

## Teaching Plan 2024

### B.Sc. Chemistry (H) NEP, III Sem

**Subject:** Discipline Specific Core Course -(DSC- 8): Carbonyls, Carboxylic Acids their derivatives, Amines, Nitro Compounds, Nitriles, Isonitriles and Diazonium Salts

**Teacher:** Dr. KANIKA SOLANKI

#### DISCIPLINE SPECIFIC CORE COURSE -8 (DSC-8): Carbonyls, Carboxylic acids, Amines, Nitro compounds, Nitriles, Isonitriles and Diazonium salts

#### 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		
Carbonyls, Carboxylic Acids, Amines, Nitro Compounds, Nitriles, Isonitriles and Diazonium salts (DSC-8)	04	03	0	01	Passed Class 12 <sup>th</sup> with Physics, Chemistry, Mathematics	NIL

#### Learning objectives

The objectives of this course are as follows:

- To infuse students with the details of the chemistry of aldehydes, ketones, carboxylic acids and their derivatives, nitro, amines and diazonium salts.
- To make students aware of the chemical synthesis, properties, reactions and key applications of the listed classes of compounds and develop understanding of detailed mechanistic pathways for each functional group to unravel the spectrum of organic chemistry and the extent of organic transformations.
- To aid in the paramount learning of the concepts and their applications.

#### Learning outcomes

By studying this course, students will be able to:

- Explain the chemistry of oxygen and nitrogen containing compounds.
  - Use the synthetic chemistry learnt in this course to do functional group transformations.
  - Propose plausible mechanisms for the reactions under study.

### SYLLABUS OF DSC-8

#### UNIT – 1: Carbonyls, Carboxylic acid & their derivatives

(27 Hours)

Carbonyl Compounds: Reaction of carbonyl compounds with ammonia derivatives, Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and

Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation,  $\alpha$ -substitution reactions, oxidations and reductions (Clemmensen, Wolff Kishner,  $\text{LiAlH}_4$ ,  $\text{NaBH}_4$ , MPV, PDC), addition reactions of  $\alpha,\beta$ -unsaturated carbonyl compounds: Michael addition.

Carboxylic acids and derivatives: Effect of substituents on acidic strength on carboxylic acids, HVZ reaction, typical reactions of dicarboxylic acids and hydroxy acids. Comparative study of nucleophilic acyl substitution for acid chlorides, anhydrides, esters and amides, Mechanism of acidic and alkaline hydrolysis of esters, Dieckmann and Reformatsky reactions, Hoffmann-bromamide degradation and Curtius rearrangement.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

## UNIT – 2: Nitro Compounds, Amines, Diazonium salts, Nitriles and Isonitriles (18 Hours)

Nitro compounds: General methods of preparation: from alkyl halides, alkanes, oxidation of amines and oximes. Henry reaction, Nef reaction, Reduction-electrolytic reduction, reaction with nitrous acid, reduction in acidic, basic and neutral medium (for aromatic compounds)

Amines: Preparation, chirality in amines (pyramidal inversion), Basicity of amines: Effect of substituents, solvent and steric effects, distinction between Primary, secondary and tertiary amines using Hinsberg's method and nitrous acid, Gabriel Phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction and Cope elimination.

Diazonium Salts: Synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, cyano and nitro compounds; Coupling reactions of diazonium salts (preparation of azo dyes).

Nitriles: Preparation using following reactions: Dehydration of amides and aldoximes, substitution reaction in alkyl halides and tosylates, from Grignard reagents and from dehydrogenation of primary amines. Properties: Physical properties, discussion on the following reactions with mechanism: Reaction with Grignard reagent, hydrolysis, addition reaction with  $\text{HX}$ ,  $\text{NH}_3$ , reaction with aqueous  $\text{ROH}$ , Reduction reactions-catalytic reduction and Stephen's reaction, Condensation reactions-Thorpe Nitrile Condensation.

Isonitriles: Preparation from the following reactions: Carbylamine reaction, substitution in alkyl halides and dehydrogenation of N-substituted formamides. Properties: Physical properties, discussion on the following reactions with mechanism: Hydrolysis, reduction, addition of  $-\text{HX}$ ,  $\text{X}_2$  and sulphur, Grignard reaction, oxidation and rearrangement.

	Week	Topic
1.	1 <sup>st</sup> week	Carbonyl Compounds Reaction of carbonyl compounds with ammonia derivatives, Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt
2.	2 <sup>nd</sup> week	Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction
3.	3 <sup>rd</sup> week	Baeyer Villiger oxidation, $\alpha$ -substitution reactions, oxidations and reductions (Clemmensen, Wolff Kishner, $\text{LiAlH}_4$ , $\text{NaBH}_4$ , MPV, PDC)

4.	4 <sup>th</sup> week	addition reactions of $\alpha,\beta$ -unsaturated carbonyl compounds: Michael addition. Carboxylic acids and derivatives
5.	5 <sup>th</sup> week	Effect of substituents on acidic strength on carboxylic acids, HVZ reaction, typical reactions of dicarboxylic acids and hydroxy acids.
6.	6 <sup>th</sup> week	Comparative study of nucleophilic acyl substitution for acid chlorides, anhydrides, esters and amides, Mechanism of acidic and alkaline hydrolysis of esters.
7.	7 <sup>th</sup> week	Dieckmann and Reformatsky reactions, Hoffmannbromamide degradation and Curtius rearrangement Dieckmann and Reformatsky reactions, Hoffmannbromamide degradation and Curtius rearrangement
8.	8 <sup>th</sup> week	Nitro compounds: General methods of preparation: from alkyl halides, alkanes, oxidation of amines and oximes. Henry reaction, Nef reaction,
9.	9 <sup>th</sup> Week	Reduction-electrolytic reduction, reaction with nitrous acid, reduction in acidic, basic and neutral medium (for aromatic compounds)
10.	10 <sup>th</sup> Week	Amines: Preparation, chirality in amines (pyramidal inversion), Basicity of amines: Effect of substituents, solvent and steric effects, distinction between Primary, secondary and tertiary amines using Hinsberg's method
11.	11 <sup>th</sup> Week	Nitrous acid, Gabriel Phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction and Cope elimination.
12.	12 <sup>th</sup> Week	Diazonium Salts: Synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, cyano and nitro compounds; Coupling reactions of diazonium salts (preparation of azo dyes).
13.	13 <sup>th</sup> Week	Nitriles: Preparation using following reactions: Dehydration of amides and aldoximes, substitution reaction in alkyl halides and tosylates, from Grignard reagents and from dehydrogenation of primary amines. Properties: Physical properties
14.	14 <sup>th</sup> Week	Discussion on the following reactions with mechanism: Reaction with Grignard reagent, hydrolysis, addition reaction with HX, NH <sub>3</sub> , reaction with aqueous ROH, Reduction reactions-catalytic reduction and Stephen's reaction,
15.	15 <sup>th</sup> week	Condensation reactions-Thorpe Nitrile Condensation. Isonitriles: Preparation from the following reactions: Carbylamine reaction, substitution in alkyl halides
16.	16 <sup>th</sup> week	Dehydrogenation of N-substituted formamides. Properties: Physical properties, discussion on the following reactions with mechanism: Hydrolysis, reduction, addition of- HX, X <sub>2</sub> and sulphur, Grignard reaction, oxidation and rearrangement.
17.		Tests / Assignments