

Rayat Shikshan Sanstha's
Yashavantrao Chavan Institute of Science, Satara(Autonomous)
Department of Chemistry
M.Sc. II Organic Chemistry: Course Structure

Course Code	Title of Course	Credits	Teaching Scheme (h/w)		Evaluation Scheme (Marks)			
			L	P	ISE-I	ISE-II	ESE	Total
M.Sc.-II Semester-III								
MCT-O-301	Organic Reaction Mechanism	4	4	-	10	10	80	100
MCT-O-302	Advanced Spectroscopic Methods	4	4	-	10	10	80	100
MCT-O-303	Advanced Organic Synthesis	4	4	-	10	10	80	100
MCT-O-304	Drugs and Heterocycles	4	4	-	10	10	80	100
MCP-O-305	Chemistry Practical-V	4	-	12	-	-	85+15 (Pro)	100
MCP-O-306	Chemistry Practical-VI	4	-	12	-	-	85+15(Pro)	100
Total		24	16	24	40	40	520	600
M.Sc.-II Semester-IV								
MCT-O-401	Theoretical Organic Chemistry	4	4	-	10	10	80	100
MCT-O-402	Stereochemistry	4	4	-	10	10	80	100
MCT-O-403	Chemistry of Natural Products	4	4	-	10	10	80	100
MCT-O-404	Applied Organic Chemistry	4	4	-	10	10	80	100
MCP-O-405	Chemistry Practical-VII	4	-	12	-	-	85+15 (Pro)	100
MCP-O-406	Chemistry Practical-VIII	4	-	12	-	-	85+15(Pro)	100
Total		24	16	24	40	40	520	600

M.Sc.-II
STRUCTURE OF COURSE:

THIRD SEMESTER

Semester III										
Paper	ESE	Internal Exam			Practical				Total	Grand Total
		ISE- I	ISE-II		Exam	Journal	Project Part-II	Day to day performance		
MCT-O-301	80	10	10	MCP-305-V	70	10	15	5	100	1
MCT-O-302	80	10	10							
MCT-O-303	80	10	10	MCP-306-VI	70	10	15	5	100	
MCT-O-304	80	10	10							
Total	320	40	40		140	20	30	10	200	

1. FOURTH SEMESTER

Semester IV											
Paper	ESE	Internal Exam		Practical					Total	Grand Total	
		ISE- I	ISE-II		Exam	Journal	Project Part-II	Day to day performance			
MCT-O-401	80	10	10	MCP-405-V	70	10	15	5	100		
MCT-O-402	80	10	10								
MCT-O-403	80	10	10	MCP-406- VI	70	10	15	5	100		
MCT-O-404	80	10	10		80						
Total	320	40	40		140	20	30	10	200		600

2. Structure and Title of Papers of M. Sc. Course:

- M. Sc. II Semester III**
 - Paper IX:** Organic Reaction Mechanism
 - Paper X:** Advanced Spectroscopic Methods
 - Paper XI:** Advanced Organic Synthesis
 - Paper XII:** Drugs and Heterocycles
 - Paper XII-A:** Elective-I
Biomolecular Organic Chemistry
- M. Sc. II Semester IV**
 - Paper XIII:** Theoretical Organic Chemistry
 - Paper XIV:** Stereochemistry
 - Paper XV :** Chemistry of Natural Products
 - Paper XVI:** Applied Organic Chemistry
 - Paper XVI-A:** Elective-II
Environmental Chemistry

Course Code	Elective -I	Course Code	Elective - II
MCT-O-304-A	Biomolecular Organic Chemistry	MCT-O-404-A	Environmental Chemistry

Rayat Shikshan Sanstha's
Yashavantrao Chavan Institute of Science, Satara (Autonomous)
Department of Chemistry
Syllabus of M. Sc. Part II (Organic Chemistry)

GENERAL OBJECTIVES OF THE COURSE:

1. To educate and prepare post graduate students from rural and urban area who will get employment on large scale in academic institutes, R & D and Quality control laboratories of Indian chemical/pharmaceutical industries as well as multinational and forensic Laboratories.
2. To provide students with broad theoretical and applied background in all specialization of Chemistry with emphasis on qualitative and quantitative technique.
3. To provide broad common frame work of syllabus to expose our young graduates to the recent and applied knowledge of interdisciplinary branches of chemistry involving applied organic, inorganic, physical, analytical, industrial, pharmaceutical, polymer, nano science & technology.
4. To conduct lesser written tests and to encourage on non-written tests.
5. To focus on encouraging students to conduct various academic activities like midterm tests, online tests, open book tests, tutorial, surprise test, oral, seminar, assignments and seminar presentation.

Learning Objectives:

1. A graduate with a Master's degree in Chemistry has in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.
2. The graduate has expert knowledge of a well-defined area of research within chemistry. The graduate has specific skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques. Skilled in examining specific phenomena theoretically and/or experimentally, the graduate is able to contribute to the generation of new scientific insights or to the innovation of new applications of chemical research.

STRUCTURE OF COURSE: SEMESTER III and IV

Semester	Paper No.	Title	Total Number of lectures/practical's	Credits
	Theory Course			
	MCT-O-301	Organic Reaction Mechanism	60hrs	4
	MCT-O-302	Advanced Spectroscopic Methods	60hrs	4
	MCT-O-303	Advanced Organic Synthesis	60hrs	4
	MCT-O-304	Drugs and Heterocycles	60hrs	4

Semester - III	Elective Paper MCT- O-304-A	Biomolecular Organic Chemistry	60 hrs	
	Practical Course			
	MCP-O-305 MCP-O-306	Chemistry Practical-V Chemistry Practical-VI		4 4
Semester- IV	Theory Course			
	MCT-O-401	Stereochemistry	60hrs	4
	MCT-O-402	Chemistry of Natural Products	60hrs	4
	MCT-O-403	Chemistry of Natural Products	60 hrs	4
	MCT-O-404	Applied Organic Chemistry	60 hrs	4
	Elective Paper MCT-O-404 A	Environmental Chemistry	60 hrs	
Practical Course				
MCP-O-405 MCP-O-406	Chemistry Practical-VII Chemistry Practical-VIII OR Internship, Industrial Training		4 4	
			Total Credits	48

- The semester examination will be conducted at the end of each term (both theory and practical examination)
- Theory paper will be of 80 marks each and 20 marks for internal evaluation test conducted in the mid of the term. Two practical's will be of 100 marks each.
- Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

Laboratory Safety Equipment's:

Part: I Personal Precautions:

1. All persons must wear safety Goggles at all times.
2. Must wear Lab Aprons/Lab Jacket and proper shoes.
3. Except in emergency, over – hurried activities is forbidden.
4. Fume cupboard must be used whenever necessary.
5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

Part: II: Use of Safety and Emergency equipment:

1. First aid Kits
2. Sand bucket
3. Fire extinguishers (dry chemical and carbon dioxide extinguishers)
4. Chemical Storage cabinet with proper ventilation
5. Material Safety Datasheets.
6. Management of Local exhaust systems and fume hoods.
7. Sign in register if using instruments

M. Sc. Part – II (Semester – III)
Paper MCT-O-301: Organic Reaction Mechanism

Learning objectives

- i) Distinguish the different of organic reactions mechanisms
- ii) Expect reaction products and the changes that occur in the structure of organic compounds interacting depending on the type of interaction.
- iii) Expect reaction products according to all mechanisms.
- iv) The completion of the short comings of a chemical equation by using suitable reagents depending on the type of reactive compound and reaction product.

UNIT-I: Methods of determining reaction mechanism (15)

Kinetic Methods: Order and Molecularity, Methods of following reaction rates, Types of reactions:

1st, 2nd and 3rd order reactions; Reversible, Consecutive and Parallel reactions. Energy of Activation, Entropy of Activation, Effect of Ionic strength, Solvent effect and Kinetic isotopic effect.

Non-Kinetic Methods: Identification of reaction products, Testing of the possible intermediates, Trapping of the intermediates, Isotopic labeling, Reaction catalysis, Cross- over experiments, Stereochemical studies and Use of physical properties. Hammett and Taft equations.

UNIT-II: Pericyclic reactions (15)

Molecular orbital symmetry, Frontier orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system, classification of pericyclic reaction, Woodward-Hoffman correlation diagrams, FMO and PMO approach, electrocyclic reactions, conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems, cycloaddition, and supra and antarafacial additions, $4n$ and $4n+2$ systems, $2+2$ additions of ketenes, 1,3-dipolar cycloaddition and chelotropic reactions, sigmatropic rearrangement, supra and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties, (3,3) and (5,5) sigmatropic rearrangement and Claisen and Cope and Aza Cope rearrangement, Ene reaction.

UNIT-III: Name Reactions (15)

A] Mechanism, Stereochemistry, migratory aptitude, (application using complicated example): Dienone-phenol, Favorskii, Baeyer-Villiger, Pinacol-pinacolone, Wolff, Smiles, Mukaiyama esterification, Mitsunobu reaction, Baylis-Hillman reaction, Wacker process, Eschenmoser fragmentation, Julia olefination.

B] Protection and deprotection of the following functional groups: hydroxyl, carbonyl, amino and carboxyl with applications

UNIT-IV: Photochemistry (15)

Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions, photo dissociation gas phase photolysis, photochemistry of alkynes, intermolecular reactions of the olefinic bonds, geometrical isomerism, cyclisation reactions, rearrangements of 1,4 and 1,5-dienes, photochemistry of carbonyl compounds, intramolecular reactions of carbonyl compounds saturated cyclic and acyclic α , β -unsaturated compounds, cyclohexadienones, intermolecular cycloaddition reactions, dimerisation and oxirane formation, photochemistry of aromatic compounds, photo Fries reactions of anilides, photo Fries rearrangements. Singlet molecular oxygen reactions, photochemistry of vision.

Learning outcomes: After completion of units, students are able to

- i) Understand the difference between kinetic and non-kinetic methods of reaction mechanism.
- ii) They must know the exact concept of pericyclic reactions.
- iii) They must know the Stereochemistry, migratory aptitude of different reactions.
- iv) Understand basic concept of photochemistry and photochemical reactions

References:

1. A guide book to mechanism in organic chemistry (orient- Longmans)- Peter Sykes [UnitI]
2. Organic Reaction Mechanism (Benjamin)- R. Breslow [UnitI]
3. Mechanism and structure in Organic Chemistry (Holt Reinhartwinston)- B. S. Gould [UnitI]
4. Organic chemistry 1st edition - Clayden, Greeves, Warren, Wothers [Allunits]
5. Photochemistry and Pericyclic reactions 3rd revised edition, Jagdamba singh and jaya Singh
6. Reactive intermediates in organic chemistry, (J. Wiley) N. S. Issacs.
7. Organic reaction mechanism (McGraw Hill) R. K. Bansal
8. Fundamentals of photochemistry K. K. Rohtagi- Mukherji Wiley- Eastern [UnitIV]
9. Essentials of molecular photochemistry, A. Gilbert and J. Baggott. Blackwell Scientific Publication.
- 10 Molecular photochemistry, N.J. Urro, W. A. Benjamin [Unit IV]
11. Introductory photochemistry. Cox and T. Camp McGraw-Hill
12. Photochemistry R.P. Kundall and A. Gilbert. Thomson Nelson.
- 13 Organic photochemistry J. Coxon and B. Hallon Cambridge University press.

M. Sc. Part – II (Semester – III)

Paper MCT-O-302: Advanced Spectroscopic Methods

Learning objectives: Students should

- i. Use spectroscopic equipment such as MS, IR, NMR spectrometers.
- ii. Learn to Identify organic compounds by analysis and interpretation of spectral data.
- iii. Study common terms in NMR (¹H and ¹³C) spectroscopy such as chemical shift, coupling constant, and anisotropy and describe how they are affected by molecular structure
- iv. Learn to investigate and determine the structure of typical organic chemical compounds using Uv, IR, NMR and Mass spectroscopic data.

UNIT-I: (15)

a) Ultraviolet Spectroscopy (05)

Woodward- Fisher rules for conjugated dienes and carbonyl compounds; Calculation of λ_{max} . Ultraviolet spectra of aromatic and heterocyclic compounds, Steric effect in biphenyls.

b) IR Spectroscopy (10)

Characteristic vibrational frequencies of alkanes; alkenes; alkynes; aromatic compounds; alcohols; ethers; phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds [ketones; aldehydes; esters; amides; acids; anhydrides; lactones; lactams and 6 conjugated carbonyl compounds] Effect of hydrogen bonding and solvent effect on vibrational frequencies; overtones; combination bands and Fermi resonance. FT-IR of gaseous; solids and

UNIT-II: Mass Spectrometry

(15)

Introduction, ion production- EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion

abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement, nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

UNIT-III: NMR Spectroscopy

(15)

General introduction and definition; chemical shift; spin-spin interaction; shielding mechanism of measurement; chemical shift values and correlation for protons bonded to carbons [aliphatic; olefinic; aldehydic and aromatic] and other nuclei [alcohols; phenols; enols; acids; amines; amides and mercaptans]; chemical exchange; effect of deuteration; complex spin-spin interaction between two; three; four; and five nuclei [first order spectra]; virtual coupling. stereochemistry; hindered rotation; Karplus curve variation of coupling constant with dihedral angle. Simplification of complex spectra; nuclear magnetic double resonance; shift reagent; solvent effect. Fourier transform technique, nuclear overhauser effect [NOE] Resonance of other nuclei. INEPT and INADEQUATE.

UNIT- IV:

(15)

a) Carbon-13 NMR Spectroscopy

General considerations; chemical shift [aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl compounds]; problems associated with ^{13}C , FT-NMR, proton decoupled off resonance.

b) Structural problems based on combined spectroscopic techniques (including reaction sequences)

Learning outcomes

- i) Student should know the difference in various spectroscopic techniques.
- ii) They came to predict the molecular structure of the given problem.
- iii) Student should solve the problems by combined spectroscopic entities.
- iv) Students should understand basic theory of UV, IR, MR and Mass spectroscopy.

REFERENCE BOOKS:

1. V.M. Parikh, Application spectroscopy of organic molecules. (Mehata) [All units]
2. Donald L. Pavia, Lampman, Kriz, Vyvyan Spectroscopy, Indian edition [All units]
3. Silverstein and Basslar, Spectroscopic identification of organic compounds
4. P.S. Kalsi Spectroscope of organic compounds (New age publisher) [All units]
5. Clayden, Greeves, Warren, Wothers, Organic Chemistry.
6. Jackman and Sterneil , Application of NMR spectroscopy
7. Nuclear magnetic resonance. J.D. Roberts (J. Wiley) [Unit III]
8. Theory and application of U.V. Jafee and Orchin.
9. Mass spectroscopy K. Benjamin. [Unit II]
10. The mass spectra of organic molecules. Beynon J H. [Unit II]
11. Interpretation of carbon 13 NMR Wehli F.W, Marchand A. P. (J. Wiley) [Unit IV]
12. Organic Spectroscopy W. Kemp, ELBS [All units]

Learning objectives : Students should

- i) Study the logical thinking and imagination for disconnection.
- ii) Learn Application of synthetic reagents and reactions in organic synthesis.
- iii) Study the metals and nonmetals and their applications in organic synthesis.
- iv) Implementation of green techniques in synthetic organic chemistry.

UNIT–I: Disconnection approach (15)

An introduction to Synthons and synthetic equivalents, disconnection approach, functional group interconversions. One group C-X and two group disconnections in 1, 2; 1,3 -1, 4 & 1, 5-difunctional compounds, Retro - synthesis of alkene, acetylenes and aliphatic nitro alcohols and carbonyl compounds, amines. Importance of the Order of events in organic synthesis, Chemoselectivity, Regioselectivity. Protecting groups, Diels-Alder reaction, Michael addition and Robinson annulation. Retrosynthesis of aromatic heterocycles, 3, 4, 5 & 6 membered carbocyclic and heterocyclic rings. Reversal of polarity (Umpolung).

UNIT–II: Application of the reagents and reaction in synthesis. (15)

Complex metal hydrides, sodium cyanoborohydride, lithium diisopropyl amide(LDA) Dicyclohexyl carbodiimide(DCC), Trimethylsilyl iodide, peracids, lead tetra acetate, PPA, Diazomethane, ozone, phase transfer catalyst, Woodward-Prevost hydroxylation, Barton and Shapiro reaction, Hoffmann – Löffler-Fretag, Peterson synthesis, Selenium dioxide, Dess-Martin periodinane, periodic acid and iodo isobenzyl diacetate, organ catalysis and Grub's catalysts.

UNIT–III: Applications of metals and non-metals in organic synthesis (15)

Pd, Hg, Cu, Sn, Boron and Si

UNIT–IV: Green chemistry (15)

A] Introduction, basic principles of green chemistry. Designing a green synthesis: Green starting materials, green reagents, green solvents and reaction conditions, green catalysts. Use of the following in green synthesis with suitable examples: Green reagents: dimethylcarbonate, polymer supported reagents. Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts, phase transfer catalysts.

B] Green solvents: Ionic liquids: Synthesis of ionic liquids, applications in alkylation, hydroformylations, epoxidations, synthesis of ethers, Friedel-craft reactions, Diels-Alder reactions, Knoevenagel condensations, Wittig reactions, Phase transfer catalyst, Synthesis, applications.

C] Microwave assisted synthesis: reactions in water, reactions in organic solvents, solvent free reactions. Ultrasound assisted reactions. Comparison of traditional processes versus green processes in the syntheses.

Learning outcomes

- i) Student should be able to predict the designing of molecule with correct disconnection.
- ii) Students are skilled in reaction mechanism of different synthetic reagents.
- iii) Students should understand use of metals and nonmetals in organic synthesis.
- iv) Students are skilled to perform green synthetic procedure like microwave, ultrasonic bath, as well as different green solvents like ionic liquids, DEM, etc.

REFERENCE BOOKS:

1. Designing of organic synthesis.- S.Warren [UnitI]
2. Organic synthesis -J. Fuhrhop & G. Penzlin. (2nded.)
3. Some modern methods of organic synthesis. - Carruthres: [Unit II,III]
4. Modern synthetic reaction. - H.O.House [Unit II,III]
5. Reagent in organic synthesis. - Fieser&Fieser [Unit II,III]
6. Principle of organic synthesis. - R.O.C. Norman [Unit II,III]
7. Advanced organic Chemistry - .Carey&Sundharg
8. Organic synthesis. - P.E.Realand: [UnitIV]
9. Comprehensive organic Chemistry. - Bartan and Ollis
10. Organic reactions. - R.Admas
11. Advances in organometallic Chemistry. - Stone & West [UnitIII]

M. Sc. Part – II (Semester – III)

Paper MCT-O-304: Drugs and Heterocycles

Learning objective : Students should

- i) Learn computational approach in drug designing of a molecule.
- ii) Learn synthetic methods for drug.
- iii) Study synthesis of five, six, membered etc heterocycles with mechanistic approach.
- iv) Study synthesis of fused heterocyclic compounds and six membered heterocycles.

UNIT–I: Drug discovery and design (15)

Development of new drugs, procedures followed in drug design, concepts of prodrugs and soft drugs. Theories of drug activity, Quantitative structure activity relationship. Theories of drug activity, Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors.

(B) Computational Chemistry

Introduction, applications in organic synthesis and its role in drug discovery.

UNIT–II: Synthesis of drugs (15)

(A) Study of Antibiotics

Preparation of semi synthetic penicillin, conversion of penicillin into cephalosporin, general account of tetracycline & macrocyclic antibiotics (no synthesis).

B) Synthesis

a) **Antimalarials:** Trimethoprim.

b) **Analgesic & Antipyretics:** Paracetamol, Meperidine, methadone, Aminopyrine.

c) **Anti-inflammatory:** Oxyphenylbutazone, Diclophenac, Indomethacin.

d) **Antitubercular & antileprotic:** Dapsone

e) **Anaesthetics:** Lidocaine, Thiopental.

f) **Antihistamines:** Diphenhydramine.

g) **Tranquilizers:** Diazepam, Trimeprazine.

h) **Anti AIDS:** General study

i) **Cardiovascular:** Synthesis of diltiazem, quinidine, methyl dopa, atenolol, oxyprenol.

j) **Anti-neoplastic drugs:** Cancer chemotherapy, Synthesis of mechloreaethamine, cyclophosphamide, Mephalan, uracils, mustards. Recent development in cancer

chemotherapy. Hormones and natural products.

UNIT–III:Heterocyclic Chemistry-I (15)

a) Five and six membered heterocycles with one and two heteroatoms:

Synthesis, reactivity, aromatic character and importance of following heterocyclic rings: Furan, Pyrrole, Thiophene, Pyrazole, Imidazole, Pyridine, Pyrimidine, diazines

b) Five and Six membered Heterocycles with more than two Heteroatoms

Synthesis and reactions of triazines, 1,2,3-triazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,5-oxadiazole.

UNIT – IV: Heterocyclic Chemistry-II (15)

a) Benzofused Heterocycles

Synthesis and reactions of benzopyrroles, benzofurans, benzothiophenes, Benzoxazole, Benzthiazole, and Quinoline, Benzimidazole

b) Six membered Heterocycles with one heteroatom

Synthesis and reactions of pyrilium salts and pyrones and their comparison pyridinium And thiopyrylium salts and pyridones. Synthesis and reactions of coumarins, chromones.

Learning outcomes: After completion of units, students are able to

- i) Understand the drug synthesis with their computational designing.
- ii) Understand synthesis and mechanism of pharmaceutical drugs.
- iii) Understand preparations and applications of 5 and 6 membered heterocyclic systems.
- iv) Understand preparations and applications of fused ring heterocyclic systems

REFERENCE BOOKS:

1. Medicinal Chemistry. - Burger : [Unit I,II]
2. Medicinal Chemistry - A. Kar. (Wiley East) [Unit I, II]
- 3 Principals of medicinal chemistry. - W. O. Foye : [Unit I,II]
- 4 Text book of organic medical and pharmaceutical chemistry. -Wilson, Gisvold & Dorque: [Unit I, II]
- 5 Pharmaceutical manufacturing encyclopedia.
- 6 An introduction to chemistry of heterocyclic compounds. - R. M. Acheson:(Interscience).
- 7 Heterocyclic chemistry. - Joule &Smith : (Van Nostrand). [Unit III, IV]
- 8 Heterocyclic chemistry. - R. K. Bansal: (Wiley E). [Unit III, IV]
- 9 Principals of modern heterocyclic chemistry. - L. A. Paquette :
- 10 The structure and reactions of heterocyclic compounds. - M. H. Palamer : [Unit III, IV]
- 11 Advances in Heterocyclic chemistry. - A. R. Katritzky: (A.P.). [Unit III, IV]
- 12 Organic chemistry (Vol. 1&2) - Finar.
- 13 Outline of Biochemistry. - Cohn &Stumpt
- 14 Introduction to the chemistry of enzyme action. - Williams:
- 15 The Organic Chemistry of Drug design and Drug action. - R. B. Silverman Academic press.
- 16 Strategies for Organic Drug synthesis and Design.- D. Lednicer, J. Willey. [Unit I, II]
- 17 Heterocyclic Chemistry. Vol-1-3, - R. R. Gupta, M. Kumar and V. Gupta, [Unit III,IV] Springer Veriag.

Elective Paper

M. Sc. Part – II (Semester – III)

Paper MCT-O-304-A: BIMOLECULAR ORGANIC CHEMISTRY

Learning objective : Students should

- i) Learn properties and applications of Amino acids, peptides and proteins.
- ii) Study chemistry of enzyme and their applications in organic synthesis.
- iii) Study the preparation and applications of organic smart materials.
- iv) Learn basic concepts, properties in Lipid

UNIT–I: Amino acids, peptides and proteins (15)

Chemical and enzymatic hydrolysis of proteins to peptides, amino acids sequencing. Secondary structure of proteins, forces responsible for holding of secondary structures, α -helix, β -sheets, super secondary structure. Tertiary structure of protein: folding and domain structure. Quaternary structure. Nucleic acids: Structure and function of physiologically important nucleotides (c-AMP, ADP, ATP) and nucleic acids (DNA and RNA), replication, genetic code, protein biosynthesis, mutation. Chemical synthesis of oligonucleotides: Phosphodiester, Phosphotriester, Phosphoramidite and H-phosphonate methods including solid phase approach. Computational study of proteins.

UnitII: Enzymes (15)

Chemistry of enzymes: Introduction, nomenclature, classes and general types of reactions Catalyzed by enzymes. Properties of enzymes : i) Enzyme efficiency / catalytic power ii) Enzyme specificity ; Fischer's 'lock and key' and Koshland 'induced fit' hypothesis. Concept and identification of active site. Factors affecting enzyme kinetics: Substrate concentration, enzyme concentration, temperature, pH, product concentration etc. Reversible and irreversible inhibition. Mechanism of enzyme action: transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Mechanism of chymotrypsin catalyzed hydrolysis of a peptide bond.

Unit-III: Organic Smart Materials (15)

Introduction, shape memory material (SMM) and shape memory technology (SMT), types of smart materials: Piezoelectric, Shape-memory alloys and shape-memory polymers, Photovoltaic materials or optoelectronics, Electroactive polymers (EAPs), Magnetostrictive, Smart inorganic polymers, Temperature-responsive polymers, Halochromic materials, Chromogenic systems, thermochromic materials, Ferrofluids, Photomechanical materials, Polycaprolactone (polymorph), Self-healing materials, Magnetocaloric materials, Thermo electric materials, Chemoresponsive materials. Classification of photomechanical organic crystals based on photo reactions. Applications

UNIT–IV: Lipids (15)

Fatty acids, essential fatty acids, structures and function of triglycerides, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins composition and function, role in atherosclerosis. Properties of lipid aggregates – micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism - β -oxidation of fatty acids

Learning outcomes: After completion of units, students are able to

- i) Understand properties and applications of Amino acids, peptides and proteins.
- ii) Understand chemistry of enzyme and their applications in organic synthesis.
- iii) Understand the preparation and applications of organic smart materials.
- iv) Describe basic concepts and properties of Lipids.

REFERENCE BOOKS:

1. Principles of Biochemistry - A. L. Lehinger, Worth Publications. [Unit I]
2. Biochemistry - L. Stryer, W. H. Freeman [Unit I,II]
3. Biochemistry - J. David Rawn, Neil Patterson. [Unit I,II]
4. Biochemistry - Voet and Voet, JohnWiley.
5. Outlines of Biochemistry - E. E. Conn and P. K. Stumpt, JohnWiley.

Practical Course (Paper MCP-O-305 & MCP-O-306)

M.Sc. Part-II (Sem-III)

MCP-O-305 & MCP-O-306 Organic Chemistry Practical

Learning objective: Students should

- i) Study process of qualitative analysis of ternary mixture using semi microanalysis technique.
- ii) Study the two steps preparations of important Organic products
- iii) Learn how to solve the number of spectral problems.

A. Qualitative Analysis

Separation, purification and identification of compounds of ternary mixtures using semi microanalysis, TLC, column chromatography and chemical tests. IR spectra to be used for functional group identification. Assign theoretical value of ^1H NMR, ^{13}C NMR and Mass Spectroscopy of chemical compounds of ternary mixture.

B. Analysis of commercial available active organic compound and its comparison with natural compounds which is extracted from natural sources.

C. Quantitative analysis

1. Two step Preparations (Any Three)

1. Benzaldehyde \rightarrow Benzalacetophenone \rightarrow Epoxide
2. 4-Nitro toluene \rightarrow 4-Nitro benzoic acid \rightarrow 4-Amino benzoic acid
3. Resorcinol \rightarrow 4-methyl-7-hydroxy coumarin \rightarrow 4-Methyl-7-acetoxycoumarin
4. Cyclohexanone \rightarrow Phenyl hydrazone \rightarrow 1,2,3,4-Tetrahydrocarbazole
5. Hydroquinone \rightarrow Hydroquinonediacetate \rightarrow 1,2,4-Triacetoxybenzene
6. Acetanilide \rightarrow p-Acetamidobenzenesulphonyl chloride \rightarrow P. Acetamidobenzenesulphonamide
7. p-Amino phenol \rightarrow p-Acetyl amino phenol \rightarrow p-Ethoxyacetanilide
8. Hippuric acid \rightarrow Azalactone \rightarrow 4-Benzylidene 2-phenyloxazol-5-one
9. p-Cresol \rightarrow p-Cresyl benzoate \rightarrow 2-Hydroxy-5-methylbenzophenone
10. Phthalimide \rightarrow N-Benzylphthalimide \rightarrow Benzylamine
11. o-Nitroaniline \rightarrow o-Phenylenediamine \rightarrow Benzimidazole
12. Phthalic acid \rightarrow Phthalimide \rightarrow Anthranilic acid

13. Benzyl cyanide → p-Nitrobenzylcyanide → p-Nitro phenyl acetic acid
14. Hydroquinone → Hydroquinonediacetate → 2,5 Dihydroxy acetophenone
15. Cyclohexanone → Enamine → 2-Acetylcyclohexanone
16. α-Pinene → Disiamylborane → Pinanol
- 17) Preparation of m-Nitroaniline
- 18) Preparation of Benzanilide from benzophenone
- 19) Preparation of Phthalimide
- 20) Preparation of N-Bromosuccinimide
- 21) Benzilic acid rearrangement: Benzilic acid from benzil
- 22) Sandmeyer reaction: p-Nitroiodobenzene from p-nitroaniline
- 23) Heterocyclic compound: 7-Hydroxy-4-methylcoumarin from resorcinol
- 24) Acetylation: Mannitolhexaacetate from mannitol
- 25) Claisen-Schmidt reaction: Dibenzalacetone from benzaldehyde
- 26) Oxidation: Fluorenone from fluorene
- 27) Acetylation: Acetyl ferrocene from ferrocene
- 28) Synthesis of acetanilide from aniline.

2. Structure elucidation by using given spectral data as well as perform its retrosynthetic analysis.

3. Any other suitable expt. may be added

Learning Outcomes

- 1) Student should understand the difference between water soluble and ether soluble components.
- 2) Student must know the separation method of ternary mixture by micro technique (Green approach).
- 3) Student should understand two step preparations of different reactions.
- 4) Student should understand how and why to check TLC for monitoring the reaction.
- 5) Student should understand the method of solving spectral problems by spectra of different compounds

RECOMMENDED BOOKS:

1. Textbook of Practical Organic Chemistry – A. I. Vogel.
2. Practical Organic Chemistry – Mann & Saunders.
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blatt

M. Sc. Part – II (Semester – IV)

Paper MCT-O-401: Theoretical Organic Chemistry

Learning objective

- i) Able to absorb the aromaticity concept of non-benzoid system.
- ii) Student should learn the supramolecular chemistry with various molecules.

- iii) Students should study free radical reactions and their applications in organic synthesis.
- iv) Students should learn the difference between the kinetic and thermodynamic controlled reactions with applications

UNIT–I: Molecular Orbital Theory (15)

Aromaticity in benzenoids, alternant and non alternant hydrocarbon, Huckels rule, energy level of pi- molecular orbital and concept of aromaticity, calculation of energies of orbitals cyclic and acyclic systems. Determination energies and stabilities of different systems calculation of charge densities PMO theory and reactivity index.

UNIT – II: Supramolecular Chemistry (15)

Host-Guest approach, Chiral recognition, Ionophores, Crown ethers, cryptands, Micelles, Cyclodextrins, calixarenes. Annulenes and heteroannulenes, fullerene C₆₀, tropone, tropoloneazulene, fulvene, tropylium salts, ferrocene, Three and five membered systems. Crown ether complexes, cyclodextrins, cryptands, catenanes and rotaxanes, bonding in fullerenes.

UNIT – III: Free radical reactions (15)

Types of free radical reactions, detection by ESR, free radical substitution mechanism, mechanism at an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in attacking radicals. The effect of solvent on reactivity. Allylic hydrogenation (NBS), oxidation of aldehydes to carboxylic acids, auto oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salt, Sandmeyer's reaction. Free radical rearrangement, Hunsdiecker reaction.

UNIT– IV (15)

a) Kinetic and thermodynamic controlled reactions (9)

Nitration and Sulphonation of naphthalene, Wittig, Enolization, Friedel-Crafts and Diels Alder reactions.

b) Non-classical carbocations: Formation, stability and reactivity. (6)

Learning outcomes

- i) Student should understand the MOT and the concept of aromaticity.
- ii) They should describe the free radical reactions.
- iii) Student should understand kinetic and thermodynamic controlled reactions.
- iv) They should know the supra molecules with their structural explanation.

REFERENCE BOOKS :

1. I. Lehar and Merchand: Orbital Symmetry. [Unit I,II]
2. R. B. Woodward and Hoffman: Conservation of orbital symmetry.
3. Kan: Organic Photochemistry
4. Cixon and Halton : Organic photochemistry
5. Arnold: Photochemistry
6. N. Turro : Modern molecular photochemistry.
9. Ginsburg: Nonbenzenoid aromatic compound. [Unit III,IV]
10. A. Streitwieser : Molecular orbital theory for organic chemistry.
10. E. Cler : The aromatic sextet. [Unit II]
11. Lloyd: Carbocyclic non- benzenoid aromatic compounds. [Unit I]
12. W. B. Smith: Molecular orbital methods in organic chemistry.

M. Sc. Part – II (Semester – IV)

Paper MCT-O-402: Stereochemistry

Learning objectives : Students should

- i) Learn implementation of the newer methods of stereoselective synthesis.
- ii) Learn conformational approach to acyclic and alicyclic systems.
- iii) Learn stereochemistry of Fused and bridged rings.
- iv) Study the stereochemistry of Allenes, Spiranes and Biphenyls.

UNIT- I: Newer methods of stereoselective synthesis. (15)

Introduction and Stereoselective and Stereospecific reactions; Enantioselective synthesis (chiral approach) reactions with hydride donors, hydroboration, catalytic hydrogenation via chiral hydrazones and oxazolines, Sharpless epoxidation, Diels Alder selective synthesis, Aldol and related reactions including Cram's rule and Felkin Anh rule use of calculations of optical purity and enantiomeric excess.

UNIT- II: Stereochemistry of acyclic and alicyclic compounds (15)

A) Conformation and reactivity in acyclic compounds and cyclohexanes. (5)
Stability and Reactivity of diastereoisomers. Curtin- Hammett principle.

B) Some aspects of the stereochemistry of ring systems: (5)
Stereoisomerism and determination of the configuration of alicyclic rings; Stability of rings and ease of rings formation

C) The shapes of the rings other than six membered: (5)
D) Shapes of five, six, and seven membered rings. Conformational effects In medium sized rings, Concept of I' strain.

UNIT-III: Stereochemistry of the ring system, conformation and configuration (15)

a) Fused and bridged rings: Fused bicyclic ringsystems: (8)

b) Types of fused ring systems, Cis and trans-Decalins, Perhydroanthracene, Perhydrophenanthrene; Bridged rings: Types of bridged ring systems, Nomenclature, stereochemical restrictions, and Bredt's rule.

c) O.R.D. and C.D.: Types of curves, circular dichroism, Determination of the conformation and configuration, The Octant rule and axial haloketone rule. (7)

UNIT-IV: Stereochemistry of compounds containing no chiral carbon atoms and diastereoisomerism (Geometrical isomerism) (15)

a) Stereochemistry of Allenes, Spiranes and Biphenyls Assignment of configuration

b) Configuration of diastereomers (Geometrical isomerism) based on physical and chemical methods. (7)

15

Learning outcomes

- i) Student should understand difference between basic stereochemistry and modern stereochemistry.
- ii) Student must explore conceptual fact of stereoselective synthesis.
- iii) Student should understand the shapes of ring other than five membered.
- iv) Student must learn the allene, spirane and biphenyls systems.

REFERENCE BOOKS:

1. E.L. Eliel : Stereochemistry of carbon compounds. [All units]
2. D. Nasipuri : Stereochemistry of organic compounds [All units]
3. P.S. Kalsi: Stereochemistry, Conformation and Mechanism. [All units]
4. Eliel, Allinger, Angyal and Morrison : Conformational analysis.
5. Hallas: Organic stereochemistry
6. Mislow and Benjamin: Introduction to Stereochemistry.
7. H. Kagan :Organic stereochemistry.
8. Carl Djerassi ; Optical Rotatory Dispersion. [Unit III]
9. P. Crabbe : Optical Rotatory Dispersion and C.D. [UnitIII]

M. Sc. Part – II (Semester – IV)

Paper MCT-O-403: Chemistry of Natural Products

Learning objectives: Students should

- i) Learn the introduction of naturally occurring organic molecules.
- ii) Study synthesis and stereochemistry of alkaloid molecules
- iii) Study synthesis steroids, terpenoids, prostaglandins, etc.
- iv) Designing a natural product through a biogenesis approach.

UNIT-I: a) Introduction of natural products (3)

Classification and isolation methods.

b) Terpenoids (12)

Introduction of natural products : Classification and isolation methods carvone, abietic acid, zingiberene, α -santonin, β -cuparenone and β -caryophyllene.

UNIT-II: Alkaloids (15)

Structure, stereochemistry, synthesis and biosynthesis of the following:

Morphine, Reserpine,

UNIT-III: a) Steroids (10)

Occurrence, nomenclature, basic skeleton, Diels hydrocarbon. Study of the following: hormones, Cholesterol, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone and cortisone (only synthesis).

b) Prostaglandins (5)

Occurrence, nomenclature, classification, biogenesis and physiological effects, Synthesis of PGE₂ and PGE₂

UNIT-IV: a) Biogenesis (8)

a) **Terpenoids:** mono, sesqui., di- and triterpenoids, cholesterol.

b) **Alkaloids:** Derived from ornithine, lysine, tyrosine, tryptophan, pyridine, morphine and indole type alkaloids.

c) **Shikimate pathway**– cinnamic acids, lignans, coumarins, flavonoids, isoflavonoids

and terpenoids quinines and the compds. belonging to the classes bisabolene, eudesman and steroids, cholesterol, steroids.

b) Vitamins

(7)

Synthesis and structure of **biotin** and vitamin **B₁**, **B₂**, **B₆**: **biological** functions of Vitamin **B₆**, **D** and **E**.

Learning outcomes

- i) Student should understand Classification and isolation methods.
- ii) Student should know Structure and synthesis of camphor, carvone, abietic acid, zingiberene, α -santonin, β -cuparenone and β -caryophyllene.
- iii) Student should understand different Structure, stereochemistry, synthesis and biosynthesis the following: Morphine, Reserpine, Ephedrine and (+)Conin.
- iv) They should understand Occurrence, nomenclature, classification, biogenesis and physiological effects, Synthesis of PGE₂ and PGE₁

REFERENCE BOOKS:

1. ApSimon: The total synthesis of natural products.
2. Manskey and Holmes: Alkaloids
3. A.A. Newman: Chemistry of Terpenes.
4. P. D B. Mayo: The chemistry of natural products.
5. Simonson: Terpenes. [Unit I]
6. T.W. Goddwin: Aspects of terpenoid chemistry and biochemistry.
7. Woguer: Vitamins and Co-enzymes.
8. P. W. Bentley: Chemistry of Natural products,
9. Fieser and Fieser: Steroids [Unit III]
10. I. Finar: Organic chemistry Vol. II and I [All units]
11. J.B. Hendrickson, The molecules of nature.
12. Peter Bernfield: The biogenesis of natural products [Unit IV]
13. R.T. Slickenstaff A.C. Ghosh and G.C. Wole : Total synthesis of steroids.
14. Nakanishi.: The chemistry of natural products

Paper MCT-O-404 Applied Organic Chemistry

Learning objectives

- i) Study of different types of Agrochemicals used for the pest control.
- ii) To study the synthesis and application of different perfumery based compounds
- iii) To study the commercial synthesis of different dyes.
- iv) students should learn different process of polymers.

UNIT-I: Agrochemicals

(15)

- a. Carbamate pesticides: Introduction and synthesis of carbaryl, carbofuran, Baygon, Aldicarb, Ziram, Zineb.
- b. Organophosphorus pesticides: Malathion, monocrotophos, dimethoate, phorate, mevinphos, chloropyrifos.
- c. Natural and synthetic pyrethroids: Isolation and structures of natural allethrin, fenvalerate, cypermethrin.
- d. Plant growth regulators: General survey and synthesis of simple compounds and applications.
- e. Insect repellents: General survey, synthesis and applications.
- f. Juvenile hormone: introduction & structures JHA importance synthesis

g. Pheromones: introduction, examples, and importance in IPM. Synthesis of juvabione bombykol, grandisol and disparlure.

UNIT-II: A) Synthesis and applications of perfumery (5)

2-Phenylethanol, vanillin and other food flavours, synthetic musk and ionones.

B) Synthesis and applications of pharmaceuticals: (5)

Beridryl, Oxyphenbutazone & Ethambutol

C) Sugar based chemicals : Manufacture of furfural from bagasse, citric acid from molasses, acetic acid , butane aldehyde & butyl acetate from ethanol. (5)

UNIT-III: Dyes and Intermediates (15)

Classification and synthesis of important dye intermediates by using nitration, sulphonation, diazotization reactions. Commercial processes for azo-dyes, reactive dyes, optical brighteners, thermal sensitive dyes, dispersed dyes and reactive dyes.

UNIT-IV:A)Polymers (10)

Mechanism of polymerization. Study of polyesters, polyamides, PVC, polystyrene, polyvinyl acetate and polyvinyl alcohol, polyethenes, viscose rayon, synthesis of polyethylene, polypropylene. Synthetic rubbers: Styrene-butadiene, butyl polyisoprene, phenol formaldehydesin. Plasticizers and anti - oxidants for polymers, natural polymers: starch and cellulose.

B) Applications of Oxo and Wacker process; Soaps and Synthetic detergents (5)

References:

1. Allan: Colour Chemistry
2. K. Venkataraman: Chemistry of Synthetic Dyes Vol- 1 to7
3. Abrahart: Dyes & theirintermediates
4. N. N. Melikov: The Chemistry of Pesticides and formulations
5. K. H. Buchel: Chemistry of Pesticides.
6. R. Clemlyn:Pesticides
7. K. H. Buchel: Chemistry of Pesticides
8. H. R. Alcock and F. W. Lambe: Contemporary PolymerChemistry
9. J. M. G. Cowie, Blackie: Physics & Chemistry ofPolymers
10. P. H. Groggins: Unit Processes in OrganicSynthesis
11. B. Biollot& P. V. Wells: PerfumaryTechnology
12. M. Ash & I. Ash: A formulary of Cosmetic Preparations

Learning outcomes

UNIT-I: Agrochemical

- 1) Student should understand organic reaction mechanism with respect to structure and reactivity.
- 2) Student must explore conceptual fact of Chemical bonding and basis of reactivity.
- 3) Understanding formation of atomic orbital through quantum approach.
- 4) They should know energy level in atom using modern classical quantum mechanics.
- 5) They should understand behavior of electron in atom.

UNIT-II: A) Synthesis and applications of perfumery

- 1) Student should understand formation of various types of Aliphatic Nucleophilic substitutions.
- 2) Student should compare The SN2, SN1 and SNi reactions with respects to mechanism and stereochemistry.
- 3) Student should know Ambident nucleophiles, Neighbouring Group Participation.

- 4) Student must explain Aromatic Electrophilic Substitutions.
- 5) Student must state approach of the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in aromatic systems.
- 6) They should demonstrate concept of aromaticity, orientation in their ring systems. Diazo-coupling, Vilsmeier reaction, Von Richter rearrangement.

UNIT-III: Dyes and Intermediates

- 1) They must explain the Addition to C-C multiple bonds - mechanism and stereochemical aspects of addition reaction.
- 2) They should explain nucleophile and free radicals, Regio and chemoselectivity,
- 3) They should understand Regio and chemoselectivity, orientation and reactivity, conjugate addition
- 4) Student must explain E1, E2 and E1cB mechanisms. Orientation in Elimination reactions
- 5) Student must state approach of the Hofmann versus Saytzeff elimination, Pyrolytic syn-elimination,
- 6) They should demonstrate concept of Pyrolytic elimination: Chugaev reaction, Cope reaction and Pyrolysis of acetates.

UNIT-IV: A) Polymers

- 1) Student should understand Symmetry operations: Rotation, reflection, inversion, rotation-reflection. Identification of the different axes and planes of symmetry.
- 2) Student should compare Principles of axial and planar chirality. Stereochemical features and configurational descriptors
- 3) Student should know Homotopic, heterotopic and diastereotopic ligands and faces.

Elective Paper

M. Sc. Part – II (Semester – IV)

Paper MCT-O-404-A: Environmental Chemistry

Learning objectives

- i) To provide students with broad theoretical and applied background
- ii) To provide basic principles of basic principles of environmental chemistry.
- iii) To give idea about collection of data regarding chemical and biological in relation with environment.
- iv) Student will know environmental problems relating to society.

UNIT-I: Introduction to Environmental Chemistry

[15]

Concept and scope of environmental chemistry, Environmental terminology and nomenclatures, Environmental segments, The natural cycles of environment (Hydrological, Oxygen, Nitrogen)

UNIT-II: Atmosphere, Hydrosphere and Lithosphere

[15]

Atmosphere: Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in atmosphere; Chemistry of ozone layer. Hydrosphere: Complexation in natural water and waste-water, Micro-organisms in aquatic chemical reactions, Eutrophication, Microbiology mediated redox reactions. Lithosphere: Inorganic and

organic components in soil, acid-base and ion-exchange reactions in soil, micro and macronutrients, nitrogen pathways and NPK in soil.

UNIT-III: Chemical Toxicology

[15]

Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur oxides.

UNIT-IV:

[15]

A) Air Pollution

Particulates, Aerosols, SO_x, NO_x, CO_x and hydrocarbon, Photochemical smog, Air-quality standards

B) Water Pollution and water treatment

Water-quality parameters and standards: physical and chemical parameters, Dissolved oxygen, BOD, COD, Total organic carbon, Total nitrogen, Total sulfur, Total phosphorus and Chlorine, Chemical speciation (Pb, As, Hg)

Learning outcomes: After completion of units, students are able to

- i) Understand idea about basic principles of environmental chemistry
- ii) Understands the environmental issues regarding social aspects.
- iii) Understand the burning issues of environment with their remedies.
- iv) Understand causes and treatments of air and water pollution.

Reference Books:

1. G.W. Vanloon, S.J. Duffer, Environmental Chemistry - A Global Perspective, Oxford University Press (2000).
2. F.W. Fifield and W.P.J. Hairens, Environmental Analytical Chemistry, 2nd Edition (2000), Black Well Science Ltd.
3. Colin Baird, Environmental Chemistry, W.H. Freeman and Company, New York (1995).
4. A.K. De, Environmental Chemistry, 4th Edition (2000), New Age International Private Ltd., New Delhi. [All units]
5. Peter O. Warner, Analysis of Air Pollutants, 1st Edition (1996), John Wiley, New York. [All units]
6. S.M. Khopkar, Environmental Pollution Analysis, 1st Edition (1993), Wiley Eastern Ltd., New Delhi. [All units]
7. S.K. Banerji, Environmental Chemistry, 1st Edition (1993), Prentice-Hall of India, New Delhi.

Practical Course (MCP-O-405 & MCP-O-405)

M.Sc. Part-II (Sem-IV)

Organic Chemistry Practical Course VII and VIII

Learning objectives

- i) To study the Kjeldahl's method of nitrogen estimation.
- ii) To study the messenger method of sulfur estimation.
- iii) To study the three step preparation of important organic compounds.

1. Estimation of Sulphur and Nitrogen.

20

2. Three stage organic preparations

1. Preparation of Anthranilic acid.
2. Preparation of p- Amino benzoic acid.
3. Preparation of p- Chloro nitrobenzene by Sandmeyer reaction.
4. Preparation of p- Iodonitrobenzene by Sandmeyer reaction.
5. Multicomponent synthesis.

Green methods of synthesis (Microwave and ultrasonic technique)

1. Synthesis of Schiff's base from aniline and p-anisaldehyde in the presence of lime juice
2. Synthesis of coumarin by Knoevenagel reaction using salicylaldehyde, and ethyl acetate in presence of a base.
3. Synthesis of dihydropyrimidones- Biginelli reaction: acid-catalyzed three component reaction between vanillin, ethyl acetoacetate and thiourea.
4. Synthesis of acetanilide from aniline.

3. Industry oriented Practicals

4. Any other suitable experiments may be added.

5. Project: Lab Project in Parent Institute

Literature survey. Studies of reactions, synthesis, mechanism, isolation of natural products, standardization of reaction conditions, use of new methods etc. Identification of organic compounds by spectroscopic methods. External and internal examiners will examine the project (50 Marks) jointly at the time of practical examination.

OR

Internship, Industrial Training:

Students should complete their internship programme or industrial training or research project work in well reputed organizations like IIT, NIT, IISER, NCL, ICT, Universities, Chemical Industries and Pharmaceutical Industries etc. The minimum period of their internship is 30 days. Students should submit their project report in details with certificate is compulsory.

Learning Outcomes

- 1) Student should understand the three step preparations.
- 2) Student must know the method of estimation of sulfur and nitrogen.
- 3) Student should understand how to assemble Kjeldahl's apparatus for estimation of nitrogen.
- 4) Student should understand Literature survey. Studies of reactions, synthesis, mechanism, isolation of natural products.
- 5) Student should understand standardization of reaction conditions, use of new methods etc. Identification of organic compounds by spectroscopic methods

RECOMMENDED BOOKS:

1. Textbook of Practical Organic Chemistry – A. I. Vogel.
2. Practical Organic Chemistry – Mann & Saunders.
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blatt