ORGANIC AND INORGANIC CHEMISTRY

ENSH 154

Lecture : 3 **Year : I**
Tutorial : 1 **Part : II**
Practical : 3

Course Objectives:
To familiarize the student with basic information of organic chemistry, inorganic chemistry and biologically important organic compounds.

1 Reactive Intermediates in Organic Reaction (4 hours)

1.1 Acidity of α-hydrogens, reactions involving carbanions, base-promoted halogenation of ketones, acid-catalyzed halogenations of ketones
1.2 Aldol condensation, dehydration of aldol products, use of aldol condensation in synthesis, cross aldol condensation
1.3 Malonic ester synthesis, acetoacetic ester synthesis of ketones, decarboxylation of β-keto acids and malonic acids

2 Heterocyclic Compounds (4 hours)

2.1 Sources of pyrrole, furan and thiophene, electrophilic substitution in pyrrole, saturated five-membered heterocycles
2.2 Structure of pyridine, source of pyridine compounds, reaction of pyridine, electrophilic substitution in pyridine, nucleophilic substitution in pyridine, basicity of pyridine, reduction of pyridine

3 Pericyclic Reaction (5 hours)

3.1 LCAO method, bonding and antibonding orbitals, electronic configurations of some molecules, aromatic character, the Huckel 4n+2 rule
3.2 Electrocyclic reactions, cycloaddition reactions, sigmatropic reactions

4 Coordination Chemistry (6 hours)

4.1 Stability of octahedral and tetrahedral complexes on the basis of crystal field stabilization energy, factors affecting the magnitude of Δ
4.2 Application of crystal field theory, variation of hydrated ionic radii and hydration enthalpy/stability of complexes
4.3 Distorted octahedral complexes

5 Organometallic Compounds (4 hours)

5.1 Preparation and properties of organolithium, organomagnesium, organocopper metallic compounds

5.2 Alkene and alkyne complexes: Haptonomenclature, metallocenes, ferrocene

6 Solvent (4 hours)

6.1 Introduction, classification of solvents, solvent properties, role of solvent in organic reaction, properties of solvents in polymer processing

6.2 Non aqueous solvent: Liquid ammonia, liquid Sulphur dioxide

7 Industrial Important Compounds (4 hours)

7.1 Synthesis of Sulphuric acid, comparison of catalyst V_2O_5/Pt (Contact process)

7.2 Synthesis of nitric acid (Ostwald process)

7.3 Synthesis of ammonia (Haber process)

7.4 Chemical fertilizers, nitrogen fixation, artificial method used for the fixation of nitrogen, synthetic fertilizers, essential qualities of a good fertilizer, urea, phosphate fertilizer

7.5 Detergents, soap

8 Carbohydrates and Lipids (6 hours)

8.1 Monosaccharides: Introduction, definition and classification, (+)-glucose (An aldohexose), (-)-fructose (1-ketohexose), nomenclature of aldose derivatives, oxidation, osazone formation

8.2 The Kiliani-Fischer synthesis, the Ruff degradation, conversion of an aldose into its epimer, configuration of aldoses, cyclic structure of D-(+)-glucose, configuration about C-1, methylation, determination of ring size

8.3 Disaccharides: (+)-Maltose, (+)-sucrose

8.4 Polysaccharides: Starch, structure of amylose, and amylopectin, lipids, occurrence and composition of fats, hydrolysis of fats, fats as sources of pure acids, alcohols, unsaturated fats, phosphoglycerides, phospholipids

9 Amino Acid, Proteins (4 hours)

9.1 Proteins, structure of amino acids, amino acids as dipolar ions, isoelectric point of amino acids, configuration of natural amino acids, preparation of amino acids

9.2 Reactions of amino acids, geometry of peptides, synthesis of peptides, classification and function of protein, chymotrypsin

10 Metabolites and Molecular Genetics (4 hours)

10.1 Metabolites: Definition, types of metabolites with examples
10.2 Concept of metabolism
10.3 Basic concept of genetic, flow of genetic information
10.4 Gene cloning, introduction to scope of molecular genetics

Tutorial (15 hours)

1. Reactive intermediates in organic reaction: Acidity of α-hydrogens, reactions involving carbanions, base-promoted halogenation of ketones, acid-catalyzed halogenations of ketones
2. Heterocyclic compound: Sources of pyrrole, furan and thiophene, electrophilic substitution in pyrrole, furan and thiophene
3. Pericyclic reaction: LCAO method, bonding and antibonding orbitals, electronic configurations of some molecules, aromatic character
4. Coordination chemistry: Stability of octahedral and tetrahedral complexes on the basis of crystal field stabilization energy, factors affecting the magnitude of Δ
5. Organometallic compounds: Preparation and properties of organolithium, organomagnesium, organocopper metallic compounds
6. Solvent: Introduction, classification of solvents, solvent properties, role of solvent in organic reaction
7. Industrial important compounds: Synthesis of sulphuric acid, comparison of catalyst V_2O_5/Pt (Contact process)
8. Carbohydrates and lipids
    - Monosaccharides: Introduction, definition and classification
    - (+)-glucose: an aldohexose,
    - (-)-Fructose: 1-ketohexose, nomenclature of aldose derivatives, Oxidation, Osazone formation
9. Amino acid, proteins: Proteins, structure of amino acids, amino acids as dipolar ions, Isoelectric point of amino acids, configuration of natural amino acids, preparation of amino acids
10. Metabolites and molecular genetics: Metabolites, definition of metabolites, types of metabolites with examples; Concept of metabolism

Practical (45 hours)

1. Detection of organic compounds (Identification of functional groups in organic compounds
2. Preparation of Acetanilide from Aniline
3. Benzylation of Aniline to prepare Benzanilide
4. Application of Salicylic acid for the preparation of Aspirin
5. Preparation of phenyl –Azo –β-Naphthol
6. Preparation of Salicylic acid from Methyl Salicylate
7. Determination of Amount of Vitamin C (Ascorbic Acid) from supplied commercial tablets Idometrically

8. Extraction of essential oil from natural products
9. Determination of Zinc by EDTA – complexometric titration
10. Determination of Calcium in chalk/toothpaste
11. Determination of sodium carbonate in baking/washing soda

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	4	5
2	4	5
3	5	5
4	6	10
5	4	5
6	4	5
7	4	5
8	6	10
9	4	5
10	4	5
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Morrison, R.T., Boyd, R.N. (2024). Organic chemistry. Pearson.
2. March, J. (2025). March's advanced organic chemistry: Reactions, mechanisms, and structure. John Wiley & Sons.
3. Bahl, A., Bahl, B.S. (2022). Advanced organic chemistry. S. Chand Publishing.
4. Lee, J.D. (1996). Concise inorganic chemistry (Latest Edition). Chapman & Hall / Blackwell.
5. Cotton, F.A., Wilkinson, G., Gaus, C. (2007). Basic inorganic chemistry. John Wiley & Sons.
6. Brown, T.A. (2021). Gene cloning and DNA analysis: An introduction. John Wiley & Sons.