

# Cross cutting issues - Environment & Sustainability



B. Sc. Second Year: Semester-III

Paper-VI, (CCC-III, Section A)

Organic & Inorganic Chemistry

Credits:02

Periods: 45

## Part I (Organic Chemistry)

### Unit:-I

#### Name Reaction with Mechanism

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#### [A] Condensation reactions of Aldehydes and Ketones.

1. Benzoin Condensation Reaction.
2. Knoevengel Reaction.
3. Mannich Reaction
4. Perkins Reaction,
5. Reformatsky reaction.
6. Gatterman Koch reaction.
7. Gatterman synthesis.

#### [B] Reduction reactions

1. Clemmensen Reduction Reaction.
2. Meervin-Pondorof Verly reduction reaction.
3. Reduction with  $\text{LiAlH}_4$ .
4. Reduction with  $\text{NaBH}_4$ .

#### [C] OXIDATION REACTIONS.

1. Baeyer- Villiger Oxidation Reaction.
2. Oppenauer oxidation.

### Unit:- II

#### Aromatic Carboxylic and Sulphonic Acids.

06

1. Introduction and Classification of Aromatic Carboxylic Acids.
2. Synthesis and Chemical Reactions of Following Acids.

#### [A] Benzoic Acid.

1. Preparations From: (a) Phenyl Cyanide, (b) Toluene.
2. Reactions of Benzoic Acids:
  - a) Acyl halide formation b) Reduction. c) Nitration.

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### [B] Anthranilic Acid:

1. Preparations From : (a) Phthalimide. b) O-nitroToluene.
2. Reactions of Anthranilic Acids:
  - a) Action of heat, b) Nitrous Acid, c) Action of acetic anhydride/acetyl chloride.

### [C] Salicylic Acid:

1. Preparations From: (a) Kolbe's reaction. (b) Reimer-Tiemann reaction.
2. Reactions of Salicylic Acids:
  - a) Bromination, b) Nitration, c) Decarboxylation, d) Reaction with Zn-dust.

### [D] Phthalic Acid

1. Preparations From: (a) o-xylene. (b) Naphthalene.
2. Reactions of Phthalic Acids:
  - a) Action of heat. b) Action of  $PCl_5$ . c) Action of ethanol.

### [E] Benzene Sulphonic Acid.

1. Introduction.
2. Preparation of benzene sulphonic acid from benzene with mechanism.
3. Chemical Reactions of benzene sulphonic acid,
  - a) Salt formation b) formation of sulphonyl chloride, c) formation of sulphonic ester and amide.
4. Replacement of sulphonic group by:
  - a) Hydroxyl group. b) cyano group, c) Hydrogen atom d)  $NH_2$ -group.

### Unit:- III

09

### [A] Introduction to Organometallic Compounds.

#### 1. Organomagnesium Compounds:

1. Preparation of Methyl magnesium bromide.
2. Synthetic applications of Methyl magnesium bromide ( $CH_3MgBr$ ): Hydrocarbons, Ethanol, 2-propanol, 2-methyl-2-propanol, Ethanal, 2-propanone, ethanoic acid, Methanamine, Acetonitrile, Ethyl ethanoate..

#### 2. Organo Lithium Compounds.

1. Preparation of methyl lithium from methyl iodide.
2. Synthetic application of Methyl lithium( $CH_3Li$ ): Methane, Ethanol, 1-propanol, 2-propanol.

#### 3. Organo Zinc Compounds:

1. Preparation of diethyl zinc from ethyl iodide.
2. Synthetic application of diethyl zinc [ $(C_2H_5)_2Zn$ ]: Methane, 2-propanone, Ethanol, 2-propanol.

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B. Sc. Second Year: Semester-IV  
Paper-VIII, (CCC IV, Section A)  
Organic & Inorganic Chemistry

Credits:02

Periods: 45

Part I (Organic Chemistry)

Unit:-I

08

**Stereochemistry**

1. Introduction
2. Concept and Types of isomerism. (a) Structural isomerism (b) Stereo isomerism.
3. Types of structural isomerism [Chain, Position, Functional, Metamerism, Tautomerism]
4. Types of Stereoisomerism [Conformational ( n-butane) and Configurational]
5. Geometrical isomerism: Cis -Trans and E and Z system of nomenclature.
6. Optical isomerism:
  - a) Concept of asymmetric carbon atom, Chiral centre.
  - b) Dextro and Laevo forms, Racemic mixture.
  - c) Element of symmetry [plane, Centre, and Axis]
  - d) Concept of Diastereoisomers.
  - e) Racemic modification. ( with one example)
  - f) Resolution ( Concept) ( with one example)
  - g) Walden inversion. ( with one example)
  - h) Relative Configuration and Absolute configuration.[D,L and R,S notations]

Unit:-II

08

**Carbohydrates.**

1. Introduction.
2. Classification and Nomenclature
3. Reactions of Monosaccharide's (Glucose and Fructose)
  - a) Addition reactions b) Ether formation
  - c) Reduction of glucose d) Oxidation of glucose

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- e) Osazone formation with mechanism
4. Open and cyclic structure of glucose
5. Determination of ring size
6. Mutarotation with Mechanism.
7. Epimerization.
8. Cyclic Structure of D-glucose.( supporting evidence for six member ring)
9. Interconversions:
  - a) Glucose to Fructose.
  - b) Fructose to Glucose.
  - c) Glucose to Mannose.
  - d) Glucose to Arabinose (Ruff Degradation)
  - e) Arabinose to Glucose ( Kiliani synthesis)
10. Pyranose Structure of Glucose.
11. Manufacturing of sucrose (sugar) from sugar cane.

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### Unit:-III

#### **Nitrogen Containing Organic Compounds.**

##### **A] Aromatic Nitro Compounds.**

1. Introduction, Nomenclature,
2. Preparation of Nitrobenzene from benzene
3. Physical and Chemical properties of Nitrobenzene.
4. Electrophilic substitution reactions.
5. Reductions: a) in acidic medium. b) In neutral medium.  
c) In alkaline medium. d) Electrolytic reduction.

##### **B] Aromatic amines:**

- 1) Introduction, Classification, Nomenclature,
- 2) Methods of preparations of aniline from
  - i) chlorobenzene ii) phenol
  - iii) nitrobenzene iv) from phthalimide

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B. Sc. Second Year: Semester- III & IV  
CCCP II (CCC III & IV, Section A)  
Practical based on P-VI & P-VIII  
Laboratory Course- Paper-X

Credits:02

Periods: 120

Note: At least sixteen experiments should be taken.

Part I ( Organic Chemistry)

1. Only demonstration

- i) Determination of R<sub>f</sub> values of O, M and P-nitro aniline.
- ii) Separation of benzene and water by distillation method.

2. Qualitative analysis: Identification of following organic compounds.

[Two from each of the following]


- a) Acids: Benzoic acid, Phthalic acid, Salicylic acid, Cinnamic acid, o-chloro benzoic acid.
- b) Base: Aniline, P-nitroaniline, m-nitroaniline, resorcinol, P-toluidine.
- c) Phenols: Phenol,  $\alpha$ -naphthol,  $\beta$ -naphthol, p-cresol, m-nitrophenol.
- d) Neutral: Naphthalene, Anthracene, Acetanilide, m-dinitrobenzene, Nitrobenzene.

3. Quantitative analysis: (estimation) any four.

- a) Estimation of glycine by Sorenson's method.
- b) Estimation of phenol by bromination method.
- c) Estimation of glucose by Iodination method.
- d) Estimation of unsaturation (cinnamic acid).
- e) Estimation of saponification value of an oil.
- f) Estimation of Iodine value of an oil.
- g) Estimation of vitamin-C
- h) Estimation of formaldehyde.

Part II ( Inorganic Chemistry)

- 1 Determine volumetrically the amounts of sodium carbonate and sodium hydroxide present together in the given solution provided 0.1 N HCl solution
- 2 Determine the percentage of CaCO<sub>3</sub> in the chalk sample, provided 1 N HCl and 0.1N NaOH

  
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Cross cutting issues -  
(Environment & Sustainability)

2020-21, 2021-22, 2022-23



B. Sc. Second Year: Semester-III  
Paper-VI, (CCC-III, Section A)  
Organic & Inorganic Chemistry

Credits: 02

Periods: 45

Part-I (Organic Chemistry)

Unit: I

Name Reaction of Aldehydes and Ketones (With Mechanism):

12P

[A] Condensation Reactions:

1. Aldol Condensation Reaction.
2. Benzoin Condensation Reaction.
3. Knoevenagel Reaction.
4. Mannich Reaction.
5. Perkin Reaction.
6. Reformatsky Reaction.

[B] Reduction Reactions.

1. Clemmensen Reduction Reaction.
2. Meerwein-Ponndorf-Verley reduction reaction.
3. Reduction with  $\text{LiAlH}_4$ .

[C] Oxidation Reactions.

1. Baeyer-Villiger Oxidation Reaction.
2. Oppenauer oxidation.

Unit: II

Aromatic Carboxylic and Sulphonic Acids.

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1. Introduction and Classification of Aromatic Carboxylic Acids.
2. Synthesis and Chemical Reactions of Following Acids.

[A] Benzoic Acid.

1. Preparations From: (a) Phenyl Cyanide, (b) Toluene.
2. Reactions of Benzoic Acids: a) Benzoyl halide formation b) Reduction. c) Nitration.

[B] Anthranilic Acid:

1. Preparations From: (a) Phthalimide, b) o-Nitrotoluene.
2. Reactions of Anthranilic Acids: a) Action of heat, b) Nitrous Acid, c) Action of acetic anhydride / acetyl chloride.

[C] Salicylic Acid:


1. Preparations From: (a) Kolbe's reaction. (b) Reimer-Tiemann reaction.
2. Reactions of Salicylic Acids: a) Bromination, b) Nitration, c) Decarboxylation, d) Reaction with Zn-dust.

[D] Phthalic Acid

1. Preparations From: (a) o-Xylene. (b) Naphthalene.
2. Reactions of Phthalic Acids: a) Action of heat b) Action of  $\text{PCl}_5$  c) Action of ethanol.

[E] Benzene Sulphonic Acid.

1. Introduction.
2. Preparation of benzene sulphonic acid from benzene with mechanism.

  
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3. Chemical Reactions of benzene sulphonic acid: a) Salt formation b) Formation of sulphonyl chloride, c) Formation of sulphonic ester and amide.
4. Replacement of sulphonic group by: a) Hydroxyl group, b) Cyano group, c) Hydrogen atom d)  $\text{NH}_2$  -group.

### Unit: III

#### [A] Introduction to Organometallic Compounds:

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##### 1. Organomagnesium Compounds:

1. Preparation of Methyl Magnesium Bromide ( $\text{CH}_3\text{MgBr}$ ).
2. Synthetic Applications: Ethanal, 2-Propanone, Ethanoic acid, Methanamine, Acetonitrile, Ethyl ethanoate.

##### 2. Organolithium Compounds:

1. Preparation of Methyl Lithium ( $\text{CH}_3\text{Li}$ ) from Methyl Iodide.
2. Synthetic applications: Ethanol, 1-Propanol, 2-Propanol, 2-Methyl-2-Propanol.

##### 3. Organozinc Compounds:

1. Preparation of Diethyl Zinc  $[(\text{C}_2\text{H}_5)_2\text{Zn}]$  from ethyl iodide.
2. Synthetic applications: Ethane, 2-Butanol, Ethyl methyl ketone, Diethyl mercury.

#### [B] Organic Synthesis via Enolates:

04P

1. Introduction, Acidity of alpha hydrogen.
2. Synthesis of Ethyl Acetoacetate. [Claisen Condensation Reaction with Mechanism]
3. Ketol-Enol Tautomerism of ethyl acetoacetate.
4. Synthetic Applications of Ethyl Acetoacetate: a) Synthesis of alkyl ethyl acetoacetate by alkylation, b) Synthesis of 2-Butanone, c) Synthesis of Acetyl acetone, d) Synthesis of Propanoic acid, e) Synthesis of Succinic acid.

### Unit: IV

#### Oils, Fats, Soaps and Detergents:

05P

Introduction, Chemical nature, General physical properties and chemical properties.

##### A] Oils and Fats:

- a) Hydrolysis
- b) Hydrogenation
- c) Hydrogenolysis
- d) trans-Esterification
- e) Rancidity and autoxidation
- f) Analysis of Fats and Oils i) Saponification value, ii) Iodine value

##### B] Soaps

1. Introduction,
2. Manufacture of soaps by i) Kettles process, ii) Hydrolyser process,
3. Cleansing action of soap.

##### C] Synthetic Detergents.

1. Introduction,
2. Synthetic detergent classification: i) Anionic, ii) Cationic, iii) Non-ionic.
3. Synthetic detergent versus soaps, Soft versus Hard detergents.

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B. Sc. Second Year: Semester- III & IV  
CCCP II (CCC III & IV, Section A)  
Practical based on P-VI & P-VIII  
Laboratory Course- Paper-X

Credits: 02

Periods: 120

Note: At least sixteen experiments should be taken.

**Part-I (Organic Chemistry)**

**1. Only demonstration**

- Determination of Rf values of O, M and P-nitro aniline.
- Separation of benzene and water by distillation method.

**2. Qualitative analysis: Identification of following organic compounds.**

(Two from each of the following)

- Acids: Benzoic acid, Phthalic acid, Salicylic acid, Cinnamic acid, o-chloro benzoic acid.
- Base: Aniline, P-nitroaniline, m-nitroaniline, resorcinol, P-toluidine.
- Phenols: Phenol,  $\alpha$ -naphthol,  $\beta$ -naphthol, p-cresol, m-nitrophenol.
- Neutral: Naphthalene, Anthracene, Acetanilide, m-dinitrobenzene, Nitrobenzene.

**3. Quantitative analysis: (estimation) any four.**

- Estimation of glycine by Sorenson's method.
- Estimation of phenol by bromination method.
- Estimation of glucose by iodination method.
- Estimation of unsaturation (cinnamic acid).
- Estimation of saponification value of an oil.
- Estimation of iodine value of an oil.
- Estimation of vitamin-C
- Estimation of formaldehyde.

**Part-II (Inorganic Chemistry)**

- Determine volumetrically the amounts of sodium carbonate and sodium hydroxide present together in the given solution provided 0.1 N HCl solution
- Determine the percentage of  $\text{CaCO}_3$  in the chalk sample, provided 1 N HCl and 0.1N NaOH
- Estimate the strength of the given sample of  $\text{KMnO}_4$  Solution in g/lit. Prepare a standard solution of N/10 Mohr's salt or N/10 Sodium Oxalate solution
- Estimate volumetrically the strength of Ferrous and ferric ion in the given solution provided N/10  $\text{KMnO}_4$  Solution
- Determine the strength in g/lit of each of HCl and  $\text{HNO}_3$  present together in the given solution. Provided N/10 NaOH and N/20  $\text{AgNO}_3$
- Determination of Nickel using murexide as an indicator (Direct method)
- Prepare standard solution of Zn ion standardize the give EDTA solution and estimate the amount of unknown Zn ion concentration
- To determine the total, permanent and temporary hardness of water by complexometric method using EDTA.

**Objectives:**

- ❖ To trained the thin layer chromatography and distillation techniques.
- ❖ Become skilled for qualitative analysis of organic compounds.
- ❖ Taught to do the quantitative analysis by estimations of organic molecules.
- ❖ Gain the practical knowledge for volumetric analysis.

**Outcomes:**

- Learn basics of thin layer chromatography and distillation.
- Learn fundamentals of organic qualitative analysis.
- Learn about organic estimations.
- Basics of volumetric analysis.

  
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B. Sc. Second Year: Semester-IV  
Paper-VIII, (CCC IV, Section A)  
Organic & Inorganic Chemistry

Credits: 02

Periods: 45

Part-I (Organic Chemistry)

Unit:-I

Stereochemistry:

10P

1. Introduction
2. Concept and Types of isomerism (a) Structural isomerism, (b) Stereoisomerism.
3. Types of Structural isomerism.
4. Types of Stereoisomerism.
5. Optical Isomerism: a) Concept of Asymmetric Carbon atom, Chiral centre, b) Optical Activity (Plane polarized light, dextro and laevo forms, racemic mixture), c) Element of Symmetry [Plane, Centre, and Axis], d) Concept of Enantiomers, e) Concept of Diastereomers, f) Racemic Modification, g) Resolution, h) Relative specification of configuration (D and L Notations), i) Absolute specification of configuration (R and S notations) [Examples: i) Lactic acid, ii) Glyceraldehyde, iii) Bromo chloro iodomethane, iv) 2-Chlorobutane, v) 1-Bromo-1-Chloro ethanol, vi) 1-Chloro ethylamine, vii) 1-Chloro-1-propanol, viii) Glyceric acid, ix)  $\alpha$ -Deutero ethyl bromide, x) 1-Phenyl ethanol, xi) Mendelic acid, xii) 1-Phenyl ethylchloride, xiii) Lactonitrile, xiv)  $\alpha$ -Bromo propanoic acid, xv) 2-Iodo octane and xvi) Cinnamic acid dibromide].
6. Geometrical Isomerism (Cis-trans isomerism), E and Z System of nomenclature [Examples: i) Meleic acid, ii) 1-Chloro-2-bromo-2-iodoethene, iii) 3-Hexene, iv) 1,2-Diphenylethene, v) 2-Pentene, vi) 1-Deuterium hexane, vii) 3-Methyl-3-haxene, viii) Phenyl oxime, ix) 1-Bromo-1,2-dichloroethene, x) 2-Chloro-3-methyl-2-pentenoic acid, xi) Cinnamic acid and xii) Crotonic acid.

Unit:-II

Carbohydrates:

08P

1. Introduction, Definition, Classification and Nomenclature.
2. Reactions of Monosaccharide (Glucose): a) Addition reactions, b) Ether formation, c) Reduction of glucose, d) Oxidation of glucose, e) Osazone formation with mechanism.
4. Open and cyclic structure of glucose.
5. Mutarotation with Mechanism.
6. Epimerization.
7. Inter-conversions: a) Glucose to Fructose, b) Fructose to Glucose, c) Glucose to Mannose,
- d) Glucose to Arabinose (Ruff Degradation), e) Arabinose to Glucose ( Killiani synthesis).
8. Manufacturing of sucrose (sugar) from sugar cane.

Unit:-III

Nitrogen Containing Organic Compounds:

08P

A] Aromatic Nitro Compounds:

1. Introduction, Nomenclature,
2. Preparation of Nitrobenzene from benzene
3. Physical and Chemical properties of Nitrobenzene.
4. Electrophilic substitution reactions.



5. Reductions: a) in acidic medium, b) In neutral medium, c) In alkaline medium, d) Electrolytic reduction.

**B] Aromatic amines:**

1. Introduction, Classification, Nomenclature,
2. Methods of preparations of aniline from i) chlorobenzene, ii) phenol, iii), nitrobenzene, iv) from phthalimide
3. Chemical properties: i) Diazotization reaction, ii) Action of carbon disulphide, iii) Action of benzoyl chloride, iv) Formation of Schiff's base, v) Carbylamine reaction, vi) Formation of p-nitroacetanilide
4. Effect of substituent ( $-\text{NO}_2$ ,  $-\text{OCH}_3$ ,  $-\text{CH}_3$ ) on the basicity of aniline.

**C] Diazomethane:**

1. Introduction.
2. Methods of Preparation from: i) N-nitroso-N-methylurethane, ii) Nitrous oxide and methyl lithium.
3. Reactions of Diazomethane: i) Action of heat, ii) Reaction with mineral acid, iii) Reaction with phenol, iv) Reaction with ethanol and ethanamine, v) Ring expansion (cyclopentanone to cyclohexanone).

**D] Urea:**

1. Synthesis of urea by a) Wohlers methods and b) From  $\text{CO}_2$ .
2. Reactions: a) Action of heat, b) Action of nitrous acid, c) Hydrolysis, d) Action of thionyl chloride, e) Action of formaldehyde, f) Action of hydrazine, g) Action of acetyl chloride, h) Salt formation.

**Unit:-IV**

**Applications of Reagents in Organic Synthesis:**

04P

**A] Osmium Tetraoxide [ $\text{OsO}_4$ ]:**

1. Introduction, Preparation.
2. Reactions: a) In the formation of Cis-1,2-diol, b) Acraldehyde to glyceraldehyde, c) Cis- hydroxylation of maleic acid, d) 9, 10-dihydroxylation of phenanthrene.

**B] Ozone [ $\text{O}_3$ ]:**


1. Preparation.
2. Reactions: a) Synthesis of aldehydes and ketones, b) Synthesis of dialdehydes and hydroxyl aldehydes, c) In degradation of alcohols.

**C] Selenium Dioxide. [ $\text{SeO}_2$ ]:**

1. Preparation.
2. Reactions: a) Oxidation of reactive methylene group into Carbonyl group, b) In dehydrogenation reactions, c) allylic hydroxylation and oxidation.

**D] Boron Trifluoride [ $\text{BF}_3$ ]**

1. Preparation.
2. Reactions, in the formation of: a) acids, b) esters c) diketones, d) Nitration, e) Sulphonation, f) Rearrangement reaction.

  
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