

CHE-291-MN-T: Organic and Analytical Chemistry

Course Type: Minor (Theory)

No. of Credits: 2

Course Outcomes

At the end of the course, student will be able to learn,

1. Learn types of halogenated hydrocarbons, definitions, principles, and classification of titrations, chromatography techniques, acid-base theories, and .
2. Understand the theory behind the mechanisms of nucleophilic substitution and elimination, volumetric and chromatographic techniques.
3. Determine the acidity and basicity of organic compounds, prepare and standardize solutions of different concentration.
4. Differentiate between substitution mechanisms (S_N1 vs. S_N2), including the influence of structural and electronic factors, and types of titrations (e.g., redox vs. complexometric), chromatographic techniques.
5. Investigate the reactivity of halogenated hydrocarbons and suitability of indicators, titration methods, and chromatographic techniques for given analytical tasks.
6. Categorize the organic compounds based on their structure and reactivity, titration or chromatography techniques.

Course Content

Chapter 1 : Structure, Acidity and, Basicity

[8 hours]

Introduction to acidity and basicity, Lowry-Brønsted and Lewis acids and bases, concept of conjugate acids and bases, pK_a , simple and substituted aliphatic acids, phenols, aromatic carboxylic acids, bases, pK_b , aliphatic and aromatic bases.

Chapter 2 : Reactivity and Reactions of halogenated hydrocarbons

[7 hours]

Introduction and classification, general methods of preparation, reactivity of alkyl, aryl, allyl and vinyl halides, Nucleophilic substitution reactions: S_N1 and S_N2 , Factors affecting S_N1 and S_N2 reactions, Elimination reactions: $E1$ and $E2$. Nucleophilic aromatic substitution (S_NAr) reactions.

Chapter 3: Volumetric Analysis:

[9 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 titration, EDTA, standard EDTA solution, Types of EDTA titration, metal ion indicator, total hardness of water.
- 3. Redox Titration:** Definition of oxidizing agent, reducing agent, redox titration, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agent, $KMnO_4$ as self-indicator, Determination of H_2O_2 .
- 4. Precipitation Titration:** 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 4: Chromatography:**[6 Hours]**

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

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. Instrumental Methods of Chemical Analysis, Gurdeep R. Chatwal, Sham K. Anand, Himalaya Publishing House.
4. A Guidebook to Mechanism in Organic Chemistry by Peter Sykes. 6th ed. Essex, England: Longman Scientific & Technical
5. Organic Chemistry by Morrison and Boyd, 7th Edition, Pearson Education
6. Advanced Organic Chemistry by Jerry March, 7th Edition, Wiley
7. Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren, 2nd Edition