

(iii) Determination of the composition of the  $\text{Fe}^{3+}$  - salicylic acid complex in solution by Job's method.

## 2. Complexometric titrations using disodium salt of EDTA:

- (i) Estimation of  $\text{Zn}^{2+}$  using EBT / Xylenol orange as indicator
- (ii) Estimation of  $\text{Mg}^{2+}$
- (iii) Estimation of  $\text{Ca}^{2+}$  by substitution method
- (iv) To estimate the concentration of Ca in commercially available medicines.
- (v) To estimate the Mg present in multivitamins.

### References:

#### Theory:

1. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry- Principles of Structure and Reactivity**, Pearson Education.
2. Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), **Inorganic Chemistry** 2nd Ed., Oxford University Press.
3. Cotton, F.A.; Wilkinson, G.; Gaus, P.L. **Basic Inorganic Chemistry**, 3rd Edition, Wiley India.
4. Crichton, R.R. (2008), **Biological Inorganic Chemistry: An Introduction**. Amsterdam, Elsevier.
5. Kaim, W., B. Schwederski and A. Klein. (2014), **Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life: An Introduction and Guide**. 2nd Edition, Wiley.

#### Practical:

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

#### Additional Resources:

1. Lippard, S.J.; Berg, J.M. (1994), **Principles of Bioinorganic Chemistry**, Paniama Publishing Company.
2. Greenwood, N.N.; Earnshaw, A. (1997), **Chemistry of the Elements**, 2nd Edition, Elsevier

## GE 4: Chemistry: Basic Concepts of Organic Chemistry

### 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
		Lecture	Tutorial	Practical/Practice		
Basic Concepts of Organic Chemistry (GE-4)	4	2		2		

## Learning Objectives

The Learning Objectives of this course are as follows:

- To teach the fundamentals of organic chemistry and the introduction of a new concept of visualizing the organic molecules in a three-dimensional space.
- To establish the applications of these concepts, different types of organic reactions are introduced.

## Learning Outcomes

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

- Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reaction mechanisms including free radical substitution, electrophilic addition and electrophilic aromatic substitution.
- Differentiate between various types of organic reactions possible on the basis of reaction conditions

## SYLLABUS OF GE-4

### Theory:

#### **Unit 1: Basic Concepts (6 Hours)**

Electronic displacements and their applications: Inductive, electromeric, resonance and mesomeric effects and hyperconjugation. Dipole moment, acidity and basicity.

Homolytic and heterolytic fissions with suitable examples. Types, shape and relative stability of carbocations, carbanions and free radicals. Electrophiles and nucleophiles

Concept of Aromaticity: Huckel's rule

#### **Unit 2: Stereochemistry (10 Hours)**

Stereoisomerism: Optical activity and optical isomerism, asymmetry, chirality, enantiomers, diastereomers. specific rotation; Configuration and projection formulae: Newmann, Sawhorse, Fischer and their interconversion. Chirality in molecules with one and two stereocentres; meso configuration.

CIP rules: Erythro/Threo, D/L and R/S designations.

Geometrical isomerism: *cis-trans*, *syn-anti* and *E/Z* notations.

#### **Unit 3: Types of Organic Reactions (14 Hours)**

Introduction to substitution, addition, elimination, isomerization, rearrangement, oxidation and reduction reactions.

Free radical substitutions (Halogenation), concept of relative reactivity v/s selectivity. Free radical reactions in the biological reactions

Mechanisms of E1, E2, Saytzeff, Hoffmann eliminations and Cope elimination. Biological dehydration reactions

Electrophilic Additions reactions of alkenes and alkynes: mechanism with suitable examples, (Markownikoff/Antimarkownikoff addition), syn and anti-addition; addition of H<sub>2</sub>, X<sub>2</sub>, hydroboration-oxidation, ozonolysis, hydroxylation.

Nucleophilic substitution reactions – S<sub>N</sub>1 and S<sub>N</sub>2 mechanisms with stereochemical aspects

and effect of solvent; nucleophilic substitution vs. elimination. Biological methylating agents  
Electrophilic aromatic substitution: halogenation, nitration, sulphonation, Friedel Crafts alkylation/ acylation with their mechanism. Directing effects of groups in electrophilic substitution.

### Practicals:

(60 Hours)

#### (Laboratory Periods: 60)

1. Calibration of a thermometer and determination of the melting points of the organic compounds (Kjeldahl method, electrically heated melting point apparatus and BODMEL)
2. Purification of the organic compounds by crystallization using the following solvents:
3. a. Water      b. Alcohol      c. Alcohol-Water
4. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation, capillary method and BODMEL)
5. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) and phenols ( $\beta$ -naphthol, salicylic acid) either by conventional or green method.
6. Bromination of acetanilide/aniline/phenol either by conventional or green method.
7. Nitration of chlorobenzene/nitrobenzene.

### References:

#### Theory:

1. Sykes, P. (2005), **A Guide Book to Mechanism in Organic Chemistry**, Orient Longman.
2. Eliel, E. L. (2000), **Stereochemistry of Carbon Compounds**, Tata McGraw Hill.
3. Morrison, R. N.; Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7<sup>th</sup> Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. **Mehta B.; Mehta M. (2015)**, Organic Chemistry, PHI Learning Private Limited
5. **Bahl, A; Bahl, B. S. (2012)**, Advanced Organic Chemistry, S. Chand.

### Practicals:

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), **Vogel's Textbook of Practical Organic Chemistry**, Pearson.
2. Mann, F.G.; Saunders, B.C. (2009), **Practical Organic Chemistry**, Pearson Education.