Abeda Inamdar Senior College of Arts, Science and Commerce, Pune 411001
(Autonomous)
Affiliated to Savitribai Phule Pune University, Pune

Syllabus for
M. Sc. Part-II
(M.Sc. Organic Chemistry)

NEP-2020
From Academic Year 2024-25

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce, Pune-411001.

Syllabus of Autonomous M. Sc. Part-II Organic Chemistry
NEP-2020 [w.e.f. 2024-25]

Structure of the Course:

Basic Frame work of the syllabus for M. Sc. Part-II Organic Chemistry under NEP-2020 at the Abeda Inamdar Senior College of Arts, Science and Commerce, (Autonomous), Pune affiliated to Savitribai Phule Pune University, Pune.

Sr. No.	Paper Code	Subject	Credit
		SEMEMSTER-III	
1	23SMOC31MM	Organic Reaction Mechanism II	2
2	23SMOC32MM	Organic Stereochemistry	2
3	23SMOC33MM	Pericyclic Reactions and Photochemistry	2
4	23SMOC34MM	Heterocyclic Chemistry	2
5	23SMOC35MM	NMR Spectroscopy in Organic Chemistry	2
6	23SMOC36MM	Practical: Divergent Synthesis	2
7	23SMOC37MM	Practical: Ternary Mixture Separation	2
		(Any One from Following 23SMOC38ME)	
8	23SMOC38MEA	Practical: Preparation of Heterocyclic Compounds	2
8	23SMOC38MEB	Practical: Convergent and Multi stage Synthesis	2
		(Any One from Following 23SMOC39ME)	
9	23SMOC39MEA	Mass and Two-Dimensional Spectroscopy	2
9	23SMOC39MEB	Organic Polymers and metal framework materials	2
9	23SMOC39MEC	Drug Discovery and Biological Assays	2
10	23SMOC31RP	Research Project	4
		SEMESTER-IV	
11	23SMOC41MM	Retrosynthetic Strategies and Total Synthesis of Natural Products	2
12	23SMOC42MM	Natural Product Biosynthesis: Pathways and Mechanisms	2
13	23SMOC43MM	Organometallic reagents in Organic Synthesis	2
14	23SMOC44MM	Asymmetric Synthesis	2
15	23SMOC45MM	Practical: Isolation of Natural compounds and Instrumental analysis	2
16	23SMOC46MM	Practical based on Carbohydrate, PTC and Computational Chemistry	2
		(Any One from Following 23SMOC47ME)	
17	23SMOC47MEA	Advanced Organic Synthesis	2
17	23SMOC47MEB	Applied Organic Chemistry	2
		(Any One from Following 23SMOC48ME)	
18	23SMOC48MEA	Protection-Deprotection and Carbohydrate Chemistry	2
18	23SMOC48MEB	Medicinal Chemistry	2
18	23SMOC48MEC	Techniques in Molecular Biology	2
19	23SMOC41RP	Research Project	6

***N.B.:** 1. One Credit Theory Paper = 15 Hours lectures per semester and 1 Hour per week.

2. Two Credit Practical Paper = 60 Hours practical per semester and 4 hours per week.

M. Sc. II Organic Chemistry Programme Objectives and Outcomes

Programme Objectives:

1. To develop conscience towards social responsibility, human values and sustainable development through curriculum delivery and extra-curricular activities.
2. To develop scientific temperament with strong fundamental knowledge of the subject.
3. To develop analytical thinking and problem-solving skills needed for various entrance and competitive examinations and Post Graduate Studies.
4. To train students in laboratory skills and handling equipment along with soft skills needed for placement.
5. To mold a generation of youth this can apply the chemistry in their life and careers.
6. To inculcate scientific attitude enriched with a multidisciplinary perspective in the students.
7. To update the students with the needs of the industry and society with respect to chemistry.

Programme Outcomes: After completing the M. Sc. Programme, the students shall:

1. Know the basics and applied aspects of the chemistry.
2. Be in a position to apply their knowledge in their professional, social and personal life.
3. Be competent to pursue research or a career in the chemistry.
4. Have the knowledge and confidence to pursue higher studies in Chemistry.
5. Have skills in laboratory techniques and experience in instrument handling.
6. Develop sensitivity towards social issues and become productive citizens of the nation.

Programme Specific Outcome:

M.Sc. Organic Chemistry:

1. Should gain knowledge in basic organic chemistry, re-arrangements, modern synthetic reagents, coupling reaction, multicomponent synthesis and click chemistry reactions.
2. Students should be able to gain knowledge in classical organic laboratory techniques and the uses of modern instrumentation to perform new experiments.
3. Should be able to understand Advanced Spectroscopic Techniques, Stereochemistry, Organic Synthesis, and basics of Computer Aided Drug Designing as well.
4. Should acquire the ability to synthesize, separate and characterize compounds using laboratory and instrumentation techniques.

5. Should be able to integrate the knowledge learned in Organic Chemistry to various industrial and pharmaceutical needs.
6. Learn about the potential uses of retro-synthetic analysis, medicinal chemistry, natural products chemistry, and green chemistry.
7. Should be able to shoulder responsibilities in R & D labs.
8. To interpret the data obtained from various spectral techniques, through theoretical principals.
9. Able to apply knowledge of organic chemistry in research problems.
10. Should know about global level research opportunities to pursue Ph.D. programmes, targeted approach of CSIR – NET and other competitive examinations.
11. Should know enormous job opportunities at all levels of chemical, pharmaceutical, food products, life-oriented material industries.

Evaluation Pattern:

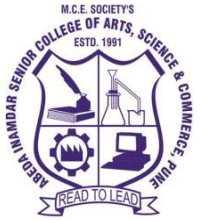
For each Theory and Practical Course, 50-50 pattern will be followed. Internal assessment will be of 50 marks for a paper of 100 Marks. Internal assessment will be of 25 marks for a paper of 50 Marks.

For Continuous Internal Evaluation (CIE), evaluation of theory courses will be done continuously. The 50 marks of Internal Evaluation shall be divided into the following:

a) One Mid Semester Exams of 15 Marks each.
b) One /Two Class Tests of 15 marks each converted to 15 Marks.
c) One Presentation/Seminar/MCQ Test of 5 Marks.
d) One Group Discussion/Open Book Test of 5 or 10 Marks.
e) Class Assignments of 10 or 5 Marks.
f) A compulsory Mock Practical Examination and Viva Voce of practical subjects.
g) Internal marks for Journal / project report/ dissertation report completion and certification.

M. Sc. Part-II Organic Chemistry

SEMESER-III



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune-1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

Course/ Paper Title	**Organic Reaction Mechanism-II**
Course Code	**23SMOC31MM**
Semester	III
No. of Credits	2 (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
	Students should;
1.	The student is expected to learn the theory of organic reaction mechanism.
2.	The course has been designed such that it will be helpful in understanding the qualitative and quantitative impacts of the substituents on reaction mechanism.
3.	Through this course, student is expected to thoroughly learn basic as well as advanced concepts and various reactions of carbanion with their applications in organic syntheses.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
	Student should be able to;
1.	After completion of the course, student shall be able to inculcate mechanistic approach for advanced organic reactions.
2.	Students will be able to correctly identify the electronic effects of various important substituents during course of the reaction.

Syllabus for 23SMOC31MM: Organic Reaction Mechanism-II

Unit No.	Title with Contents	No. of Lectures
I	**Linear free energy relationship, Hammett equation and its applications.** Hammet plots, Hammet equation, substituent constants, reaction constants, use of Hammet plots, calculation of k and K, Deviations from straight line plots, Taft equation, solvent effects.	07
II	**Methods for determining Reaction Mechanisms (non-kinetic methods)** Identification of products, Testing of possible intermediates, Trapping of intermediates, Evidences from reaction catalysis, Crossover experiments, Isotopic labelling, Stereochemical studies, Limitations of reactions, Physical detection of intermediates.	03
III	**Alkylation of Nucleophilic Carbon Intermediates (Carbanions)** Generation of carbanion, kinetic and thermodynamic enolate formation, Regioselectivity in enolate formation, alkylation of enolates, Generation and alkylation of dianion, medium effects in the alkylation of enolates, oxygen versus carbon as the site of alkylation, Alkylation of aldehydes, ketones, esters, amides and nitriles, Nitrogen analogs of enols and enolates-Enamines and Imines anions, alkylation of enamines and imines. Alkylation of carbon nucleophiles by conjugate addition (Michael reaction)	10
IV	**Reaction of carbon nucleophiles with carbonyl groups** Mechanism of Acid and base catalyzed Aldol condensation, Mixed Aldol condensation with aromatic aldehydes, Regiochemistry in mixed reactions of aliphatic aldehydes and ketones, intramolecular Aldol reaction and Robinson annulation, Addition reactions with amines and iminium ions; Mannich reaction, Amine catalyzed condensation reaction: Knoevenagel reaction. Acylation of carbanions.	10

References Books:

1. Mechanism and structure in Organic Chemistry – E. S. Gould (Holt, Rinehart and Winston)
2. Advanced organic chemistry by J. March, 6th Ed.
3. Organic Synthesis-by Michael B. Smith Third Edition
4. Advanced organic chemistry. F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
5. A guidebook to mechanism in organic chemistry – Peter Sykes 6th Ed. Orient Longman
6. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers. Oxford University Press (2001)

Course/ Paper Title	**Organic Stereochemistry**
Course Code	**23SMOC32MM**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
	Student should understand and learn
1.	To learn and apply various concepts such as stereochemistry and fundamental principles of stereoselectivity in organic chemistry.
2.	To enable a comprehensive knowledge on conformational analysis and stereochemistry of organic compounds to the students.
3.	To learn conformation and reactivity of cycloalkanes, fused and bridged ring compounds, models use for diastereoselectivity
4.	To explain the stereochemical aspects of organic compounds and stereochemical reactions with stereochemistry.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	The students should; Evaluate the stability of various conformers of acyclic and cyclic systems using steric, electronic and stereoelectronic effects and correlate them to reactivity. Use various models for determining stereoselectivity of various organic transformations
2.	Able to Predict the stereochemistry & mechanism reactions.
3.	Able to predict the stereochemistry & products for reactions
4.	Able to predict the correct Models for diastereoselective reaction

Syllabus for 23SMOC32MM: Organic Stereochemistry

Unit No.	Title with Contents	No. of Lectures
I	**Stereochemistry of six membered rings:** Conformations of polysubstituted cyclohexane, physical properties of substituted cyclohexanes, 2-alkyl and 3-alkylketone effect, conformations, reactivity and stereochemical principles involved in reactions of six membered rings; stereochemistry of addition, elimination, reduction, Iodo-lactonization, epoxidations in six membered rings.; Conformational effects in six membered heterocyclic rings- Anomeric effect, Double anomeric effects; Study of conformers with boat and twist boat forms. **Stereochemistry of rings other than six membered rings:** Shapes and stability of three, four, five, seven and eight membered rings. Conformational effects in Medium sized rings, transannular effect, Concept of I- strain, reactions in other than six membered rings	**10**
II	**Stereochemistry of fused and bridged ring systems:** Introduction of ring systems: Nomenclature, synthesis; Stereochemistry of bicyclic compounds, Fused bicyclic compounds; Stereochemical aspects of Decalin, 9-metyl decalin, Perhydrophenanthrene, Perhydroanthracene, Steroids, twistane; Bridged system (bi, tri and polycyclo system) including heteroatoms; Bredt's Rule and applications with examples;	**06**
III	**Stereoselective reactions of cyclic compounds:** Reactions on small rings, Stereochemical control in six-membered rings, Addition of Electrophiles to Cyclic Compounds, Stereochemical control in Bridged and Fused bicyclic compounds, Reactions with cyclic intermediates or cyclic transition states (ref. 3 ch-34)	**06**
IV	**Diastereoselectivity:** Cram's Model, Felkin Anh Model, dipolar model, and Cram's rigid model; Houk models.	**05**
V	**Racemic Modification**- Racemic mixture, method of formations of racemic mixture, methods of separation of racemic mixture.	**03**

Reference Books:

1. Stereochemistry of carbon compounds - E. L. Eliel
2. Modern Organic Synthesis - An Introduction by George S. Zweifel, Michael H. Nantz
3. Organic Chemistry by Jonathan Clayden (1st edition)
4. Stereochemistry of organic compounds – D. Nasipuri
5. Stereochemistry of organic compounds – P.S. Kalsi
6. Principles and Applications of Stereochemistry- Michael North
7. Chemistry of Plant Natural Products-Stereochemistry, Conformation, Synthesis, Biology, and Medicine by Sunil Kumar Talapatra Bani Talapatra (Springer)

Course/ Paper Title	**Pericyclic Reactions and Photochemistry**
Course Code	**23SMOC33MM**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
	Student should understand and learn
1.	To develop interest and understanding of the theoretical basis for Pericyclic reactions and skills for the utilization of these reactions in the organic synthesis.
2.	To learn and understand various types of pericyclic reaction, approaches in pericyclic reaction and mechanisms
3.	To learn and understand various types of Photochemical reactions and their mechanisms

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	The students should; Able to predict the stereochemistry & products of the Pericyclic reactions
2.	Predict whether the pericyclic reaction will proceed under thermal or photochemical conditions
3.	Able to identity the types of photochemical reactions and conditions.
4.	Able to Predict the stereochemistry & mechanism reactions.

Syllabus for 23SMOC33MM: Pericyclic Reactions and Photochemistry

Unit No.	Title with Contents	No. of Lectures
I	**Pericyclic reactions:** i) Introduction -Characteristics and classification of pericyclic reactions. ii) Molecular orbitals –Bonding and symmetry properties. iii) **Woodward Hoffmann rules**, Orbital analysis, Orbital Correlation Diagram, FMO approaches, Möbius–Hückel ATS concept and Stereochemistry of **Electrocyclic reactions, Cycloaddition reactions.** iv) **Electrocyclic reaction –** Torquo-selectivity, Examples of electrocyclic reactions, Nazarov reaction iv) **Cycloaddition Reactions**- study of Diels-Alder reaction - orientation, Stereochemistry, Cis rule, Alder's Endo rule and Regioselectivity; 1,3-Dipolar cycloaddition, ketene addition, other examples, **Chelotropic reactions** and **Ene reactions**. v) **Sigmatropic rearrangements-** H and C sigmatropic migration: [1,3], [1,5], [1,7] migration; [3,3] sigmatropic rearrangements- Cope, Oxy-Cope, Aza-Cope, Claisen, and Aza-Claisen rearrangements. vii) Examples based on pericyclic reactions with other reactions.	**18**
II	**Photochemistry:** Quantum yield, electronic states and transitions, modes of dissipation of energy (Jablonski diagram), electronic energy transfer. photosensitization and quenching process, Quantum yield. **Photochemistry of carbonyl compounds:** Norrish-I and Norrish-II cleavages, Photoenolisation, Photoreduction, Paterno-Buchi reaction., photochemistry of enones, photochemical rearrangements of α, β-unsaturated ketones and cyclohexadienones. Photo Fries rearrangement. **Photochemistry of olefins:** cis-trans isomerizations, dimerization and Di- π-methane rearrangements. **Photochemistry of Benzene** and Substituted Benzene.	**12**

Reference Books:

1. The Conservation of Orbital Symmetry by R.B. Woodward and R. Hoffman.

2. Pericyclic Reactions - A Textbook: Reactions, Applications and Theory by S. Sankararaman, Roald Hoffmann
3. Orbital Symmetry: A problem solving approach- R. E. Lehr and A. P. Marchand
4. Pericyclic Reactions by A Mechanistic and Problem-Solving Approach by Sunil Kumar Vinod Kumar S.P. Singh
5. Pericyclic Reactions- S. Sankararaman, A text Book, Wiley VCH, 2005
6. Organic Chemistry- Clayden, Greeves, Warren and Wothers, Oxford University press, 2001.
7. Pericyclic Reactions by S.M. Mukherji.
8. Photochemistry and Pericyclic reactions by Jagdamba Singh and Jaya singh.
9. Advanced Organic Chemistry, Part A by F. A. Carey and R. J. Sundberg
10. Excited states in Organic Chemistry by J.A. Barltrop and J.D.Coyle
11. Organic photochemistry: A visual approach by Jan Kopecky

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Course/ Paper Title	**Heterocyclic Chemistry**
Course Code	**23SMOC34MM**
Semester	III
No. of Credits	2 credits (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
Students should;	
1.	The course will give a fundamental theoretical understanding of heterocyclic chemistry, including alternative general methods for ring synthesis and application of such methods for the preparation of specific groups of heterocyclic systems.
2.	The basic ideas of heterocycles in drug development and discovery.
3.	To educate students on many areas of heterocyclic chemistry

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Student should be able to;	
1.	Theoretical understanding of heterocyclic chemistry which includes various methods for ring synthesis and application of those methods for the preparation of specific groups of heterocyclic systems.
2.	Students will be able to draw mechanisms for reactions involving heterocycles as starting materials, intermediates and products, and be able to propose syntheses of heterocycles from the major classes.

Syllabus for 23SMOC34MM: Heterocyclic Chemistry

Unit No.	Title with Contents	No. of Lectures
I	Synthesis and reactivity of the following systems of Five Membered Hetero Cyclic Compounds- Containing One, Two and Three Hetero atoms	**08**
II	Synthesis and reactivity of the following systems of Six Membered Hetero Cyclic Compounds- Containing One, Two and Three Hetero atoms	**14**
III	Synthesis and reactivity of Fused Ring Heterocyclic Compounds- Indole, Benzofuran, Benzothiophene, Quinoline and Isoquinoline	**08**

Reference Books:

1. Heterocyclic Chemistry -T. Gilchrist 15. An introduction to the chemistry of heterocyclic compounds-R M Acheso
2. Heterocyclic Chemistry- J A Joule and K Mills
3. Principles of modern heterocyclic chemistry- A Paquette
4. Heterocyclic Chemistry- J A Joule and Smith
5. Handbook of Heterocyclic Chemistry- A R Katritzky, A F Pozharskii
6. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt

Course/ Paper Title	**NMR Spectroscopy in Organic Chemistry**
Course Code	23SMOC35MM
Semester	III
No. of Credits	2 Credits (30 Hrs)

Aims & Objectives of the Course

Sr. No.	Objectives
	Student should understand and learn
1.	The basic concept of NMR spectroscopy
2.	To apply the different aspects of NMR spectroscopy to predict the structure of Compounds.
3.	To correlate the different Heteronuclear Coupling.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	The students should; Recognize the basic concept Understand the valuable concepts in NMR spectroscopy.
2.	the basic knowledge about Mass spectroscopy.
3.	Experiment the different aspects of NMR spectroscopy to predict the structure of compounds.
4.	Predict the structure of unknown molecules by using the spectral data and to identify the structure of the molecules.

Syllabus for 23SMOC35MM: NMR Spectroscopy in Organic Chemistry

Unit No.	Title with Contents	No. of Lectures
I	**Nuclear Magnetic Resonance Spectroscopy** Concepts of NMR, NMR Internal interaction parameters- External and Internal interactions in NMR, Chemical Shifts, NMR Spectrum and chemical equivalence, Conversion of frequency and ppm, Field dependence and factors affecting chemical shift and Coupling constant. Coupled spin systems and multiplicity patterns of coupled spins -Coupling among non-equivalent spins, Geminal and Vicinal couplings, Spin system Nomenclature, Isotope effect, Analysis of Strongly coupled spin systems, Analysis of three, four and five nuclei (first order spectra), Roofing effect etc. Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle spin coupled systems, Simplification of complex Spectra - Nuclear magnetic double resonance, solvent effects. Fourier transform technique, Nuclear Overhauser effect (NOE).	18
II	^{13}C-NMR Spectra -General considerations, chemical shift (aliphatic, olefin, alkyne, aromatic, hetero aromatic, and carbonyl carbon), Coupled and Decoupled ^{13}C-Spectra, Broadband decoupling in ^{13}C-NMR, Analysis of ^{13}C spectra, DEPT and APT technique. Heteronuclear couplings and satellite analysis, Analysis of spectra of other nuclei, like ^{19}F, ^{15}N, and ^{31}P.	12

Reference Books:

1. R. M. Silverstein, F. X. Webster, D. J. Kiemle, Spectrometric identification of organic compounds, 7th edition, John Wiley, 2005.
2. Introduction to Spectroscopy – D. L. Pavia, G.M. Lampman, G. S. Kriz, 3rd Ed. (Harcourt college publishers).
3. Organic Spectroscopy, W. Kemp, 3rd edition, Macmillan, 2011.
4. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, McGraw Hill, 6th edition 2007.
5. P. S. Kalsi, Spectroscopy of Organic Compounds, 6th edition, New age international, 2004.
6. Nuclear Magnetic Resonance – Basic Principles- Atta-Ur-Rehman, Springer- Verlag (1986).

Course/ Paper Title	**Practical: Divergent Synthesis**
Course Code	23SMOC36MM
Semester	III
No. of Credits	2 Credits (60 Hrs)

Aims & Objectives of the Course

Sr. No.	Objectives
Student should understand and learn;	
1.	The course provides the important topics in Organic chemistry functional groups
2.	To predict the functional group transformations, simple reaction mechanisms, and the synthesis of organic molecules by multi-step synthesis strategies.
3.	In addition of that, the course will also help students to understand the TLC and physical parameter of compound.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Student should be able to;	
1.	Acquire skills to observe and record scientific experiments.
2.	Students able to familiarize their self with the laboratory equipment, various chemicals, and set up chemical reactions to ensure safe and diligent laboratory practice.

Syllabus for 23SMOC36MM: Practical: Divergent Synthesis

Unit No.	Title with Contents
I	**Any Fifteen Practicals from following:** **SET-I** **Divergent Synthesis (Single Stage Synthesis from Acetyl acetone)** 1. Acetyl acetone to Pyrimidine 2. Acetyl acetone to 2,4-dimethyl-1H-benzo[b][1,4]diazepine 3. Acetyl acetone to Pyrazole 4. Acetyl acetone with 1mmol benzaldehyde to 3-benzylidenepentane-2,4-dione 5. Acetyl acetone with 3 mmol benzaldehyde into 3-benzylidene-6-phenylhex-5-ene-2,4-dione

	SET-II **Divergent Synthesis (Single Stage Synthesis from β-Naphthol)** 1. β-Naphthol to Synthetic dye (By diazonium coupling) 2. β-Naphthol to 6-Bromo-2-naphthol (Bromination reaction) 3. β-Naphthol to β-Naphthyl methyl ether (Methylation reaction) 4. β-Naphthol to temperature dependent sulfonation (Sulfonation reaction) 5. β-Naphthol to (β) Binol then Resolution of Binol (Resolution technique) **SET-III** **Divergent Synthesis (Single Stage Synthesis from Salicylaldehyde)** 1. Salicylaldehyde to Salicylaldehyde phenylhydrazone 2. Salicylaldehyde with melanonitrile to 2-iminochromene by intramolecular cyclization. 3. Salicylaldehyde to 2-hydroxy-3, 5-dinitrobenzaldehyde **SET-IV** **Divergent Synthesis (Single Stage Synthesis from Acetophenone)** 1. Acetophenone to Ethyl benzene by Wolf Kishner reduction 2. Acetophenone to m-Nitro acetophenone by nitration 3. Acetophenone to Chalcone using aromatic aldehyde 4. Acetophenone into Schiff base using aromatic amine 5. Acetophenone to Benzoic acid and Iodoform

References:

1. Microscale organic Laboratory: with Multistep and multiscale syntheses, 5th Ed, Dana W. Mayo, Ronald M. Pike, David C. Forbes, Wiley Global Education, 2009
2. Experimental Organic Chemistry: A miniscale and Microscale approach, John C. Gilbert, Stephen F. Martin, Cengage Learning, 2015
3. Practical organic chemistry by Mann and Saunders
4. Text book of practical organic chemistry –by Vogel
5. The synthesis, identification of organic compounds –Ralph L. Shriner, Christine K.F.
6. Hermann, Terence C. Morrill and David Y. Curtin

Course/ Paper Title	**Ternary Mixture Separation**
Course Code	23SMOC37MM
Semester	III
No. of Credits	2 Credits (60 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	Students should understand and learn; The application of theoretical principles and experimental
2.	To understand analysis of ternary mixtures of organic compound by using Ether separation method.
3.	To identify the type of compound with different nature
4.	Learn about Element present in the given compound and how to confirm functional groups

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	Students will able to separate ternary mixture and can analyse each component of the mixture.
2.	They can use this knowledge to identify the unknown compound.

Syllabus for 23SMOC37MM: Ternary Mixture Separation

Unit No.	Title with Contents	Practical Sessions
I	Separation and analysis of minimum **10** mixtures containing three components. The mixtures should also involve separation of nitro phenols, amino acids, low boiling and water soluble and insoluble compounds solids and liquids with multifunctional groups. The mixture separation should be carried out on micro-scale using ether or water with qualitative analysis of any one of separated compounds. The students should be able to 1. Understand and employ concept of type determination and separation 2. Meticulously record physical constants 3. Perform micro scale chemical elemental analysis 4. Perform qualitative estimation of functional groups 5. Recrystallize /distill the separated compounds 6. Extend these skills to organic synthesis	**15**

Reference Books:

1. Comprehensive Practical Organic Chemistry Qualitative Analysis by V.K. Ahluwalia, S. Dhingra.

2. Qualitative Organic Analysis by B. Haynes

3. Comprehensive Organic Chemistry Experiments for the Laboratory Classroom. (2020). United Kingdom: Royal Society of Chemistry.

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Course/ Paper Title	**Practical: Preparation of Heterocyclic Compounds**
Course Code	23SMOC38MEA
Semester	III
No. of Credits	2 Credits

Aims & Objectives of the Course

Sr. No.	**Objectives**
1.	To familiarize students with practical methodologies for the synthesis of diverse heterocyclic compounds, emphasizing hands-on experience and theoretical understanding of their structures and properties.
2.	To enable students to apply various synthetic techniques and reactions to produce a range of heterocyclic compounds.
3.	To develop students' skills in purification, characterization, and analysis methods specific to heterocyclic compounds, fostering their ability to assess structure-activity relationships and potential applications.

Expected Course Specific Learning Outcomes

Sr. No.	**Learning Outcome**
After successful completion of the course the students will:	
1.	Synthetic Techniques: Proficiency in executing diverse synthetic pathways to produce specific heterocyclic compounds, demonstrating the ability to select appropriate reactions and methodologies based on structural considerations.
2.	Analytical Competence: Acquisition of skills in monitoring reaction, purification, characterization, and interpretation of data related to heterocyclic compounds, enabling students to assess reaction yields, purity, and structural confirmation effectively.

Syllabus for 23SMOC38MEA: Practical: Synthesis of Heterocyclic Compounds

Unit No.	Title with Contents	Practical Sessions
I	Synthesis of any Twelve Heterocyclic compounds containing **Epoxide, Pyrazole, Oxazole, Thiazole, Pyridine, Pyrimidine, Indole, Benzimidazole, Benzotriazole, Quinoxaline, Quinoline, Coumarin, Flavone or** any other heterocyclic ring.	**15**

References:

1. Practical Organic Chemistry, Al. Vogel (ELBS)
2. Practical Heterocylic Chemistry, Fitton and Smalley (AP)
3. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal
4. Microscale organic Laboratory: with Multistep and multiscale syntheses, 5th Ed, Dana W. Mayo, Ronald M. Pike, David C. Forbes, Wiley Global Education, 2009
5. Experimental Organic Chemistry: A miniscale and Microscale approach, John C. Gilbert, Stephen F. Martin, Cengage Learning, 2015

Course/ Paper Title	**Practical: Convergent and Multi stage Synthesis**
Course Code	23SMOC38MEB
Semester	III
No. of Credits	2 Credits (60 Hrs)

Aims & Objectives of the Course

Sr. No.	Objectives
Student should understand and learn;	
1.	The course provides the important topics in Organic chemistry functional groups
2.	To predict the functional group transformations, simple reaction mechanisms, and the synthesis of organic molecules by multi-step synthesis strategies.
3.	In addition of that, the course will also help students to understand the TLC and physical parameter of compound.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Student should be able to;	
1.	Acquire skills to observe and record scientific experiments.
2.	Students able to familiarize their self with the laboratory equipment, various chemicals, and set up chemical reactions to ensure safe and diligent laboratory practice.
3.	Students can calculate yield of multistep synthesis

Syllabus for 23SMOC38MEB: Practical: Convergent and Multi stage Synthesis

Unit No.	Title with Contents	Practical Session
I	**A) Any two set from following** **SET-I** 1. Stage I: Anisole to 4-nitro anisole to 4-amino anisole (2 steps) 2. Stage II: Toluene to 4-nitro toluene to 3-acyl nitro toluene (2 steps) 3. Stage III: Synthesis of N-(1-(2-methyl-5-nitrophenyl) ethyl) aniline from 4-amino anisole, 3-acyl nitro toluene and SBH (One pot synthesis: MCR)	**13**

	SET-II 1. Stage I: 4-Nitro toluene to 4-amino toluene (Reduction by using Sn/HCl) 2. Stage II: Phenol into 2-hydroxy benzaldehyde (Reimer-Tiemann reaction) 3. Stage III: Synthesis of amidoalkyl-2-naphthols from β-Naphthol,4-amino toluene and of 2-hydroxy benzaldehyde (One pot synthesis: MCR) **SET-III** 1. Stage I: Salicylic acid to 5-Chloro-2-hydroxybenzoic acid 2. Stage II: o- Anisidine to 2-methoxy-4-nitroaniline 3. Stage III: Synthesis of 5-chloro-2-hydroxy-N-(2-methoxy-4-nitrophenyl) benzamide from 5-Chloro-2-hydroxybenzoic acid, -methoxy-4-nitroaniline (One pot synthesis: MCR) **SET-IV** 1. Stage I: Benzene to actophenone (F.C acylation) 2. Stage II: 4-Nitrochlorobenzene into 4-amino chlorobenzene (Reduction by using hydrazine) 3. Stage III: Quinoline synthesis by using acetophenone, 4-amino chloro benzene and styrene (One pot synthesis: [3 + 2 + 1] cycloaddition reaction) **B) Multi stage synthesis** At least two linear multi stage preparations (more than two stage) should be carried out. The preparations should be carried out on micro scale	**02**

Reference Books:

1. Microscale organic Laboratory: with Multistep and multiscale syntheses, 5th Ed, Dana W. Mayo, Ronald M. Pike, David C. Forbes, Wiley Global Education, 2009
2. Experimental Organic Chemistry: A miniscale and Microscale approach, John C. Gilbert, Stephen F. Martin, Cengage Learning, 2015
3. Practical Organic Chemistry, Al. Vogel (ELBS)
4. Practical Heterocylic Chemistry, Fitton and Smalley (AP)
5. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal.

Course/ Paper Title	**Mass and Two-Dimensional Spectroscopy**
Course Code	23SMOC39MEA
Semester	III
No. of Credits	2 Credits (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	Student should understand and learn; To analyze the Mass spectroscopy.
2.	To interpret the 2D spectra for analysis
3.	To evaluate the invaluable tools in synthetic chemistry for the confirmation of known molecules and elucidation of structures of unknown compounds of high complexity with a high degree of certainty.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
	Students should be able to;
1.	Discuss the basic knowledge about Mass spectroscopy.
2.	Experiment the different aspects of NMR spectroscopy to predict the structure of compounds.
3.	Predict the structure of unknown molecules by using the spectral data and to identify the structure of the molecules.

Syllabus for 23SMOC39MEA: Mass and Two-Dimensional Spectroscopy

Unit No.	Title with Contents	No. of Lectures
I	Mass Spectrometry Instrumentation, various methods of ionization (field ionization, field desorption, SIMS, FAB, MALDI), different detectors (magnetic analyzer, ion cyclotron analyzer, Quadrupole mass filter, time of flight (TOF), factors affecting fragmentation, ion analysis, ion abundance.	06
II	Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc-Lafferty rearrangement. Nitrogen rule High resolution mass spectrometry.	06
III	Two-dimensional (2D) Spectroscopy 2D NMR Techniques, General idea about two-dimensional NMR spectroscopy, 2D NMR (^{1}H-^{1}H, ^{13}C- ^{1}H COSY/ HETCOR, HMBC) experiments and their applications.	06
IV	Structure elucidation based on spectra and data (IR, UV, NMR, Mass and 2D)	12

Reference Books:

1. R. M. Silverstein, F. X. Webster, D. J. Kiemle, Spectrometric identification of organic compounds, 7th edition, John Wiley, 2005.
2. Introduction to Spectroscopy – D. L. Pavia, G.M. Lampman, G. S. Kriz, 3rd Ed. (Harcourt college publishers).
3. Nuclear Magnetic Resonance- Basic Principles- Atta-Ur-Rehman, Springer- Verlag (1986).
4. One and Two-dimensional NMR Spectroscopy- - Atta-Ur-Rehman, Elsevier (1989).
5. Organic structure Analysis- Phillip Crews, Rodriguez, Jaspars, Oxford University Press (1998).
6. Organic structural spectroscopy- Joseph B. Lambert, Shurvell, Lightner, Cooks, Prentice-Hall (1998).
7. Organic structures from spectra- Field L. D., Kalman J.R. and Sternhell S. 4th Ed. John Wiley and sons Ltd.
8. NMR spectroscopy of Organic compounds. Jackmann and Sternhell S (1998)
9. Organic spectroscopy-RT Morrison and RN Boyd
10. Spectroscopy in organic chemistry- C N R Rao and J R Ferraro
11. NMR –Basic principle and application-H Guntur
12. Interpretation of NMR spectra-Roy H Bible
13. Mass spectrometry organic chemical applications, J H Banyon

Course/ Paper Title	**Organic Polymers and metal framework materials**
Course Code	23SMOC39MEB
Semester	III
No. of Credits	2 Credits (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	Student should understand and learn; To analyze organic polymerization.
2.	To interprete type of polymers and properties
3.	To evaluate the invaluable tools in synthetic chemistry.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Students should be able to;	
1.	Discuss the basic knowledge about organic polymer
2.	Types of polymers and their uses
3.	Should understand the Molecular Devices

Syllabus for 23SMOC39MEB: Organic Polymers and metal framework materials

Unit No.	Title with Contents	No. of Lectures
I	Introduction- polymers as materials, comparison of plastics with conventional materials like metals alloys ceramics etc. Classification of polymers / plastics. High temperature and fire-resistant polymers: Introduction, Improving low performance plastics for high temperature use, Polymers for low fire–hazards, Polymers for high temperature resistance–Fluoropolymers, Aromatic polymers, Poly ethers, Polyphenylenesulphide, Polysulphones, Polyketones and Heterocyclic polymers	06
II	Biodegradable polymers: Definition, classification. Brief description polyhydroxyalkanoates, polycaprolactones, polyactic, polyvinyl alcohol and their applications.	06
III	Introduction to: Polymers for organic light-emitting diodes (OLEDs), organic and hybrid solar cell, supramolecular polymer science. Optoelectronic molecules: OLEDs, Organic Solar Cells (Basic OLED mechanism and structures) Natural Benztetrazoles and their synthetic modifications as optoelectronic molecules.	06
IV	Metal Organic Frameworks and Porous Organic Materials Coordination polymers, porous and cavity-containing structures, metallic clusters of MOFs, Design and synthesis of MOFs, Factors affecting synthesis of MOFs; solvents, effect of temperature and pH, Factors affecting the stability of MOFs, Major applications: Catalysis, Hydrogen storage, StimuliResponsive MOFs for drug delivery, sensors. Design principle of porous organic polymers, Types of porous polymers; micro-, meso- and macro-, Microporous polymers; synthetic methodologies; Hyper-crosslinked porous polymers, Conjugated microporous polymers and Covalent organic frameworks, Applications of porous polymers (gas storage and adsorption, and catalytic applications).	12

References:

1. Organic polymer chemistry by K.J.Sanders
2. Polymer syntheses, Vol.I by S.R.Sandler and W.Karo
3. The elements of Polymer Science and Engineering by A.Rudin
4. Principles of Polymer Chemistry by A.Ravve
5. Materials science and engineering an introduction by William D Callister, Jr. Wiley Publishers

8. Core Concepts In Supra Molecular Chemistry & Nano Chemistry By J.W Steed, David.R.Turner, K.J.Wallace.
9. Thomas J. J. Müller, Uwe H. F. Bunz (Eds) “Functional Organic Materials: Syntheses, Strategies and Applications”, Wiley-VCH, 2007
10. Stefan Kaskel “The Chemistry of Metal–Organic Frameworks: Synthesis, Characterization, and Applications”, vol 1, Wiley-VCH, 2016.
11.David Farruseng, “Metal Organic Frameworks: Applications from catalysis to gas storage”, Wiley-VCH, 2011.

Course/ Paper Title	**Drug Discovery and Biological Assays**
Course Code	**23SMOC39MEC**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
Students should – 1. Provide students with a comprehensive overview of the drug discovery process, including its historical perspective, stages, and the crucial role of biological assays. 2. Familiarize students with various types of biological assays, including biochemical assays, cell-based assays, and in vivo assays, highlighting their advantages and limitations. 3. Introduce students to techniques like High-Throughput Screening (HTS), Combinatorial Chemistry, and Imaging Techniques in biological assays, emphasizing principles, applications, and data analysis. 4. Provide practical insights into drug discovery through microbiological and animal cell culture studies, covering topics such as anticancer drug discovery, antifungal and antiparasitic drug studies, and antibiotic discovery. 5. Equip students with the skills to determine Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) values in antibiotic discovery, along with an understanding of regulatory and ethical considerations.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Demonstrate a comprehensive understanding of the drug discovery process, recognizing its historical context and the importance of biological assays. 2. Design and implement assays for different biomolecular targets, with a focus on enzymes, receptors, and nucleic acids.

3. Apply knowledge of imaging techniques, combinatorial chemistry, and practical microbiological and animal cell culture studies to drug discovery scenarios.
4. Understand and adhere to regulatory and ethical considerations in microbiological and animal cell culture studies, demonstrating awareness of emerging trends in the field.
5. Communicate effectively about drug discovery concepts, assay results, and ethical considerations, both in oral and written forms.

Syllabus for 23SMAC39MEC: Drug Discovery and Biological Assays

Sr. No.	Name of the Topic	Lectures
1	**Introduction to Drug Discovery and Biological Assays:** Overview of Drug Discovery, Historical perspective, Drug development process, Importance of biological assays in drug discovery. Types of Biological Assays: Biochemical assays, Cell-based assays, In vivo assays, Advantages and limitations. **Ref. 1 and Ref. 2: Relevant pages**	04
2	**Bimolecular Targets in Drug Discovery:** Enzyme Targets: Role of enzymes in drug discovery, Assay design for enzyme targets. Receptor Targets: G protein-coupled receptors (GPCRs), Ligand-gated ion channels. Nucleic Acid Targets: DNA and RNA as drug targets, Assays for nucleic acid targets, Emerging trends. **Ref. 2 and Ref. 3: Relevant pages**	06
3	**Techniques in Biological Assays:** High-Throughput Screening (HTS) – Principles and applications, Automation in HTS, Data analysis and interpretation. Combinatorial Chemistry in Drug Discovery – Solid-phase synthesis, Library design, Screening techniques. Imaging Techniques in Biological Assays: Fluorescence microscopy, Live-cell imaging, Applications in drug discovery. **Ref. 3 and Ref. 4: Relevant pages**	08
4	**Practical Applications in Microbiology and Animal Cell Culture:** Anticancer Drug Discovery: Introduction to anticancer assays, Cell culture techniques for anticancer studies, Cytotoxicity Assays, Determination of IC50 Values. Antifungal and Antiparasitic Drug Discovery: Microbiological assays for antifungal agents, Animal cell culture in antiparasitic drug studies.	12

	Antibiotic Discovery and Resistance Assays. Determination of MIC and MBC Values. Regulatory and Ethical Considerations, Emerging Trends: Guidelines and ethical considerations in microbiological and animal cell culture studies **Ref. 5 and Ref. 6: Relevant pages**	

References:

1. Microbiology: Principles and Explorations" by Jacquelyn G. Black
2. High Throughput Screening: The Discovery of Bioactive Substances" by H. G. Günther, M. J. H. van den Berg
3. GPCR Molecular Pharmacology and Drug Targeting: Shifting Paradigms and New Directions" by Annette Gilchrist
4. Ligand-Gated Ion Channels" by A. Richard Green
5. Cancer Drug Discovery and Development: Anticancer Drug Development Guide" by Beverly A. Teicher
6. Antimicrobial Susceptibility Testing Protocols" by Stephen A. B. Borron and Philip C. Carlyn
7. Live Cell Imaging: A Laboratory Manual" by Robert D. Goldman, David L. Spector
8. Antibiotics: Challenges, Mechanisms, Opportunities" by Christopher Walsh.

Course/ Paper Title	**Research Project**
Course Code	23SMOC31RP
Semester	III
No. of Credits	4 Credits

Aims & Objectives of the Course

Sr. No.	**Objectives**
Student should understand and learn;	
1.	Each student should carry out a research project.
2.	This should make them familiar with i. Literature survey, research methodologies ii. Data Analysis iii. Column and TLC chromatographic techniques iv. Characterization of the products by analytical and spectral methods.

Expected Course Specific Learning Outcomes

Sr. No.	**Learning Outcome**
1.	Understand the various synthetic pathways and implement it in the production of pharmacological compounds.
2.	Students will be able to interpret spectral data and other observations.

Details for 23SMOC31RP: Research Project

The candidates shall undertake the project work in the Third and Fourth Semester either in the Department or in Industries, Research Institute, or any other Organizations (National / International). The progress report of the project to be submitted in the third semester and the project report has to be submitted at the end of the fourth semester.

In case the candidate undertakes the project work outside the Department, **any one teacher from the Department** shall be the co-guide and the teacher/scientist under whom the work is carried out will be the guide. The candidate shall bring the attendance certificate from the place where the project work is carried out.

Following points must be included during the project work:

1. Students should undertake projects related to Chemistry
2. Interdisciplinary projects shall be encouraged; however, there **must be some Chemistry component**.
3. Students should spend enough time for the project works (**more than** 4 hours per week)
4. If student is performing project in another institute, for such student, internal mentor must be allotted and he will be responsible for internal assessment of the student. In this case student has to obtain certificate from both external and internal mentor.
5. Systematic record of attendance of project students must be maintained by the mentor.
6. Students must present his monthly progressions to his mentor/guide/co-guide and prepare his report with geotag photo as monthly progress report and submit at time of examination.
7. Daily Project work book / dairy will be maintained by students and weekly checked from mentor / guide.
8. If sufficient work is not carried out in third semester, literature survey and research papers related project work will be presented as review paper in front of examiner along with the work.
9. Project progression of third semester will be evaluated jointly by all examiners. Typically, student must present his practical work and discuss results / difficulties / records in details (15-20 min.) which will be followed by question-answer session (10 min). It shall be open type of examination.

Semester IV

M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune-1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

Course/ Paper Title	**Retrosynthetic Strategies and Total Synthesis of Natural Products**
Course Code	23SMOC41MM
Semester	IV
No. of Credits	2 (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	The student should be able to Conceptualize retrosynthesis of one or more than one functional group with respect to disconnection approach.
2.	Independently design synthetic routes for the target molecules and understand synthetic strategies used by renowned research groups.
3.	Solve problems based on retrosynthetic perspectives.
4.	Identify the role and use of various reagents in asymmetric synthesis, stereochemistry of some important naturally occurring molecules and evaluate correct structure and stereochemistry.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	Students shall be able to Understand conversion of one functional group to another and functional group additions to enable viable disconnections
2.	Apply a range of standard functional group interconversions and to change the position of a functional group.
3.	Use disconnections to design effective organic synthesis of molecules using a range of known reaction types.
4.	To make big molecules from small molecules with specific stereochemistry
5.	Logical problem-solving approach.
6.	Synthetic methods to design new synthetic strategies.
7.	Retrosynthesis and synthesis of natural products.

Syllabus for 23SMOC41MM: Retrosynthetic Strategies and Total Synthesis of Natural Products

Unit No.	Title with Contents	No. of Lectures
I	**Concepts of Retrosynthesis** Retrosynthetic analysis, disconnection approach, Synthons, multiple step synthesis, functional group interconversion, Illogical two group interconversion, C-C disconnection, Donor and acceptor Synthons, two group disconnection, 1,5 related functional group disconnection, Umpolung, convergent synthesis, special methods for small rings, Heteroatom and Heterocyclic compounds, problems	**14**
II	**Application of Retrosynthetic Approach** Retrosynthesis and synthesis of following Molecules: Juvabione, Longifolene (by E.J. Corey and Co-worker), Subincanadine E	**04**
III	**Total Synthesis and stereochemistry determination of Pinnaic acid**	**12**

Reference Books:

1. Designing Organic Syntheses by Stuart Warren
2. Organic Chemistry from Retrosynthesis to Asymmetric Synthesis, by Vitomir Sunjic, Springer; 1st ed. 2016 edition
3. Classics in Total Synthesis by K.C. Nicolaou and E.J. Sorensen
4. Angew. Chem. Int. Ed. 2001, 40 (23), 4450-4452.
5. Angew. Chem. Int. Ed. 2001, 40, (23), 4453-4456.
6. Angew. Chem. Int. Ed. 2007, 46, 5746–5749
7. J. Org. Chem. 2017, 82, 11126- 11133
8. Advanced Organic Chemistry Carey, Sundberg; Part B

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Course/ Paper Title	**Natural Product Biosynthesis: Pathways and Mechanisms**
Course Code	23SMOC42MM
Semester	IV
No. of Credits	2 (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	Understand the role of main building blocks in biosynthesis of natural products along with the basic construction mechanisms.
2.	Develop understanding of mechanistic details in the biosynthetic routes covered in the syllabus.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	Explain the broad features of the sequences and able to predict how and why intermediates get transformed during the biosynthesis of natural products.
2.	Understand and apply biomimetic strategies in organic synthesis for the preparation of various natural products.

Syllabus for 23SMOC42MM: Natural Product Biosynthesis: Pathways and Mechanisms

Unit No.	Title with Contents	No. of Lectures
I	Terpenoids – Mono, Sesqui, Di and Triterpenoids and cholesterol	**14**
II	Alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine, and tryptophan.	**08**
III	The shikimate pathway – cinnamic acids, lignans and lignin, coumarins, flavonoids stilbenes and isoflavonoids	**08**

Reference Books:

1. Natural Product Biosynthesis: Chemical Logic and Enzymatic Machinery by Christopher T Walsh, Yi Tang
2. From Biosynthesis to Total Synthesis: Strategies and Tactics for Natural Products- Editor Alexandros L. Zografo
3. Medicinal Natural Products: A Biosynthetic Approach, 3rd Edition By Paul M. Dewick

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Course/ Paper Title	**Organometallic reagents in Organic Synthesis**
Course Code	23SMOC43MM
Semester	IV
No. of Credits	2 Credits (30 Hrs)

Aims & Objectives of the Course

Sr. No.	Objectives
Student should understand and learn;	
1.	To learn how to design a new route for synthesis of various reactions.
2.	To investigate the mechanisms of organometallic reactions to gain insights into the bonding, reactivity, and stereochemistry of metal-carbon bonds
3.	Develop new methodologies for cross-coupling reactions, enabling the formation of C-C, C-N, and other bonds

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Students should be able to;	
1.	Understand how to design a new route for synthesis of various reactions.
2.	Students should comprehend the nature of organometallic bonds and recognize the factors affecting bond stability.
3.	To recognize the key features that enhance the effectiveness of specific complexes as catalysts.

Syllabus for **23SMOC43MM: Organometallic reagents in Organic Synthesis**

Unit No.	Title with Contents	No. of Lectures
I	**Organometallic reagent complexes in organic synthesis:** Introduction- oxidation states of transition metals, 16-18 rule, dissociation, association, insertion, oxidative addition, reductive elimination of transition metal. OrganoPalladium in organic synthesis- Heck arylation, allylic activation, carbonylation, wacker oxidation, Stille, Sonogashira, Fukuyama, Kumada, Hiyama, Negeshi, Tsuji Trost, Buchwald-Hartwig and Suzuki coupling reactions and their importance. Organonickel- coupling, carbonylation, Oligomerisation and Reppe reaction. OrganoIron - Noyori annulation, Collmann's reagent, and Eletrophilic reactions. OrganoCobalt – Oxo Process, Pausand Khand reaction, Volhardt's co-trimerisation reaction. OrganoRuthenium and organoRhodium reagents	20
II	**Use of Boron and Si in organic synthesis** OrganoBoron, OrganoSilicon reagents in organic synthesis.	10

References

1. G. S. Zweifel and M. H. Nantz, Modern Organic Synthesis-An Introduction, W. H.Freeman and Company, 2006.
2. Francis A. Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part B: Reactions and Synthesis", 5th Edition, Springer, 2007.
3. "Organic Chemistry" Clayden, Greeves, Warren and Wothers, Oxford University press, 2001
4. E. J. Corey and X. M. Cheng, the Logics of Chemical Synthesis, Wiley, 1989.
5. J. H. Fuhrhop, G. Li, Organic Synthesis: Concepts and Methods, 3rd edition, VCH, 1994.
6. W. Carruthers, Some Methods of Organic Synthesis, Cambridge University Press.
7. H. O. House, Modern Synthetic Reactions, Benjamin-Cummings Publishing Co. 1972
8. "Organic Synthesis – state of the art 2003-2005". Douglas Taber.

Course/ Paper Title	**Asymmetric Synthesis**
Course Code	23SMOC44MM
Semester	IV
No. of Credits	2 Credits (30 hours)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	Student should understand and learn the concept of Asymmetric synthesis
2.	Discover reactions that will reliably provide optically pure compounds.
3.	Develop effective strategies for using chiral auxiliaries, catalysts, and the substrate to control stereochemical relationships.
4.	Be able to give a detailed account of the course and mechanism of illustrative examples of the following asymmetric reactions that utilize chiral auxiliaries: enolate alkylation (oxazolidinones, oxazolines and chiral hydrazones), asymmetric (Evans) Aldol reaction and cycloaddition.
5.	Be able to suggest the correct type of catalyst used for asymmetric reactions, the mechanism, and applications of these reactions

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	Describe the asymmetric synthesis using the chiral auxiliary component.
2.	Explain industrial applications and importance of asymmetric reactions
3.	Able to understand enolate reaction in asymmetric synthesis
4.	Understand various aspects and definitions of asymmetric synthesis

Syllabus for 23SMOC44MM: Asymmetric Synthesis

Unit No.	Title with Contents	No. of Lectures
I	1. **Introduction of Asymmetric Synthesis:** Classification of Asymmetric reactions, Optical purity, ee and de, calculation of % ee and optical purity, Stereoselective Synthesis, Categories and Strategies in Asymmetric Synthesis: - Chiral substrate controlled, Chiral auxiliary controlled, Chiral reagent controlled, Chiral catalyst controlled Asymmetric Synthesis. 2. **Chiral pool and Chiral auxiliaries:** Chiral pool strategies in asymmetric synthesis, Chiral auxiliary- Evan's chiral Auxiliary, RAMP, SAMP; Synthesis and Uses of Chiral Auxiliaries in asymmetric synthesis. 3. **Aldol reactions and related reactions-** Diastereoselective Aldol reaction, Aldol reaction of chiral enolate & achiral aldehydes, achiral enolate & chiral aldehydes, Heathcock aldol reaction, Double diastereoselective Aldol reaction, Chiral auxiliary-controlled Asymmetric Aldol reactions, Mukaiyama aldol reactions, Proline - catalyzed asymmetric Aldol reactions. 4. **Asymmetric Hydrogenation and Reduction-** catalytic hydrogenation using Rh, Ru metals, Use of chiral BINOL, BINAP, Noyori asymmetric hydrogenation, CBS reduction. 5. **Asymmetric Epoxidation-** Sharpless Epoxidation, Jacobsen Epoxidation, Shi epoxidation, 6. **Asymmetric dihydroxylation** – Phthalazine-based ligands DHQ and DHQD in hydroxylation, Amino-hydroxylation 7. **Asymmetric Organocatalysis-** Enantioselective Organocatalysis Involving Iminium, Enamine. Proline and Macmillan Imidazolidinone catalyzed reactions, Organocascade Catalysis. asymmetric organocatalytic epoxidation	**30**

Reference Books:

1. ORGANIC CHEMISTRY by Jonathan Clayden (1st edition)
2. ORGANIC CHEMISTRY by Jonathan Clayden (2nd edition)
3. Modern Methods of Organic Synthesis by W. Carruthers
4. Advanced Organic Chemistry by Carey and Sundberg, Fifth Edition
5. Principles and Applications of Asymmetric Synthesis by Lin, Li, Chan. (2001 by John Wiley & Sons)
6. Catalytic Asymmetric Synthesis, by I. Ojima, John Wiley & Sons, New Jersey, 2010, 3rd Ed.
7. Catalysis in Asymmetric Synthesis by Vittorio Caprio and Jonathan M. J. Williams

8. Asymmetric synthesis by Garry Procter, Oxford Science
9. Asymmetric Synthesis by R.A. Aitken and S.N. Kilenyi
10. Modern Methods in Stereoselective Aldol Reactions by Rainer Mahrwald, Wiley-VCH
11. Selectivity in Organic Synthesis. Ward, R. S. (1999). United Kingdom: Wiley.
12. Angew. Chem. Int. Edn. 2008, 47, 4638–4660.
13. Stereochemistry of Organic compounds by Ernest L. Eliel, SAMUEL H. Willey (Ch.12)

Course/ Paper Title	**Practical: Isolation of Natural compounds and Instrumental analysis**
Course Code	23SMOC45MM
Semester	IV
No. of Credits	2 Credits (60 Hours)

Aims & Objectives of the Course

Sr. No.	**Objectives**
Student should understand and learn;	
1.	Introduction to modern Analytical Instrumentation techniques and their applications.
2.	To describe basic principles of methods of pharmaceutical analysis according to IP.
3.	Explain importance particular test in pharmaceutical raw material and finished product analysis.
4.	Perform and explain importance of limit tests, identification tests and limit test of raw materials and finished products.

Expected Course Specific Learning Outcomes

Sr. No.	**Learning Outcome**
After successful completion of the course the students will:	
2.	Understand how to operate and importance of different modern Analytical instruments
3.	How to analyze the spectra obtained from different instruments.
4.	Understand about Medicinal chemistry and its terminology like pharmacodynamic agents, pharmacophore, pharmacodynamics etc.
5.	Know about Drug designing methods, SAR and study of Pro and Soft drugs.
6.	Students will be able to interpret spectral data and other observations.
7.	Interpret spectra, HPLC chromatogram, UV-Visible spectra of pharmaceutical materials. To perform total analysis of pharmaceutical raw material and finished product analysis according to IP / BP / USP.

Unit No.	Title with Contents	Practical Sessions
I	**Part A: Isolations** **Unit I: Isolation of pigments from the natural products** 1. Orange Marigold 2. Rose 3. Sunflower 4. Hibiscus 5. Any coloured flowers/fruits available in the local area **Note:** Students should be able to collect reasonable quantities of colour pigments to do the characterization (Physical Constant, Elemental analysis functional group test etc) and should also form the appropriate derivative. They are encouraged to use these pigments for developing food grade natural colours from lesser-known plant sources. **Unit II: Isolation of essential oils from the natural products** 1. Ginger 2. Lemongrass 3. Garlic 4. Ajwain /ajowan / Trachyspermum ammi 5. Vekhand (achourus calamus) root 6. Any natural products available in the local area **Note:** Students should be able to collect a reasonable quantity of essential oils to do the characterization (Physical Constant, Density, Elemental analysis functional group test) Should form the appropriate derivative. They are encouraged to use these essential oils for the development of the products like soap, perfumes etc. **Unit III: Isolation of medicinally important component from the natural products** 1. Nimbin from Neem leave 2. Amyrin from Apati/Apta bark 3. Eujenol from Tulsi leaves 4. D-Galacturonic Acid from Jeshtamadh 5. Piper from Betel leaf 6. Any medicinally important plants available in the local area	**08**
II	**PART B- INSTRUMENTAL ANALYSIS** The laboratory part is designed to complement the Principles of Analytical Instrumentation. This course will provide a practical introduction and experience in the use of modern analytical instrumentation. Students will face a number of real-world challenges and learn how to apply instrumental approaches to overcome them.	**07**

	Emphasis will be placed on sample preparation, instrumental operation/methods, and data interpretation for a range of pharmaceutical, biological, environmental, and industrial samples by using HPLC, Gas Chromatography, UV Spectrophotometer 1. Demonstration of purification of components by Flash Chromatography 2. Distillation and recycle of solvents by using rota-vapaour 3. The Determination of % of isolated product or mixture by High Performance Liquid Chromatography (HPLC). 4. IR instrument 5. Preparation of sample for NMR study. 6. UV absorption in different solvent 7. Quantitative Estimation of any biological molecule using Cyclic voltammetry. 8. Determination of Paracetamol from pharmaceutical sample by Spectrophotometry. 9. Estimation of Vit. C from tablet using by Spectrophotometry.	

References:

1. Experimental Organic Chemistry, Daniel R. Palleros · Wiley, 2000

2. Systematic Lab Experiments in Organic Chemistry, Arun Sethi, New Age International (P) Limited, 2006

3. Comprehensive Organic Chemistry Experiments for the Laboratory Classroom, Alexandre F Trindade, Bin Tan, Carlos A M Afonso, Dulce Pereira Simão, Jaime A S Coelho, Nuno R Candeias, Robert Franzén; Royal Society of Chemistry, 2020

4. Isolation, characterization, and therapeutic application of natural bioactive compounds by Ajeet Singh, IGI global publication, 2022

Course/ Paper Title	**Practical based on Carbohydrate, PTC and Computational Chemistry**
Course Code	23SMOC46MM
Semester	IV
No. of Credits	2 Credits

Aims & Objectives of the Course

Sr. No.	**Objectives**
Student should understand and learn;	
1.	Introduction to modern Analytical Instrumentation techniques and their applications.
2.	Introduction to computer aided drug designing, and to learn the same using different software.
3.	To describe basic principles of methods of pharmaceutical analysis according to IP.
4.	Explain importance particular test in pharmaceutical raw material and finished product analysis.
5.	Perform and explain importance of limit tests, identification tests and limit test of raw materials and finished products.

Expected Course Specific Learning Outcomes

Sr. No.	**Learning Outcome**
After successful completion of the course the students will:	
2.	Understand how to operate and importance of different modern Analytical instruments
3.	How to analyze the spectra obtained from different instruments.
4.	Understand about computational chemistry and its terminology like pharmacodynamic agents, pharmacophore, pharmacodynamics etc.
5.	Know about carbohydrate synthesis and application.
6.	Students will be able to interpret spectral data and other observations.

Syllabus for 23SMOC46MM: Practical based on Carbohydrate, PTC and Computational Chemistry

Unit No.	Title with Contents	Practical Sessions
I	**Part A: Carbohydrate Synthesis (any Two)** Carry out any two-synthesis related carbohydrate 1) Synthesis and structural determination of α- and β-D-glucose penta-acetate. 2) Selective deacylation of α- and β-D-glucose penta-acetate. 3) Benzoylation of D-glucose.to D-glucose penta-benzoate. 4) Selective debenzoylation of D-glucose penta-benzoate 5) Synthesis 1, 2, 5,6-di-O-isopropylene-D-glucofuranose. 6) Synthesis of 1,2:5,6–di-O-isopropylene-3-O-benzyl –D-glucofuranose.	**02**
II	**Part B: Organic synthesis using PTC: phase transfer catalysts (any Four)** Carry out any two-synthesis using PTC	**04**
III	**Part C: Organic synthesis using Sonicator (any three)** Carry out any three-synthesis using sonicator	**03**
IV	**PART D- COMPUTATIONAL CHEMISTRY**	
	To study ADMET properties of Drug Molecules.	**01**
	To study protein ligand interaction using Docking software.	**03**
	To analyze and finalize the 1D NMR spectral file (fid file) using Mnova, topspin or ACD Lab Software	**02**

Reference:
1. Essentials of Carbohydrate and Chemistry and Biology: Thisbe K. Lindhorst, WILEY-VCH, 2000.
2. Vogel's Textbook of Organic Chemistry Practicals.
3. Phase transfer catalysis in Organic synthesis by William P. Weber, George W. Gokel, Springer, 2012
4. Synthetic organic sonochemistry by Jean Louis Luche, Springer, 2013
5. Computational drug design by David C. Young; Wiley-2009
6. Essential Practical NMR for Organic Chemistry, By S. A. Richards, J. C. Hollerton, Wiley, 2023

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Course/ Paper Title	**Advanced Organic Synthesis**
Course Code	23SMOC47MEA
Semester	IV
No. of Credits	2 Credits (30 Hrs)

Aims & Objectives of the Course

Sr. No.	Objectives
Student should understand and learn;	
1.	Develop efficient and sustainable synthetic routes for the production of complex organic molecules.
2.	Expand the scope of organic synthesis by developing methods that tolerate a wide range of functional groups, allowing for greater versatility.
3.	Investigate and understand the underlying mechanisms of reactions to gain insights into reaction pathways and selectivity.

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Students should be able to;	
1.	Advanced functional group transformations, expanding the synthetic selection for complex molecule synthesis.
2.	Apply named reactions in advanced contexts, understanding their limitations and modifications for specific synthetic challenges.
3.	Gain expertise in the synthesis and manipulation of complex heterocyclic compounds, which play a crucial role in medicinal chemistry and materials science.

Syllabus for 23SMOC47MEA: Advanced Organic Synthesis

Unit No.	Title with Contents	No. of Lectures
I	C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford Stevens, McMurry, Julia-Lythgoe and Peterson olefination reactions.	08
II	Metathesis of NHC's – Synthesis and reactivity, Grubbs catalysts, Olefin metathesis by I^{st} , and II^{nd} generation catalyst, reaction mechanism and application in the synthesis of homo and heterocyclic compounds	08
III	Multi-component reactions: Ugi, Passerini, Biginelli and Mannich reactions	04
IV	Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization, Click chemistry reaction	05
V	Other important reactions: Baylis Hilman, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction.	05

Reference Books:

1. G. S. Zweifel and M. H. Nantz, Modern Organic Synthesis-An Introduction, W. H.Freeman and Company, 2006.
2. Francis A. Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part B: Reactions and Synthesis", 5th Edition, Springer, 2007.
3. "Organic Chemistry" Clayden, Greeves, Warren and Wothers, Oxford University press, 2001
4. E. J. Corey and X. M. Cheng, the Logics of Chemical Synthesis, Wiley, 1989.
5. J. H. Fuhrhop, G. Li, Organic Synthesis: Concepts and Methods, 3rd edition, VCH, 1994.
6. W. Carruthers, Some Methods of Organic Synthesis, Cambridge University Press.
7. H. O. House, Modern Synthetic Reactions, Benjamin-Cummings Publishing Co. 1972
8. "Organic Synthesis – state of the art 2003-2005". Douglas Taber.

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Course/ Paper Title	**Applied Organic Chemistry**
Course Code	23SMOC47MEB
Semester	IV
No. of Credits	2 Credits (30 Hours)

Aims & Objectives of the Course

Sr. No.	Objectives
Student should understand and learn;	
1.	The concept of Covalent Organic Frameworks; It's Synthesis and Applications
2.	Idea of Organic Electroluminescent Materials
3.	The concept of Supramolecular Organic Compounds

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Student should be able to;	
1.	Understand chemistry of Covalent Organic Frameworks
2.	Comprehend function of Organic Electroluminescent Materials.
3.	Comprehend Host-Guest molecules their types and their applications

Syllabus for 23SMOC47MEB: Applied Organic Chemistry

Unit No.	Title with Contents	No. of Lectures
I	**Covalent Organic Frameworks: Structures, Synthesis,-** Ionothermal Synthesis, Microwave Synthesis, Mechanochemical Synthesis, Room-Temperature Synthesis and **Applications** – (Heterogeneous Catalytic Application of COFs Heterogeneous Catalysts of COFs for C–C Bond Coupling Reactions; Suzuki–Miyaura Reaction , Heck, Sonogashira, and Silane-Based Cross-Coupling Reactions, Chiral Heterogeneous Catalysts of COFs for Asymmetric C–C Bond Coupling Reactions, Heterogeneous Bimetallic or Bifunctional Catalysts of COFs.	**12**
II	**Supramolecular Organic Compounds:** Overview of Supramolecular Chemistry, The Chemistry of Molecular Recognition – Host Molecules and Guest Molecules, (Crown Ethers, Cyclodextrin, Calixarene, etc), Supramolecular Topology (Carbon Nanotubes; Dendrimers, Rotaxanes).	**08**
III	Applications of supramolecular chemistry in chemical sensing of ions, catalysis, electronic display (liquid crystal) Molecular Self-Assembly: Examples of Self-assembly in Nature, Biological Self-assembly Rotaxanes and Catenanes: From Cyclophanes to Catenanes, Properties of Catenanes, Rotaxanes, Switchable Catenanes and Rotaxanes Molecular devices, Molecular Machines, and molecular wires. Organic switches	**10**

Reference Books:

1. Review article by Maria S. Lohse and Thomas Bein Adv. Funct. Mater. 2018, 28(33), 1705553.
2. Review article by L.S. Hunga and C. H. Chen Materials Science and Engineering 2002, R 39, 143–222
3. Review by Matthew C. T. Fyfe and J. Fraser Stoddart Accounts of Chemical Research 1997, 30 (10), 393-401
4. Review article by Wei Chen and et al. Chem. Soc. Rev., 2015, 44, 2998-3022.
5. The Chemistry of Metal–Organic Frameworks- Wiley Online. Print ISBN: 9783527338740, Online ISBN:9783527693078, DOI:10.1002/9783527693078

6. Covalent Organic Frameworks - 1st Edition - Atsushi Nagai, ISBN 9789814800877, Published January 24, 2020 by Jenny Stanford Publishing.
7. Introduction to Supramolecular Chemistry- Kluwer Academic Publishers, Helena Dodziuk; Print ISBN: 1-4020-0214-9.
8. Supramolecular Chemistry-Fundamentals and Applications, Springer Publications, Katsuhiko Ariga ISBN-10 3-540-01298-2

Course/ Paper Title	**Protection-Deprotection and Carbohydrate Chemistry**
Course Code	23SMOC48MEA
Semester	IV
No. of Credits	2 Credits (30 Hrs)

Aims & Objectives of the Course

Sr. No.	Objectives
Student should understand and learn;	
1.	Concept of Protection and de-protection groups and its application in organic synthesis
2.	Concept of chiral templates and use of chiral canters for synthesis natural molecules
3.	Basic interconversion of sugar molecules in different forms
4.	Donor and Acceptor concept in glycosylation
5.	Arming, and disarming groups concept and effect of proctective group in glycosylation reaction
6.	Various Glycosyl donors and their activation

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Student should be able to;	
1.	Know and apply the protective groups during organic synthesis that include Protection and deprotection mechanism.
2.	Identify different forms sugar molecules
3.	Understand the formation of Glycosidic bonds using Donor and Acceptor in glycosylation
4.	Understand the Arming, and disarming groups and their role in glycosylation reaction
5.	Identify different Glycosyl donors and their activation.

Syllabus for 23SMOC48MEA: Protection-Deprotection and Carbohydrate Chemistry

Unit No.	Title with Contents	No. of Lectures
I	Protection and de-protection of functional group in organic synthesis: Hydroxyl group- alkyl ether, benzyl ether, acyl, PMB, Trityl, TMS, TBDMS, THP, MOM, MEM, MIP ether; Diol - Acetone, Cyclohexanone; Amines- Benzyl, Acyl, CBZ, BOC, FMOC, Carboxyl group-Ester, DCCI, DIPCDI; Ketone and aldehydes- Glycol, Thioglycol, Ketal, Acetal; Orthoesters as protecting groups, Protection de-protection approach - In Solid phase synthesis of polypeptide; polynucleotide, cyclitols, and amino-sugars.	10
II	Basics of Carbohydrates: Introduction of sugars, structures of monosaccharides, triose, tetrose, pentose, hexose, D/L forms of aldoses and ketoses in Fisher projections, cyclic hemiacetal forms of monosaccharides, representation of monosaccharide structure (Fisher, Zig-zag, Mills, Haworth projection and Chair conformation), The structure of Glucose, the anomeric configuration, mutarotation (D-Glucose), Conformations of monosaccharides, the anomeric effect. Modified monosaccharides, Alditols, Cyclitols, Nomenclature of monosaccharides, Cyclic forms of the α and β-D-aldoses.	05
III	Glycosyl donor and acceptor concept, their role in glycosylation Effect of protecting groups on glycosylation stereoselectivity and coupling efficiency, Arming, and disarming groups concept. General methods and stereochemical aspect of glycosyl bond formation	08
IV	Synthesis of glycosyl donor such as; Halides, Trichloroacetimides, Glycals and Glycal derivatives, Thioglycosides, Phosphites, n-Pentyl glycosides, Sulfoxides Diazarines and their glycosylation reaction, Alkylation of reducing sugars. Mannosides, Synthesis of 2-Deoxy Sugars, Orthogonal strategy in Oligosaccharide synthesis. Intramolecular glycosylation	07

Reference Books: -

1. Greene's protective groups in organic synthesis –Wuts and Green 4th Edn. Wiley-India
2. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
3. Modern organic synthesis-An introduction- George S. Zweifel, Michael H. Nantz.
4. Advanced Organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)
5. Chiron Approach in organic synthesis – S. Hanessianh
6. Organic Chemistry – R. P. Morrison and R. N. Boyd
7. Organic Chemistry – I. L. Finar, volume II.
8. Essentials of Carbohydrate Chemistry and Biology: T. K. Lindhorst, WILEY-VCH, 2000, Chapter 3.
9. Monosaccharide's: Their Chemistry and their Roles in Natural Products: Peter M. Collins, Robert J. Ferrier: John Wiley & Sons, 1995.
10. Carbohydrate in Chemistry and Biology: Part 1 Chemistry of Saccharides Vol.1. WILEY-VCH, 2000.
11. The Organic Chemistry of Sugars; By: Daniel E. Levy Peter Fugedi, Publication: Taylor & Francis, Published on 2006
12. Handbook of Chemical Glycosylation by Alexei V. Demchenko, Wiley VCH, 2008.

Course/ Paper Title	**Medicinal Chemistry**
Course Code	**23SMOC48MEB**
Semester	IV
No. of Credits	2 Credits (30 hours)

Aims & Objectives of the Course

Sr. No.	Objectives
Student should understand and learn;	
1.	The basic ideas of drug development and discovery.
2.	To educate students on many areas of novel drug development and discovery
3.	Drug interaction with biological target

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
Student should be able to;	
1.	Do Drug screening, target identification
2.	lead discovery, optimization
3.	The molecular basis of drug design and drug action.

Syllabus for 23SMOC48MEB: Medicinal Chemistry

Unit No.	Title with Contents	No. of Lectures
I	**Introduction to Medicinal Chemistry** - History, drug targets, Drug discovery, design and development, Case Study: Design of Oxamniquine.	**04**
II	**Pharmacokinetics and Pharmacodynamics of drug**: Drug absorption, distribution, metabolism, elimination and toxicity, drug metabolism, biotransformation, Drug receptor interactions, Hansch Equation and significance of terms involved in it.	**06**
III	Structure and activity Relationship: QSAR, Applications of SAR and QSAR in drug design, physio-chemical parameters lipophilicity, partition coefficient, electronic ionization constant, Case Study: Statins.	**10**
IV	Introduction, Developments, SAR, Mode of action, limitations and adverse effect of Anti-infective Agents, Beta lactam antibacterial agents (Penicillins, Cephalosporins), Tetracyclins, Macrolides, Chloramphenicol, Polyenes, Amphotrecin-B, Azoles, Amantadine, Acyclovir, Quinine, Quinolines, Quinolones, Refamycine, Sulphonamides.	**10**

Reference Books:

1. Biochemistry, 5th Ed.(Hardcover) by Lubert Stryer, Jeremy M.Berg, and John L. Tymoczko.

2. Amino acids, peptides and proteins, by J.S. Davies, Royal Society of Chemistry, UK, Vol. 35, 2006.

3. Medicinal Chemistry and Drug Discovery by Burger.

4. Introduction to Medicinal Chemistry by Grham and Patrick.

5. Introduction to Drug Design by J. R. Dimmock and S.S. Pandeya.

6. The Organic Chemistry of Drug Design and Drug Action, 3rd Edition, R. B. Silverman, Academic Press, 2014.

7. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F Dorge, 12th Edition, 2010.

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Course/ Paper Title	**Techniques in Molecular Biology**
Course Code	**23SMOC48MEC**
Semester	IV
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
Students should – 1. To encourage students to adopt a multidisciplinary approach by integrating principles and techniques from Biology into the field of Chemistry. 2. To provide students with a thorough understanding of the principles and techniques employed in Molecular Biology, Recombinant DNA Technology, Immunotechniques, Microscopic Techniques, and Radiolabelling. 3. To familiarize students with practical applications of Molecular Biology and other techniques in the analysis of biological molecules, cells, and tissues. 4. To develop critical thinking skills for interpreting and analyzing data generated through various biological methods. 5. To introduce students to advanced techniques such as one and two-dimensional gel electrophoresis, ELISA, western blot, FISH, GISH, and radiolabelling.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Students should demonstrate a deep understanding of the fundamental concepts and principles of molecular biology, recombinant DNA technology, immunotechniques, microscopic techniques, and radiolabelling. 2. Apply knowledge gained to effectively analyze and interpret data generated through various biological methods. 3. Evaluate the significance of techniques in addressing biological questions and their applications in diverse fields, including medical research. 4. Critically analyze scientific literature related to the methods covered in the course, understanding their implications and limitations. 5. Communicate effectively about biological methods, research findings, and ethical considerations, both in oral and written forms.

Syllabus for 23SMAC48MEC: Techniques in Molecular Biology

Sr. No.	Name of the Topic	Lectures
1	**Recombinant DNA Technology:** Isolation, purification of RNA, DNA and Proteins. Analysis of RNA, DNA and Proteins by one and two dimensional gel electrophoresis, Isoelectric focusing gels. Isolation, separation and analysis of carbohydrates and lipid molecules. RFLP, RAPD and AFLP techniques. **Ref. 1 and Ref 2: Relevant Pages**	08
2	**Immunoanalytical Techniques:** Radioimmunoassay, its principle and applications, instrumentation for radio bioassay, clinical application of the radioimmunoassay of insulin, Estrogen and progesterone. Enzyme- linked immunosorbent assay (ELISA), Types of ELISA, principles, practical aspects, applications. Detection of Molecules using: ELISA, RIA, western blot, Immunoprecipitation, flow cytometry and immunofluorescence. Detection of Molecules in living cells, Insitu localization by techniques such as FISH and GISH. **Ref. 6: Pages 201-210, Ref. 7: Pages 199-221**	08

	Ref. 3: Relevant Pages	
3	**Microscopic Techniques:** Visualization of cells and sub-cellular components by light microscope. Resolving power of different microscopes, Microscopy of living cells, SEM and TEM. , Different fixation and staining techniques. **Ref. 4: Relevant Pages**	06
4	**Radioanalytical Methods of Analysis:** Introdcution, **a) Activation analysis:** Neutron activation analysis, principle, technique, steps involved in neutron activation analysis. Radiochemical and instrumental methods of analysis, important applications of NAA. **b) Isotope dilution analysis:** Principle, types of isotope dilution analysis, typical applications of isotope dilution analysis. Detection and measurement of different types of Radio isotopes used in biology. Incorporation of radioisotopes in biological cells and tissues. Molecular imaging of radioactive material, Safety guidelines. **Ref. 5: Pages 337-350**	08

References:

1. Molecular Biology of the Cell" by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter.
2. Molecular Biology Techniques: An Intensive Laboratory Course" by Heather B. Miller, D. Scott Witherow.
3. Current Protocols in Immunology" by John E. Coligan, Ada M. Krieg, David M. Shevach, et al.
4. Fundamentals of Light Microscopy and Electronic Imaging" by Douglas B. Murphy.
5. Nuclear and Radiochemistry : Fundamentals and Applications by Karl Heinrich Lieser, VCH Publishers, Inc., New York, NY (USA)
6. Immunology An Introductory Textbook by Anil K. Sharma, Pan Stanford Publishing Pvt. Ltd., Singapore.
7. Understanding Bioanalytical Chemistry - Principles and applications by Victor A. Gault and Neville H. McClenaghan, A John Wiley & Sons, Ltd.
8. Principles and Practice of Immunoassay by Christopher P. Price and David J. Newman, Macmillan Publishers Ltd, 1991

Course/ Paper Title	**Research Project**
Course Code	23SMOC41RP
Semester	IV
No. of Credits	6 Credits

Aims & Objectives of the Course

Sr. No.	Objectives
	Student should understand and learn;
1.	Students should carry out a small research project separately.
2.	This should make them familiar with i. Literature survey, research methodologies ii. Data Analysis iii. Column and TLC chromatographic techniques iv. Characterization of the products by analytical and spectral methods. v. paper writing

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	Understand the various synthetic pathways and implement it in the production of pharmacological compounds.
2.	Students will be able to interpret spectral data and other observations.
3.	Students will be to write research paper and submission process to journals

Details for 23SMOC41RP: Project

The candidates should continue the project work in the Fourth Semester as mentioned in course 23SMOC31RP.

Complete Project report copies must be submitted to department and guide at the time of examination. Project report must contain following point.

Contents
Project report must be written and submitted in a proper format as follows; i. Certificate (Signed by Project guide and Head of the Department) ii. Certificates for Poster/Paper presented in conferences (if any) iii. Self-declaration certificate for plagiarism iv. Introduction (not more than 6 pages) v. Experimental Section vi. Results and Discussions vii. Conclusion viii. References (Use ACS format) ix. Spectroscopic or other relevant supporting data x. Acknowledgement The submission of review paper with minimum 200 references is expected from the students. Final Project will be evaluated jointly by all examiners. Typically, student must present his project work with discussion of results and conclusions in details (15-20 min.) which will be followed by question-answer session (10 min). It is open type of examination.

Dr. Khursheed Ahmed
Chairman, BoS Chemistry
and Head, Department of Chemistry.