VIVEKANAND COLLEGE, KOLHAPUR

(EMPOWERED AUTONOMOUS)

DEPARTMENT OF CHEMISTRY

Two Years PG Programme

As Per NEP 2020

Department/Subject Specific Core or Major (DSC)

Curriculum, Teaching and Evaluation Structure

for

M.Sc. II

Organic Chemistry

Implemented from the academic year 2024-25 onwards

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

DEPARTMENT OF CHEMISTRY

Syllabus for the Master of Science in Chemistry

M. Sc. II (Sem. III & IV)

(National Education Policy 2020)

Applicable From Academic Year: 2024 – 2025

1. Title: M. Sc. Chemistry, Vivekanand College, Kolhapur (Empowered Autonomous)

2. Faculty: Faculty of Science and Technology.

3. Year of Implementation: For M. Sc. II (Semester III and Semester IV) From July 2024.

4. Programme Outcomes (POs): After completing the M. Sc. Programme, the students will able to:

PO 1:	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the concerned discipline and execute theoretical and practical understanding
PO 2:	**Research-related skills and Scientific temper:** Infer scientific literature and formulate hypothesis for research problems; plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct, and creating awareness about intellectual property rights and issues of plagiarism.
PO 3:	**Entrepreneurship Development:** Apply acquired knowledge to build entrepreneurship

PO 4:	**Environment and Sustainability:** Understand the impact of scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO 5:	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

5. Programme Specific Outcomes (POs): After completing the M. Sc. Programme in Chemistry, the students will able to:

PSO1:	Demonstrate, solve, and understand major concepts in all disciplines of chemistry.
PSO2:	Think methodically, and independently, and draw a logical conclusion of chemistry.
PSO3:	Employ critical thinking and scientific knowledge to design, carry out, record, and analyze the results of chemical reactions.
PSO4:	Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
PSO5:	To inculcate the scientific temperament in the students and outside the scientific community.
PSO6:	Use modern techniques, decent equipment, and various chemistry software.

VIVEKANAND COLLEGE, KOLHAPUR (EMPOWERED AUTONOMOUS)

Department of Chemistry

Departmental Teaching and Evaluation Scheme

Two - Years PG Programme

Department/Subject Specific Core or Major (DSC)(as per NEP-2020 Guidelines)

Organic Chemistry

First Year Semester-I &II

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-I										
1	DSC-I	DSC14CHE11	Inorganic & Organic Chemistry	4	-	80	20	-	100	4
2	DSC-II	DSC14CHE12	Physical & Analytical Chemistry	4	-	80	20	-	100	4
3	DSE-I	DSE14CHE11	Inorganic Chemistry	4	-	80	20	-	100	4
	DSE-II	DSE14CHE12	Organic Chemistry							
	DSE-III	DSE14CHE13	Physical Chemistry							
	DSE-IV	DSE14CHE14	Analytical Chemistry							
4	RMD-I	RMD14CHE11	Research Methodology	4	-	80	20	-	100	4
5	DSC-PR-I	DSC14CHE19	Chemistry Lab-I	-	12		-	150	150	6
Total				**16**	**12**	**320**	**80**	**150**	**550**	**22**
Semester-II										
1	DSC-III	DSC14CHE21	Inorganic & Organic Chemistry	4	-	80	20	-	100	4
2	DSC-IV	DSC14CHE22	Physical & Analytical Chemistry	4	-	80	20	-	100	4
3	DSE-V	DSE14CHE21	Inorganic Chemistry	4	-	80	20	-	100	4
	DSE-VI	DSE14CHE22	Organic Chemistry							
	DSE-VII	DSE14CHE23	Physical Chemistry							
	DSE-VIII	DSE14CHE24	Analytical Chemistry							
7	OJT-I	OJT16CHE21	On Job Training (OJT)	-	4	-	-	-	100	4
8	DSC-PR-II	DSC14CHE29	Chemistry Lab-II	-	12	-	-	100	100	4
Total				**12**	**16**	**240**	**60**	**100**	**550**	**22**
Total (Sem. I & II)				**28**	**28**	**560**	**140**	**250**	**1100**	**44**

Second Year Semester-III &IV

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-III										
1	DSC-V	DSC14CHE31	Advanced Spectroscopic Methods	4	-	80	20	-	100	4
2	DSC-VI	DSC14CHE32	Advanced Synthetic Methods	4	-	80	20	-	100	4
3	DSE-IX	DSE14CHE31	Drugs and Heterocycles	4	-	80	20	-	100	4
	DSE-X	DSE14CHE32	Polymer Chemistry							
4	DSC-PR-III	DSC14CHE39	Chemistry Lab-III	-	12		-	150	150	6
5	RPR-I	RPR14CHE31	Research Project	-	4	-	-	-	100	4
				12	16	240	60	150	550	22
Semester-IV										
1	DSC-III	DSC14CHE41	Theoretical Organic Chemistry	4	-	80	20	-	100	4
2	DSC-IV	DSC14CHE42	Stereochemistry	4	-	80	20	-	100	4
3	DSE-V	DSE14CHE41	Chemistry of Natural Products	4	-	80	20	-	100	4
	DSE-VI	DSE14CHE42	Applied Organic Chemistry							
7	DSC-PR-III	DSC14CHE49	Chemistry Lab-IV	-	4	-	-	100	100	4
5	RPR-II	RPR14CHE41	Research Project	-	6	-	-	-	150	6
				12	06	240	80	100	550	22
	Total (Sem. I & II)			**24**	**22**	**580**	**140**	**250**	**1100**	**44**

M. Sc. Part – II (Semester –III)

MANDATORY PAPER No. DSC14CHE31
ADVANCED SPECTROSCOPIC METHODS (4 Credits)

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. Understand how molecules vibrate when they absorb IR radiation and how electronic excitations occur when absorbing UV radiation. This knowledge will help students identify the structures of unknown organic compounds and determine functional groups such as alcohols, aldehydes, ketones, esters, and aromatic compounds. Additionally, students will learn about overtones, combination bands, and the Fermi resonance FT-IR spectroscopic method.

CO2: Understand the recapitulation of proton NMR spectroscopy and factors affecting coupling constants. Also learned how to analyze the first-order spectra, simplification of complex spectra, and complex spin-spin splitting of second-order spectra. They will learn the effect of deuteration and spectra of Homotopic, Enantiotropic and Diastereotopic systems. Also adopt the knowledge of the 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 in solving the problems on C^{13} NMR.

Unit No.	Syllabus	Lectures
UNIT I	**Study of UV and IR Spectroscopy** **(A) Ultraviolet Spectroscopy (6)** Woodward-Fisher rules for conjugated dienes and carbonyl compounds and calculation of λmax, Ultraviolet spectra of aromatic and heterocyclic compounds, Steric effect in biphenyls. **(B) IR Spectroscopy (9)** Characteristic vibrational frequencies of; (i) alkanes, (ii) alkenes (iii) alkynes (iv) aromatic compounds (v) alcohols (vi) ethers (vii) phenols (viii) amines, (ix) carbonyl compounds: aldehydes, ketones, 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; (i) gaseous (ii) solids and (iii) polymeric materials.	**(15)**
UNIT II	**Proton NMR Spectroscopy** **(A) Recapitulation:** Recapitulation of proton NMR spectroscopy, (ii) Factors affecting coupling constants: Karplus curve variation, dihedral angle, bond order, electronegativity, (iii) analysis of first order spectra, (iv) complex spin-spin splitting of second order spectra, (v) different spin systems: AB, AM, AX, ABX/AMX spin systems with examples, (vi) simplification of complex spectra: high field strength, chiral resolving agent, effect of deuteration, nuclear magnetic double resonance, shift reagent, solvent effect, (vii) Spectra of homotopic, enantiotopic and diastereotopic systems. **(B) Advanced NMR techniques**: (i) Fourier transform technique, (ii) nuclear overhauser effect (NOE), (iii) COSY, (iv) NOESY, (v) resonance of ^{19}F, and ^{31}P nuclei.	**(15)**
UNIT III	**Mass Spectrometry** **(A) Instrumentation**: (i) Introduction, (ii) ion techniques: EI, CI, FD, FAB, MALDI, TOF (iii) factors affecting on fragmentation, (iv) ion analysis, (v)	**(15)**

	ion abundance, (vi) types of ions, (vii) types of peaks (viii) High resolution mass spectrometry (HRMS). **(B) Mass spectral fragmentation**; (i) hydrocarbons (alkanes. alkenes, alkynes and aromatic compounds), (ii) carbonyl compounds; aldehydes, ketones, carboxylic acids, acid chlorides, amides (iii) alkyl halides (iv) ethers, (v) alcohols, (vi) amines, (viii) nitro compounds, (viii) cyano compounds.	
UNIT IV	**(A) Carbon-13 NMR Spectroscopy** (i) General introduction to 13C NMR spectroscopy, (ii) chemical shift values of (a) aliphatic, (b) olefinic, (c) alkyne, (d) aromatic, (e) heteroaromatic and (f) carbonyl compounds, (iii) proton coupled and proton decoupled 13C NMR spectra, (iv) advanced 13C NMR techniques: NOE, DEPT, Off resonance, HETCOR, (v) heteronuclear coupling, (vi) problems associated with 13C NMR. **(B) Structural problems**: Structural problems based on combined spectroscopic techniques (including reaction sequences)	**(15)**
	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. 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. **1.** Organic Spectroscopy W. Kemp, ELBS	

MANDATORY PAPER No. DSC14CHE32

ADVANCED SYNTHETIC METHODS (4 Credits)

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

CO1: Understand the disconnection approach using synthons, retrosynthesis of difunctional compounds, and the importance of reaction order, chemoselectivity regioselectivity, and stereoselectivity. Retro Diels-Alder reaction, Michael addition, Robinson annulation, and Umpolung concept.

CO2: Study the applications of different reagents like LDA, DCC, TBTH, lead tetra-acetate, as well as applications of hypervalent iodine acid.

CO3: Learn how the different metals like Pd, Ru, Rh, Tl, Si, and Cu as well as phosphines, NHCs, and oxazoline ligands in synthetic chemistry.

CO4: Learn the mechanism, stereochemistry, migratory aptitude, and applications of various name reactions such as Dienone–phenol, Favorskii, Smile's, Brook, Sommelet–Hauser rearrangement, etc.

UNIT I	**Disconnection approach** (i) Introduction to Synthons and synthetic equivalents, disconnection approach, functional group interconversions. (ii) One and two group disconnections in 1,2; 1,3; 1,4 & 1,5-difunctional compounds. (iii) Retro-synthesis of (a) alkene, (b) alkynes, (c) alcohols, (d) amines, (e) carbonyl, (f) and (g) 5,6 membered heterocyclic compounds. (iv) Importance of the Order of events in organic synthesis, (v) Chemoselectivity, Regioselectivity, Stereoselectivity, and Protecting groups, (vi) retro Diels-Alder reaction, (vii) use of Michael addition, and Robinson annulations, (viii) Reversal of polarity (Umpolung).	**(15)**
UNIT II	**Application of the following reagents** **(A) Reagents: (10)** (i) Lithium diisopropylamide (LDA), (ii) Tri-n-butyl tin hydride (TBTH), (iii) m-CPBA, (iv) Lead tetra acetate, (v) Diazomethane, (vi) Phase Transfer	**(15)**

	Catalyst (PTC; including quaternary ammonium salts and crown ethers), (vii) Dess-Martin periodinane, (viii) Periodic acid, (ix) Corey Kim oxidation (x) SeO_2 (xi) DCC. **(B) Enolates in organic synthesis:** Formation and applications **(5)**	
UNIT III	**Study of the following reactions** Mechanism, Stereochemistry, migratory aptitude, and applications of; (i) Dienone–phenol, (ii) Favorskii, (iii) Wolff, (iv) Smile's, (v) Brook, (vi) (vii) Neber, (viii) Stevens, (ix) Sommelet–Hauser rearrangement, (x) Eschenmoser fragmentation, (xi) von Richter reaction, (xii) Woodward-Prevost hydroxylation, (xiii) Barton reaction, (xiv) Shapiro reaction, (xv) Hoffmann-Loffler-Fretag and (xvi) Epoxide rearrangement with Lewis acid	**(15)**
UNIT IV	**Applications of the following metals and ligands in organic synthesis** **A) Applications of the following metals in organic synthesis (10)** (i) Pd, (ii) Rh, (iii) Ir, (iv) Tl, (v) Si, (vi) Grub's catalysts **B) Applications of ligands in organic synthesis (5)** (i) Phosphines, (ii) N-heterocyclic carbenes, (iii) Oxazoline ligand.	**(15)**
	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	

ELECTIVE PAPER No. DSE14CHE31
DRUGS AND HETEROCYCLEs (4 Credits)

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

CO1: Develop the new drugs, and procedures followed in drug design, History, and QSAR. Also, learn the concept of drug receptors and the relationship between structure and chemical reactivity. In addition, they will learn about antibiotics like β-lactam, cephalosporin, and SAR of both and understand the structural features of tetracycline & macrocyclic antibiotics.

CO2: Study the different types of drugs like antimalarials, anti-inflammatories, anesthetics, antitubercular, tranquilizers, etc. Also, they can study cardiovascular and antineoplastic drugs.

CO3: Understand the synthesis and reactions of five-membered heterocycles like furan, pyrrole, thiophene, benzofuran, and benzothiophene. In addition, they will learn about the synthesis and reactions of six-membered heterocycles like pyridine, quinoline, and coumarine.

CO4: Learn the synthesis and reactions of six-membered heterocycles diazines and triazines as of azepines, oxepines, and thiepines as well as seven-membered heterocycles.

UNIT I	**DRUGS DESIGN AND ANTIBIOTICS** **(A) Drug Design** **(10)** (i) Development of new drugs, and procedures followed in drug design. (ii) History and development of Quantitative Structure-Activity Relationship (QSAR). (iii) Concepts of drug receptors, (iv) Relation of chemical structure and chemical activity. **(B) Study of Antibiotics** **(05)** (i) Introduction: General information of recent antibiotics and their types (ii) Structure-Activity Relationship (SAR) study (iii) Synthesis of some β-lactum, and cephalosporin ring containing antibiotics.	**(15)**

UNIT II	**Study of the following types of drugs** **a) Antimalarials:** Trimethoprim. **b) Analgesic and Antipyretics:** Paracetamol, Meperidine, methadone, Aminopyrine. **c) Anti-inflammatory:** Diclophenac, Indomethacin. **d) Antitubercular and 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 **Anti-neoplastic drugs:** Introduction, Cancer chemotherapy, Synthesis of mechloraethamine, cyclophosphamide, Mephalan, uracils, mustards. Recent development in cancer chemotherapy. Hormones and natural products.	**(15)**
UNIT III	**Study of five and six-membered heterocycles containing one heteroatom** **(A) Five-membered heterocycles (10)** Synthesis and reactions of (i) Pyrrol, (ii) Furan, (iii) Thiophene, (iv) Benzopyrroles (v) Benzofurans, and (vi) Benzothiophenes. **(B) Six-membered heterocycles with one heteroatom (05)** Synthesis and reactions of (i) Pyridine, (ii) Quinoline, and (iii) Coumarin.	**(15)**
UNIT IV	**Study of six and seven-membered heterocycles containing two or more heteroatoms** **(A) Six-membered heterocycles (8)** Synthesis and reactions of (i) Diazines: 1,2-diazine, 1,3-diazine, and 1,4-diazine (ii) Triazines: 1,2,3-triazine, 1,2,4-triazine and 1,3,5-triazine **(B) Seven-membered heterocycles (7)** Synthesis and reactions of (i) Azepines, (ii) Oxepines and (iii) Thiepines.	**(15)**

RECOMMENDED BOOKS:

10. V.M. Parikh, Application spectroscopy of organic molecules. (Mehata)
11. D.W. Williams and Flemming, Spectroscopic methods of organic compound.
12. Silverstein and Basslar, Spectroscopic identification of organic compounds V.M. Parikh Absorption spectroscopy of organic molecules.
13. P.S. Kalsi Spectroscopy of organic compounds (New age publisher)
14. J.R. Dyer. Application of absorption spectroscopy of organic compounds.
15. Jackman and Sterneil , Application of NMR spectroscopy
16. Nuclear magnetic resonance. J.D. Roberts (J. Wiley)
17. Theory and application of U.V. Jafee and Orchin.
18. Mass spectroscopy K. Benjamin.

Organic Spectroscopy W. Kemp, ELBS

ELECTIVE PAPER No. DSE14CHE32

POLYEMR CHEMISTRY (4 Credits)

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

CO1: Demonstrate a comprehensive understanding of fundamental polymer concepts such as monomers, functionality, repeat units, and degree of polymerization. Correctly define and use terms related to the general structure and naming of polymers.

CO2: Calculate and interpret the degree of crystallinity in polymers. understand the concept of crystallites and factors affecting crystallinity in polymers. identify and describe the properties and applications of key individual monomers. Understand the synthesis processes and properties of various polymers derived from individual monomers.

CO3: Understand and explain the different types of polymer degradation including thermal, mechanical, photo, oxidative, and hydrolytic degradation. Identify the factors that contribute to each type of degradation.

CO4: Understand and explain geometric and optical isomerism in polymers. Analyze the results and understand the significance of molecular weight in polymer properties.

UNIT I	Terminology and basic concepts of Polymers: Monomers, Functionality, repeat units, degree of polymerization. General structure and naming of polymers. Average molecular weight and average chain dimension concept. Expressions for average molecular weight. Molecular weight distribution and Polydispersity. Classification based on various considerations-source, preparation methods, thermal behavior, chain structure, etc. Types –Homopolymers and copolymers; linear, branched, and network polymers. Techniques of polymerization: Techniques of preparation of addition and condensation polymers. Kinetics of Polymerization: Kinetics and mechanism of addition and condensation polymerization. Kinetics of copolymerization-reactivity ratio and copolymer equation. Free radical chain polymerization- Cationic polymerization – Anionic polymerization – Poly condensation. Glass transition temperature: Glassy solids and Glass transition – associated properties – Factors influencing glass transition temperature – molecular weight – Plasticisers – melting point – importance of glass transition temperature.	**(15)**
UNIT II	Crystalline Nature: Crystalline soils and their behaviour towards X-rays – Polymers and X- ray diffraction – Degree of crystallinity – crystallites – factors affecting crystallinity, Helix structures. Copolyemerization: Free radical copolymerization – Ionic copolymerization – Copolycondensation – Individual monomers: Polyethylene, polypropylene, polystyrene, poly acrylonitrile, polymethyl methacrylate, polyesters, polycarbonates, polyamides, polyurethanes, polyvinyl acetate, polyvinyl chloride, poly isoprene's, silicone polymers.	**(15)**
UNIT III	Polymer degradation: Types of degradation, thermal and mechanical – photo degradation – oxidative and hydrolytic degradation. Polymer reactions – Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions – cyclization, cross-linking reactions – Graft and Block copolymers. Experimental methods: Polymer synthesis,	**(15)**

	isolation and purification of polymers –Fractional - Molecular weight determination – Molecular weight distribution curve – determination of glass transition temperature. Elastomeric materials.	
UNIT IV	Stereochemistry of polymers: Geometric and optical isomerism in polymers. Structure, properties and preparation of stereoregular polymers. Determination of molecular weight: Osmometry and viscometry. Thermal Characterization: Glass Transition and melting-correlation with structure- Factors affecting Tg and Tm. Techniques of thermal characterization: DSC, DTA, DTG and TGA techniques. Structural features, properties and uses of commercial polymers: Polyethylene, polystyrene, PVC, polyesters, polyamides, polyurethanes and polycarbonates. Conducting polymers, liquid crystal polymers and biomedical polymers.	**(15)**
	RECOMMENDED BOOKS: 1 Contemporary Polymer Chemistry-H.R. Allcock and F.W. Lampe (Prentice Hall). 2 Polymer Science and Technology-J.R. Frird (Prentice Hall). 3 Polymer Science: V.R. Gowariker, N.V.Viswanathan & T.Sreedhar 4 Principles of Polymer Science- P.Bahadur and N.V.Sastry (Narosa Publishers) 5 'Organic Polymer Chemistry', K.J.Saunders, Chapman and Hall, 1976. 6 'Polymer Chemistry – An Introduction', Raymond B.Seymour, Marcel Dekker Inc., New York and Based, 1981. 7 'Fundamentals of Polymer Science and Engineering', Kumar Gupta, Tata Mc Graw Hill, 1981. 8 Polymer Chemistry, B.K.Sharma, Krishna Prakashan Mandir, Meerut.	

Chemistry Lab-III DSC14CHE39

Organic Chemistry Practical (6 Credits) (150 Marks)

(A). Qualitative Analysis (70 Marks): Separation, purification, identification, and derivatives of compounds of ternary mixtures using **semi-microanalysis**

(B). Quantitative analysis: Two-step Preparations (40 Marks)

1. Preparation of m-Nitroaniline from nitrobenzene
2. Preparation of Benzanilide from benzophenone
3. Preparation of p-Bromoaniline from acetanilide
4. Preparation of Anthranilic acid Phthalic anhydride

(C). Combined Spectral problems (20 Marks)

(D). Jornal and Oral (20 Marks)

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 4. Organic Synthesis Collective Volumes by Blat

RPR: DSC14CHE31

Research Project (4 Credits) (100 Marks)

Research Project Paper Guidelines

1. The students should write a synopsis of the proposed research work.
2. The students should perform a detailed literature survey related to the research problem.
3. The students should write a review article related to the research problem.
4. It is expected to publish the review article in peer-reviewed journals.
5. The students should design the problem and start experimental work. The students should complete at least 25% of their experimental work during semester III and the same work to be continued in semester IV.
6. The student should submit the spiral-bound copy of research work carried out during

semester III including the synopsis, research proposal, review article, and certified progress report.

7. The Research Project will be examined jointly by internal and external examiners during the practical examination at the end of the semester.
8. The students should present their work during the evaluation in the form of PowerPoint presentation (PPT).

Marking Scheme:

Sr. No.	Description	Marks
1	Synopsis	10
2	Research Proposal	20
3	Review article on proposed work	20
4	Daily Lab notebook record	10
5	Progress of Experimental work	20
6	Quality and effectiveness of presentation	20
	Total	**100**

Broad guidelines for the preparation of synopsis

A. The proposed synopsis for research should be self-contained and should cover the rationale for carrying out research.

B. There should not be a repetition of the work topic or theme.

C. The synopsis of the proposed research shall contain the following points :

1 Title of the Research Proposal

2 Motivation with reasoning and significance of the proposed research

3 Statement of the problem

4 Review of the relevant literature

5. Objectives of the study
6. The methodology comprising
   - **a)** Methods of research
   - **b)** Sampling design and assumptions
   - **c)** Conceptual framework if any
   - **d)** Research design (explanation of how research is being conducted and the tools

used for the same)

e) Methods of data collection

f) Methods of data analysis (use of parametric and non-parametric tools and techniques as the case may be)

7. Expected outcome

8. Bibliography.

Template for Research Proposal

1. Title

2. Introduction

3. Origin of the research problem

4. Interdisciplinary relevance

5. Review of Research and Development in the Subject

6. Significance of the study

7. Objectives

8. Plan of research work

M. Sc. Part – II (Semester – IV)

MANDATORY PAPER No. DSC14CHE41

THEORETICAL ORGANIC CHEMISTRY

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: 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.

CO3: 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. Understand non-classical carbonation - Formation, stability, reactivity and synthetic applications.

CO4: Understand the concept of Pericyclic reactions, Woodword Hoffman correlation diagrams – FMO, PMO approach, conrotatory 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.

UNIT I	**Molecular Orbital Theory** (i) Aromaticity in benzenoids, (ii) alternant and non-alternant hydrocarbon, (iii) Huckels rule, (iv) energy level of pi- molecular orbital and concept of aromaticity, (v) calculation of energies of orbitals cyclic and acyclic systems, (vi) determination energies and stabilities of different systems calculation of charge densities (vi) PMO theory and (vii) reactivity index.	**(15)**

UNIT II	**Methods of Determining Reaction Mechanism** **(A) 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 **(B) 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.	**(15)**
UNIT III	**(A) Kinetic and Thermodynamic Control of Reactions** Nitration and Sulphonation of naphthalene, Wittig, Enolization, Friedel-Crafts and Diels Alder reactions. **(B) Non-classical carbocations**: Formation, stability, reactivity and synthetic applications**.**	**(15)**
UNIT IV	**Pericyclic Reactions** (i) Molecular orbital symmetry, (ii) Frontier orbital of; (a) ethylene, (b) 1,3-butadiene, (c) 1,3,5-hexatriene and (d) allyl system, (iii) Classification of pericyclic reaction: Wood-ward Hoffman correlation diagrams; FMO and PMO approach, (iv) Electrocyclic reactions; conrotatory and disrotatary motions, 4n , 4n+2 and allyl systems, (v) Cycloaddition; supra and antara facial additions, 4n and 4n+2 systems, 2+2 additions of ketenes, 1,3-dipolar cycloaddition and chelotropic reactions, (vi) 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.	**(15)**
	1. **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. Lloyd: Carbocyclic non- benzenoid aromatic compounds.
11. W. B. Smith: Molecular orbital methods in organic chemistry.
12. Jagdamba sing and L. D. S. Yadav Organic synthesis

MANDATORY PAPER No. DSC14CHE42

STEREOCHEMISTRY (4 Credits)

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. Understand in depth stability and reactivity of diastereoisomers – Curtin-Hammett principle. Some aspects of stereochemistry of ring compounds. The shapes of the rings other than six membered rings. Also, they will learn the conformational effects in medium sized rings and the concept of I-strain.

CO3: Knowledge about conformation and configuration fused bicyclic rings and bridged rings – Types, Nomenclature, stereochemical restrictions, and Bredt's rule. 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** (i) Introduction, (ii) Stereoselective and Stereospecific, reactions, (iii) Enantioselective synthesis (chiral approach); using (a) chiral pool strategy (b) chiral auxiliaries (c) chiral reagents; with hydride donors, hydroboration, catalytic hydrogenation via chiral hydrazones and oxazolines, (d) chiral catalysts; Sharpless epoxidation, asymmetric Wilkinson catalysts, (iv) Diels Alder selective synthesis.	**(15)**
UNIT II	**Stereochemistry of Acyclic and Alicyclic Compounds** **(A)** Conformational analysis (stability and reactivity) of acyclic compounds and cyclohexane derivatives including diastereoisomers. Curtin- Hammett principle. Stability of rings and ease of rings formation. **(B) The shapes of the rings other than six membered:** Shapes of five, six, and seven membered rings. Conformational effects In medium sized rings, Concept of I -strain.	**(15)**
UNIT III	**Stereochemistry of the Fused, Bridged rings** **(A) Fused and bridged rings: Fused bicyclic ring systems:** Types of fused ring systems, Cis and trans-Decalins, Perhydro anthracene, Perhydro phenanthrene. **(b) 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**, d**etermination of the conformation and configuration, The Octant rule and axial haloketone rule.	**(15)**
UNIT IV	**Stereochemistry of Allenes, Spiranes and Biphenyls and Geometrical isomerism.** **(A)** Stereochemistry of Allenes, Spiranes and Biphenyls, Assignment of configuration **(B)** Configuration of diastereomers (Geometrical isomerism) based on physical and chemical methods**.**	**(15)**

	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.	
ELECTIVE PAPER DSE14CHE41 **CHEMISTRY OF NATURAL PRODUCTS (4 Credits)**		
Course Outcomes: After the completion of the course, the student will be able to: **CO1:** Learn the classification and isolation methods of natural products. Reveal the classification and isolation methods of terpenoids-structure and synthesis of Camphor, Carvone, Abietic acid, zingiberene, alpha-santonin and β-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:** Learn the occurrence, nomenclature, basic skeleton of steroids and study the synthesis of hormones like cholesterol, Androsterone, Testosterone, Estrone etc. 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:** Introduction of natural products, classification and isolation methods. **(B) Terpenoids:** Classification and isolation methods. Structure and	**(15)**

	synthesis of (i) camphor, (ii) carvone, (iii) abietic acid, (iv) zingiberene, (v) α-santonin, (vi) β-cuparenone and (vii) β- caryophyllene.	
UNIT II	**Alkaloids** Introduction, occurrence, isolation and functions of alkaloids, Structure, stereochemistry and synthesis of the following: (i) Morphine, (ii) Reserpine, (iii) Atropine and (iv) Lysergic acid.	**(15)**
UNIT III	**(A) Steroids:** (i) Occurrence, (ii) nomenclature, (iii) basic skeleton, (iv) Diels hydrocarbon, (v) Introductions and synthesis of the following hormones: (a) Cholesterol, (b) Androsterone, (c) Testosterone, (d) Estrone, (e) Progesterone, (f) Aldosterone and (g) Cortisone. **(B) Prostaglandins:** Occurrence, nomenclature, classification, biogenesis and physiological effects, Synthesis of PGE2 and PGF2	**(15)**
UNIT IV	**Vitamins** (i) Introduction of Vitamins, (ii) Classification and nomenclature of Vitamins, (iii) Sources of vitamins and their deficiency, (iv) Synthesis, structure and biological functions of vitamin B1, B2, B5, B6 and Biotin (Vitamin H).	**(15)**
	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 DSE14CHE42 **APPLIED ORGANIC CHEMISTRY (4 Credits)**		
UNIT I	**Agrochemical** **a**. Carbamate pesticides: Introduction and synthesis of carbaryl, carbofuran, Baygon, Aldicarb, Ziram, Zineb.	**(15)**

	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** 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.	**(15)**
UNIT III	**Dyes and Intermediates:** 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.	**(15)**
UNIT IV	**Polymers:** 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.	**(15)**
	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. P. H. Groggins: Unit Processes in Organic Synthesis
10. B. Biollot& P. V. Wells: Perfumary Technology

Chemistry Lab-IV DSC14CHE45

Organic Practicals: (4 Credits)

(A) Estimation: Estimations of (i) Sulphur and (ii) Nitrogen. **(30 Marks)**

(B) Organic preparations: Three stage preparations starting with 5 g or less and practical techniques such as steam distilation, fractional, disilation, vaccum distilation **(60 Marks)**

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.

(C) Journal and Oral (10 Marks)

RECOMMENDED 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.

RPR14CHE41

RESEARCH PROJECT: (6 CREDITS) (150 MARKS)

1. The student should submit the final bound dissertation/thesis copy of research work carried out during semester III and IV.
2. It should include title page, certificate, declaration, acknowledgement, abbreviations, index, abstract, introduction, experimental section, results and discussion, conclusions, references, participation in conferences/seminars and publications if any.
3. The students should present their work during the evaluation in the form of power point presentation (PPT).

- **Marking Scheme:**

Sr. No.	Description	Marks
1	Dissertation/thesis bound copy	30
2	Quality of work (Innovative concepts, social relevance, extent of work etc.)	50
3	Publications	20
4	Participation in conferences	10 maximum
	a) Oral/Poster Presentation (10 marks)	
	b) Only attended (7 marks)	
5	Final Dissertation/thesis defence	40
	Total	**150**

Note:

1. The Project will be examined jointly by internal (Project Supervisor) and external examiners (preferably Associate professor and above with Ph. D.) at the end of the semester. The project can be given individually or a maximum group of three students is allowed. (Not more than three students allowed).
2. There will be a industrial visit for M.Sc. Part- II Students during the academic year.

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Dr. (Mrs). S, D, Shirke
HEAD
DEPARTMENT OF CHEMISTRY
VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)