

## Teaching Plan 2024

B.Sc. (P) Chemistry, NEP, Semester-I

Subject: **Basic Concepts of Organic Chemistry (DSC- 1)**

Teacher: **Dr. Padma Dechan**

Week	Topic
Week 1	Inductive effect, Resonance effect, Hyperconjugation, Electromeric Effect. Reactive intermediates and their stability: carbocations, free radicals, carbanions, benzyne, carbenes
Week 2	Acidity and basicity in organic compounds (comparison of carboxylic acids, alcohols, phenols, primary, secondary and tertiary aliphatic amines, aniline and its derivatives)
Week 3	Flying Wedge Formula, Newmann, Sawhorse and Fischer representations and their interconversion. Stereoisomerism: Concept of chirality (upto two carbon atoms)
Week 4	Configurational isomerism: geometrical and optical isomerism; enantiomerism, diastereomerism and meso compounds). Threo and erythro; D and L; Cis-trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E/Z nomenclature (for upto two C=C systems)
Week 5	Conformational isomerism with respect to ethane, butane and cyclohexane
Week 6	Electrophilic addition reaction (with respect to propene, propyne, 3,3-dimethyl-1-butene): Hydration, Addition of HX in the absence and presence of peroxide, Hydroboration oxidation, Addition of bromine (with stereochemistry)
Week 7	Nucleophilic addition reaction of carbonyl compounds: Addition of HCN, ammonia derivatives (Hydroxylamine, Hydrazine, Semicarbazide and 2, 4-DNP), the addition of carbanion (Aldol condensation, Claisen Schmidt, Benzoin condensation, Perkin reaction, reactions involving Grignard reagent)
Week 8	Nucleophilic addition reaction of carbonyl compounds: Continue..
Week 9	<b>SEMESTER BREAK</b>
Week 10	Nucleophilic substitution reaction (SN1 and SN2) in alkyl halides (mechanisms with stereochemical aspect), alcohols (with nucleophiles like ammonia, halides, thiols, ambident nucleophiles (cyanide and nitrite ion)), ethers (Williamson ether synthesis)
Week 11	Nucleophilic substitution reactions.....Continue
Week 12	Elimination reaction (E1 & E2), elimination vs substitution (w.r.t. potassium t-butoxide and KOH)
Week 13	Nucleophilic aromatic substitution in aryl halides-elimination addition reaction w.r.t. chlorobenzene, including the effect of nitro group (on the ring) on the reaction. relative reactivity and strength of C-X bond in alkyl, allyl, benzyl, vinyl and aryl halides towards substitution reactions

Week 14	Remedial Class, Assignment and Class Test
Week 15	Electrophilic Aromatic substitution with mechanism (benzene)- sulphonation, nitration, halogenations
Week 16	Friedel craft acylation :o-, m- and p- directive influence giving examples of toluene/nitrobenzene/ phenol/ aniline/ chlorobenzene
Week 17	Free radicals (Birch Reduction); Carbocations (Pinacol-Pinacolone, Wagner-Meerwein, Rearrangement, and Beckmann rearrangement); Carbanions (Michael Addition); Carbenes ( Reimer-Tiemann)

## Syllabus

<b>SEMESTER I</b>
<p><b>Course Code DSC-1: CHEMISTRY- I</b>  <b>Course Title: Basic Concepts of Organic Chemistry</b>  <b>Total Credits: 04 (Credits: Theory-02, Practical-02)</b>  <b>Total Lectures: Theory- 30, Practical-60</b></p>
<p><b>Objectives:</b> The course is infused with the recapitulation of fundamentals of organic chemistry and the introduction of the concept of visualizing the organic molecules in a three-dimensional space. To establish the applications of these concepts, a study of diverse reactions through mechanisms is included. The constitution of the course strongly aids in the paramount learning of the basic concepts and their applications.</p> <p><b>Learning Outcomes:</b>  By the end of the course, the students will be able to:</p> <ul style="list-style-type: none"> <li>• Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.</li> <li>• Understand the fundamental concepts of stereochemistry.</li> <li>• Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.</li> <li>• Learn and identify many organic reactions and their mechanisms including electrophilic addition, nucleophilic addition, nucleophilic substitution, electrophilic substitution and rearrangement reactions.</li> </ul> <p><b>Unit 1: Fundamentals of organic chemistry</b> <span style="float: right;"><b>Lectures: 05</b></span></p> <p>Types of Electronic displacements: Inductive effect, Resonance effect, Hyperconjugation,</p>

Electromeric Effect. Reactive intermediates and their stability: carbocations, free radicals, carbanions, benzyne, carbenes.

Acidity and basicity in organic compounds (comparison of carboxylic acids, alcohols, phenols, primary, secondary and tertiary aliphatic amines, aniline and its derivatives)

### **UNIT 2: Stereochemistry**

**Lectures: 07**

Types of projection formulae: Flying Wedge Formula, Newmann, Sawhorse and Fischer representations and their interconversion.

Stereoisomerism: Concept of chirality (upto two carbon atoms). Configurational isomerism: geometrical and optical isomerism; enantiomerism, diastereomerism and meso compounds). Threo and erythro; D and L; *Cis-trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and *E/Z* nomenclature (for upto two C=C systems).

Conformational isomerism with respect to ethane, butane and cyclohexane.

### **UNIT 3: Types of Organic Reactions (Including reactions of alkenes, alkyl and aryl halides, alcohols, aldehydes, ketones)**

**Lectures: 18**

#### ***Electrophilic addition reactions***

Electrophilic addition reaction (with respect to propene, propyne, 3,3-dimethyl-1-butene): Hydration, Addition of HX in the absence and presence of peroxide, Hydroboration oxidation, Addition of bromine (with stereochemistry).

#### ***Nucleophilic addition reactions***

Nucleophilic addition reaction of carbonyl compounds: Addition of HCN, ammonia derivatives (Hydroxylamine, Hydrazine, Semicarbazide and 2,4-DNP), the addition of carbanion (Aldol condensation, Claisen Schmidt, Benzoin condensation, Perkin reaction, reactions involving Grignard reagent).

#### ***Elimination and Nucleophilic substitution reactions***

Nucleophilic substitution reaction ( $S_N1$  and  $S_N2$ ) in alkyl halides (mechanisms with stereochemical aspect), alcohols (with nucleophiles like ammonia, halides, thiols, ambident nucleophiles (cyanide and nitrite ion)), ethers (Williamson ether synthesis), Elimination reaction ( $E1$  &  $E2$ ), elimination *vs* substitution (*w.r.t.* potassium *t*-butoxide and KOH); Nucleophilic aromatic substitution in aryl halides-elimination addition reaction *w.r.t.* chlorobenzene, including the effect of nitro group (on the ring) on the reaction. relative reactivity and strength of C-X bond in alkyl, allyl, benzyl, vinyl

**Electrophilic substitution reactions**

Electrophilic Aromatic substitution with mechanism (benzene)- sulphonation, nitration, halogenation, Friedel craft acylation :*o*-, *m*- and *p*- directive influence giving examples of

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toluene/nitrobenzene/ phenol/ aniline/ chlorobenzene.

**Reactive intermediates and Rearrangement Reactions**

*Free radicals* (Birch Reduction); *Carbocations* (Pinacol-Pinacolone, Wagner-Meerwein, Rearrangement, and Beckmann rearrangement); *Carbanions* (Michael Addition); *Carbenes* (Reimer-Tiemann).

**PRACTICALS:****Credits: 02****(Laboratory periods: 60)**

1. Purification of an organic compound by crystallization (from water and alcohol) and distillation, Criteria of purity: Determination of M.P.
2. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)
3. Detection of extra element
4. Preparations: (Mechanism of various reactions involved to be discussed).
  - a. Bromination of phenol/aniline.
  - b. 2,4-Dinitrophenylhydrazone of aldehydes and ketones
  - c. Semicarbazone of aldehydes/ ketones
  - d. Aldol condensation reaction using green method.



- e. Bromination of Stilbene.
- f. Acetanilide to p-Bromoacetanilide.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

#### References:

#### Theory:

1. Sykes, P.(2003), **A Guide Book to Mechanism in Organic Chemistry**, 6<sup>th</sup> Edition Pearson Education.
2. Eliel, E. L. (2001), **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, Pearson Education.
4. Bahl, A; Bahl, B. S. (2019), **Advanced Organic Chemistry**, 22<sup>nd</sup> Edition, S. Chand.

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### Annexure-II

#### Practical:

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.
3. Dhingra, S; Ahluwalia V.K., (2017), **Advanced Experimental Organic Chemistry**, Manakin Press.
4. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume I**, I K International Publishing House Pvt. Ltd., New Delhi.

#### Teaching Learning Process:

- Blend of conventional blackboard teaching, modern teaching learning tools and
- Computational infrastructure- based instructions and Practical training.
- Problem solving and quizzes for enhanced understanding of the concepts.
- Explaining the handling and usage of the hardware and softwares required for solution to the given set of problems.

#### Assessment Methods:

- Presentations by individual student/ group of students
- Class Tests at periodic intervals.
- Written assignment(s)
- End semester University theory examination presentations by individual student/ group of students

**Keywords:** Chirality, Electrophilic addition, Nucleophilic addition, Nucleophilic substitution, Electrophilic substitution.

## Teaching Plan 2024

B.Sc. (P) Chemistry, NEP, Semester-III and Semester V

Subject: **Forensic Chemistry (SEC)**

Course Title: **Chemical Aspects of Forensic Science**

Teacher: **Dr. Padma Dechan**

<b>Week</b>	<b>Topic</b>
Week 1	Unit 1: History of Development of Forensic Science in India
Week 2	Continuation of Unit 1
Week 3	Unit 2: Fingerprints
Week 4	Continuation of Unit 2
Week 5	Continuation of Unit 2
Week 6	Scope & significance of Forensic Chemistry, Types of cases/exhibits received for analysis
Week 7	Trap Cases: Collection, and Preliminary analysis of evidence in trap cases
Week 8	Alcoholic Beverages: Types of alcohols, country made liquor, illicit liquor, denatured spirits, Indian made foreign alcoholic and non-alcoholic beverages
Week 9	Dyes: Scope & Significance of dyes in crime investigation, analysis of ink by TLC and UV visible spectrophotometry
Week 10	Petroleum products and their adulterations: Chemical composition of various fractions of Petroleum Products, Analysis of petrol, kerosene, diesel
Week 11	Introduction to Fire & Arson, origin of fire, Chemistry of Fire, Fire tetrahedron, Firefighting operations, preservation of fire scene, collection of evidences, Seat of fire, cause of fire, motives, Analysis of fire debris, Case studies related to fire and Arson
Week 12	Continuation of Fire & Arson
Week 13	<b>Semester Break</b>
Week 14	Remedial Class, Assignment and Class Test
Week 15	Scope & significance of explosive analysis in forensic science. Types of explosives, deflagration and detonation, explosive trains, collection, preservation and forwarding of exhibits, preliminary analysis of explosives
Week 16	Dos and Don'ts. Case studies related to explosives
Week 17	Drugs of abuse: Classification, including designer drugs. Ill effects of drugs of abuse, Preliminary and confirmatory tests

## Syllabus

### Forensic 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 (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Chemical Aspects of Forensic Science</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>1</b>	XII <sup>th</sup> Pass with Science	NA

#### Learning Objectives

- To introduce students to this fascinating branch of science and familiarize them with important concepts like fingerprints, explosives/arson, drugs and their detection.

#### Learning outcomes

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

- Describe latent fingerprints, various methods of detection of latent fingerprints, explosive analysis in forensic science, collection and preservation of evidence from crime scene etc



## SYLLABUS

### Theory:

#### **Unit 1: History of Development of Forensic Science in India (2 WEEKS)**

Definitions, Scope and Need of forensic science, Ethics in forensic science, History of forensic science, Basic principles of forensic science, Organizational structure of forensic science laboratories, Different branches in forensic science

#### **Unit 2: Fingerprints (5 WEEKS)**

Definition, History of fingerprint identification, Fingerprint as forensic evidence, Visible Finger marks, Latent Finger marks, ten-digit classification, Methods of Development of latent fingerprints using

conventional methods–Powdering (Black and grey, fluorescent and magnetic), Methods of development of latent fingerprint using chemical method (iodine fuming, silver nitrate, Ninhydrin, Vacuum metal deposition), Automated Fingerprint identification system (AFIS), Poroscopy and Edgescopy

#### **Unit 3: Forensic Chemistry (8 WEEKS)**

Scope & significance of Forensic Chemistry, Types of cases/exhibits received for analysis. Trap Cases: Collection, and Preliminary analysis of evidence in trap cases.

Alcoholic Beverages: Types of alcohols, country made liquor, illicit liquor, denatured spirits, Indian made foreign alcoholic and non-alcoholic beverages.

Dyes: Scope & Significance of dyes in crime investigation, analysis of ink by TLC and UV visible spectrophotometry. Petroleum products and their adulterations: Chemical composition of various fractions of Petroleum Products, Analysis of petrol, kerosene, diesel.

Fire/Arson and Explosives Fire: Introduction to Fire & Arson, origin of fire, Chemistry of Fire, Fire tetrahedron, Firefighting operations, preservation of fire scene, collection of evidences, Seat of fire, cause of fire, motives, Analysis of fire debris, Case studies related to fire and Arson. Explosive and Explosion: Scope & significance of explosive analysis in forensic science, Types of explosives, deflagration and detonation, explosive trains, collection, preservation and forwarding of exhibits, preliminary analysis of explosives. Dos and Don'ts. Case studies related to explosives.

Drugs of abuse: Classification, including designer drugs. Ill effects of drugs of abuse, Preliminary and conformatory tests.

#### **Practicals/ Hands-on Training**

**(15 WEEKS)**

1. Development of fingerprint through conventional powder method.
2. Development of fingerprint through chemical methods.
3. To check the alcohol presence in different liquor.
4. Phenolphthalein test for trap cases.
5. Identification of Handwriting Individual Characteristics.
6. Study of Disguise in handwriting.
7. TLC of amino acids

#### **Essential/recommended readings**

1. Saferstein, R. (1990) Criminalistics, Prentice Hall, New York.
2. Basic Principles of Forensic Chemistry by JaVed I. Khan • Thomas J. Kennedy Donnell R. Christian, Jr.
3. Fundamentals of FINGERPRINT ANALYSIS Hillary Moses Daluz
4. Clarke's Analysis of Drugs and Poisons 3<sup>rd</sup> Ed.