Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Autonomous)

Syllabus

For

Master of Science

M. Sc. Part - II Organic Chemistry

(Semester III, IV)

Under Choice Based Credit System

Syllabus with effect from the June, 2019

(Subject to modifications in the future)

Vivekanand College, Kolhapur (Autonomous)

Department of Chemistry

M. Sc. Part-II, (Sem III and IV)

Organic Chemistry Syllabus (CBCS) 2019-20

Total No. of Semester – 02

Total No. of Papers – 08

No. of papers (theory) per semester – 04

No. of practical course per semester – 02

Maximum marks per paper (practical) -100

Distribution of Marks – Internal evaluation - 20

External evaluation - 80

(Semester exam.)

Total Marks for M. Sc. Degree

Theory Paper: 1600

Practical course: 800

Total: 2400

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

Paper No. (CC – 1143 C): Organic Reaction Mechanism

Paper No. (CC – 1144 C): Advanced Spectroscopic methods

Paper No. (CC – 1145 C): Advanced Synthetic methods

Paper No. (CC – 1146C): Drugs and Heterocycles

Practical Course: (CC – 1147 C) and (CC – 1148 C)

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

Paper No. (CC – 1149 D): Theoretical Organic Chemistry

Paper No. (CC – 1150 D): Stereochemistry

Paper No. (CC – 1151 D): Chemistry of Natural Products

ELECTIVE PAPER

Paper No. (CC – 1152 D): Applied Organic Chemistry

Paper No. (CC – 1153 D): Bioorganic Chemistry

Practical Course: (CC – 1152 D) and (CC – 1152 D)

Vivekanand College (Autonomous), Kolhapur
M. Sc. Part - II (Organic Chemistry)
CBCS Syllabus with effect from June - 2019
Semester - III
(CC – 1143 C): Organic Reaction Mechanism
Theory: 60hrs

Course Outcomes: After the completion of the course, the student will be able to:

CO1: Adopt the knowledge about the path and to determine the rates of reactions by Kinetic and non kinetic methods - steps involved, reaction rate determination, order and molecularity, Testing and trapping of intermediates, stereochemistry and Hammet Taft equation.

CO2: Understand the concept of Pericyclic reactions, Woodword Hoffman correlation diagrams – FMO, PMO approach, conrotatoy and disrotatory motion. Also identify the reactions as 4n, 4n+2 and 2+2 addition of ketenes, sigmatropic shifts (3,3) and (5,5) Claisen and Cope and Aza Cope rearrangement.

CO3: Learn the mechanism and stereochemistry, migratory aptitude and applications of different name reactions like Dienone-phenol, Favorskii, Smile's, Brooke, Neber, Steven's, Sommelet - Houser rearrangement reaction, etc.

CO4: Adapt the knowledge about photochemistry – photochemical reactions, their types and they will come to know the difference between thermal and photochemical reactions, laws of photochemistry. Also know the types of photochemical reactions, quenching and chemiluminescence.

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 labelling, 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, Wood-ward Hoffman correlation diagrams, FMO and PMO approach, electrocyclic reactions, conrotatory and disrotatary motions, 4n , 4n+2 and allyl systems, cycloaddition, and supra and antara facial 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: Study of following reactions **(15)**

Mechanism, Stereochemistry, migratory aptitude and applications of Dienone–phenol, Favorskii, Wolff, Smile's, Brook, Neber, Stevens, Sommelet–Hauser rearrangement, Eschenmoser fragmentation, von Richter reaction, Epoxide rearrangement with lewis acid..

UNIT– IV: Photochemistry **(15)**

Effect of light intensity on the rate of photochemical reactions, Types of photochemical reactions, phtodissociation gas phase photolysis, photochemistry of alkynes, intramolecular reactions of the olefinic bonds, geometrical isomerism, cyclisation reactions, rearragements 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 oxitane formation, photochemistry of aromatic compounds, photo fries reactions of anilides, photo fries rearrangements, Singlet molecular oxygen reactions, photochemistry of vision.

RECOMMENDED BOOKS:

1. A guide book to mechanism in organic chemistry (orient- Longmans) - Peter Sykes
2. Organic Reaction Mechanism (Benjumin) - R. Breslow
3. Mechanism and structure in Organic Chemistry (Holt Reinhartwinston) - B. S. Gould
4. Organic chemistry (McGraaw Hill) - Hendrikson, cram and Hammond
5. Basic principles of organic chemistry (Benjamin) J. D. Roberts and M. C. Caeserio.
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

9. Essentials of molecular photochemistry, A. Gilbert and J. Baggott. Blackwell Scientific Publication.
10 Molecular photochemistry, N.J. Urro, W. A. Benjamin
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.

(CC – 1144 C): Advanced Spectroscopic Methods
Theory: 60hrs

Course Outcomes: After the completion of the course, the student will be able to:

CO1: Learn the principles and theory behind UV and IR spectroscopy and the concept of molecular vibrations occurring due to absorption of IR radiation and electronic excitations due to absorption of UV radiations so that students will be able to identify the structures of unknown organic compounds. They can identify the functional groups in organic compounds like alcohol, aldehyde, ketone, ester, aromatic compounds etc. They will learn overtones, combination bands and Fermi resonance FT-IR spectroscopic method.

CO2: Understand the recapitulation of proton NMR spectroscopy, Factors affecting coupling constants. Also learn how to analyse the first order spectra, simplification of complex spectra, complex spin-spin splitting of second order spectra. They will learn the effect of deuteration and spectra of Homotopic, Enantiotopic and Diastereotopic systems. Also adopt the knowledge of Advanced NMR technique and about Fourier transform technique, Nuclear overhauser effect (NOE), COSEY, NOSEY and resonance of F^{19} and P^{31} nuclei.

CO3: Learn the ion production - EI, CI, FD and FAB and factors affecting fragmentation analysis. Also understand the mass spectral fragmentation of different functional groups like aldehydes, ketones, esters, alcohols etc. so that they will be able to solve the problems on mass spectroscopy.

CO4: Understand the concept of C^{13} NMR spectroscopy – chemical shift values of alkanes, alkenes, alkynes, aromatic compounds, carbonyl and heterocyclic compounds. Also learn this advanced C^{13} technique – NOE, DEPT, HETCOR and heteronuclear coupling. They will become confident to solve the problems on C^{13} NMR.

UNIT - I: 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

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 polymeric materials.

UNIT - II: Proton NMR Spectroscopy **(10)**

a) Recapitulation of proton NMR spectroscopy, Factors affecting coupling constants (Karplus curve variation, dihedral angle, bond order, electronegativity), analysis of First order spectra, Complex spin-spin splitting of second order spectra, different spin systems (AB, AM, AX, ABX/AMX spin systems with examples). Simplification of complex spectra (High field strength, chiral resolving agent, effect of deuteration, nuclear magnetic double resonance, shift reagent, solvent effect); Spectra of Homotopic, Enantiotopic and Diastereotopic systems.

b) Advanced NMR techniques **(5)**

Fourier transform technique, nuclear overhauser effect (NOE), COSY, NOESY, Resonance of other nuclei – ^{19}F, ^{31}P.

UNIT - III: Mass Spectrometry **(15)**

Introduction, ion production- EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance; Mass spectral fragmentation of aldehydes, ketones, aromatic hydrocarbons, carboxylic acids, ethers, alcohols, amines, nitro, cyano compounds; molecular ion peak, metastable ion peak; High resolution mass spectrometry (HRMS), MALDI, TOF; Problems associated with Mass Spectroscopy.

UNIT – IV: a) Carbon-13 NMR Spectroscopy **(7)**

General introduction to ^{13}C NMR spectroscopy; chemical shift values [aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl compounds]; proton coupled, proton decoupled ^{13}C NMR spectra, advanced ^{13}C NMR techniques (NOE, DEPT, Off resonance, HETCOR), Heteronuclear coupling, problems associated with ^{13}C NMR.

b) Structural problems based on combined spectroscopic techniques (including reaction sequences) **(8)**

RECOMMENDED BOOKS:

1. V.M. Parikh, Application spectroscopy of organic molecules. (Mehata)
2. D.W. Williams and Flemming, Spectroscopic methods of organic compound.
3. Silverstein and Basslar, Spectroscopic identification of organic compounds V.M.

Parikh Absorption spectroscopy of organic molecules (J. Wiley)

4. P.S. Kalsi Spectroscopy of organic compounds (New age publisher)
5. J.R. Dyer. Application of absorption spectroscopy of organic compounds.
6. Jackman and Sterneil , Application of NMR spectroscopy
7. Nuclear magnetic resonance. J.D. Roberts (J. Wiley)
8. Theory and application of U.V. Jafee and Orchin.
9. Mass spectroscopy K. Benjamin.
10. The mass spectra of organic molecules. Beynon J H.
11. Interpretation of carbon 13 NMR Wehli F.W, Marchand A. P. (J. Wiley)
12. Organic Spectroscopy W. Kemp, ELBS
13. Instrumental methods of analysis CBS. Willard Merritt and Dean.
14. Mass Spectroscopy. Das and Jame
15. Organic structural spectroscopy : J. B. Lambert, S. Gronert, H. F. Shurvell, D. Lightneli, R. G. Cooks (Prentice Hall 2nd edition)

CC – 1145 C): Advanced Synthetic Methods
Theory: 60hrs

Course Outcomes: After the completion of the course, the student will be able to:

CO1: Understand the concept of disconnection approach through the introduction of synthons, synthetic equivalents and functional group interconversions. Also understand 1,2; 1,3; 1,4; 1,5 difunctional compounds, retrosynthesis of alkene, alkyne, alcohol, amines …etc. Importance of the order of reaction in organic synthesis, the meaning of the terms – Chemoselectivity, Regioselectivity, protectecting groups. They will learn Diel's Alder reaction, Michael addition, Robinson annulation and what is mean by reversal of polarity i.e. Umpolung reaction.

CO2: Study the applications of different reagents like LDA, DCC, TBTH, lead tetra-acetate, etc. in chemical reactions like Woodward – Prevost hydroxylation, Barton and Shapiro reaction as well as applications of Periodic acid in Grub's catalysis.

CO3: Learn how the different metals like Pd, Mg, Rh, Tl, Si and Cu in Click chemistry.

CO4: Learn the new concept of supramolecular chemistry, advanced synthetic methods by using microwave oven, ultrasound waves, using the enzymes, electro-organic synthesis, use of multicomponent reactions as well as the use of Ionic liquids in chemical reactions.

UNIT – I: Disconnection approach **(15)**

Introduction to Synthons and synthetic equivalents, disconnection approach, functional group interconversions. One group and two group disconnections in 1,2; 1,3; 1,4 & 1,5-difunctional compounds, Retro-synthesis of alkene, alkynes, alcohols, amines, carbonyl and 5,6 membered heterocyclic compounds. Importance of the Order of events in organic synthesis, Chemoselectivity, Regioselectivity, Protecting groups, Diels-Alder reaction, Michael addition and Robinson annulations, Reversal of polarity (Umpolung).

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

Sodium cyanoborohydride, Lithium diisopropylamide (LDA) Dicyclohexylcarbodiimide (DCC), Tri-n-butyl tin hydride (TBTH), Per acids, Lead tetra acetate, Poly phosphoric acid (PPA), Diazomethane, Ozone, Phase transfer catalyst, Woodward-Prevost hydroxylation, Barton and Shapiro reaction, Hoffmann-Loffler-Fretag, Selenium dioxide, Dess-Martin periodinane, Periodic acid and Grub's catalysts.

UNIT – III: Applications of following metal in organic synthesis **(15)**

Pd, Mg, Rh, Tl, Si, use of Cu in Click chemistry

UNIT – IV: Application of the following in synthesis **(15)**

Supramolecular chemistry (use of crown ethers, cyclodextrins), Merrifield resin for synthesis of polypeptide, use of ferrites and metal nanoparticles in organic synthesis, Electro-organic synthesis, Enzyme catalyzed reaction in synthesis, Ionic liquids, Multi-component reactions, Microwave and Ultrasound techniques and their applications.

RECOMMENDED BOOKS:

1. Designing of organic synthesis. S. Warren
2. Organic synthesis J. Fuhrhop & G. Penzlin. (2nd ed.)
3. Some modern methods of organic synthesis. Carruthres
4. Modern synthetic reaction. H.O. House
5. Reagent in organic synthesis. Fieser & Fieser
6. Principle of organic synthesis. R.O.C. Norman
7. Advanced organic Chemistry. Carey & Sundharg
8. Organic synthesis. P.E. Realand
9. Comprehensive organic Chemistry. Bartan and Ollis
10. Organic reactions. R.Admas
11. Advances in organometallic Chemistry. Stone & West
12. Transition metal intermediate in organic synthesis. C.W. Bird
13. Organometallic in organic synthesis. Swan & black
14. Synthesis of prostaglandins .A. Mitra
15. Total synthesis of natural products. John Apsimon
16. Polymers as aid in organic synthesis. M. K. Mathur, C. K. Narang & R.E. Williams
17. Polymer supported reaction in organic synthesis. P. Hodge & D.C. Sherrington
18. Enzyme catalysed reactions. C.J. Gray
19. Electroorganic Chemistry. T.Shona
20. Phase transfer catalyst in organic synthesis. Weber & Gokel.

(CC – 1146C): Drug and Heterocycles
Theory: 60hrs

Course Outcomes: After the completion of the course, the student will be able to:

CO1: a) Develop the new drugs, procedures followed in drug design, History and development quantitative structure activity relationship (QSAR). Also learn the concept of drug receptors and relationship between structure and chemical reactivity.

b) Learn about Antibiotics like beta-lactum, cephalosporin and SAR of both and understand the structural features of tetracycline & macrocyclic antibiotics.

CO2: Study the different types of drugs like Antimalarials, Anti- inflammatory, (e.g. Diclophenac), Anaesthetics, (e.g. lidocaine and thiopental), Antitubercular (Dapsone), Tranquilizers (Diazepam) etc. Also they can study about cardiovascular and Antineoplastic drugs.

CO3: a) Understand synthesis and reactions of five membered heterocycles – Furan, benzofuran, pyrrole, thiophene, and benzothiophene etc.

b) Learn the synthesis and reactions of six membered heterocycles like Pyridine, Quinoline and Coumarine.

CO4: a) Learn the synthesis and reactions of diazines and triazines. (six membered heterocycles).

b) Synthesis the reactions of azepines, oxepines & thiepines. (seven membered heterocycles)

Part - A: DRUGS

UNIT - I: a) Drug design **(10)**

Development of new drugs, procedures followed in drug design. History and development of Quantitative structure activity relationship (QSAR). Concepts of drug receptors, Relation of chemical structure and chemical activity.

b) Study of Antibiotics **(05)**

Introduction, β-lactum Antibiotics, cephalosporin Antibiotics, SAR of β-lactum and cephalosporin, Structural features of tetracycline & macrocyclic antibiotics (no synthesis).

UNIT – II: Study of the Following types of drugs **(15)**

a) Antimalerials: Trimethoprim.

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

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

d) Antitubercular & antileprotic: Dapsone

e) Anaesthetics: Lidocaine, Thiopental.

f) Antihistamines: Diphenylhydramine.

g) Tranquilizers: Diazepam, Trimeprazine.

h) Anti AIDS: General study, Introduction, structure and life cycle of the AIDS virus, recent development, Azedothymidine (AZT) derivatives

i) Cardiovascular: Synthesis of dilliazem, quinidine, methyldopa, atenolol, oxyprenol.

j) Anti-neoplastic drugs: Introduction, Cancer chemotherapy, Synthesis of mechloraethamine, cyclophosphamide, Mephalan, uracils, mustards. Recent development in cancer chemotherapy. Hormones and natural products.

Part - B: HETEROCYCLES

UNIT–III:

a) Five membered Heterocycles **(10)**

Synthesis and reactions of Furan, benzofurans, Pyrrol, benzopyrroles, Thiophene, Benzothiophenes.

b) Six membered Heterocycles with one heteroatom **(05)**

Synthesis and reactions of Pyridine, Quinoline, Coumarine,

UNIT – IV: a) Six membered Heterocycles with two and more Heteroatoms **(8)**

Synthesis and reactions of diazines & triazines.

b) Seven membered Heterocycles **(7)**

Synthesis and reactions of azepines, oxepines & thiepines.

RECOMMENDED BOOKS:

1. Synthetic drugs, G. R. Chatwal
2. Medicinal Chemistry A. Kar.
3 Medicinal chemistry, P. Yogeshwari and D. Shriram
4 Medicinal chemistry Alka Gupta
5 Pharmaceutical manufacturing encyclopedia.
6 An introduction to chemistry of heterocyclic compounds. R. M. Acheson :(Interscience).
7 Heterocyclic chemistry. Joule & Smith : (Van Nostrand).
8 Heterocyclic chemistry. R. K. Bansal: (Wiley E).

9 Principals of modern heterocyclic chemistry. L. A. Paquitte :
10 The structure and reactions of heterocyclic compounds. M. H. Palamer
11 Advances in Heterocyclic chemistry. A. R. Katritzky: (A.P.).
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.
17 Heterocyclic Chemistry. Vol-1-3, R. R. Gupta, M. Kumar and V. Gupta, Springer Veriag.
18 The Chemistry of Heterocycles. T. Eicher and S. Hauptmann, Thieme
19 Heterocyclic Chemistry. J. A. Joule, K. Mills and G. F. Smith, Chapman and Hall
20 Heterocyclic Chemistry. T. L. Gilchrist, Longman Scientific Technical
21 Contemporary Heterocyclic Chemistry. G. R. Nikome and W. W. Poudler, Willey
22 An Introduction to Heterocyclic Compounds., R. M. Acheson, J. Willey
23 Comprehensive Heterocyclic Chemistry. A. R. Katritzky and C. W. Rees

M. Sc. Part - II (Sem-III) Organic Chemistry
Practical Course (CC – 1147C) and (CC – 1148C)

A. Qualitative Analysis

1. Separation, purification and identification of compounds of ternary mixtures using **semimicroanalysis**,

2. TLC, column chromatography and chemical tests. IR spectra to be used for functional group identification.

B. Quantitative analysis 1. Two step Preparations

a) Preparation of m-Nitroaniline

b) Preparation of Benzanilide from benzophenone

c) Preparation of o-Nitroaniline → o-Phenylene diamine → Benzimidazole

d) Preparation of p-Cresol → p-Cresyl benzoate → 2-Hydroxy-5-methyl benzophenone

e) Preparation of Anthranilic acid

f) Structure elucidation by using given spectral data.

RECOMMONDED 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 Blat

Vivekanand College (Autonomous), Kolhapur
M. Sc. Part - II (Organic Chemistry)
CBCS Syllabus with effect from June - 2019
Semester - IV
(CC – 1149 D): Theoretical Organic Chemistry
Theory: 60hrs

Course Outcomes: After the completion of the course, the student will be able to:

CO1: Understand the concept of aromaticity in benzenoids, Huckel's rule, energy level of pi-molecular orbital, calculation of energies of cyclic and acyclic systems, different concepts of Huckel's as well as calculation of charge densities – PMO theory and reactivity index.

CO2: a) Learn synthesis and reactions of polycyclic aromatic compounds - Linear and Non linear polynuclear hydrocarbons.

b) Understand the concept of aromaticity and anti-aromaticity, the knowledge about 3- and 5- membered carbocyclic compounds, crown ethers complexes, cyclodextrins, catenanes and rotaxanes.

CO3: Understand the types of free radicals, their detection by ESR, free radical substitution reaction mechanism, and reactivity at an aromatic substrate, reactivity at a bridgehead and reactivity in attacking reagent. They also learn the effect of solvent on reactivity, Sandmeyer's reaction, Hunsdiecker reaction.

CO4: a) Learn about the Kinetic and thermodynamic control of reaction, they will get the knowledge about Nitration and sulphonation of naphthalene, about Wittig reaction, Enolization, F. C. reaction and Diel's Alder reaction.

b) Understand Non-classical carbonation - Formation, stability, reactivity and synthetic 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: Benzenoid and Non benzenoid aromatic Compounds **(15)**

a) Polycyclic aromatic compounds: Synthesis, reactions, Linear and non-linear ortho fused polynuclear hydrocarbons.

b) Introduction to Aromaticity and anti-aromaticity, Non- benzenoids compounds, Three and five membered carbocyclic compounds, Crown ether complexes, cyclodextrins, cryptands, catenanes and rotaxanes.

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, Sandmeyers reaction. Free radical rearrangement, Hunsdiecker reaction.

UNIT – IV a) Kinetic and thermodynamic control of reactions **(7)**

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

b) Non-classical carbocations: Formation, stability, reactivity and synthetic applications. **(8)**

RECOMMENDED BOOKS:

1. I. Lehar and Merchand: Orbital Symmetry.
2. R. B. Woodward and Hoffman: Conservation of orbital symmetry.
3. Kan: Organic Photochemistry
4. Coxon and Halton: Organic photochemistry
5. Arnold: Photochemistry
6. N. Turro: Modern molecular photochemistry.
7. Rohatgi- Mukherji: Fundamentals of photochemistry.
8. Ginsburg: Nonbenzenoid aromatic compound.
9. A. Streitwieser: Molecular orbital theory for organic chemistry.
10. E. Cler: The aromatic sextet.
11. Lloyd: Carbocyclic non- benzenoid aromatic compounds.
12. W. B. Smith: Molecular orbital methods in organic chemistry
13. Jagdamba sing and L. D. S. Yadav Organic synthesis

(CC – 1150 D): Stereochemistry
Theory: 60hrs

Course Outcomes: After the completion of the course, the student will be able to:

CO1: Adopt the knowledge of about stereoselective, stereospecific synthesis as well as chemoselective and regioselective reactions -enantioselective synthesis, reactions with hydride donar, catalytic hydrogenation via chiral hydrazones and oxazolines etc.

CO2: Understand the stereochemistry of acyclic and alicyclic compounds. A) Understand in depth Stability and Reactivity of diastereoisomers – Curtin-Hammett principle B) Some aspects of stereochemistry of ring compounds C) The shapes of the rings other than six membered rings (5, 6 and 7 membered rings). Also they will learn the conformational effects in medium sized rings and the concept of I-strain.

CO3: a) Knowledge about conformation and configuration fused bicyclic rings and bridged rings – Types, Nomenclature, stereochemical restrictions, and Bredt's rule.
b) Understand O. R. D. and C. D. - Types of curves, circular dichroism, the Octane rule and axial haloketone rule.

CO4: Explain the stereochemistry of Allenes, Spiranes, and Biphenyls and how to assign the configuration and by using physical and chemical methods.

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

Introduction, Stereoselective, Stereospecific, Chemoselective and regioselective reactions; Enantioselective synthesis (chiral approach) reactions with hydride donors, hydroboration, catalytic hydrogenation via chiral hydrazones and oxazolines, Sharpless epoxidation, Diels Alder selective synthesis.

UNIT - II: Stereochemistry of acyclic and alicyclic compounds

A) Conformation and reactivity in acyclic compounds and of 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)**

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

a) Fused and bridged rings: Fused bicyclic ring systems: (8)

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.

b) 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).

a) Stereochemistry of Allenes, Spiranes and Biphenyls (8)
Assignment of configuration

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

(7)

RECOMMENDED BOOKS:

1. E.L. Eliel: Stereochemistry of carbon compounds.
2. D. Nasipuri: Stereochemistry of organic compounds
3. P.S. Kalsi: Stereochemistry, Conformation and Mechanism.
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.
9. P. Crabbe: Optical Rotatory Dispersion and C.D.

(CC – 1151 D): Chemistry of Natural Products
Theory: 60hrs

Course Outcomes: After the completion of the course, the student will be able to:

CO1: a) Learn the classification and isolation methods of Natural Products.

b) Reveal the classification and isolation methods of terpenoids – structure and synthesis of – Camphor, Carvone, Abietic acid, zingiberene, alpha-santonin and beta-caryophyllene.

CO2: Know all about Alkaloids - the occurrence, isolation, structures, functions, stereochemistry and synthesis of the major Alkaloids like – Morphine, Reserpine, Atropine and Conin.

CO3: a) Learn the occurrence, nomenclature, basic skeleton of steroids and study the synthesis of hormones like cholesterol, Androsterone, Testosterone, Estrone etc.

b) Study the nomenclature, classification, biogenesis, physiological effects and synthesis of prostaglandin PGE2 and PGF2.

CO4: Study about the Vitamins - Classification, Nomenclature, Source, effects due to deficiency, synthesis and biological functions of vitamin B1, B2, B5, B6 and Biotin i.e. vitamin H.

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

Classification and isolation methods.

b) Terpenoids **(12)**

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

UNIT - II: Alkaloids **(15)**

Introduction, occurrence, isolation and functions of alkaloids, Structure, stereochemistry and synthesis of the following: Morphine, Reserpine, Atropine and Conin.

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 PGF2

UNIT - IV:

Vitamins **(15)**

Introduction of Vitamins, Classification and nomenclature of Vitamins, Sources of vitamins and their deficiency, Synthesis, structure and biological functions of vitamin B1, B2, B5, B6 and Biotin (Vitamin H).

RECOMMENDED BOOKS:

1. O. P. Agarwal: Chemistry of organic natural products vol. I & II
2. Gurdeep Chatwal: Organic chemistry of Natural products vol. I & II
3. Jain, Sahai, Pimplapure, Soni: Chemistry of Natural products
4. P. D B. Mayo: The chemistry of natural products.
5. Simonson: Terpenes.
6. T.W. Goddwin: Aspects of terpenoid chemistry and biochemistry.
7. Woguer: Vitamins and Co- enzymes.

Elective Paper (CC – 1152 D): Applied Organic Chemistry
Theory: 60hrs

Course Outcomes: After the completion of the course, the student will be able to:

CO1: Learn about the synthesis and uses of different types of Agrochemicals – Carbamates (carbaryl, Aldicarb, Ziram and Zineb), Organophosphorous insecticides (malathion, monocrotophos, mevinphos etc.), Natural and Synthetic Pyrethroids - structures classification and their synthesis. They will learn synthesis of some plant growth regulators as well as synthesis and applications of Juvenile hormones and Pheromones (bombykol, grandisol and disparlure).

CO2: Learn about the perfumery compounds – commercial process, preparation and importance of essential oils, synthesis of 2 - phenyl ethanol, yara-yara, vanillin, synthetic musk, jasmine, ionone etc. from citral, phenyl acetate ester, benzyl acetate ester.

CO3: Understand classification, synthesis of azo dyes, reactive dyes, optical brightners, dispersed dyes etc. by nitration, sulphonation and diazotization reactions.

CO4: Understand about Polymers: the mechanism of polymerization with some examples – polyesters, polyamide, PVC, etc. Also they will study about manufacturing processes of synthetic rubber like butadiene - styrene, formaldehyde resin, about plasticizers, anti-oxidents required for natural polymers like starch and cellulose. They will get the knowledge about Oxo and Wacker process necessary for Soap and Synthetic detergents.

UNIT - I: Agrochemical **(15)**

a. Carbamate pesticides: Introduction and synthesis of carbaryl, carbofuran, Baygon, Aldicarb, Ziram, Zineb.

b. Organophosphorus pesticides: Malathion, monocrotophos, dimethoate, phorate, mevinphos, chloropyriphos.

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 harmone: introduction & structures JHA importance synthesis

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

UNIT - II: Synthesis and applications of perfumery **(15)**

Introduction to perfumery compounds and its commercial process, essential oil, method of preparation and importants, synthesis of 2-Phenylethanol, Yara-yara, vanillin and other food flavours, synthetic musk, Jasmone, ionones, β-ionones from citral, phenyl acetic acid and its ester, benzyl acetate.

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: 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 formaldehyde resin. Plasticizers and anti - oxidants for polymers, natural polymers: starch and cellulose.

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

RECOMMENDED BOOKS:

1. Allan: Colour Chemistry
2. K. Venkataraman: Chemistry of Synthetic Dyes Vol - 1 to 7
3. Abrahart: Dyes & their intermediates
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 Polymer Chemistry
9. J. M. G. Cowie, Blackie: Physics & Chemistry of Polymers
10. P. H. Groggins: Unit Processes in Organic Synthesis
11. B. Biollot& P. V. Wells: Perfumary Technology
12. M. Ash & I. Ash: A formulary of Cosmetic Preparations

Elective Paper (CC – 1153 D): BioOrganic Chemistry
Theory: 60hrs

UNIT - I: a) Cell Structure and Functions **(10)**

Structure of prokaryotic and eukaryotic cells, Intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic process- catabolism and anabolism. ATP – the biological energy currency. Origin of life- uniqueproperties of carbon, chemical evolution and rise of living system. Introduction to biomolecules, building blocks of biomacromolecules.

b) Enzymes **(5)**

Structure activity and reactions, catalyzed determination of active site, inhibition mechanism chemical transformations using enzymes.

UNIT - II: Carbohydrates **(15)**

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. Naceylmuramic acid, sialic acid disaccharides and polysaccharides. Structural polysccharides- cellulose and chitin. Storage polysaccharides- starch and glycogen. Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoprotines and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism- Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, pentose phosphate pathway.

UNIT - III: Lipids **(15)**

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

UNIT - IV: a) Amino acids, Peptides and Proteins **(10)**

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of protein, forces responsible for holding of secondary structures. α-helix, β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure

of protein- folding and domain structure. Quaternary structure. Amino acid metabolism degradation and biosynthesis of amino acids, sequence determination: chemical/ enzymatic/ mass spectral, racemization / detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH).

b) Nucleic Acids **(5)**

Purine and pyrimidine of nucleic acids, base pairing via H – bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and poly nucleosides.

RECOMMENDED BOOKS:

1. Principles of Biochemistry, A. L. Lehinger, Worth Publications.
2. Biochemistry, L. Stryer, W. H. Freeman 3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry, E. E. Conn and P. K. Stumpt, John Wiley.

M. Sc. Part - II (Sem-IV) Organic Chemistry
Practical Course (CC – 1154B) and (CC – 1155B)

A. Estimation of Sulphur and Nitrogen.

B. Organic preparations: Three stage preparations starting with 5g or less and TLC

1. Preparation of o-Chloro benzoic acid.
2. Preparatin of p- Amino benzoic acid.
3. Preparation of p- Chloro nitrobenzene by Sandmeyer reaction.
4. Preparation of p- Iodonitrobenzene by Sandmeyer reaction.
5. Preparation of p-Iodoazobenzene.
6. Multi-component synthesis

C. Project: Literature survey. Studies of reactions, synthesis, mechanism, isolation of 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.

D. Any other suitable experiments may be added.

E. Study tour is compulsory for M.Sc. Part- II Students to visit Chemical Industries in India.

REFERENCE BOOKS:

1. A 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.

for Co-ordinator,
M. Sc. Organic Chemistry,
Vivekanand College, Kolhapur

VIVEKANAND COLLEGE ★ ESTD. JUNE 1964 ★ KOLHAPUR-416 003

for Head
Dept. of Chemistry
Vivekanand College Kolhapur