

CHE-252-MJ-T: Analytical Chemistry-I

Course Type: Major (Theory)

No. of Credits: 2

Course Outcomes

At the end of the course, students will be able to

1. Learn concepts, definitions, and reagents used in volumetric analysis, colorimetry, chromatography, and solvent extraction.
2. Explain the principles of titrations, Beer-Lambert law, chromatographic separation, and solvent extraction mechanisms.
3. Use standard analytical techniques to determine concentrations of substances through titration, colorimetry, chromatography, and extraction.
4. Interpret titration curves, calibration plots, chromatograms, and extraction efficiencies to assess analytical results.
5. Compare the accuracy, precision, and suitability of analytical techniques like redox titrations vs. complexometry or paper chromatography vs. TLC.
6. Perform an analytical procedure of titrimetric, colorimetric, or extraction methods to determine unknown concentrations in a sample.

Course Contents

Chapter 1: Volumetric Analysis:

[12 Hours]

Introduction, Classification of reaction in volumetric analysis, standard solutions, equivalents, normalities, oxidation numbers, primary and secondary solutions, Types of volumetric analysis:

1. **Neutralization titrations:** Theory of indicators, neutralization curves for strong acid-strong base, weak acid-strong base, weak base-strong acid, Preparation of 0.1 M HCl and standardization with sodium carbonate, determination of sodium carbonate in washing soda.
2. **Complexometric Titrations:** Definition of complexing agents and complexometric titrations, EDTA, standard EDTA solution, Types of EDTA titrations, metal ion indicator, total hardness of water.
3. **Redox Titrations:** Definition of oxidizing agent, reducing agent, redox titrations, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agent, $KMnO_4$ as self-indicator, Determination of H_2O_2 .

4. Precipitation Titrations: Principle, precipitation reaction, determination of end point, standard silver nitrate solution, standardization of silver nitrate solution, determination of chloride and bromide.

(**Ref.-1:** Pages-257-275, 286, 295, 309-322, 328-332, 340-351, 364-372, **Ref.-2:** Pages-282-302, 322-334, 366-374, 437-452).

Chapter 2: Colorimetry:

[6 Hours]

Introduction, interaction of electromagnetic radiation with matter, essential terms-radiant power, transmittance, absorbance, Lambert's Law, Beer's Law, Lambert's-Beer's Law, molar absorptivity, deviations from Beer's law, Colorimeter: Principle, Construction and components, working, Applications-unknown concentration by calibration curve method, Determination of unknown concentration of Fe (III) by thiocyanate method, Numericals (**Ref. 1:** Pages-645-651, 658-661, 690, **Ref.3:** Pages-97, 100, 159-172, **Ref. 4:** Pages-144-153, 157-160).

Chapter 3: Chromatography:

[6 Hours]

Introduction, Principle, Types of chromatography, Paper Chromatography-Introduction, Principle, Migration parameters, Types of paper chromatography, Experimental details, Applications. Thin layer chromatography-Introduction, Experimental Techniques, Applications of TLC, Limitations. (**Ref.5:** Pages-2.588-2.615)

Chapter 4: Solvent extraction:

[6 Hours]

Introduction solvent extraction, organic Phase, Partition the theory of extraction, distribution coefficient, Distribution ratio, solute remaining unextracted separation coefficient, factor favouring solvent extraction, Quantitative treatment to solvent extraction equilibrium, ion association complexes, synergic extraction, some extraction reagents specially used for inorganic ion (Acetyl acetone, 8-Hydroxy quinoline, Diphenylthiocarbazone, sodium diethyl dithiocarbamate, ammonium pyrrolidine, dithiocarbamate), some practical aspects, applications, determination of copper as the diethyl dithiocarbamate complex, Determination of Fe(III) with 8-hydroxy quinoline, determination of Ni by synergistic extraction solid phase extraction, Numericals; (**Ref.6:** Pages-579-593)

References

1. Vogel's Textbook of Quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset. J. Mendham, R. C. Denny, Longman Scientific and Technical, 1989.
2. Analytical Chemistry, G. D. Christian, P. K. Dasgupta, K. A. Schug, 7th Ed, Wiley, 2004.

3. Basic Concept of Analytical Chemistry, S. M. Khopkar, 3rd Ed. New Age International Publishers.
4. Vogel's Textbook of Practical Organic Chemistry, Durniss, Hannaford, Smith, Tatchel, 5th Ed. Longman Scientific and Technical, 2004.
5. Instrumental Methods of Chemical Analysis, Gurdeep R. Chatwal, Sham K. Anand, Himalaya Publishing House.
6. Vogel's Textbook of Inorganic Quantitative Analysis, 6th Ed. Mendham, Deney Barnes Pearson Education.