DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
Four Year Undergraduate Course Structure:
Subject: Chemistry Semester II NEP (Revised)
For students admitted in session 2024-25 onwards

Semester II						
Paper	**Paper Title**	**Type**	**Credits**	**Internal Assessment**	**Univ Exam**	**Total Marks**
Paper 3	Organic Chemistry 1	Theory (Major)	4	25	75	100
Paper 4	Chemistry Practical 2	Practical (Major)	4	-	100	100
VC 1	Chemistry Vocational 1	Food Chemistry	2	25	75	100
P2"	Organic Chemistry 1A	Theory (Minor)	2	25	75	100
P3'	Second major subject	Theory	4	25	75	100
P4'	Second major subject	Theory	4	25	75	100
	Total Credits		**20**			

Organic Chemistry 1 (Major)

Semester II **Paper 3** **Credits 4**

MM 100 (75 + 25)

Course outcome

Upon successful completion of this course, the student will be able to

- CO-1 Understand different organic compounds with respect to the functional group and thus capable to name the organic compounds as per IUPAC nomenclature.
- CO-2 Understand the basics of chemical reactions i.e. Substrate and Reagent, types of Reagents, Electrophilic and Nucleophilic Homolytic and heterolytic fission. Electron mobility, Inductive effect etc.
- CO-3 Recognize and draw constitutional isomers, stereoisomers, including enantiomers and diasteromers, racemic mixture and meso compounds.
- CO-4. Understand fundamental principles of organic chemistry and predict outcomes and derive mechanism of various types of organic reactions.
- CO-5 Understand various types of reactive intermediates and factors affecting their stability
- CO-6 Understand the nomenclature, synthesis, isomerism and physical properties of alkanes and cycloalkanes.
- CO-7 Understand the concept of Aromaticity of benzenoids & non- benzenoids, the preparation, reactivity & structure of aromatic compounds. CO-8 Learn the preparations, reactivity & stereochemistry of SN1 &SN2 reactions of Halogen compounds.

Unit 1

- **Structure and bonding:**
  - Resonance, electromeric effect, inductive and field effects. Generation, structure, stability and reactions of carbenes, arynes and nitrenes.
- **Stereoisomerism:**
  - **Optical isomerism**: elements of symmetry, molecular chirality, optical activity, stereogenic centres, enantiomers, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythrodiastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configurations. Sequence rules. D, L and R, S nomenclature.
  - **Geometrical isomerism:** determination of configuration of geometric isomers. E, Z system, geometrical isomerism in oximes and alicyclic compounds.
  - Conformational isomerism: conformational analysis of ethane and n-butane and cyclohexane, axial and equatorial bonds, Saw-horse and flying wedge

formulae, Fischer and Newman projections formulae. Difference between conformation and configuration.

Unit 2

- **Alkanes, Alkenes and Alkynes:**
  - **Alkanes and Cycloalkanes:** Methods of formation, physical and chemical properties of alkanes.Baeyer's strain theory and its limitations. Ring strain in (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring and banana bond.
  - **Alkenes:** Methods of formation, physical and chemical properties of alkenes and their relative stabilities.Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, chemical reaction – 1, 2 and 1, 4 additions, Diels-Alder reaction.
  - **Alkynes**: Structure and bonding in alkynes. Methods of formation, chemical reactions and acidity of alkynes.

Unit 3

- **Arenes and Aromaticity**:
  - Huckel's rule, Stability and carbon-carbon bond length of benzene, resonance structure, MO picture.
  - Aromatic electrophilic substitution- general pattern of the mechanism, Arrhenium ion intermediate. Mechanism of nitration, halogenation, sulfonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio.
- **Alkyl and Aryl Halides**:
  - Methods of formation and chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides, SN2 andSN1 reactions with energy profile diagrams, Methods of formation of aryl halides, nuclear and side chain reactions. Mechanisms of nucleophilic aromatic substitutions.

Unit 4

- **Heterocyclic compounds:**
  - Introduction: Molecular orbital picture and aromatic characteristic of pyrrole, furan, thiophene and pyridine, methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, mechanism of nucleophilic substitution reactions. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six membered heterocycles. Preparation and reactions of indols, quinoline and

isoquinoline with special reference to Fisher Indol synthesis, Skraup synthesis and Bischler – Nepieralski synthesis.

- **Organometallic Compounds:**
  - Grignard reagents, formation, structure and chemical reactions.

Text Books (Theory Courses):

1. Organic Chemistry, Vol. I, I.L. Finar, Pearson Education.
2. Organic Chemistry, M.K. Jain, Shoban Lal& Co.
3. Pradeep's Organic Chemistry, S.N. Dhawan, Pradeep Publication.

Reference Books:

1. Organic Chemistry, Morrison and Boyd, Prentice Hall.
2. Organic Chemistry, L.G. Wade Jr. Prentice Hall.
3. Fundamentals of Organic Chemistry, Solomons, John Wiley.
4. Organic Chemistry, Vol. I, II, III S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
5. Organic Chemistry, F.A. Carey, Tata McGraw-Hill publishing company
6. Introduction to Organic Chemistry, Streitwiesser, Hathcock and Kosover, Macmillan.

Organic Chemistry 1A (Minor)

Semester II **P2"** **Credits 2**

MM 100 (75 + 25)

Course outcome

Upon successful completion of this course, the student will be able to

- CO-1 Understand different organic compounds with respect to the functional group and thus capable to name the organic compounds as per IUPAC nomenclature.
- CO-2 Understand the basics of chemical reactions i.e. Substrate and Reagent, types of Reagents, Electrophilic and Nucleophilic Homolytic and heterolytic fission. Electron mobility, Inductive effect etc.
- CO-3 Recognize and draw constitutional isomers, stereoisomers, including enantiomers and diasteromers, racemic mixture and meso compounds.
- CO-4. Understand fundamental principles of organic chemistry and predict outcomes and derive mechanism of various types of organic reactions.
- CO-5 Understand various types of reactive intermediates and factors affecting their stability
- CO-6 Understand the nomenclature, synthesis, isomerism and physical properties of alkanes and cycloalkanes.

Unit 1

- **Structure and bonding:**
  - Resonance, electromeric effect, inductive and field effects. Generation, structure, stability and reactions of carbenes, arynes and nitrenes.
- **Stereoisomerism:**
  - **Optical isomerism**: elements of symmetry, molecular chirality, optical activity, stereogenic centres, enantiomers, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythrodiastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

Unit 2

- **Relative and absolute configurations.**
  - Sequence rules. D, L and R, S nomenclature.
- **Geometrical isomerism:**
  - Determination of configuration of geometric isomers. E, Z system, geometrical isomerism in oximes and alicyclic compounds.

Unit 3

- **Alkanes and Cycloalkanes:**
  - Methods of formation, physical and chemical properties of alkanes. Baeyer's strain theory and its limitations. Ring strain in (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring and banana bond. Conformational analysis of ethane and n-butane and cyclohexane, axial and equatorial bonds, Saw-horse and flying wedge formulae, Fischer and Newman projections formulae. Difference between conformation and configuration.

Unit 4

- **Alkenes:**
  - Methods of formation, physical and chemical properties of alkenes and their relative stabilities. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, Methods of formation, chemical reaction – 1, 2 and 1, 4 additions, Diels-Alder reaction.
- **Alkynes**:
  - Structure and bonding in alkynes. Methods of formation, chemical reactions and acidity of alkynes.

Text Books (Theory Courses):

4. Organic Chemistry, Vol. I, I.L. Finar, Pearson Education.
5. Organic Chemistry, M.K. Jain, Shoban Lal& Co.
6. Pradeep's Organic Chemistry, S.N. Dhawan, Pradeep Publication.

Reference Books:

7. Organic Chemistry, Morrison and Boyd, Prentice Hall.
8. Organic Chemistry, L.G. Wade Jr. Prentice Hall.
9. Fundamentals of Organic Chemistry, Solomons, John Wiley.
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Chemistry Practical 2 (Major)

Semester II **Paper 4** **Credits 4**

MM 100

Course outcome

Upon successful completion of this course, the student will be able to

- CO 1 Identify, classify, organize, analyze, and draw structures of organic molecules.
- CO 2 Apply the basic rules of organic nomenclature to convert between structures and names.
- CO 3 Recall reagents and predict products for a defined set of organic reactions.
- CO 4 Draw organic structures consistent with the results of specific chemical tests.
- CO 1 Predict the physical properties of organic chemicals based on their structures (e.g. relative boiling point, melting point, and solubility.)
- CO 5 Demonstrate proficiency in organic chemical laboratory techniques. (Chemical tests, extraction, filtration, instrumental analysis, molecular model building)

Organic Chemistry

- Identification of organic compounds
  - Ignition Test
  - Melting Point
  - Solubility
  - Additional Elements (Nitrogen, Halogens, Sulphur)
  - Unsaturation Test
  - Functional Group
  - Preparation of Derivative
  - Melting point of derivative

Record & Viva

Books Recommended

- Chemistry Practical by S. Giri, D.N. Bajpai and O.P. Pandey S. Chand Publication.
- Practical Chemistry Volume 1-3 by Fateh Bahadur, Vishal Publication
- Advanced Physical Chemistry by J.B. Yadav, Goel Publication

Distribution of Maximum Marks:

The maximum marks in the evaluation of the practical exercises, viva-voce and records of their class-work are given below.

Chemistry Practical 2				
Class	Organic Chemistry	Viva	Class Record	Total
B.Sc. Semester II	60	30	10	100

Note: For exempted students, marks of class record will be added to the marks of viva-voce for practical examinations since they do not have the class record.

Food Chemistry (Chemistry Vocational 1)

Semester II **VC 1** **Credits 2**

MM 100 (75 + 25)

Course outcome

Students admitted in B.Sc. Chemistry semester program will gain precise insight into the:

- CO-1- Chemistry of water and its significance in foods
- CO-2- Role of each component of food such as carbohydrates, proteins, fats, vitamins and minerals and their interaction.
- CO-3- Functional aspects of various food components and to study their role in food processing.
- CO-4- Enzyme activity in different food systems and their functional importance in preparation of food additives.

Unit 1

- **General**
  - Water molecule, hydrogen bonding, different types of water, physical properties of water, water activity and its role in food processing and storage, industrial and nutritional significance of water.

Unit 2

- **Carbohydrates and Proteins:**
  - Role of carbohydrates in food industry (sugars starch, cellulose, glucans, hemicellulose). Proteins: Major protein systems, Food proteins derived from milk, egg proteins, meat proteins, fish muscle proteins, oil seed proteins and cereal proteins.

Unit 3

- **Lipids:**
  - Vegetables and animal fats, butter and their use in food processing. Lipid oxidation, factors affecting lipid oxidation, autooxidation and biological significance.

Unit 4

- **Enzymes:**
  - Enzyme definition, characteristics, classifications. Role of Amylase, Protease, Lipase, Pectinase, and Rennet in food processing. Role of enzymes in Baking, Cheese making, fruit juice preparation, and in meat tenderization.

References Books

1. Principles of Food Chemistry by John deMan, Springer.
2. Food chemistry by H.K Chopra P.S Panesar, Alpha Science International Ltd.
3. Food chemistry by Owen R. Fennema, CRC Publications.
4. Food Chemistry by Lillian Hoagland Meyer, Reinhoad Publishing Corporation.
5. Food theory and application second edition by Jane Bower, Pearson
6. Spices and Seasonings: A Food Technology Handbook, by Donna R. Tainter, Antony T.Grenis, Wiley
7. Handbook of Herbs and Spices: Volume 3 edited by K.V. Peter Woodhead Publishing