

**JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER**

Programme: B.Sc.

Semester: V

**CHEMISTRY PAPER V
ORGANIC CHEMISTRY**

Course Code: 18VCH5

No. of Hours: 45

COURSE OBJECTIVES:

The course is designed so that the student can:

- Apply the concepts of Stereochemistry and relate them to the properties of organic molecules.
- Understand the properties of amines and their importance in the synthesis of commercially important azo dyes.
- Become familiar with specific Heterocyclic compounds and understand their importance as precursors for the synthesis of medicines.
- Understand the importance of naturally occurring molecules and structure – function correlation along with their medicinal applications.
- Understand the application of molecular spectroscopy to obtain the structure of organic molecules.
- Learn the types and differences between commercially important dyes and their mechanism of action and their applications in the field of medicine (Laser dyes)
- Become familiar with the historical synthetic methods of important medicinal molecules along with the medicinal applications.
- Explain concepts as well as write structures of organic molecules, equations and reaction mechanisms.
- Master the skill of identifying an unknown organic compound using a combination of physical methods (including physical constant and solubility), and qualitative chemical tests (The laboratory component)

LEARNING OUTCOMES:

On completion of the course, the student should be able to:

- Understand the fundamentals, principals and recent developments in organic chemistry as a foundation to research and development.
- Write the structures of molecules in different structural conformations and classify them according to stereochemical notations.
- Theoretically describe the distinguishing tests of amines and synthesis of azo compounds along with their applications.
- Carry out simple reactions of heterocyclic compounds and differentiate their properties from homocyclic compounds.
- Apply the various isolation/extraction methods of isolation/extraction for natural products.
- Interpret the infrared, ultraviolet and NMR spectrum of an unknown compound and elucidate its structure.
- Use the synthetic methods learned in this paper to plan the synthesis of novel dyes and drugs.

- Carry out detailed physicochemical qualitative tests and find the functional groups of mono-functional organic compounds and prepare a solid derivative to confirm the classification. (The laboratory component)

UNIT I

10 HRS

Chapter 1 STEREOCHEMISTRY

Review: Isomerism and its types

Enantiomerism: Plane polarized light, polarimeter, specific rotation – factors affecting specific rotation. The origin of optical activity. Use of +/- and d/l notation. Molecular chirality: Elements of symmetry and their relation to chirality (center of symmetry, plane of symmetry and improper axis of rotation with examples). Stereogenic center. Representation of stereoisomers: Flying wedge and Fischer projection. Properties of enantiomers. Configuration: definition, Relative configuration - Use of D/L notation. Absolute configuration – Cahn-Ingold-Prelog sequence rules, Use of R/S notation. Molecules with two Stereogenic centers: Diastereomers – definition, properties, Threo and Erythro isomers - Newman Projection, Meso compounds. Racemic modification and resolution: methods of forming a racemic modification, resolution by mechanical, biochemical and chemical methods (reaction with acids and bases). Enantiomerism due to restricted rotation about single bonds (Atropisomerism) - diphenyl systems.

Geometrical isomerism: Necessary conditions, determination of configuration of *cis*- and *trans*- isomers, *E-Z* system of nomenclature. Geometric isomerism in oximes.

Stereochemistry of Alicyclic compounds: Conformations of four to eight membered cycloalkanes and disubstituted cyclohexanes.

Bicyclic systems: Nomenclature and conformations of decalins and norbornanes.

UNIT II

05 HRS

2.1 AMINES

Classification. Preparation of alkyl and aryl amines: reductive amination of carbonyl compounds, Gabriel phthalimide synthesis. Basicity of amines in aqueous solution: Inductive, resonance, steric and solvation effects on the basicity of amines. Reactions of amines: as nucleophiles-methylation - quaternary salts, Hoffmann degradation. Distinguishing reactions of primary, secondary and tertiary amines - Hinsberg test. Diazotization and synthetic application of diazonium salts. Sandmeyer's reaction - conversion to chlorobenzene, bromobenzene and benzonitrile, hydrolysis, reduction to phenyl hydrazine and aniline, coupling reactions to give azo dyes: p-hydroxyazobenzene and 1-phenylazo-2-naphthol.

2.2 HETEROCYCLIC COMPOUNDS

05 HRS

Introduction, classification – benzenoid, non-benzenoid and fused ring heterocycles. Five membered heterocyclic compounds: structures, resonance and aromatic character of furan, pyrrole, and thiophene. Methods of preparation: Furan - from mucic acid, pyrrole – Pall-Knorr synthesis, thiophene – from n-butane. Reactions: Electrophilic substitution – reactivity and orientation, Furan: Diels Alder reaction, conversions to pyrrole and thiophene. Pyrrole: Gatterman-Koch reaction and ring expansion. Thiophene: Nucleophilic substitution reaction with n-butyl lithium. Six membered heterocyclic compounds: structures, resonance and

aromatic character of pyridine. Preparation from acetylene, Reactions: Alkylation, nucleophilic substitution of pyridine – amination, conversion to piperidine. Comparison of basicity of pyrrole, pyridine and piperidine. Fused ring Heterocyclic compounds: Quinoline: Structure, Preparation by Skraup synthesis, Reactions: oxidation, Chichibabin reaction. Isoquinoline: structure, Preparation by Bischler-Napieralski synthesis, oxidation. Indole: Structure, Fischer Indole synthesis.

UNIT III

12 HRS

Chapter 3 NATURAL PRODUCTS

3.1 Carbohydrates:

03 HRS

Introduction, general characteristics, occurrence, classification. Monosaccharides: Aldoses and Ketoses. Elucidation of open chain structure of D-glucose. Ring structure of D-glucose Including conformation structure. Mechanism of mutarotation and anomeric effect. Ketoses: Fructose, interconversion of glucose and fructose.

3.2 TERPENES AND TERPENOIDS:

03 HRS

Introduction, occurrence, general characteristics, classification. Isoprene rule, elucidation of the structure and synthesis of citral, α -terpineol. Structure and uses of limonene, menthol, zingiberene, camphor, β -carotene, vitamin A.

3.3 ALKALOIDS:

03 HRS

Introduction, occurrence, classification, general characteristics, structural elucidation and synthesis of nicotine. Structure and importance of ephedrine, caffeine, morphine, cocaine and atropine.

3.4 STEROIDS:

03 HRS

Introduction, classification – sterols, bile acids, sex hormones and corticosteroids. General structure and nomenclature. Importance of Diel's hydrocarbon – structure, synthesis by Bogert-Cook method. Sterols – Cholesterol – structure, physiological importance.

UNIT IV

09 HRS

Chapter 4 SPECTROSCOPY OF ORGANIC COMPOUNDS

UV spectroscopy: Principle, electronic transitions, influence of conjugation on UV absorption. Woodward's rules for calculation of λ_{\max} of conjugated dienes. Problems.

IR spectroscopy: Principle, vibrational transition, stretching and bending modes of vibrations, influence of force constant and atomic weight on IR absorption positions, identification of common functional groups: carbonyl, hydroxyl (alcohol, phenol), carboxyl and amine

NMR spectroscopy: Principle, Nuclear spin, Interpretation of ^1H NMR spectra: Number of signals – equivalent and non-equivalent protons, Position of signals – chemical shift, shielding and deshielding, TMS as a standard in NMR spectroscopy, Peak area and proton counting, Splitting of signals, spin-spin coupling. Problems based on ^1H NMR spectra.

UNIT V

Synthetic dyes: Introduction and classification. Colour and constitution.

Synthesis of congo red, malachite green, alizarin and indigo.

Laser Dyes: Classification – coumarin, xanthene, oxazine, structure and applications.

Drugs: Chemotherapy, classification of drugs, synthesis and uses of ibuprofen, structure and uses of paracetamol, chloramphenicol, diclofenac, ranitidine and sulphanilamide.

REFERENCES:

1. Morrison R.T, Boyd R.N and Bhattacharjee S.K, Organic Chemistry, 7th Ed., 2014, Pearson Publications.
2. Finar I.L., Organic Chemistry, Vol I and II, 6th Ed., 2014, Pearson Publications.
3. Fryhle C.B., Solomon's Organic Chemistry, Global Edition, 2017, Wiley International Publications.
4. Bahl C.S and Bahl A, Advanced Organic Chemistry, 22nd Ed., 2016, S. Chand & Co.
5. Smith M.B., March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 7th Ed., 2015, Wiley Publications.
6. Sykes P., A Guide Book to Mechanism in Organic Chemistry, 6th Ed., 2014, Pearson Publications.
7. Eliel E.L, Wilen S.H and Mander L.K, Stereochemistry of Organic Compounds, Wiley student Edition, 2008, Wiley Publications.
8. Norman R.O.C and Coxon J.M, Principles of Organic Synthesis, 3rd Ed., 2017, CBC Publications.
9. Silverstein R.M, Webster F.K, Kiemle D.J and Bryce D.L, Spectrometric Identification of Organic Compounds, 8th Ed., 2015, Wiley Publications.

CHEMISTRY PRACTICAL

V SEMESTER - PAPER - V (ORGANIC)

DURATION: 3 HRS / WEEK

NO. OF UNITS: 15

Organic qualitative analysis – identification of mono-functional organic compounds through functional group analysis, determination of physical constant, preparation and characterization of a suitable derivative.

REFERENCES:

1. Lab Experiments In Organic Chemistry, Arun Sethi, New Age International Publishers, 2003
2. Experimental Organic Chemistry, Volume I & II, P.R .Singh, D.S.Gupta, K.S.Bajpai,1981
3. Advanced Practical Organic Chemistry, N.K.Vishnoi,Vikas Publishing House Pvt Ltd,1979
4. Practical Organic Chemistry, Vol I&II ,Vogel,1973