University of Mumbai

R.E. Society's

R.P. Gogate College of Arts & Science

&

R.V. Jogalekar College of Commerce (Autonomous)

Ratnagiri

Syllabus For

M. Sc. II

Organic Chemistry

Semester III and IV

Under Choice Based Credit System

(CBCS)

As Per framework of NEP 2020

With effect from Academic Year 2024-2025

R.P. Gogate College of Arts and Science &
R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri
Board of Studies in Chemistry
Academic Year 2024-25

Sr. No.	Type of the course	No. of Cr.	Course Code	Nomenclature	Sr. No.	Type of the course	No. of Cr.	Course Code	Nomenclature
Semester I					**Semester II**				
1	Major Mandatory	04	PSCH 101	Inorganic Chemistry-I	1	Major Mandatory	04	PSCH 201	Inorganic Chemistry-II
2	Major Mandatory	04	PSCH 102	Organic Chemistry-I	2	Major Mandatory	04	PSCH 202	Organic Chemistry-II
3	Major Mandatory	04	PSCH 103	Analytical Chemistry-I	3	Major Mandatory	04	PSCH 203	Analytical Chemistry-II
4	Major Mandatory	02	PSCH 104	Chemistry Practical-I (Organic Chemistry and Analytical Chemistry)	4	Major Mandatory	02	PSCH 204	Chemistry Practical- (Organic Chemistry and Analytical Chemistry)
5	Major Electives	02	PSCH 105	Physical Chemistry I	5	Major Electives	02	PSCH 205	Physical Chemistry III
6	Major Electives	02	PSCH 106	Chemistry Practical E-I (Physical and Inorganic Chemistry)	6	Major Electives	02	PSCH 206	Chemistry Practical E-III (Physical and Inorganic Chemistry)
7	Major Electives	02	PSCH 107	Physical Chemistry II	7	Major Electives	02	PSCH 207	Physical Chemistry IV
8	Major Electives	02	PSCH 108	Chemistry Practical E-II (Physical and Inorganic Chemistry)	8	Major Electives	02	PSCH 208	Chemistry Practical E-IV (Physical and Inorganic Chemistry)
Semester III (Organic)					**Semester IV (Organic)**				
1	Major Mandatory-I	4	PSOCH301	Theoretical Organic Chemistry I	1	Major Mandatory-I	4	PSOCH401	Theoretical Organic Chemistry II
2	Major Mandatory-II	4	PSOCH302	Synthetic organic chemistry I	2	Major Mandatory-II	4	PSOCH402	Synthetic organic chemistry II
3	Major Mandatory-III	4	PSOCH303	Natural products & Spectroscopy I	3	Major Mandatory-III	4	PSOCH403	Organic Chemistry Practical IV

4	Major Mandatory-IV	02	PSOCH304	Organic Chemistry practical I					
5	Major Electives-I	02	PSOCH305	Medicinal Chemistry	5	Major Electives-I	4	PSOCH404	Natural products & Heterocyclic Chemistry
6	Major Electives-I	02	PSOCH306	Organic Chemistry practical II	6	Major Electives-II	4	PSOCH405	Bio –Organic Chemistry
7	Major Electives-II	02	PSOCH307	Biogenesis & Green Chemistry	**7**	Major Mandatory	06	PSOCH406	Research Project (RP)
8	Major Electives-II	02	PSOCH308	Organic Chemistry practical III					
9	Major Mandatory	04	PSOCH309	Research Project (RP)					

Master of Science (M.Sc.) Programme

Under Choice Based Credit System (CBCS)

Course Structure

M.Sc .II Organic chemistry

(To be implemented from Academic Year 2024-25)

Course Code	Semester III	Credits	Course Code	Semester IV	Credits
	Major Mandatory			Major Mandatory	
24_PSOCH301	Theoretical Organic Chemistry I	4	24_PSOCH401	Theoretical Organic Chemistry II	4
24_PSOCH302	Synthetic organic chemistry I	4	24_PSOCH402	Synthetic organic chemistry II	4
24_PSOCH303	Natural products & Spectroscopy I	4	24_PSOCH403	Organic Chemistry Practical IV	4
24_PSOCH304	Organic Chemistry practical I	2			
	Major Electives (Any one)			Major Electives (Any one)	
24_PSOCH305	Medicinal Chemistry	2	24_PSOCH404	Natural products & Heterocyclic Chemistry	4
24_PSOCH306	Organic Chemistry practical II	2			
	OR			OR	
24_PSOCH307	Biogenesis & Green Chemistry	2	24_PSOCH405	Bio –Organic Chemistry	4
24_PSOCH308	Organic Chemistry practical III	2			
24_PSOCH309	Research Project (RP)	4	24_PSOCH406	Research Project (RP)	6
		22			22

Major Mandatory - I
Theoretical Organic Chemistry-I

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Organic reaction mechanisms	15
II	Pericyclic reactions	15
III	Stereochemistry-I	15
IV	Photochemistry	15
Total		**60**

Syllabus for Masters of Science in Organic Chemistry for the year 2024-25

Nomenclature of the Course	Theoretical Organic Chemistry I
Class	M.Sc.-II
Semester	III
Course Code	24_PSOCH301
No. of Credits	04
Nature	Theory
Type	Major: Mandatory

Course Outcomes:

At the end of the Course, the learner will be able to

CO1: Explain structure, stabilities, preparation methods and reactions of the different organic reactive intermediates; Explain the concept of neighboring group participation (NGP) and its significance in organic reactions.

CO2: Apply Woodward Hoffmann rules for different types of pericyclic reactions, predict the products of different pericyclic reactions, explain synthesis of useful natural compounds using pericyclic reactions

CO3: Explain the basic concepts of molecular symmetry and symmetry elements; analyze the conformations of medium-sized rings and stereochemistry of fused ring and bridged ring compounds and explain stereochemistry of various reactions

CO4: Explain the fundamental principles of photochemistry,**;** analyze photochemical reactions of various classes of compounds like olefins, carbonyl compounds, aromatic compounds and various photochemical oxidation and reduction reactions

Curriculum:

Unit No.	Unit Title	Sub-titles (Learning Points)
I	Organic reaction mechanism	1.1 Organic reactive intermediates, methods of generation, structure, stability and important reactions involving carbocations, nitrenes, carbenes, arynes and ketenes. [5L] 1.2 Neighbouring group participation: Mechanism and effects of anchimeric assistance, NGP by unshared/ lone pair electrons, π- electrons, aromatic rings, σ-bonds with special reference to norbornyl and bicyclo[2.2.2] octyl cation systems (formation of non-classical carbocation) [3L] 1.3 Role of FMOs in organic reactivity: Reactions involving hard and soft electrophiles and nucleophiles, ambident nucleophiles,

		ambident electrophiles, the α effect.[2L] 1.4 Pericyclic reactions: Classification of pericyclic reactions; thermal and photochemical reactions. Three approaches: Evidence for the concertedness of bond making and breaking Symmetry-Allowed and Symmetry-Forbidden Reactions : • The Woodward-Hoffmann Rules-Class by Class • The generalised Woodward-Hoffmann Rule Explanations for Woodward-Hoffmann Rules • The Aromatic Transition structures [Huckel and Mobius] • Frontier Orbitals • Correlation Diagrams, FMO and PMO approach • Molecular orbital symmetry, Frontier orbital of ethylene, 1,3 – butadiene, 1,3,5-hexatriene and allyl system [5L]
II	Pericyclic reactions	2.1 Cycloaddition reactions: Supra and antra facial additions, 4n and 4n+2 systems, 2+2 additions of ketenes. Diels-Alder reactions, 1, 3-Dipolar cycloaddition and cheletropic reactions, ene reaction, retro-Diels-Alder reaction, regioselectivity, periselectivity, torquoselectivity, site selectivity and effect of substituents in Diels-Alder reactions. Other Cycloaddition Reactions- [4+6] Cycloadditions, Ketene Cycloaddition, Allene Cycloadditions, Carbene Cycloaddition, Epoxidation and Related Cycloadditions. Other Pericyclic reactions: Sigmatropic Rearrangements, Electrocyclic Reactions, Alder 'Ene' Reactions. [7L] 2.2 Electrocyclic reactions: Conrotatory and disrotatary motions, 4nπ and (4n+2)π electron and allyl systems. [3L] 2.3 Sigmatropic rearrangements: H-shifts and C-shifts, supra and antarafacial migrations, retention and inversion of configurations. Cope (including oxy- Cope and aza-Cope) and Claisen rearrangements. Formation of Vitamin D from 7-dehydrocholesterol, synthesis of citral using pericyclic reaction, conversion of Endiandric acid E to Endiandric acid A. [5L]
III	Stereochemistry-I	3.1 Classification of point groups based on symmetry elements with examples (nonmathematical treatment). [2L] 3.2 Conformational analysis of medium rings: Eight to ten membered rings and their unusual properties, I-strain, transannular reactions. [3L] 3.3 Stereochemistry of fused ring and bridged ring compounds: decalins, hydrindanes, perhydroanthracenes, steroids, and Bredt's rule. [5L] 3.4 Anancomeric systems, Effect of conformation on reactivity of

		cyclohexane derivatives in the following reactions (including mechanism): electrophilic addition, elimination, molecular rearrangements, reduction of cyclohexanones (with $LiAlH_4$, selectride and MPV reduction) and oxidation of cyclohexanols. [5L]
IV	Photochemistry	4.1 Principles of photochemistry: quantum yield, electronic states and transitions, selection rules, modes of dissipation of energy (Jablonski diagram), electronic energy transfer: photosensitization and quenching process. [3L] 4.2 Photochemistry of carbonyl compounds: $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions, Norrish- I and Norrish-II cleavages, Paterno Buchi reaction. Photoreduction, calculation of quantum yield, photochemistry of enones, photochemical rearrangements of α, β-unsaturated ketones and cyclohexadienones. Photo Fries rearrangement, Barton reaction. [8L] 4.3 Photochemistry of olefins: cis-trans isomerizations, dimerizations, hydrogen abstraction, addition and Di-π- methane rearrangement including aza-di- π-methane. Photochemical Cross-Coupling of Alkenes, Photo-dimerisation of alkenes [2L] 4.4 Photochemistry of arenes: 1, 2- , 1, 3- and 1, 4- additions. Photocyclo-additions of aromatic Rings. [1L] 4.5 Singlet oxygen and photo-oxygenation reactions. Photochemically induced Radical Reactions. Chemiluminescence. [1L]

References:

1. March's Advanced Organic Chemistry, Jerry March, sixth edition, 2007, John Wiley and sons.
2. A guide to mechanism in Organic Chemistry, 6**th** edition, 2009, Peter Sykes, Pearson education, New Delhi.
3. Organic Reaction Mechanism, 4th edition, V. K. Ahluvalia, R. K. Parashar, Narosa Publication.
4. Reaction Mechanism in Organic Chemistry, S.M. Mukherji, S. P. Singh, Macmillan Publishers, India.
5. Organic Chemistry, Part A and B, Fifth edition, 2007, Francis A. Carey and Richard J. Sundberg, Springer.
6. Organic Chemistry, J. Clayden, S. Warren, N. Greeves, P. Wothers, 1st Edition, Oxford University Press (2001).
7. Organic Chemistry, Seventh Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson. Advanced Organic Chemistry: Reactions & Mechanisms, second edition, B. Miller and R. Prasad, Pearson.
8. Organic reactions & their mechanisms, third revised edition, P.S. Kalsi, New Age International Publishers.

9. Pericyclic Reactions, S. Sankararaman, Wiley VCH, 2005.
10. Advanced organic chemistry, Jagdamba Singh L. D. S. Yadav, Pragati Prakashan, 2011
11. Pericyclic reactions, Ian Fleming, Oxford University press, 1999.
12. Organic chemistry, 8th edition, John McMurry
13. Modern methods of Organic Synthesis, 4th Edition W. Carruthers and Iain Coldham, Cambridge University Press 2004
14. Modern physical chemistry, Eric V Anslyn, Dennis A. Dougherty, University science books, 2006
15. Physical Organic Chemistry, N. S. Isaacs, ELBS/Longman
16. Stereochemistry of Carbon Compounds: Principles and Applications, D, Nasipuri, 3**rd** edition, New Age International Ltd.
17. Stereochemistry of Organic Compounds, Ernest L. Eliel and Samuel H. Wilen, Wiley-India edit
18. Stereochemistry, P. S. Kalsi, 4^{th} edition, New Age International Ltd
19. Bioorganic, Bioinorganic and Supramolecular chemistry, P.S. Kalsi and J.P. Kalsi. New Age International Publishers
20. Supramolecular Chemistry; Concepts and Perspectives, J. M. Lehn, VCH.
21. Fundamentals of Photochemistry, K. K. Rohtagi-Mukherji, Wiley- Eastern
22. Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Sciertific Publication.
23. Molecular Photochemistry, N. J. Turro, W. A. Benjamin.
24. Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill.
25. Photochemistry, R. P. Kundall and A. Gilbert, Thomson Nelson.
26. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Organic reaction mechanisms	Lecture, PPT	15
II	Pericyclic reactions	Lecture, PPT	15
III	Stereochemistry-I	Lecture, PPT	15
IV	Photochemistry	Lecture, PPT	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Method	**Marks**
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	30
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	10

B) Semester End Examination: Maximum Marks: 60

Question No.	**Unit**	**Type of Question**	**Marks**
Q.1	Unit I	Descriptive. short note etc.	12
Q.2	Unit II	Descriptive. short note etc.	12
Q.3	Unit III	Descriptive. short note etc.	12
Q.4	Unit IV	Descriptive. short note etc.	12
Q.5	All Units	short note / objective, etc.	12

Major Mandatory- II

Synthetic Organic Chemistry-I

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Name reactions with mechanism and application	15
II	Radicals in organic synthesis	15
III	Enamines, Ylides and α-C-H functionalization	15
IV	Metals / Non-metals in organic synthesis	15
Total		**60**

Nomenclature of the Course	Synthetic Organic Chemistry-I
Class	M.Sc.-II
Semester	III
Course Code	24_PSOCH302
No. of Credits	04
Nature	Theory
Type	Major: Mandatory
Course Outcomes:	
At the end of the Course, the learner will be able to: CO1: Demonstrate knowledge in rearrangement reactions with respect to mechanism and applications. CO2: Explain the generation of free radicals, different types of free radical mechanisms and various reactions which are involved with free radicals. CO3: Explain the concept of enamines, ylides and α-C-H functionalization. CO4: Study the important metals / Non-metals in organic synthesis.	

Curriculum:		
Unit No.	**Unit Title**	**Sub titles (Learning Points)**
I	Name reactions with mechanism and application	1.1 Mukaiyama esterification, Mitsonobu reaction, Darzen's Glycidic Ester synthesis, Ritter reaction, Yamaguchi esterification, Peterson olefination. [5L] 1.2 Domino reactions: Characteristics; Nazerov cyclization [3L] 1.3 Multicomponent reactions: Strecker Synthesis, Ugi 4CC, Biginelli synthesis, Hantzsch synthesis, Pictet-Spengler synthesis [5L] 1.4 Click Reactions: Characteristics; Huisgen 1,3-Dipolar Cycloaddition [2L]
II	Radicals in organic synthesis	2.1 Introduction: Generation, stability, reactivity and structural and stereochemical properties of free radicals, Persistent and charged radicals, Electrophilic and nucleophilic radicals. [3L] 2.2 Radical Initiators: azobisisobutyronitrile (AIBN) and dibenzoyl peroxide. [1L] 2.3 Characteristic reactions - Free radical substitution, addition to multiple bonds. Radical chain reactions, Radical halogenation of hydrocarbons (Regioselectivity), radical cyclizations, autoxidations: synthesis of Cumene hydroperoxide from cumene. [4L] 2.4 Radicals in synthesis: Inter and intra molecular C-C bond formation via mercuric hydride, tin hydride, thiol donors. Cleavage of C-X, C-Sn, C-Co, C-S, O-O bonds. Oxidative

		coupling, C-C bond formation in aromatics: $S_{RN}Ar$ reactions [4L] 2.5 Hunsdiecker reaction, Pinacol coupling, McMurry coupling, Sandmeyer reaction, Acyloin condensation. [3L]
III	Enamines, Ylides and α-C-H functionalization	3.1 Enamines: Generation & application in organic synthesis with mechanistic pathways, Stork enamine reaction. Reactivity, comparison between enamines and enolates. Synthetic reactions of enamines including asymmetric reactions of chiral enamines derived from chiral secondary amines. [4L] 3.2 Phosphorus, Sulfur and Nitrogen Ylides: Preparation and their synthetic applications along with their stereochemical aspects. Wittig reaction, Horner-Wadsworth-Emmons Reaction, Barton-Kellogg olefination. [6L] 3.3 α-C-H functionalization: By nitro, sulfoxide, sulfone and phosphonate groups: generation of carbanions by strong bases (LDA/n-butyl lithium) and applications in C-C bond formation. Bamford-Stevens reaction, Julia olefination and its modification, Seyferth–Gilbert homologation, Steven's rearrangement. [5L]
IV	Metals / Non-metals in organic synthesis	4.1 Mercury in organic synthesis: Mechanism and regiochemistry of oxymercuration and demercuration of alkenes, mercuration of aromatics, transformation of aryl mercurials to aryl halides. Organomercurials as carbene transfer reagents. [3L] 4.2 Organoboron compounds: Mechanism and regiochemistry of hydroboration of alkenes and alkynes, asymmetric hydroboration using chiral boron reagents, 9-BBN hydroboration, oxazaborolidine (CBS catalyst) and functional group reduction by diborane. [3L] 4.3 Organosilicons: Salient features of silicon governing the reactivity of organosilicons, preparation and important bond-forming reactions of alkyl silanes, alkenyl silanes, aryl silanes and allyl silanes. β-silyl cations as intermediates. Iodotrimethylsilane in organic synthesis. [3L] 4.4 Silyl enol ethers: Application: As nucleophiles (Michael reaction, Mukaiyama aldol reaction), in ring contraction reactions. [2L] 4.5 Organotin compounds: Preparation of alkenyl and allyl tin compounds; application in C-C bond formation, in replacement of halogen by -H at the same C- atom. [2L] 4.6 Selenium in organic synthesis: Preparation of selenols/selenoxide, selenoxide elimination to create unsaturation, selenoxide and seleno acetals as α-C-H activating groups [2L]

References:

1. Advanced Organic Chemistry, Part A and Part B: Reaction and Synthesis, Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer Verlag.
2. Modern Methods of Organic Synthesis, 4th Edition, W. Carruthers and Iain Coldham, Cambridge University Press, 2004.
3. Chem. Rev. 2002, 102, 2227-2302, Rare Earth Metal Triflates in Organic Synthesis, S. Kobayashi, M. Sugiura, H. Kitagawa, and W.W.L. Lam.
4. Organic Chemistry, Clayden Greeves Warren and Wothers, Oxford Press (2001).
5. Moder Organic Synthesis: An Introduction, G.S. Zweifel and M.H. Nantz, W.H. Freeman and Company, (2007).
6. Advanced Organic Chemistry: Reaction Mechanism, R. Bruckner, Academic Press (2002).
7. Principles of Organic Synthesis, R.O.C. Norman & J. M. Coxon, 3rd Edn., Nelson Thornes.
8. Organic Chemistry, 7th Edn, R. T .Morrison, R. N. Boyd, & S. K. Bhattacharjee, Pearson.
9. Strategic Applications of Name Reactions in Organic Synthesis, L. Kurti & B. Czako (2005), Elsevier Academic Press.
10. Advanced Organic Chemistry: Reactions & Mechanisms, 2nd Edn., B. Miller & R. Prasad, Pearson.
11. Organic reactions and their mechanisms, 3rd revisededition, P.S. Kalsi, New Age International Publishers.
12. Organic Synthesis: The Disconnection Approach, Stuart Warren, John Wiley & Sons, 2004.
13. Name Reactions and Reagents in Organic Synthesis, 2nd Edn., Bradford P. Mundy, Michael G. Ellard, and Frank Favoloro, Jr., Wiley-Interscience.
14. Name Reactions, Jie Jack Lie, 3rd Edn., Springer.
15. Organic Electrochemistry, H. Lund, and M. Baizer, 3rd Edn., Marcel Dekker.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures (in hrs)
I	Name reactions with mechanism and application	Lecture, PPT	15
II	Radicals in organic synthesis	Lecture, PPT	15
III	Enamines, Ylides and α-C-H functionalization	Lecture, PPT	15
IV	Metals / Non-metals in organic synthesis	Lecture, PPT	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Method	Marks
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	30
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	10

B) Semester End Examination: Maximum Marks: 60

Question No.	Unit	Type of Question	Marks
Q.1	Unit I	Descriptive. short note etc.	12
Q.2	Unit II	Descriptive. short note etc.	12
Q.3	Unit III	Descriptive. short note etc.	12
Q.4	Unit IV	Descriptive. short note etc.	12
Q.5	All Units	short note / objective, etc.	12

Major Mandatory- III

Natural products and Spectroscopy

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Natural products-I	15
II	Natural products-II	15
III	Advanced spectroscopic techniques-I	15
IV	Advanced spectroscopic techniques-II	15
Total		**60**

Nomenclature of the Course	Natural products and Spectroscopy
Class	M.Sc.-II
Semester	III
Course Code	24_PSOCH303
No. of Credits	04
Nature	Theory
Type	Major: Mandatory

Course Outcomes:

At the end of the Course, the learner will be able to:

CO1: Discuss the importance of carbohydrates, general structural features natural pigments, insect pheromones and alkaloids.

CO2: Study about the multi-step synthesis of natural products, prostaglandins, lipids, insect growth regulators, plant growth regulators.

CO3: Study the fundamentals and applications of advanced spectroscopic techniques such as proton NMR spectroscopy and 13C –NMR spectroscopy.

CO4: Study the advanced NMR techniques such as DEPT experiment, COSY and HETCOR spectra, NOE and NOESY techniques.

Curriculum:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Natural products-I	1.1 Carbohydrates: Introduction to naturally occurring sugars: Deoxysugars, aminosugars, branched sugars. Structure elucidation of lactose and D-glucosamine (synthesis not expected).Structural features and applications of inositol, starch, cellulose, chitin and heparin.[5L] 1.2 Natural pigments: General structural features, occurrence, biological importance and applications of: carotenoids, anthocyanins, quinones, flavones, pterins and porphyrins (chlorophyll). Structure elucidation of β-carotene and Cyanin (with synthesis). Synthesis of ubiquinone from 3, 4, 5- trimethoxyacetophenone.[5L] 1.3 Insect pheromones: General structural features and importance. Types of pheromones (aggregation, alarm, releaser, primer, territorial, trail, sex pheromones etc.), advantage of pheromones over conventional pesticides. Synthesis of bombykol from acetylene, disparlure from 6- methylhept-1-ene,grandisol from 2-methyl-1, 3-butadiene.[3L] 1.4 Alkaloids: Occurrence and physiological importance of morphine and atropine. Structure elucidation, spectral data and synthesis of coniine.[2L]

II	Natural products-II	2.1 Multi-step synthesis of natural products: Synthesis of the following natural products with special reference to reagents used, stereochemistry and functional group transformations:[8L] a) Woodward synthesis of Reserpine from benzoquinone b) Corey synthesis of Longifoline from resorcinol c) Gilbert-Stork synthesis of Griseofulvin from phloroglucinol d) Corey's Synthesis of Caryophyllene from 2-Cyclohexenone and Isobutylene e) Synthesis of Juvabione from Limonene 2.2 Prostaglandins: Classification, general structure and biological importance. Structure elucidation of PGE_1.[2L] 2.3 Lipids: Classification, role of lipids, Fatty acids and glycerol derived from oils and fats.[2L] 2.4 Insect growth regulators: General idea, structures of JH_2 and JH_3. [1L] 2.5 Plant growth regulators: Structural features and applications of arylacetic acids, gibberellic acids and triacontanol. Synthesis of triacontanol (synthesis of stearyl magnesium bromide and 12-bromo-1-tetrahydropyranyloxydodecane expected).[2L]
III	Advanced spectroscopic techniques-I	3.1 Proton NMR spectroscopy: Recapitulation, chemical and magnetic equivalence of protons, First order, second order, Spin system notations (A_2, AB, AX, AB_2, AX_2, AMX and A_2B_2-A_2X_2 spin systems with suitable examples). Long range coupling (Allylic coupling, 'W' coupling and Coupling in aromatic and heteroaromatic systems), Temperature effects, Simplification of complex spectra, nuclear magnetic double resonance, chemical shift reagents. [7L] 3.2 ^{13}C –NMR spectroscopy: Recapitulation, equivalent and non-equivalent carbons (examples of aliphatic and aromatic compounds), ^{13}C- chemical shifts, calculation of ^{13}C- chemical shifts of aromatic carbons, heteronuclear coupling of carbon to ^{19}F and ^{31}P [4L] 3.3 Spectral problems based on UV, IR, ^{1}HNMR and ^{13}CNMR and Mass spectroscopy.[4L]

IV	Advanced spectroscopic techniques-II	4.1 Advanced NMR techniques: DEPT experiment, determining number of attached hydrogens (Methyl/methylene/methine and quaternary carbons), two dimensional spectroscopic techniques, COSY and HETCOR spectra, NOE and NOESY techniques. [10L] 4.2 Spectral problems based on UV, IR, ^{1}HNMR, ^{13}CNMR (Including 2D technique) and Mass spectroscopy [5L]

References:

1. Natural products chemistry and applications, Sujata V. Bhat, B.A. Nagasampagi and S. Meenakshi, Narosa Publishing House, 2011.
2. Organic Chemistry Natural Products Volume-II, O. P. Agarwal, Krishna Prakashan, 2011.
3. Chemistry of natural products, V.K. Ahluwalia, Vishal Publishing Co. 2008.
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6. Stereoselective Synthesis: A Practical Approach, M. Nogradi, Wiley-VCH, 1995.
7. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
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9. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.
10. Total. Synthesis of Longifolene, J. Am. Chem. Soc., E. J. Corey, M. Ohno, R. B. Mitra, and P. A. Vatakencherry. 1964, 86, 478.
11. Total. Synthesis of Longifolene, J. Am. Chem. Soc. 1961, 83, 1251.
12. The Total Synthesis of Reserpine, Woodward, R. B.; Bader, F. E.; Bickel, H., Frey, A. J.; Kierstead, R. W. Tetrahedron 1958, 2, 1-57.
13. Total synthesis of Griseofulvin, Stork, G.; Tomasz, M. J. Am. Chem. Soc. 1962, 84, 310.
14. The Alkaloids, The fundamental Chemistry A biogenetic approach, Marcel Dekker Inc. New York, 1979.
15. Selected Organic synthesis, Ian Fleming, John Wiley and Sons, 1973.
16. Total synthesis of Natural Products, J. Apsimon, John Wiley and Sons.
17. The Logic of Chemical Synthesis, E. J. Corey and Xue-Min Cheng, Wiley Interscience.
18. Classics in Total Synthesis, K. C. Nicolaou and E. J. Sorensen, Weinhem: VCH, 1996.
19. Spectroscopy of Organic compounds, P. S. Kalsi, New Age International Pub. Ltd. And Wiley Eastern Ltd., Second edition, 1995.
20. Spectrometric Identification of Organic compounds, R.M. Silverstein and others, John Wiley and Sons Inc., 5th ed., 1991.
21. Spectroscopic methods in organic chemistry, Williams and Fleming, Tata McGraw Hill, 4th ed, 1989.
22. Organic structures from spectra, L. D. Field, S. Sternhell, John R.Kalman, Wiley, 4th ed., 2011.
23. Introduction to spectroscopy, Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, 4th ed., 2009.
24. Organic spectroscopic structure determination: a problem-based learning approach Douglass F. Taber, Oxford University Press, 17- Sep-2007.

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Natural products-I	Lecture, PPT	15
II	Natural products-II	Lecture, PPT	15
III	Advanced spectroscopic techniques-I	Lecture, PPT	15
IV	Advanced spectroscopic techniques-II	Lecture, PPT	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Method	Marks
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	30
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	10

B) Semester End Examination: Maximum Marks: 60

Question No.	Unit	Type of Question	Marks
Q.1	Unit I	Descriptive. short note etc.	12
Q.2	Unit II	Descriptive. short note etc.	12
Q.3	Unit III	Descriptive. short note etc.	12
Q.4	Unit IV	Descriptive. short note etc.	12
Q.5	All Units	short note / objective, etc.	12

Nomenclature of the Course	Organic Chemistry Practical I
Class	M.Sc. II
Semester	III
Course Code	24_PSOCH304
No. of Credits	02
Nature	Practical
Type	Major: Mandatory

Course Outcomes:

At the end of the Course, the learner will be able to
CO1: Find the chemical type of mixture in the given ternary mixture.
CO2: Decide scheme for separation of components using proper reagents.
CO3: Purify separated organic compound using different purification technique.
CO4: Identify Organic compounds.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I & II	Separation of a ternary mixture of organic compounds and identification including derivative preparations using micro-scale technique.	1. Separation of a ternary mixture (S-S-S, S-S-L, S-L-L and L-L-L) (for solid mixture: water insoluble/ soluble including carbohydrates) based upon differences in the physical and the chemical properties of the components. 2. Identification of the two components (indicated by the examiner) using micro-scale technique. 3. Preparation of derivatives (any one of separated compound). **(Minimum 8 experiments)**

References:

1. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis- V.K. Ahluwalia and Renu Aggarwal, Universities Press India Ltd., 2000.
2. Advanced Practical Organic Chemistry – N. K. Vishnoi, Third Addition, Vikas Publishing House PVT Ltd.
3. Systematic Laboratory Experiments in Organic Synthesis- A. Sethi, New Age International Publications.
4. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.
5. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
6. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, Fifth edition,2008, B.S.Furniss, A. J.Hannaford, P. W. G. Smith, A. R. Tatchell, Pearson Education.
8. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.
9. Organic structures from spectra, L. D. Field, S. Sternhell, John R. Kalman, Wiley, 4th ed., 2011.

Te**aching Plan:**

Unit No.	Unit Title	Teaching Methods	No. of Lectures (in hrs)
I	Separation of a ternary mixture of organic compounds	Lecture, Demo, experiment	60
II	Identification including derivative preparations using micro-scale technique.	Lecture, Demo, experiment	

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
Assessment during practical's (Interaction / Performance) skill, Accuracy, precision of measurement, Record of observation, calculations, result and conclusion.	10
Timely submission of journal	05
Overall performance (attendance, punctuality, interaction during practical session throughout semester)	05
Total	20

B) Semester End Examination: Maximum Marks: 30

Sr. No.	Name of course	Method	Duration	Marks
1.	Separation of a ternary mixture	Experiment performance as per the practical slip	Three hours and half hours	25
2.	Identification of the one component and preparation of any one derivative.	Experiment performance as per the practical slip	Three hours and half hours	25
Journal & Viva				10
Total				60

Practical examination will be of 60 marks at the end of semester which will be converted to 30 Marks.

CIE/ Internal	Semester End	Total Marks
20	30	50

Major Elective - I

Medicinal Chemistry

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Drug discovery, design and development	15
II	Drug design, development and synthesis	15
Total		**30**

Nomenclature of the Course	Medicinal Chemistry
Class	M.Sc.-II
Semester	III
Course Code	24_PSOCH305
No. of Credits	02
Nature	Theory
Type	Major Electives

Course Outcomes:

At the end of the Course, the learner will be able to:

CO1: Analyze the important terms used in medicinal chemistry, study the procedures in drug design.

CO2: Study the modern methods of drug design and their synthesis, understand modern methods of drug design and synthesis.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Drug discovery, design and development	1.1 Introduction, important terms used in medicinal chemistry: receptor, therapeutic index, bioavailability, drug assay and drug potency. General idea of factors affecting bioactivity: Resonance, inductive effect, bioisosterism, spatial considerations. Basic pharmacokinetics: drug absorption, distribution, metabolism (biotransformation) and elimination. Physical and chemical parameters like solubility, lipophilicity, ionization, pH, redox potential, H-bonding, partition coefficient and isomerism in drug distribution and drug-receptor binding. [7L] 1.2 Procedures in drug design: Drug discovery without a lead: Penicillin, Librium. Lead discovery: random screening, non-random (or targeted) screening. Lead modification: Identification of the pharmacophore, Functional group modification. Structure-activity relationship, Structure modification to increase potency and therapeutic index: Homologation, chain branching, ring-chain transformation, bioisosterism, combinatiorial synthesis (basic idea). [8L]
II	Drug design, development and synthesis	2.1 Introduction to quantitative structure activity relationship studies. QSAR parameters: - steric effects: The Taft and other equations; Methods used to correlate regression parameters with biological activity: Hansch analysis- A linear multiple regression analysis.[5L] 2.2 Introduction to modern methods of drug design and synthesis-computer aided molecular graphics based drug design, drug

		design via enzyme inhibition (reversible and irreversible), bioinformatics and drug design.[3L] 2.3 Concept of prodrugs and soft drugs. (a) Prodrugs: Prodrug design, types of prodrugs, functional groups in prodrugs, advantages of prodrug use. (b) Soft drugs: concept and properties. [3L] 2.4 Synthesis and application of the following drugs: Fluoxetine, cetrizine, esomeprazole, fluconazole, zidovudine, methotrexate, diclofenac, labetalol, fenofibrate. [4L]

References:

1. Nelson, D. L, and Cox, M. M, (2008) Lehninger principles of Biochemistry 5th Edition, W. H. Freeman and Company, NY., USA.
2. Stryer, Lubert; Biochemistry; W. H. Freeman publishers**.**
3. Voet, D. and J. G. Voet (2004) Biochemistry, 3rd Edition, John Wiley & sons, Inc. USA.
4. Zubay, Goffrey L; Biochemistry; Wm C. Brown publishers.
5. V. Polshettiwar, R. Luque, A. Fihri, H. Zhu, M. Bouhrara and J-M Basset, Chem. Rev. 2011, 111, 3036-3075;
6. R. B. Nasir Baig and R. S.Varma, Chem. Comm., 2013, 49, 752-770;
7. M. B. Gawande, A. K. Rathi, P. S. Varma, Appl. Sci., 2013, 3, 656-674;
8. J. Govan and Y. K. Gun'ko, Nanomaterials, 2014, 4, 222-214.
9. K. Philippot and P. Serp, Nanomaterials in catalysis, First Edition. Edited by P. Serp and K. Philippot; 2013 Wiley –VCH Verlag GmbH & Co. K GaA.
10. D. Astruc, Nanomaterials and Catalysis, Wiley-VCH Verlag GmbH & Co. KgaA, 2008, 1-48;
11. C. N. R. Roa, A. Muller and A. K. Cheetham, The chemistry of Nanomaterials, Wiley-VCH Verlag GmbH & Co. KgaA, 2005, 1-11;
12. The organic chemistry of drug design and drug action, Richard B. Silverman, 2nd edition, Academic Press.
13. Medicinal chemistry, D.Sriram and P. Yogeeswari, 2nd edition, Pearson.
14. An introduction to drug design-S. S. Pandeya and J. R. Dimmock (New age international).
15. T. B. of Organic medicinal and pharmaceutical chemistry-Wilson and Gisvold's (Ed. Robert F. Dorge).
16. An introduction to medicinal chemistry-Graham L. Patrick, OUP Oxford, 2009.
17. Principles of medicinal chemistry (Vol. I and II)-S. S. Kadam, K. R. Mahadik and K.G. Bothara, Nirali prakashan.
18. Strategies for organic drug synthesis and design – D. Lednicer Wiley.
Pharmacological basis of therapeutics-Goodman and Gilman's (McGraw Hill).

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Drug discovery, design and development	Lecture, PPT	15
II	Drug design, development and synthesis	Lecture, PPT	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	**Marks**
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	15
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	05

B) Semester End Examination: Maximum Marks: 30

Question No.	**Unit**	**Type of Question**	**Marks**
Q. 1	Unit I	Descriptive, short note	10
Q. 2	Unit II	Descriptive, short note	10
Q. 3	All units	short note , objective, etc.	10

Nomenclature of the Course	Organic Chemistry Practical II	
Class	M.Sc. II	
Semester	III	
Course Code	24_PSOCH306	
No. of Credits	02	
Nature	Practical	
Type	Major: Elective	
Course Outcomes: At the end of the course, the learner will be able to:		
CO1: Study the planning of synthesis, effect of reaction parameters including stoichiometry, and safety aspects including MSDS. CO2: Apply the possible mechanism, expected spectral data (IR and NMR) of Starting material and final product. CO3: Purify the product by steam distillation/vacuum distillation/column chromatography. CO4: Measure its mass or volume, check the purity by TLC, determine physical constant and calculate percentage yield.		
Syllabus:		
Unit No.	**Unit Title**	**Sub titles (Learning Points)**
I & II	Single step organic preparation (1.0g scale) involving purification by Steam distillation / Vacuum distillation / Column chromatography.	1. Preparation of acetanilide from aniline and acetic acid using Zn dust. (Purification by column chromatography) 2. Preparation of 1-nitronaphthalene from naphthalene. (Purification by steam distillation) 3. Preparation of acetyl ferrocene from ferrocene. (Purification by column chromatography) 4. .Preparation of 3-nitroaniline from 1, 3-dinitrobenzene. (Purification by column chromatography) 5. Preparation of benzyl alcohol from benzaldehyde. (Purification by vacuum distillation). 6. Preparation of methyl salicylate from salicylic acid. (Purification by vacuum distillation). 7. .Preparation of 4-methylacetophenone from toluene. (Purification by vacuum distillation). 8. .Preparation of phenyl acetate from phenol. (Purification by vacuum distillation) 9. Preparation of 2-chlorotoluene from *o*-toluidine. (Purification by steam distillation) 10. Preparation of 4-nitrophenol from phenol. (Purification by steam distillation/ column chromatography) 11. Preparation of fluorenone from fluorene. (Purification by column chromatography)

		12. Preparation of dimethylphthalate from phthalic anhydride. (Purification by vacuum distillation). **(Minimum 8 experiments)**

References:

1. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis- V.K. Ahluwalia and Renu Aggarwal, Universities Press India Ltd., 2000.
2. Advanced Practical Organic Chemistry – N. K. Vishnoi, Third Addition, Vikas Publishing House PVT Ltd.
3. Systematic Laboratory Experiments in Organic Synthesis- A. Sethi, New Age International Publications.
4. Systematic Identification of Organic compounds, 6th edition, R. L. Shriner, R. C. Fuson and D.Y. Curtin Wiley, New York.
5. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.
6. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
7. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
8. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
9. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
10. Vogel's Textbook of Practical Organic Chemistry, Fifth edition,2008, B.S.Furniss, A. J.Hannaford, P. W. G. Smith, A. R. Tatchell, Pearson Education.
11. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures (in hrs.)
I	Single step organic preparation (1.0 g scale)	Lecture, Demo, experiment	60
II	Purification by Steam distillation / Vacuum distillation / Column chromatography.	Lecture, Demo, experiment	

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
One Periodical Class Test / Written objectives/Assignments/Short answer Questions / Seminar to be conducted in the given semester	15
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities.	05
Total	20

B) Semester End Examination: Maximum Marks: 30

Sr. No.	Name of course	Method	Duration	Marks
1.	Preparation	Experiment performance as per the practical slip	Three and half hours	25
2.	Purification	Experiment performance as per the practical slip	Three and half hours	25
Journal & Viva				10
Total				60

Practical examination will be of 60 marks at the end of semester which will be converted to 30Marks.

CIE/ Internal	Semester End	Total Marks
20	30	50

Biogenesis & Green Chemistry

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Biogenesis and biosynthesis of natural products	15
II	Green Chemistry	15
Total		**30**

Nomenclature of the Course	Biogenesis & Green Chemistry
Class	M.Sc.-II
Semester	III
Course Code	24_PSOCH307
No. of Credits	02
Nature	Theory
Type	Major Electives

Course Outcomes:

At the end of the Course, the learner will be able to:

CO1: Apply the general pathway of amino acid biosynthesis, study various pathways involved in biogenesis.

CO2: Discuss the principles of green chemistry and designing the green synthetic routes, study the microwave assisted synthesis, ultrasound assisted reactions.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Biogenesis and biosynthesis of natural products	3.1 Primary and secondary metabolites and the building blocks, general pathway of amino acid biosynthesis. [3L] 3.2 Acetate pathway: Biosynthesis of malonylCoA, saturated fatty acids, prostaglandins from arachidonic acid, aromatic polyketides. [4L] 3.3 Shikimic Acid pathway: Biosynthesis of shikimic acid, aromatic amino acids, cinnamic acid and its derivatives, lignin and lignans, benzoic acid and its derivatives, flavonoids and isofalvonoids. [4L] 3.4 Mevalonate pathway: Biosynthesis of mevalonic acid, monoterpenes – geranyl cation and its derivatives, sesquiterpenes – farnesyl cation and its derivatives and diterpenes. [4L]
II	Green Chemistry	4.1 Introduction, basic principles of green chemistry. Designing a green synthesis: Green starting materials, green reagents, green solvents and reaction conditions, green catalysts. [1L] 4.2 Use of the following in green synthesis with suitable examples: [9L] a) Green reagents: dimethyl carbonate, polymer supported reagents. b) Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts, phase transfer catalysts [Aliquat 336,

		benzyltrimethyl ammonium chloride (TMBA), Tetra-n-butyl ammonium chloride, crown ethers], biocatalysts. c) Green solvents: water, ionic liquids, deep eutectic solvents, supercritical carbon dioxide. d) Solid state reactions: solid phase synthesis, solid supported synthesis e) Microwave assisted synthesis: reactions in water, reactions in organic solvents, solvent free reactions. f) Ultrasound assisted reactions. 4.3 Comparison of traditional processes versus green processes in the syntheses of ibuprofen, adipic acid, 4 aminodiphenylamine, p-bromotoluene and benzimidazole. [3L] 4.4 Green Cataysts : Nanocatalyst, Types of nanoctalysts, Advantages and Disadvantages of Nanocatalysts, Idea of Magnetically separable nanocatalysts. [2L]

References:

1. Enzyme catalysis in organic synthesis, 3rd edition. Edited by Karlheinz Drauz, Harold Groger, and Oliver May, Wiley-VCH Verlag GmbH & Co KgaA, 2012.
2. Biochemistry, Dr U Satyanarayan and Dr U Chakrapani, Books and Allied (P) Ltd.
3. Bioorganic, Bioinorganic and Supramolecular chemistry, P.S. Kalsi and J.P. Kalsi. New Age International Publishers.
4. The Organic Chemistry of Enzyme-Catalysed Reactions, Academic Press, By Richard B. Silverman.
5. Enzymes: Practical Introduction to structure, mechanism and data analysis, By Robert A. Copeland, Wiley-VCH, Inc.
6. The Organic Chemistry of Biological Pathways By John McMurry,Tadhg Begley by Robert and company publishers.
7. Biochemistry: The chemical reactions in living cells, by E. Metzler. Academic Press.
8. Concepts in biotechnology by D. Balasubrarnanian & others.
9. Principals of biochemistry by Horton & others.
10. Bioorganic chemistry – A chemical approach to enzyme action by Herman Dugas and Christopher Penney.
11. Medicinal Natural Products: A Biosynthetic Approach by Paul M. Dewick. 3rd Edition, Wiley.
12. Natural products Chemistry and applications, Sujata V Bhat, B.A. Nagasampagi and S. Meenakshi, Narosa Publishing House.
13. Natural Products Volume- 2, By O. P. Agarwal.
14. Chemistry of natural products, V.K. Ahluwalia, Vishal Publishing Co.
15. Organic synthesis in water. By Paul A. Grieco, Blackie.
16. Green chemistry, Theory and Practical, Paul T. Anastas and John C. Warner.
17. New trends in green chemistry By V. K. Ahulwalia and M. Kidwai, 2nd edition, Anamaya Publishers, New Delhi.
18. An introduction to green chemistry, V. Kumar, Vishal Publishing Co.
19. Organic synthesis: Special techniques. V.K.Ahulwalia and Renu Aggarwal

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Biogenesis and biosynthesis of natural products	Lecture, PPT	15
II	Green Chemistry	Lecture, PPT	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	**Marks**
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	15
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	05
Total	20

B) Semester End Examination: Maximum Marks: 30

Question No.	**Unit**	**Type of Question**	**Marks**
Q. 1	Unit I	Descriptive, short note	10
Q. 2	Unit II	Descriptive, short note	10
Q. 3	All units	Short note , objective, etc.	10

Nomenclature of the Course	Organic Chemistry Practical III
Class	M.Sc. II
Semester	III
Course Code	24_PSOCH308
No. of Credits	02
Nature	Practical
Type	Major: Elective

Course Outcomes: At the end of the Course, the learner will be able to:

CO1: Study the planning of synthesis, effect of reaction parameters including stoichiometry, and safety aspects including MSDS.
CO2: Apply the possible mechanism, expected spectral data (IR and NMR) of starting material and final product.
CO3: Purify the product by steam distillation/vacuum distillation/column chromatography.
CO4: Measure its mass or volume, check the purity by TLC, determine physical constant and calculate percentage yield.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I & II	Single step organic preparation (1.0 g scale) involving purification by Steam distillation / Vacuum distillation or Column chromatography.	1. Preparation of acetanilide from aniline and acetic acid using Zn dust. (Purification by column chromatography) 2. Preparation of 1-nitronaphthalene from naphthalene. (Purification by steam distillation) 3. Preparation of acetyl ferrocene from ferrocene. (Purification by column chromatography) 4. .Preparation of 3-nitroaniline from 1,3-dinitrobenzene. (Purification by column chromatography) 5. Preparation of benzyl alcohol from benzaldehyde. (Purification by vacuum distillation). 6. Preparation of methyl salicylate from salicylic acid. (Purification by vacuum distillation). 7. .Preparation of 4-methylacetophenone from toluene. (Purification by vacuum distillation). 8. .Preparation of phenyl acetate from phenol. (Purification by vacuum distillation) 9. Preparation of 2-chlorotoluene from *o*-toluidine. (Purification by steam distillation) 10. Preparation of 4-nitrophenol from phenol. (Purification by steam distillation/ column chromatography) 11. Preparation of fluorenone from fluorene. (Purification by column chromatography)

		12. Preparation of dimethyl phthalate from phthalic anhydride. (Purification by vacuum distillation). **(Minimum 6 experiments)**	

References:

1. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis- V.K. Ahluwalia and Renu Aggarwal, Universities Press India Ltd., 2000.
2. Advanced Practical Organic Chemistry – N. K. Vishnoi, Third Addition, Vikas Publishing House PVT Ltd.
3. Systematic Laboratory Experiments in Organic Synthesis- A. Sethi, New Age International Publications.
4. Systematic Identification of Organic compounds, 6th edition, R. L. Shriner, R. C. Fuson and D.Y. Curtin Wiley, New York.
5. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.
6. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
7. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
8. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
9. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
10. Vogel's Textbook of Practical Organic Chemistry, Fifth edition,2008, B.S.Furniss, A. J.Hannaford, P. W. G. Smith, A. R. Tatchell, Pearson Education.
11. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures (in hrs.)
I	Single step organic preparation	Lecture, Demo, experiment	60
II	Purification by Steam distillation / Vacuum distillation or Column chromatography.	Lecture, Demo, experiment	

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	15
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities.	05
Total	20

B) Semester End Examination: Maximum Marks: 30

Sr. No.	Name of course	Method	Duration	Marks
1.	Preparation	Experiment performance as per the practical slip	Three and half hours	25
2.	Purification	Experiment performance as per the practical slip	Three and half hours	25
Journal & Viva				10
Total				60

Practical examination will be of 60 marks at the end of semester which will be converted into 30 Marks.

CIE/ Internal	Semester End	Total Marks
20	30	50

Nomenclature of the Course	Research Project (RP)
Class	M.Sc. II
Semester	III
Course Code	24_PSOCH309
No. of Credits	04
Nature	Research Project
Type	Major: Mandatory

Course Outcomes:

On successful completion of this course, learners will be able to:

CO1: Identify a suitable research problem in chemistry or applied chemistry through comprehensive literature review and define clear research objectives.

CO2: Develop and demonstrate core laboratory competencies in chemical synthesis, sample preparation, and analytical method development relevant to various branches of chemistry and applied chemistry.

CO3: Utilize standard instruments such as UV-Vis, IR, NMR, GC, HPLC, or AAS for the characterization and analysis of chemical compounds.

CO4: Analyze experimental data critically to draw meaningful conclusions using appropriate chemical principles and instrumental responses.

CO5: Prepare a concise scientific report presenting the methodology, data, and interpretations in alignment with research protocols.

Curriculum:

Unit No.	Unit Title	Sub titles (Learning Points)
I	**Project-I (120hrs)**	Identifying problem for project work, literature survey, deciding methodology, practical implementation of the project, data analysis and conclusions, preparing project report (a dissertation).

References:

1. Research Papers
2. Internet
3. Books and journals

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Identifying problem for project work, literature survey	Discussion, literature review.	120
	Deciding methodology and practical implementation of the project (if any).	Discussion, Experimental work.	
	Data analysis (if any) and conclusions, preparing project report (a dissertation).	Presentation and discussion.	

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Sr. No.	Method	Marks
1	Identifying problem for project work, literature review	15
2	Regularity, lab work and progress	10
3	Internal Presentation and viva	15

B) Semester End Examination: Maximum Marks: 60

Sr. No	Criteria	Marks
1	Significance of the study /Society application and Inclusion of recent references	10
2	Experimental Work & data presentation	10
3	Final report	20
4	Viva voce / presentation	20

Project guidelines:

1. Every learner is required to complete a research project during the academic year as a part of their curriculum.
2. Learners may opt for either: One long-term project spanning both Semester III and Semester IV, or two short-term projects, one in each semester.
3. For learners undertaking a long-term project: A separate project report/dissertation must be submitted in each semester.
   - The Semester III report (4 credits) should include: Problem definition, Literature review and current status, Objectives of the study, Methodology, Preliminary experimental work
   - The Semester IV report (6 credits) must cover: Detailed experimental work, Results and analysis Interpretation and conclusions
4. The research project may include one or more of the following:

   Experimental work related to an advanced topic in Chemistry or applied chemistry

- Interdisciplinary research
- Industrial research project

5. The project should involve original work which may include experimental, computational, theoretical or review-based research with critical analysis.
6. A maximum of **three learners** may jointly work on a project. However, each student must submit an **individual report**.
7. Each project will be 100 marks with 40% by continuous evaluation and 60% by semester end evaluation.
8. The final report must be submitted as a bound hard copy.
9. Number of copies of report to be submitted: 02 (Department copy and candidate copy)

Format of Project Report:

a) Title Page:

Mentioning the title of the report, name of the learner, program, institution, and the project.

b) Declaration:

A statement by the learner declaring that the report is the original work and acknowledging any assistance or references used.

c) Acknowledgments:

Recognizing individuals or organizations that provided support, guidance, or resources during the training/project.

d) Table of Contents:

Providing a clear outline of the report's sections and page numbers.

e) Abstract:

A bird's eye view of learner's entire presentation has to be precisely offered under this category. A brief overview of the project, its objectives and key findings should be mentioned.

f) Introduction:

Background information about the project and its significance. Objectives and scope of the project.

g) Literature Review:

Overview of relevant literature and studies related to the chosen field and development issues.

h) Methodology:

Description of: Planning of experimental procedure as per the need of the project. Designing and implementation of the project as per the objectives through theoretical, experimental or computational methods.

i) References & **Appendices:**

List of all sources cited in the project report. Additional supporting materials.

The project report shall be prepared as per the broad guidelines given below:

- Font type: Times New Roman.
- Font size: 13-For content, 14-for Title.
- Line Space: 1.5-for content and 1-for in table work, justified format.
- Page Size: A4.
- Margin: in Left-1.5, Up-Down-Right-1.
- The Project Report shall be hard bound.

Format
1st page (Main Page)

Title of the problem of the Project
A Project Submitted

To

R. P. Gogate College of Arts & Science and
R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri

of

Master in Science

Under the Faculty of Science

By

Name of Student

Under the Guidance of
Name of the Guiding Teacher

R**. P. Gogate college of Arts & Science and**
R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri
Advocate N.V. Joshi Road,
Near Ratnagiri District Court, Ratnagiri

Month and Year

On separate page

Index

On separate page

Declaration by learner

I the undersigned Miss/Mr. _____
[Name of the learner] here by, declare that work embodied in this Research project work titled _____ forms my own contribution to the research work carried out under the guidance of [Name of the guiding teacher] _____ is a result of my own research work and has not been previously submitted to any other University or College for any other Degree/ Diploma.

Wherever reference has been made to previous works of others, it has been clearly indicated as such and included in the bibliography.

I, here by further declare that all information of this document has been obtained and presented in accordance with academic rules and ethical conduct.

Name and Signature of the learner

Certified by

Name and signature of the Guiding Teacher

On separate page

Acknowledgment

(Model structure of the acknowledgement)

To list who all have helped me is difficult because they are so numerous and the depth is so enormous.

I would like to acknowledge the following as being idealistic channels and fresh dimensions in the completion of this Research project.

I thank the **R. P. Gogate college of Arts & Science and R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri** for giving me opportunity to do this project.

I would like to thank my **Principal, Prof. Dr M. R. Sakhalkar Sir**, for providing the necessary facilities required for completion of this project.

I take this opportunity to thank our Coordinator_____, for his moral support and guidance. I would also like to express my sincere gratitude towards my project guide _____ whose guidance and care made the project successful.

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Theoretical Organic Chemistry II

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Physical organic chemistry	15
II	Supra-molecular chemistry	15
III	Stereochemistry-II	15
IV	Asymmetric synthesis	15
Total		**60**

Nomenclature of the Course	Theoretical Organic Chemistry II
Class	M.Sc.-II
Semester	IV
Course Code	24_PSOCH401
No. of Credits	04
Nature	Theory
Type	Major: Mandatory

Course Outcomes:

At the end of the Course, the learner will be able to

CO1: Explain fundamental principles of physical organic chemistry, various equations that deal with linear free energy relationship

CO2: Explain molecular associations and organization in biological world, synthetic molecular receptors, properties and synthesis of macrocyclic molecules, explain molecular recognition and assembly

CO3: Explain mechanisms of racemization, methods of resolution and determination of enantiomers & diastereomer composition, explain molecular dissymmetry and chiroptical properties, explain correlative methods of configurational assignment

CO4: Define and apply principles of asymmetric synthesis in L-DOPA, industrially important reactions and explain use of BINOL, BINAP and chiral oxazolines in asymmetric synthesis

Curriculum:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Physical organic chemistry	1.1 Structural effects and reactivity: Linear free energy relationship (LFER) in determination of organic reaction mechanism, The Hammett equation, substituent constants, theories of substituent effects, interpretation of σ- values, reaction constants ρ, Yukawa-Tsuno equation. [7L] 1.2 Uses of Hammett equation, deviations from Hammett equation. Dual parameter correlations, Inductive substituent constants. The Taft model, σ_I and σ_R scales, steric parameters Es and β. Solvent effects, Okamoto-Brown equation, Swain- Scott equation, Edward and Ritchie correlations, Grunwald- Winstein equation, Dimroth's E_T parameter, Solvatochromism Z-scale, Spectroscopic Correlations, Thermodynamic Implications. [8L]

II	Supramolecular chemistry	2.1 Principles of molecular associations and organizations as exemplified in biological macromolecules like nucleic acids, proteins and enzymes [3L] 2.2 Synthetic molecular receptors: receptors with molecular cleft, molecular tweezers, receptors with multiple hydrogen sites. [3L] 2.3 Structures and properties of crown ethers, cryptands, cyclophanes, calixarenes, rotaxanes and cyclodextrins. Synthesis of crown ethers, cryptands and calixarenes. [5L] 2.4 Molecular recognition and catalysis, molecular self-assembly. Supramolecular Polymers, Gelsand Fibres. [4L]
III	Stereochemistry- II	3.1 Racemisation and resolution of racemates including conglomerates: Mechanism of racemisation, methods of resolution: mechanical, chemical, kinetic and equilibrium asymmetric transformation and through inclusion compounds. [3L] 3.2 Determination of enantiomer and diastereomer composition: enzymatic method, chromatographic methods. Methods based on NMR spectroscopy: use of chiral derivatising agents (CDA), chiral solvating agents (CSA) and Lanthanide shift reagents (LSR). [3L] 3.3 Correlative method for configurational assignment: chemical, optical rotation, and NMR spectroscopy. [4L] 3.4 Molecular dissymmetry and chiroptical properties: Linearly and circularly polarized light. Circular birefringence and circular dichroism. ORD and CD curves. Cotton effect and its applications. The octant rule and the axial α– haloketone rule with applications. [5L]
IV	Asymmetric synthesis	4.1 Principles of asymmetric synthesis: Introduction, the chiral pool in Nature, methods of asymmetric induction – substrate, reagent and catalyst-controlled reactions. [3L] 4.2 Synthesis of L-DOPA [Knowles's Mosanto process]. Asymmetric reactions with mechanism: Aldol and related reactions, Cram's rule, Felkin-Anh model, Sharpless enantioselective epoxidation, hydroxylation, aminohydroxylation, Diels-Alder reaction, reduction of prochiral carbonyl compounds and olefins. [9L] 4.3 Use of chiral auxiliaries in diastereoselective reductions, asymmetric amplification. Use of chiral BINOLs, BINAPs and chiral oxazolines asymmetric transformations. [3L]

References:

1. March's Advanced Organic Chemistry, Jerry March, sixth edition, 2007, John Wiley and sons.
2. A guide to mechanism in Organic Chemistry, 6th edition, 2009, Peter Sykes, Pearson education, New Delhi.
3. Organic Reaction Mechanism, 4th edition, V. K. Ahluvalia, R. K. Parashar, Narosa Publication.
4. Reaction Mechanism in Organic Chemistry, S.M. Mukherji, S.P.Singh, Macmillan Publishers, India.
6. Organic Chemistry, Part A and B, Fifth edition, 2007, Francis A. Carey and Richard J. Sundberg, Springer.
7. Organic Chemistry, J. Clayden, S. Warren, N. Greeves, P. Wothers, 1st Edition, Oxford University Press (2001).
8. Organic Chemistry, Seventh Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson. Advanced Organic Chemistry: Reactions & Mechanisms, second edition, B. Miller and R. Prasad, Pearson.
9. Organic reactions & their mechanisms, third revised edition, P.S. Kalsi, New Age International Publishers.
10. Organic Chemistry, W. G. Solomons, C. B. Fryhle, , 9th Edition, Wiley India Pvt. Ltd., 2009.
11. Organic chemistry, 8th edition, John McMurry.
12. Modern methods of Organic Synthesis, 4th Edition W. Carruthers and Iain Coldham, Cambridge University Press 2004.
13. Modern physical chemistry, Eric V Anslyn, Dennis A. Dougherty, University science books, 2006.
14. Physical Organic Chemistry, N. S. Isaacs, ELBS/Longman.
15. Stereochemistry of Carbon Compounds: Principles and Applications, D, Nasipuri, 3rd edition, New Age International Ltd.
16. Stereochemistry of Organic Compounds, Ernest L. Eliel and Samuel H. Wilen, Wiley- India edit.
17. Stereochemistry, P. S. Kalsi, 4th edition, New Age International Ltd.
18. Bioorganic, Bioinorganic and Supramolecular chemistry, P.S. Kalsi and J.P. Kalsi. New Age International Publishers.
19. Supramolecular Chemistry; Concepts and Perspectives, J. M. Lehn, VCH.
20. Crown ethers and analogous compounds, M. Hiraoka, Elsevier, 1992.
21. Large ring compounds, J.A.Semlyen, Wiley-VCH, 1997.
22. Molecular Orbitals and Organic Chemical Reactions by Ian Fleming (Wiley – A john Wiley and Sons, Ltd., Publication).
23. Advanced organic chemistry, Jagdamba Singh L. D. S. Yadav, Pragati Prakashan, 2011.

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Physical organic chemistry	Lecture, PPT	15
II	Supra-molecular chemistry	Lecture, PPT	15
III	Stereochemistry-II	Lecture, PPT	15
IV	Asymmetric synthesis	Lecture, PPT	15

Method	**Marks**
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	30
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	10

B) Semester End Examination: Maximum Marks: 60

Question No.	**Unit**	**Type of Question**	**Marks**
Q.1	Unit I	Descriptive. short note etc.	12
Q.2	Unit II	Descriptive. short note etc.	12
Q.3	Unit III	Descriptive. short note etc.	12
Q.4	Unit IV	Descriptive. short note etc.	12
Q.5	All Units	short note / objective, etc.	12

Synthetic Organic Chemistry II

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Designing Organic Synthesis-I	15
II	Designing Organic Synthesis-II	15
III	Electro-organic chemistry and Selected methods of Organic synthesis	15
IV	Transition and rare earth metals in organic synthesis	15
Total		**60**

Nomenclature of the Course	Synthetic organic chemistry II
Class	M.Sc.-II
Semester	IV
Course Code	24_PSOCH402
No. of Credits	04
Nature	Theory
Type	Major: Mandatory

Course Outcomes:

At the end of the Course, the learner will be able to:

CO1: Explain the protecting groups for different functional groups, concept of umpolung and the various termed involved in the retrosynthesis.

CO2: Study about the C-C one group and two group disconnections by their applications in different organic reactions.

CO3: Discuss the concept of Electro-organic chemistry and selected methods of Organic synthesis.

CO4: Explain the important transition and rare earth metals in organic synthesis with its mechanism and application.

Curriculum:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Designing Organic Synthesis-I	1.1 Protecting groups in Organic Synthesis: Protection and de-protection of the hydroxyl, carbonyl, amino and carboxyl functional groups and its applications. [3L] 1.2 Concept of umpolung (Reversal of polarity): Generation of acyl anion equivalent using 1,3-dithianes, methyl thiomethyl sulfoxides, cyanide ions, cyanohydrin ethers, nitro compounds and vinylated ethers. [3L] 1.3 Introduction to Retrosynthetic analysis and synthetic planning: Linear and convergent synthesis; Disconnection approach: An introduction to synthons, synthetic equivalents, disconnection approach, functional group interconversions (FGI), functional group addition (FGA), functional group removal (FGR) importance of order of events in organic synthesis, one and two group C-X disconnections (1,1; 1,2; 1,3 difunctionalized compounds), selective organic transformations: chemoselectivity, regioselectivity, stereoselectivity, enantioselectivity. [9L]
II	Designing Organic Synthesis-II	2.1 General strategy: choosing a disconnection-simplification, symmetry, high yielding steps, and recognizable starting material. [3L]

		2.2 One group C-C Disconnections: Alcohols (including stereoslectivity), carbonyls (including regioselectivity), Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis. [6L] 2.3 Two group C-C Disconnections: 1, 2- 1, 3- 1, 4- 1, 5- and 1,6- difunctionalized compounds, Diels-Alder reactions, α, β-unsaturated compounds, control in carbonyl condensations, Michael addition and Robinson annelation. [6L]
III	Electro-organic chemistry and Selected methods of Organic synthesis	3.1 Electro-organic chemistry: 3.1.1 Introduction: Electrode potential, cell parameters, electrolyte, working electrode, choice of solvents, supporting electrolytes. 3.1.2 Cathodic reduction: Reduction of alkyl halides, aldehydes, ketones, nitro compounds, olefins, arenes, electro-dimerization. 3.1.3 Anodic oxidation: Oxidation of alkylbezene, Kolbe reaction, Non-Kolbe oxidation, Shono oxidation. [7L] 3.2 Selected Methods of Organic synthesis Applications of the following in organic synthesis: 3.2.1 Crown ethers, cryptands, micelles, cyclodextrins, catenanes. 3.2.2 Organocatalysts: Proline, Imidazolidinone. 3.2.3 Pd catalysed cycloaddition reactions: Stille reaction, Saeguse-Ito oxidation to enones, Negishi coupling. 3.2.4 Use of Sc (OTf), and Yb(OTf) as water tolerant Lewis acid catalyst in aldol condensation, Michael reaction, Diels-Alder reaction, Friedel – Crafts reaction. [8L]
IV	Transition and rare earth metals in organic synthesis	4.1 Introduction to basic concepts: 18 electron rule, bonding in transition metal complexes, C-H activation, oxidative addition, reductive elimination, migratory insertion. [3L] 4.2 Palladium in organic synthesis: π-bonding of Pd with olefins, applications in C-C bond formation, carbonylation, alkene isomerisation, cross-coupling of organometallics and halides. Representative examples: Heck reaction, Suzuki-Miayura coupling, Sonogashira reaction and Wacker oxidation. Heteroatom coupling for bond formation between aryl/vinyl groups and N, S, or P atoms. [5L] 4.3 Olefin metathesis using Grubb's catalyst. [1L] 4.4 Application of Ni, Co, Fe, Rh, and Cr carbonyls in organic synthesis. [4L]

		4.5 Application of samarium iodide including reduction of organic halides, aldehydes and ketones, α-functionalised carbonyl and nitro compounds. [1L] 4.6 Application of Ce(IV) in synthesis of heterocyclic quinoxaline derivatives and its role as a de-protecting agent. [1L]

References:

1. Advanced Organic Chemistry, Part A and Part B: Reaction and Synthesis, Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer Verlag.
2. Modern Methods of Organic Synthesis, 4th Edition, W. Carruthers and Iain Coldham, Cambridge University Press, 2004.
3. Chem.Rev. 2002, 102, 2227-2302, Rare Earth Metal Triflates in Organic Synthesis, S. Kobayashi, M. Sugiura, H. Kitagawa, and W.W.L. Lam.
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5. Moder Organic Synthesis: An Introduction, G.S. Zweifel and M.H. Nantz, W.H. Freeman and Company, (2007).
6. Advanced Organic Chemistry: Reaction Mechanism, R. Bruckner, Academic Press (2002).
7. Principles of Organic Synthesis, R.O.C. Norman & J. M. Coxon, 3rd Edn, Nelson Thornes.
8. Organic Chemistry, 7th Edn, R. T .Morrison, R. N. Boyd, & S. K. Bhattacharjee, Pearson
9. Strategic Applications of Name Reactions in Organic Synthesis, L. Kurti & B. Czako (2005), Elsevier Academic Press.
10. Advanced Organic Chemistry: Reactions & Mechanisms, 2nd Edn, B. Miller & R. Prasad, Pearson.
11. Organic reactions and their mechanisms, 3rd revisededition, P.S. Kalsi, New Age International Publishers.
12. Organic Synthesis: The Disconnection Approach, Stuart Warren, John Wiley & Sons, 2004.
13. Name Reactions and Reagents in Organic Synthesis, 2nd Edn., Bradford P. Mundy, Michael G. Ellard, and Frank Favoloro, Jr., Wiley-Interscience .
14. Name Reactions, Jie Jack Lie, 3rd Edn, Springer.
15. Organic Electrochemistry, H. Lund, and M. Baizer, 3rd Edn, Marcel Dekker.

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Designing Organic Synthesis-I	Lecture, PPT	15
II	Designing Organic Synthesis-II	Lecture, PPT	15
III	Electro-organic chemistry and Selected methods of Organic synthesis	Lecture, PPT	15
IV	Transition and rare earth metals in organic synthesis	Lecture, PPT	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Method	Marks
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	30
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	10

B) Semester End Examination: Maximum Marks: 60

Question No.	Unit	Type of Question	Marks
Q.1	Unit I	Descriptive. short note etc.	12
Q.2	Unit II	Descriptive. short note etc.	12
Q.3	Unit III	Descriptive. short note etc.	12
Q.4	Unit IV	Descriptive. short note etc.	12
Q.5	All Units	short note / objective, etc.	12

Nomenclature of the Course	Organic Chemistry Practical IV
Class	M.Sc.-II
Semester	IV
Course Code	24_PSOCH403
No. of Credits	04
Nature	Practical
Type	Major: Mandatory

Course Outcomes:

At the end of the Course, the learner will be able to:

CO1: Apply the planning of synthesis, effect of reaction parameters including stoichiometry, and safety aspects including MSDS.

CO2: Apply the possible mechanism, expected spectral data (IR and NMR) of starting material and final product.

CO3: Purify the product, measure its mass or volume, check the purity by TLC, determine physical constant and calculate percentage yield.

Curriculum:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Two steps preparations	1. Acetophenone → Acetophenone phenyl hydrazine → 2-phenyl indole. 2. 2-naphthol → 1-phenyl azo-2-naphthol → 1-amino-2-naphthol. 3. Cyclohexanone → cyclohexanone oxime → Caprolactum. 4. Hydroquinone → hydroquinone diacetate → 2, 5-dihydroxyacetophenone. 5. 4-nitrotoluene → 4-nitrobenzoic acid → 4-aminobenzoic acid. 6. *o*-nitroaniline → *o*-phenylene diamine → Benzimidazole. 7. Benzophenone → benzophenone oxime → benzanilide. 8. *o*-chlorobenzoic acid → N-phenyl anthranilic acid → acridone. 9. Benzoin → benzil → benzilic acid. 10. Phthalic acid → phthalimide → anthranilic acid. 11. Resorcinol → 4-methyl-7-hydroxy coumarin → 4-methyl-7-acetoxy coumarin. 12. Anthracene → anthraquinone → anthrone. **(Minimum6 experiments)**
II	Combined spectral identification	Interpretation of spectral data of organic compounds (UV, IR, PMR, CMR and Mass spectra). A student will be given UV, IR, PMR, CMR, and Mass spectra of a compound from which preliminary information should be reported within first half an hour of the examination without referring to any book/reference

		material. The complete structure of the compound may then be elucidated by referring to any standard text-book/reference material etc. **(Minimum 6 spectral analysis).**

References:

1. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis- V. K. Ahluwalia and Renu Aggarwal, Universities Press India Ltd., 2000.
2. Advanced Practical Organic Chemistry – N. K. Vishnoi, Third Addition, Vikas Publishing House PVT Ltd.
3. Systematic Laboratory Experiments in Organic Synthesis- A. Sethi, New Age International Publications.
4. Systematic Identification of Organic compounds, 6th edition, R. L. Shriner, R. C. Fuson and D.Y. Curtin Wiley, New York.
5. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.
6. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
7. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
8. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
9. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
10. Vogel's Textbook of Practical Organic Chemistry, Fifth edition,2008, B.S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, Pearson Education.
11. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.
12. Organic structures from spectra, L. D. Field, S. Sternhell, John R. Kalman, Wiley, 4th ed., 2011.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures (in hrs)
I	Two steps preparations	Lecture, Demo, experiment	120
II	Combined spectral identification	Lecture, problem solving	

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Method	Marks
Assessment during practicals (Interaction / Performance) Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	30
Overall performance (attendance, punctuality, interaction during Practical session throughout semester)	10

B) Semester End Examination: Maximum Marks: 60

Sr. No.	Name of course	Method	Duration	Marks
1.	Two steps preparations	Experiment performance as per the practical slip	seven hours	80
2.	Combined spectral identification	Experiment performance as per the practical slip	Three and half hours	40
Total				120

Practical examination will be of 120 marks at the end of semester which will be converted to 60 Marks.

CIE	Semester End	Total Marks
40	60	100

Natural products and heterocyclic Chemistry

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Natural products-III	15
II	Natural products-IV	15
III	Heterocyclic compounds-I	15
IV	Heterocyclic compounds-II	15
Total		**60**

Nomenclature of the Course	Natural products and heterocyclic Chemistry
Class	M.Sc.-II
Semester	IV
Course Code	24_PSOCH404
No. of Credits	04
Nature	Theory
Type	Major Electives

Course Outcomes:

At the end of the Course, the learner will be able to

CO1: Explain the biological importance and synthesis of steroids.

CO2: Explain the biological importance and synthesis of different vitamins, antibiotics, naturally occurring insecticides and terpenoids.

CO3: Gain a comprehensive understanding of the nomenclature, structure, reactivity, synthesis, and chemical behavior of monocyclic heterocyclic compounds (3–6 membered).

CO4: Develop ability in the nomenclature, structure, synthesis, and reactivity of bicyclic and tricyclic fused heterocycles, along with an understanding of nucleophilic ring-opening reactions.

Curriculum:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Natural products-III	1.1 Steroids: General structure, classification. Occurrence, biological role, important structural and stereochemical features of the following: corticosteroids, steroidal hormones, steroidal alkaloids, sterols and bile acids.[5L] 1.2 Synthesis of 16-DPA from cholesterol and plant sapogenin. [2L] 1.3 Synthesis of the following from 16-DPA: androsterone, testosterone, oestrone, oestriol, oestradiol and progesterone. [5L] 1.4 Synthesis of cinerolone, jasmolone, allethrolone, exaltone and muscone. [3L]

II	Natural products-IV	2.1 Vitamins: Classification, sources and biological importance of vitamin B_1, B_2, B_6, folic acid, B_{12}, C, D_1, E (α-tocopherol), K_1, K_2, H (β- biotin). [5L] Synthesis of the following: Vitamin A from β-ionone and bromoester moiety. Vitamin B_1 including synthesis of pyrimidine and thiazole moieties Vitamin B_2 from 3, 4-dimethylaniline and D(-)ribose Vitamin B_6 from: 1) ethoxyacetylacetone and cyanoacetamide, 2) ethyl ester of N-formyl-DL-alanine (Harris synthesis) Vitamin E (α-tocopherol) from trimethylquinol and phytyl bromide Vitamin K_1 from 2-methyl-1, 4-naphthaquinone and phytol. 2.2 Antibiotics: Classification on the basis of activity. Structure elucidation, spectral data of penicillin-G, cephalosporin-C and chloramphenicol. Synthesis of chloramphenicol (from benzaldehyde and β-nitroethanol) penicillin-G and phenoxymethylpenicillin from D-penicillamine and t-butyl phthalimide malonaldehyde (synthesis of D-penicillamine and t-butyl phthalimide malonaldehyde expected). [6L] 2.3 Naturally occurring insecticides: Sources, structure and biological properties of pyrethrums (pyrethrin I), rotenoids (rotenone). Synthesis of pyrethrin I. [2L] 2.4 Terpenoids: Occurrence, classification, structure elucidation, stereochemistry, spectral data and synthesis of zingiberene. [2L]
III	Heterocyclic compounds-I	Heterocyclic compounds: Introduction, classification, Nomenclature of heterocyclic compounds of monocyclic (3-6 membered) (Common, systematic (Hantzsch-Widman) and replacement nomenclature). Structure, reactivity, synthesis and reactions of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyridazines, pyrimidine, pyrazines and oxazines. [15L]
IV	Heterocyclic compounds-II	Nomenclature of heterocyclic compounds of bicyclic/tricyclic (5- 6 Membered) fused heterocycles (up to three hetero atoms). (Common, systematic (Hantzsch-Widman) and replacement nomenclature) Nucleophilic ring opening reactions of oxiranes, aziridines, oxetanes and azetidines. Structure, reactivity, synthesis and reactions of coumarins, quinoxalines, cinnolines, indole, benzimidazoles, benzoxazoles, benzothiazoles, purines and acridines [15L].

References:

1. Natural product chemistry, A mechanistic, biosynthetic and ecological approach, Kurt B.G. Torssell, Apotekarsocieteten – Swedish Pharmaceutical Press.
2. Natural products chemistry and applications, Sujata V. Bhat, B.A.Nagasampagi and S. Meenakshi, Narosa Publishing House, 2011.
3. Organic Chemistry Natural Products Volume-II, O. P. Agarwal, Krishna Prakashan, 2011.
4. Chemistry of natural products, F. F. Bentley and F. R. Dollish, 1974.
5. Chemistry of natural products, V.K. Ahluwalia, Vishal Publishing Co. 2008.
6. Heterocyclic chemistry, 3rd edition, Thomas L. Gilchrist, Pearson Education, 2007.
7. Stereoselective Synthesis: A Practical Approach, M. Nogradi, Wiley-VCH, 1995.
8. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
9. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.
10. Comprehensive Organic Chemistry by Barton and Olis, Pergamon Press, Oxford, 1979.
11. Medicinal Natural Products, a Biosynthetic Approach, Derick Paul, John Wiley and Sons, 2002.
12. Total synthesis of Natural Products, J. Apsimon, John Wiley and Sons.
13. The Logic of Chemical Synthesis, E. J. Corey and Xue-Min Cheng, Wiley Interscience.
14. Classics in Total Synthesis , K. C. Nicolaou and E. J. Sorensen, Weinhem: VCH, 1996.
15. Alkaloids,V.K. Ahuluwalia, Ane Books Pvt.Ltd.
16. Biotransformations in Organic Chemistry, 5thEdition, Kurt Faber, Springer .
17. Structure Determination of Organic Compounds, EPretsch, P. Buhlmann, C.Affolter, Springer

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Natural products-III	Lecture, PPT	15
II	Natural products-IV	Lecture, PPT	15
III	Heterocyclic compounds-I	Lecture, PPT	15
IV	Heterocyclic compounds-II	Lecture, PPT	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Method	Marks
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	30
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	10

B) Semester End Examination: Maximum Marks: 60

Question No.	Unit	Type of Question	Marks
Q.1	Unit I	Descriptive. short note etc.	12
Q.2	Unit II	Descriptive. short note etc.	12
Q.3	Unit III	Descriptive. short note etc.	12
Q.4	Unit IV	Descriptive. short note etc.	12
Q.5	All Units	short note / objective, etc.	12

Bioorganic Chemistry

Modules at a Glance

Unit No.	Modules	No. of Lectures (in hrs.)
I	Biomolecules-I	15
II	Biomolecules-II	15
III	Biomolecules - III	15
IV	Biomolecules – IV	15
Total		**60**

Nomenclature of the Course	Bioorganic Chemistry
Class	M.Sc.-II
Semester	IV
Course Code	24_PSOCH405
No. of Credits	04
Nature	Theory
Type	Major Electives

Course Outcomes:

At the end of the Course, the learner will be able to:

CO1: Study about amino acids, peptides, proteins, nucleic acids, RNAs and DNA.

CO2: Study about the chemistry of enzymes.

CO3: Explain about the chemistry of coenzymes.

CO4: Study about the various reactions involved with different biomolecules.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Biomolecules-I	1.1 Amino acids, peptides and proteins: Chemical and enzymatic hydrolysis of proteins to peptides, amino acid 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.[2L] 1.2 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.[3L] 1.3 Structure: Purine & pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP) formation of polynucleotides strand with its shorthand representation.[3L] 1.4 RNAs (various types in prokaryotes and eukaryotes) m-RNA and r- RNA – general account , t- RNA-clover leaf model, Ribozymes.[2L] 1.5 DNA: Physical properties – Effect of heat on physical properties of DNA (Viscosity, buoyant density and UV absorption), Hypochromism, Hyperchromism and Denaturation of DNA. Reactions of nucleic acids (with DPA and Orcinol).[2L]

		1.6 Chemical synthesis of oligonucleotides: Phosphodiester, Phosphotriester, Phosphoramidite and H- phosphonate methods including solid phase approach.[3L]
II	Biomolecules-II	2.1 Chemistry of enzymes: Introduction, nomenclature, classes and general types of reactions catalyzed by enzymes. Properties of enzymes: a) enzyme efficiency/ catalytic power b) enzyme specificity; Fischer's 'lock and key' and Koshland 'induced fit' hypothesis. Concept and identification of active site.[6L] 2.2 Factors affecting enzyme kinetics: Substrate concentration, enzyme concentration, temperature, pH, product concentration etc. Reversible and irreversible inhibition.[4L] 2.3 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.[5L]
III	Biomolecules - III	3.1 Chemistry of coenzymes. Structure, mechanism of action and bio-modeling studies of the following coenzymes: nicotinamide adenine dinucleotide, flavin adenine dinucleotide, thiamine pyrophosphate, pyridoxal phosphate, Vitamin B_{12}, biotin, lipoic acid, Coenzyme A.[12L] 3.2 Oxidative phosphorylation, chemiosmosis, rotary model for ATP synthesis and role of cytochrome in oxygen activation.[3L]
IV	Biomolecules – IV	4.1 Role of main enzymes involved in the synthesis and breakdown of glycogen.[2L] 4.2 Enzyme catalyzed organic reactions: Hydrolysis, hydroxylation, oxidation and reduction.[6L] 4.3 Enzymes in organic synthesis. Fermentation: Production of drugs/drug intermediates by fermentation. Production of chiral hydroxy acids, vitamins, amino acids, β-lactam antibiotics. Synthesis of chemicals via microbial transformation, synthesis of L-ephedrine. Chemical processes with isolated enzymes in free form (hydrocyanation of mphenoxybenzaldehyde) and immobilized form (production of 6- aminopenicillanic acid).[7L]

References:

1. Nelson, D. L, and Cox, M. M, (2008) Lehninger principles of Biochemistry 5th Edition,
2. W. H. Freeman and Company, NY., USA.
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4. Voet, D. and J. G. Voet (2004) Biochemistry, 3rd Edition, John Wiley & sons, Inc. USA
5. Zubay, Goffrey L; Biochemistry; Wm C. Brown publishers.
6. Enzyme catalysis in organic synthesis, 3rd edition. Edited by Karlheinz Drauz, Harold Groger, and Oliver May, Wiley-VCH Verlag GmbH & Co KgaA, 2012.
7. Biochemistry, Dr U Satyanarayan and Dr U Chakrapani, Books and Allied (P) Ltd.
8. The Organic Chemistry of Enzyme-Catalysed Reactions, Academic Press, By Richard B. Silverman.
9. Enzymes: Practical Introduction to structure, mechanism and data analysis, By Robert A. Copeland, Wiley-VCH, Inc.
10. The Organic Chemistry of Biological Pathways By John McMurry, Tadhg Begley by Robert and company publishers.
11. Bioorganic Chemistry- A practical approach to Enzyme action, H. Dugas and C. Penny. Springer Verlag, 1931.
12. Bioorganic chemistry - A chemical approach to enzyme action by Herman Dugas and Christopher Penney.
13. Medicinal Natural Products: A Biosynthetic Approach by Paul M. Dewick. 3rd Edition, Wiley.
14. Natural product chemistry, A mechanistic, biosynthetic and ecological approach, Kurt B.
15. Natural products Chemistry and applications, Sujata V Bhat, B.A. Nagasampagi and S. Meenakshi, Narosa Publishing House.
16. Natural Products Volume- 2, By O. P. Agarwal.
17. Chemistry of natural products, V.K. Ahluwalia, Vishal Publishing Co.
18. Organic synthesis: Special techniques. V.K.Ahulwalia and Renu Aggarwal.

Teaching Plan:			
Unit No.	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
I	Biomolecules-I	Lecture, PPT	15
II	Biomolecules-II	Lecture, PPT	15
III	Biomolecules - III	Lecture, PPT	15
IV	Biomolecules – IV	Lecture, PPT	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 40

Method	Marks
One Periodical Class Test / Written objectives / Assignments/ Short answer Questions / Seminar to be conducted in the given semester	30
Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	10

B) Semester End Examination: Maximum Marks: 60

Question No.	Unit	Type of Question	Marks
Q.1	Unit I	Descriptive. short note etc.	12
Q.2	Unit II	Descriptive. short note etc.	12
Q.3	Unit III	Descriptive. short note etc.	12
Q.4	Unit IV	Descriptive. short note etc.	12
Q.5	All Units	short note / objective, etc.	12

Nomenclature of the Course	Research Project
Class	M.Sc.-II
Semester	IV
Course Code	24_PSOCH406
No. of Credits	06
Nature	Project
Type	Mandatory

Course Outcomes:

On the successful completion of this course learners will be able to:

CO1: Design and execute independent experimental work in the chosen area of chemistry, adhering to proper research methodology and lab safety practices.

CO2: Apply appropriate laboratory techniques and instrumental methods for the synthesis, separation, purification, or analysis of chemical substances.

CO3: Perform systematic characterization of compounds or materials using suitable analytical techniques such as UV-Vis, IR, NMR, Mass Spectrometry, GC, HPLC, etc.

CO4: Analyze experimental data critically and interpret results with logical reasoning supported by scientific principles and literature.

CO5: Discuss the significance of the results obtained in the context of existing knowledge and draw meaningful conclusions.

CO6: Compile and present the research findings in the form of a well-structured dissertation and deliver an effective oral/poster presentation.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	**Research Project (180hrs)**	After identifying problem for project work, actual experimental work which involve Analysis (qualitative and quantitative), separations, purification, characterization, etc and preparing project report (a dissertation).

References:

1. Previous Project Literature.
2. Internet.
3. Research Publications.
4. Project related references

Teaching Plan:			
Unit	**Unit Title**	**Teaching Methods**	**No. of Lectures (in hrs)**
II	Deciding methodology and practical implementation of the Project	Discussion, Experimental work	180
	Data analysis (if any) and conclusions, preparing project report (a dissertation).	Presentation and discussion	

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 60

Sr. No	Method	Marks
1	Experimental work	25
2	Presentation	15
3	Lab work and regularity	10
4	Viva voce	10

B) Semester End Examination: Maximum Marks: 90

Sr. No	Criteria	Marks
1	Dissertation/report quality	30
2	Experimental design, execution & results	30
3	Presentation	15
3	Final viva voce and defense of work	15

Project guidelines:

1. Every learner is required to complete a research project during the academic year as a part of their curriculum.
2. Learners may opt for either: One long-term project spanning both Semester III and Semester IV, or two short-term projects, one in each semester.
3. For learners undertaking a long-term project: A separate project report/dissertation must be submitted in each semester.
4. The Semester III report (4 credits) should include: Problem definition, Literature review and current status, Objectives of the study, Methodology, Preliminary experimental work
5. The Semester IV report (6 credits) must cover: Detailed experimental work, Results and analysis Interpretation and conclusions
6. The research project may include one or more of the following:
   - Experimental work related to an advanced topic in Chemistry or applied chemistry
   - Interdisciplinary research
   - Industrial research project

7. The project should involve original work which may include experimental, computational, theoretical or review-based research with critical analysis.

8. A maximum of **three learners** may jointly work on a project. However, each student must submit an **individual report**.

9. Each project will be 100 marks with 40% by continuous evaluation and 60% by semester end evaluation.

10. The final report must be submitted as a bound hard copy.
Number of copies of report to be submitted: 02 (Department copy and candidate copy)

Format of Project Report:

a) **Title Page:**
Mentioning the title of the report, name of the learner, program, institution, and the project.

b) **Certificate of Completion:**
A certificate issued by guide confirming the successful completion of the project.

c) **Declaration:**
A statement by the learner declaring that the report is the original work and acknowledging any assistance or references used.

d) **Acknowledgments:**
Recognizing individuals or organizations that provided support, guidance, or resources during the training/project.

e) **Table of Contents:**
Providing a clear outline of the report's sections and page numbers.

f) **Abstract:**
A bird's eye view of learner's entire presentation has to be precisely offered under this category. A brief overview of the project, its objectives and key findings should be mentioned.

g) **Introduction:**
Background information about the project and its significance. Objectives and scope of the project.

h) **Literature Review:**
Overview of relevant literature and studies related to the chosen field and development issues.

i) **Methodology:**
Description of: Planning of experimental procedure as per the need of the project. Designing and implementation of the project as per the objectives through theoretical, experimental or computational methods.

j) **Result and Discussion:**
Factual presentation of project finding including data and observations. Analysis and interpretation of finding.

k) **Conclusion:**

Summary of the key findings and outcomes of the project.

l) References & **Appendices:**

List of all sources cited in the project report. Additional supporting materials.

The project report shall be prepared as per the broad guidelines given below:

- Font type: Times New Roman,
- Font size: 12-For content, 14-for Title
- Line Space: 1.5-for content and 1-for in table work, Justified format
- Page Size: A4
- Margin: in Left-1.5, Up-Down-Right-1
- The Project Report shall be hard bounded.

Format

1st page (Main Page)

Title of the problem of the Project

A Project Submitted

To

R. P. Gogate College of Arts & Science and
R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri

of

Master in Science

Under the Faculty of Science

By

Name of Student

Under the Guidance of
Name of the Guiding Teacher

R**. P. Gogate college of Arts & Science and**
R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri
Advocate N.V. Joshi Road,
Near Ratnagiri District Court, Ratnagiri

Month and Year

On separate page

Index

On separate page

Declaration by learner

I the undersigned Miss/Mr. _____
[Name of the learner] here by, declare that work embodied in this Research project work titled _____ forms my own contribution to the research work carried out under the guidance of [Name of the guiding teacher] _____ is a result of my own research work and has not been previously submitted to any other University or College for any other Degree/ Diploma.

Wherever reference has been made to previous works of others, it has been clearly indicated as such and included in the bibliography.

I, here by further declare that all information of this document has been obtained and presented in accordance with academic rules and ethical conduct.

Name and Signature of the learner

Certified by

Name and signature of the Guiding Teacher

On separate page

Acknowledgment

(Model structure of the acknowledgement)

To list who all have helped me is difficult because they are so numerous and the depth is so enormous.

I would like to acknowledge the following as being idealistic channels and fresh dimensions in the completion of this Research project.

I thank the **R. P. Gogate college of Arts & Science and R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri** for giving me opportunity to do this project.

I would like to thank my **Principal, Prof. Dr M. R. Sakhalkar Sir**, for providing the necessary facilities required for completion of this project.

I take this opportunity to thank our Coordinator_____, for his moral support and guidance. I would also like to express my sincere gratitude towards my project guide _____ whose guidance and care made the project successful.

I would like to thank my College Library, for having provided various reference books and magazines related to my project.

Lastly, I would like to thank each and every person who directly or indirectly helped me in the completion of the project especially my Parents and Peers who supported me throughout my project

_____

Date: 30/11/2024

Place: Ratnagiri

Signature

Dr. M. G. Gore

Chairperson & HOD, Chemistry

Ratnagiri Education Society's
R. P. Gogate College of Arts and Science and R. V. Jogalekar College of Commerce
(Autonomous), Ratnagiri

Meeting of BoS in Chemistry

Date	30th November 2024
Time	11.30 AM
Venue	Library Hall
Mode	Hybrid

Attendance

Sr. No.	Name and type of the Member	Present mode Online / Offline	Signature
1	Name: Dr. Milind Ganesh Gore Head of the Department (Chairman)	offline	
2	Name: Dr. Ghanashyam B. Sathe (VC nominee)	Online	–
3	Name: Prof. Savita Ladage Dean. HBCSE, TIFR Mumbai	Online	–
4	Name: Dr. Ganpat K. Naik HOD Chemistry, Parvatibai Chougule College Madgaon, Goa	Online	–
5	Name: Mr. Sandeep Suresh Gongale GM (HR) Finolex Industries Pvt Ltd, Ranpar	leave	–
6	Name: Dr. Vikas Kulkarni, GM, Lupin Pharmaceuticals, Mumbai Alumnus	Online	–
7	Name: Dr. Mrs. Aparna M. Kulkarni Department faculty member (1)	offline	
8	Name: Mr. Maruti B. Kamble Department faculty member (2)	offline	
9	Name: Dr. Swaminath L Bhattar Department faculty member (3)	offline	
10	Name: Dr. Umesh B. Sankpal Department faculty member (4)	offline	
11	Name: Dr. Meghana E. Mhadye Department faculty member (5)	offline	
12	Name: Mrs. Pratikha Barsakar Department faculty member (6)	offline	
13	Name: Mr. Ankit A Surve Department faculty member (7)	offline	
14	Name: Trupti Gajanan Joshi Department faculty member (8)	offline	
15	Name: Miss Rina B. Shinde Department faculty member (9)	offline	
16	Name: Mr. Shirin S Limaye Department Faculty member (10)	offline	
17	Name: Mr. Ganesh M. Rathod Department faculty member (11)	offline	