixture.

Learning Outcomes:

By the end of this course, students will be able to:

- Perform experiments with accuracy and precision.
- Develop methods of analysis for different samples independently.
- Test contaminated water samples.
- Understand basic principles of instruments like Flame Photometer, UV-vis spectrophotometer.
- Learn separation of analytes by chromatography.
- Apply knowledge of geometrical isomers and keto-enol tautomers to analysis.
- Determine composition of soil.
- Estimate macronutrients using Flame photometry.

Unit 1: Qualitative and quantitative aspects of analysis Hours : 04

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression. Normal law of distribution of indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Unit 2: Optical methods of analysis Hours :10

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Transmittance. Absorbance and Beer-Lambert law. Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs).

Unit 3: Thermal methods of analysis

Hours :04

Theory of thermogravimetry (TG) and basic principle of instrumentation of thermal analyser. Techniques for quantitative estimation of Ca and Mg from their mixture.

Unit 4: Electroanalytical methods

Hours :04

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

Unit 5: Separation techniques

Hours :08

Solvent extraction: Classification, principle and efficiency of the technique. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique, Mechanism of separation: adsorption, partition & ion-exchange, Development of chromatograms: frontal, elution and displacement methods.

Practical

(Credits: 02, Laboratory periods: 60)

1. Separation of mixtures by paper chromatography and reporting the Rf values:
 - (i) Co^{2+} and Ni^{2+} .
 - (ii) Amino acids present in the given mixture.
2. Solvent Extractions
To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+} DMG complex in chloroform, and determine its concentration by spectrophotometry.
3. Analysis of soil:
 - (i) Determination of pH of soil.
 - (ii) Total soluble salt
 - (iii) Estimation of calcium and magnesium
 - (iv) Qualitative detection of nitrate and phosphate
4. Ion exchange:
 - (i) Determination of exchange capacity of cation exchange resins and anion exchange resins.
 - (ii) Separation of amino acids from organic acids by ion exchange chromatography.

5. Spectrophotometry
 - (i) Verification of Lambert-Beer's law and determination of concentration of a coloured species (CuSO_4 , KMnO_4 , CoCl_2 , CoSO_4)
 - (ii) Determination of concentration of coloured species via following methods;
 - (a) Graphical method
 - (b) Epsilon method
 - (c) Ratio method
 - (d) Standard addition method

References (Theory):

1. Willard, H.H.(1988), **Instrumental Methods of Analysis**, 7th Edition, Wardsworth Publishing Company.
2. Christian, G.D.(2004), **Analytical Chemistry**, 7th Edition, John Wiley & Sons, New York.
3. Harris, D. C.(2007), **Quantitative Chemical Analysis**, 7th Edition, Freeman.
4. Khopkar, S.M. (2008), **Basic Concepts of Analytical Chemistry**, New Age International Publisher.
5. Skoog, D.A.; Holler F.J.; Nieman, T.A. (2017), **Principles of Instrumental Analysis**, Thomson Asia Pvt. Ltd.

References (Practical):

1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C.(1989), **Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.

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Basics of Polymer Chemistry	04	02	--	02	Class 12th with Physics, Chemistry, Mathematics	NA

Learning Objectives

The Learning Objectives of this course are as follows:

- To help the student to know about the synthesis, properties and applications of polymers.
- To give glimpse of polymer industry to the student and help them to choose their career in the field of polymer chemistry.