Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year Degree Program in Chemistry
(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Organic Chemistry) Part-II Semester -III

For Department of Chemistry

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2023-2024

Title of the Programme: M.Sc. II (Organic Chemistry)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Chemistry and related subjects, the Board of Studies in Chemistry at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of M.Sc. Part-II Chemistry , which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

A chemistry degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Graduates in chemistry find opportunities in various fields, including This includes industries like glass, cement, paper, textile, leather, dye, etc. We also see huge chemistry applications in industries like paints, pigments, petroleum, sugar, plastics, and Pharmaceuticals.

Overall, revising the chemistry syllabus in accordance with the NEP 2020 ensures that

students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing healthcare needs.

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science & Commerce, Baramati.

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati is an autonomous & dynamic institute and has successfully implemented the National Education Policy-2020 since the academic year 2023-24. We are updating our academic policies as per local needs keeping in view the global perspectives. Accordingly, we have updated our program outcomes as per the graduate attributes defined in New Education Policy.

Program Outcomes for M.Sc.

1. Comprehensive Knowledge and Understanding:

Postgraduates will possess a profound understanding of their field, encompassing foundational theories, methodologies, and key concepts within a multidisciplinary context.

2. Practical, Professional, and Procedural Knowledge:

Postgraduates will acquire practical skills and expertise necessary for professional tasks, including industry standards, regulations, and ethical considerations, with effective application in real-world scenarios.

3. Entrepreneurial Mindset, Innovation, and Business Understanding:

Postgraduates will cultivate an entrepreneurial mindset, identify opportunities, foster innovation, and understand business principles, market dynamics, and risk management strategies.

4. Specialized Skills, Critical Thinking, and Problem-Solving:

Postgraduates will demonstrate proficiency in technical skills, analytical abilities, effective communication, and leadership, adapting and innovating in response to changing circumstances.

5. Research, Analytical Reasoning, and Ethical Conduct:

Postgraduates will exhibit observational and inquiry skills, formulate research questions, utilize appropriate methodologies for data analysis, and adhere to research ethics while effectively reporting findings.

6. Communication, Collaboration, and Leadership:

Postgraduates will effectively communicate complex information, collaborate in diverse teams, demonstrate leadership qualities, and facilitate cooperative efforts toward common goals.

7. Digital Proficiency and Technological Skills:

Postgraduates will demonstrate proficiency in using ICT, accessing information sources, analyzing data using appropriate software, and adapting to technological advancements.

8. Multicultural Competence, Inclusive Spirit, and Empathy:

Postgraduates will engage effectively in multicultural settings, respect diverse perspectives, lead diverse teams, and demonstrate empathy and understanding of others' perspectives and emotions.

9. Value Inculcation, Environmental Awareness, and Ethical Practices:

Postgraduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and promote sustainability and environmental conservation.

10. Autonomy, Responsibility, and Accountability:

Postgraduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts, contributing to societal well-being.

List of Members Present for the BOS Meeting

The following internal and external BOS members were attended the Board of Studies

Sr. No.	Name of Member	Designation
1.	**Dr. Sanjay R. Kale** Head & Professor, Department of Chemistry, T. C. College, Baramati.	Chairman
2.	**Dr. Namdeo N. Bhujbal** Professor, Department of Chemistry Magar College, Hadapsar, Pune	External Member VC Nominee.
3.	**Dr. D. M. Pore** Professor, Department of Chemistry Shivaji University, Kolhapur	External Member from other University
4.	**Dr.Shrikrushna T. Salunke** Associate Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
5.	**Mr. Bhimrao R. Torane** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
6.	**Mr. Maharudra A. Dudhe** Assistant Professor, Department of Chemistry, T. C. College, Baramati	Internal Member
7.	**Mr. Ravikiranamrut R. Gandhi** Assistant Professor, Department of Chemistry T. C. College, Baramati	Internal Member
8.	**Dr. Vaibhav P. Landage** Associate Professor, Department of Chemistry T. C. College, Baramati	Internal Member
9.	**Dr. Yogesh N. Indulkar** Assistant Professor, Department of Chemistry T. C. College, Baramati	Internal Member
10.	**Dr. Rahul S. Bhondwe.** Assistant Professor, Department of Chemistry T. C. College, Baramati	Internal Member
11.	**Dr. Nilam C. Dige** Assistant Professor, Department of Chemistry T. C. College, Baramati.	Internal Member
12.	**Mrs. Supriya S. Deokate** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
13.	**Mrs. Jyoti T. Waghmode** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
14.	**Ms. Geetanjali S. Bhunje** Assistant Professor, Department of Chemistry,	Internal Member

	T. C. College, Baramati.	
15.	**Mrs. Reshma T. Gadadare** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
16.	**Mrs. Swati A. Deokate** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
17.	**Mrs. Gaytri D. Pirale** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
18.	**Mrs. Sonali P. Nale** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
19.	**Ms. Farhin H. Shaikh** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
20.	**Ms. Anjali N. Bhong** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
21.	**Mr. Harshad J. Salunkhe** Assistant Professor, Department of Chemistry, T. C. College, Baramati.	Internal Member
22.	**Mr. Saurabh Pandhare** T. C. College, Baramati	PG Student
23.	**Mr. Niranjan Ghuge** T. C. College, Baramati	UG Student
24.	**Mr. Vijay Gorave** T. C. College, Baramati	UG Student

Course & Credit Structure for M. Sc. II Organic Chemistry (2023 Pattern)
as per NEP – 2020

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
III	Major Mandatory	CHO-601-MJM	**Retrosynthesis and stereochemistry**	Theory	**04**
	Major Mandatory	CHO-602-MJM	**Spectroscopy in Organic chemistry**	Theory	**04**
	Major Mandatory	CHO-603-MJM	Ternary Mixture Analysis	Practical	**02**
	Major Mandatory	CHO-604-MJM	Double stage preparation	Practical	**02**
	Major Elective	CHO-611-MJE(A)	Pericyclic reactions	Theory	**02**
		CHO-611-MJE(B)	Photochemistry		
	Major Elective	CHO-612-MJE(A)	Preparation of Analogs	Practical	**02**
		CHO-612-MJE(B)	Single stage preparation		
		CHO-621-RP	Research Project	Practical	**04**
				Total Credits Semester-III	**20**
IV	Major Mandatory	CHO-651-MJM	Chemistry of Natural Products	Theory	**04**
	Major Mandatory	CHO-652MJM	Advanced Synthetic Organic Chemistry	Theory	**04**
	Major Mandatory	CHO-653-MJM	Green Chemistry Practical	Practical	**02**
	Major Elective	CHO-661-MJE(A)	A)Organic Stereochemistry	Theory	**02**
		CHO-661-MJE(B)	B) Asymmetric Synthesis		
	Major Elective	CHO-662-MJE(A)	A) Innovative experiments in organic chemistry	Practical	**02**
		CHO-662-MJE(B)	**B)** Multiple stage preparation		
	Research Project (RP)	CHO-681-RP	Research Project	Practical	**06**
				Total Credits Semester-IV	**20**
				Cumulative Credits Semester III + Semester IV	**40**

CBCS Syllabus as per NEP 2020 for M.Sc. II Organic chemistry (NEP Pattern)

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** CHE
Class	**:** M.Sc. II
Semester	**:** III
Course Type	**:** Mandatory Theory
Course Name	**:** Retrosynthesis and Stereochemistry
Course Code	**:** CHO-601-MJM
No. of Lectures	**:** 60
No. of Credits	**:** 4 credits

Course Objective

Course Objective:

1) To provide students with a thorough understanding of the principles and strategies involved in retrosynthetic analysis, including the identification of key functional groups, disconnections, and the selection of appropriate synthetic pathways.
2) To introduce students to the concept of protecting functional groups during organic synthesis and the selection of appropriate protective groups.
3) To understand the rationale behind protection, the methods for introducing and removing protective groups, and the impact of protective groups on reaction selectivity.
4) To develop students' problem-solving skills and critical thinking abilities by providing them with opportunities to analyze complex synthetic problems, propose synthetic routes, and evaluate the feasibility and efficiency of different strategies.
5) To explore the different conformations and their energy profiles of six-membered and fused bridge cage ring compounds. This includes understanding the factors that influence conformational stability and the interconversion between different conformers.
6) To study the stereochemistry of reactions involving six-membered and fused bridge cage ring compounds.
7) To gain a deep understanding of the stereochemistry of six-membered and fused bridge cage ring compounds, enabling them to analyze and predict stereochemical outcomes in reactions, design synthetic routes.

Course Outcome

Course Outcomes : On completion of the course, the student should be able to;

CO1. Understand the principles of stereochemistry and apply them to analyze the stereochemistry of six-membered rings, rings other than six-membered, fused bridged, and caged rings.

CO2. Analyze the conformation and physical properties of cyclohexane derivatives, and apply this knowledge to predict their behavior in different environments.

CO3. Evaluate the conformation and reactivity of cyclohexane in various chemical reactions, and explain the factors influencing these processes.

CO4. Compare and contrast the stereochemistry of rings other than six-membered rings, such as three, four, and five-membered rings, as well as larger rings.

CO5. Identify and explain the concept of I-strain in ring structures, and predict its impact on the stability and reactivity of different ring systems.

CO6. Understand the concept of synthons and synthetic equivalents, and apply the disconnection approach to plan retrosynthetic analysis in organic synthesis.

CO7. Analyze and perform functional group interconversions, recognizing the importance of the order of events in organic synthesis to achieve desired transformations efficiently.

Topics and Learning Points

1. Retrosynthesis and Protection of functional group (30 L)

A) An introduction to Synthons and synthetic equivalents, disconnecttion approach, functional group interconversions. Importance of the Order of events in organic synthesis, Chemoselectivity, Regioselectivity, Protecting groups, Diels-Alder reaction, Michael addition and Robinson annulation. Retro- synthesis of - alkene, acetylenes and aliphatic nitro alcohols, carbonyl compounds, amines, aromatic heterocycles, 3, 4, 5 & 6 membered carbocyclic and heterocyclic rings. Synthesis of some typical organic molecules- Abscisic acid and Longifolene. Umpolung in organic synthesis.

B) Protection and de-protection of hydroxyl, amino, carbonyl and carboxyl groups. Importance of Chemoselectivity and Regioselectivity in protection and deprotection. Ketone and aldehyde functions as illustrated in the synthesis of polypeptide and polynucleotide.

2. Organic Stereochemistry-I (30 L)

1. Stereochemistry of six membered rings.:disubstituted and polysubstituted

cyclohexanes,conformation and physical properties in cyclohexane derivatives,conformation and reactivity in cyclohexane Ref.1,3, 4, 5

2. Stereochemistry of rings other than six membered:three, four, five membered ring, larger than six mebered rings, concept of I-strain Ref.1,3, 4, 5

3. Fused Bridged and caged rings:conformational study of perhydrophenanthrene, and perhydroanthracene Ref. 1,2, 3,4

References:

1. Designing of organic synthesis– S.Warren (Wiley)
2. Some modern methods of organic synthesis–W.Carruthers (Cambridge)
3. Organic chemistry–J. Clayden, N. Greeves, S.Warren andP. Wothers (OxfordPress)
4. Advanced organic chemistry,PartB–F.ACareyandR.J.Sundberg,5thedition(2007)
5. Guide book to organic synthesis-RKMeckie,D MSmithand RAAtken
6. Organic synthesis-RobertE Ireland
7. Stereochemistry of carbon compounds - E.L. Eliel
8. Stereochemistry of carbon compounds - E.L.Eliel and S. H. Wilen
9. Stereochemistry of organic compounds –Nasipuri
10. Stereochemistry of organic compounds-Kalsi
11. Organic stereochemistry–Jagdamba Singh

Choice Based Credit System Syllabus
(NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**:Organic Chemistry
Course: Retrosynthesis and Stereochemistry **Course Code**: CHO-601-MJM
Weightage: 1=weak or low relation, 2= moderate or partial relation, 3=strong or direct relation

Program Outcomes (POs) and Course Outcomes (COs) Matrix with Weightage:

	Programme Outcomes(POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	0	0	0	0	3	0	0	2	1
CO2	2	2	0	3	0	0	0	0	0	0
CO3	1	3	2	0	0	0	0	0	0	0
CO4	2	0	0	2	3	0	0	0	0	0
CO5	1	3	0	2	2	0	0	0	0	0
CO6	3	3	0	0	0	3	0	0	2	0
CO7	0	0	2	2	2	0	3	2	3	0

Justification for the mapping

PO1 **Comprehensive Knowledge and Understanding:**
CO1. Understand the principles of stereochemistry and apply them to analyze the stereochemistry of six-membered rings, rings other than six-membered, fused bridged, and caged rings.
CO2. Analyze the conformation and physical properties of cyclohexane derivatives, and apply this knowledge to predict their behavior in different environments.
CO3. Evaluate the conformation and reactivity of cyclohexane in various chemical reactions, and explain the factors influencing these processes.
CO4. Compare and contrast the stereochemistry of rings other than six-membered rings, such as three, four, and five-membered rings, as well as larger rings.
CO5. Identify and explain the concept of I-strain in ring structures, and predict its impact on the stability and reactivity of different ring systems.
CO6. Understand the concept of synthons and synthetic equivalents, and apply the disconnection approach to plan retrosynthetic analysis in organic synthesis.

PO2 Practical, Professional, and Procedural Knowledge:
CO2. Analyze the conformation and physical properties of cyclohexane derivatives, and apply this knowledge to predict their behavior in different environments.
CO3. Evaluate the conformation and reactivity of cyclohexane in various chemical reactions, and explain the factors influencing these processes.
CO5. Identify and explain the concept of I-strain in ring structures, and predict its impact on the stability and reactivity of different ring systems.
CO6. Understand the concept of synthons and synthetic equivalents, and apply the disconnection approach to plan retrosynthetic analysis in organic synthesis.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:
CO3. Evaluate the conformation and reactivity of cyclohexane in various chemical reactions, and explain the factors influencing these processes.
CO7. Analyze and perform functional group interconversions, recognizing the importance of the order

of events in organic synthesis to achieve desired transformations efficiently.

PO4 Specialized Skills, Critical Thinking, and Problem-Solving:
CO2. Analyze the conformation and physical properties of cyclohexane derivatives, and apply this knowledge to predict their behavior in different environments.
CO4. Compare and contrast the stereochemistry of rings other than six-membered rings, such as three, four, and five-membered rings, as well as larger rings.
CO5. Identify and explain the concept of I-strain in ring structures, and predict its impact on the stability and reactivity of different ring systems.
CO7. Analyze and perform functional group interconversions, recognizing the importance of the order of events in organic synthesis to achieve desired transformations efficiently.

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO4. Compare and contrast the stereochemistry of rings other than six-membered rings, such as three, four, and five-membered rings, as well as larger rings.
CO5. Identify and explain the concept of I-strain in ring structures, and predict its impact on the stability and reactivity of different ring systems.
CO7. Analyze and perform functional group interconversions, recognizing the importance of the order of events in organic synthesis to achieve desired transformations efficiently..

PO6 Communication, Collaboration, and Leadership:
CO1. Understand the principles of stereochemistry and apply them to analyze the stereochemistry of six-membered rings, rings other than six-membered, fused bridged, and caged rings.
CO6. Understand the concept of synthons and synthetic equivalents, and apply the disconnection approach to plan retrosynthetic analysis in organic synthesis.

PO7 Digital Proficiency and Technological Skills:
CO7. Analyze and perform functional group interconversions, recognizing the importance of the order of events in organic synthesis to achieve desired transformations efficiently.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO7. Analyze and perform functional group interconversions, recognizing the importance of the order of events in organic synthesis to achieve desired transformations efficiently.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO1. Understand the principles of stereochemistry and apply them to analyze the stereochemistry of six-membered rings, rings other than six-membered, fused bridged, and caged rings.
CO6. Understand the concept of synthons and synthetic equivalents, and apply the disconnection approach to plan retrosynthetic analysis in organic synthesis.
CO7. Analyze and perform functional group interconversions, recognizing the importance of the order of events in organic synthesis to achieve desired transformations efficiently.

PO10 Autonomy, Responsibility, and Accountability:
CO1. Understand the principles of stereochemistry and apply them to analyze the stereochemistry of six-membered rings, rings other than six-membered, fused bridged, and caged rings.

CBCS Syllabus as per NEP 2020 for M.Sc. II Organic chemistry (NEP Pattern)

Name of the Programme	: M.Sc. Chemistry
Program Code	: CHE
Class	: M.Sc. II
Semester	: III
Course Type	: Mandatory Theory
Course Name	: Spectroscopy in Organic chemistry
Course Code	: CHO-602-MJM
No. of Lectures	: 60
No. of Credits	: 4 credits

Course Objective

Course Objective:

1) Students will learn how to use ^{1}HNMR, ^{13}CMR and Mass Spectroscopy data to determine the structure of organic compounds.
2) Students will assign peaks in NMR spectra, correlating NMR data with molecular structure, and using Mass Spectroscopy data to support structural assignments.
3) Students will explore the various applications of ^{1}HNMR, ^{13}CMR and Mass Spectroscopy in chemistry, such as identifying unknown compounds, monitoring chemical reactions, and studying molecular dynamics.
4) Students will learn the fundamental principles and theory behind ^{1}HNMR, ^{13}CMR and Mass Spectroscopy techniques.
5) Students will develop the skills to interpret ^{1}HNMR, ^{13}CMR and Mass Spectroscopy spectra, including identifying functional groups, determining chemical shifts, analyzing peak patterns, and understanding fragmentation patterns in Mass Spectroscopy.
6) Students will gain knowledge about the instrumentation used in ^{1}HNMR, ^{13}CMR and Mass Spectroscopy, including the components and operation of the instruments.
7) Students will also learn data analysis techniques, such as peak integration and spectral manipulation.

Course Outcomes

Course Outcomes: On completion of the course, the student should be able to:

CO1. Apply ^{1}HNMR, ^{13}CMR spectroscopy to determine the electronic transitions and conjugation in organic compounds.

CO2. Integrate multiple spectroscopic techniques to solve complex structural problems.

CO3. Develop critical thinking and problem-solving skills in the context of spectroscopic

analysis.

CO4. Understand the principles and theory behind different spectroscopic methods.

CO5. Interpret ^{1}HNMR, spectra to determine the non equivalent protons in organic compounds.

CO6. Interpret ^{13}CMR spectra to determine the non equivalent protons in organic compounds.

CO7. Utilize mass spectrometry to determine the molecular weight and fragmentation pattern of organic compounds.

Topics and Learning Points

1. ^{1}HNMR Spectroscopy (20 L)

Recapitulation of basic principle, Chemical shift, factors influencing chemical shift, deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei(alcohols, phenols, enols, acids, amides and mercaptans), chemical exchange, effect of deuteration, spin-spin coupling, (n+1) rule, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), factors effecting coupling constant "*J*", Spin decoupling. Significance of coupling constant, simplification of complex spectra, nuclear magnetic double resonance, spin decoupling, contact shift reagents, solvent effects, nuclear over-hauser effect (NOE). NMR of other nuclei such as Al, P, F, Si etc.

2. ^{13}CNMR spectroscopy (20 L)

FT NMR, Types of ^{13}C NMR Spectra: un-decoupled, Proton decoupled, Off resonance, , DEPT with 3 different angles, chemical shift, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbons, factors affecting chemical shifts, chemical shifts of solvents, Homo nuclear (^{13}C-^{13}C) and Hetero nuclear (^{13}C-^{1}H)coupling constants.

3. Mass Spectrometry (15L)

Instrumentation, various methods of ionization (field ionization, field desorption, SIMS, FAB, MALDI, Californium plasma), different detectors (magnetic analyzer, ion cyclotron analyzer, Quadrapole mass filter, time of flight (TOF). Rules of fragmentation of different functional groups, factors controlling fragmentation

4. Structural problems based on combined spectroscopic techniques. **(05L)**

References:

1. Introduction to Spectroscopy-D.L. Pavia, G. M. Lampman, G. S. Kriz,3rd Ed. (Harcourtcollege publishers).
2. Spectrometric identification of organic compounds R. M. Silverstein, F. X. Webster,6th Ed. John Wiley and Sons.
3. Spectroscopic methods in organic chemistry- D. H. Williams and I. Flemming McGraw Hill
4. Absorption spectroscopy of organic molecules - V. M. Parikh
5. Nuclear Magnetic Resonance- Basic Principles - Atta-Ur-Rehman, Springer-Verlag (1986).
6. One and Two dimensional NMR Spectroscopy-Atta-Ur-Rehman, Elsevier(1989).
7. Organic structure Analysis- Phillip Crews, Rodriguez, Jaspars, Oxford University Press (1998)
8. Organic structural Spectroscopy- Joseph B. Lambert, Shurvell, Lightner, Cooks, Prentice-Hall(1998).

Choice Based Credit System Syllabus
(NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**:Organic Chemistry
Course: Spectroscopy in Organic chemistry **Course Code**: CHO-602-MJM
Weightage: 1=weak or low relation, 2= moderate or partial relation, 3=strong or direct relation

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	Programme Outcomes(POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	0	0	0	0	2	2	0	2	1
CO2	2	0	2	3	0	0	0	0	0	0
CO3	2	0	2	3	0	0	0	0	0	0
CO4	2	0	3	3	3	0	0	0	0	0
CO5	0	3	0	3	2	0	0	0	0	0
CO6	0	3	0	2	0	1	0	0	2	0
CO7	0	2	0	0	3	0	0	2	3	0

Justification for the mapping

PO1 **Comprehensive Knowledge and Understanding:**

CO8. Apply ^{1}HNMR, ^{13}CMR spectroscopy to determine the electronic transitions and conjugation in organic compounds.

CO9. Integrate multiple spectroscopic techniques to solve complex structural problems.

CO10. Develop critical thinking and problem-solving skills in the context of spectroscopic analysis.

CO11. Understand the principles and theory behind different spectroscopic methods.

PO2 Practical, Professional, and Procedural Knowledge:

CO5. Interpret 1HNMR, spectra to determine the non equivalent protons in organic compounds.
CO6. Interpret 13CMR spectra to determine the non equivalent protons in organic compounds.
CO7. Utilize mass spectrometry to determine the molecular weight and fragmentation pattern of organic compounds.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:

CO2. Integrate multiple spectroscopic techniques to solve complex structural problems.
CO3. Develop critical thinking and problem-solving skills in the context of spectroscopic analysis.
CO4. Understand the principles and theory behind different spectroscopic methods.

PO4 Specialized Skills, Critical Thinking, and Problem-Solving:

CO2. Integrate multiple spectroscopic techniques to solve complex structural problems.
CO3. Develop critical thinking and problem-solving skills in the context of spectroscopic analysis.
CO4. Understand the principles and theory behind different spectroscopic methods.
CO5. Interpret 1HNMR, spectra to determine the non equivalent protons in organic compounds.

CO6. Interpret 13CMR spectra to determine the non equivalent protons in organic compounds.

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO4. Understand the principles and theory behind different spectroscopic methods.
CO5. Interpret 1HNMR, spectra to determine the non equivalent protons in organic compounds.
CO7. Utilize mass spectrometry to determine the molecular weight and fragmentation pattern of organic compounds.

PO6 Communication, Collaboration, and Leadership:
CO1. Apply 1HNMR, 13CMR spectroscopy to determine the electronic transitions and conjugation in organic compounds.
CO6. Interpret 13CMR spectra to determine the non equivalent protons in organic compounds.

PO7 Digital Proficiency and Technological Skills:
CO1. Apply 1HNMR, 13CMR spectroscopy to determine the electronic transitions and conjugation in organic compounds.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO7. Utilize mass spectrometry to determine the molecular weight and fragmentation pattern of organic compounds.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO1. Apply 1HNMR, 13CMR spectroscopy to determine the electronic transitions and conjugation in organic compounds.
CO6. Interpret 13CMR spectra to determine the non equivalent protons in organic compounds.
CO7. Utilize mass spectrometry to determine the molecular weight and fragmentation pattern of organic compounds.

PO10 Autonomy, Responsibility, and Accountability:
CO1. Apply 1HNMR, 13CMR spectroscopy to determine the electronic transitions and conjugation in organic compounds.

CBCS Syllabus as per NEP 2020 for M.Sc. II Organic chemistry (NEP Pattern)

Name of the Program	**:** M.Sc. Chemistry
Program Code	**:** CHO
Class	**:** M.Sc. II
Semester	**:** III
Course Type	**:** Mandatory Practical
Course Name	**:** Ternary Mixture Analysis
Course Code	**:** CHO-603-MJM
No. of Lectures	**:** 30
No. of Credits	**:** 02 credits

Course Objectives

Course Objective:

1. To understand the principles used in the analysis of ternary mixtures of organic compounds,
2. To learn the techniques used in the analysis of ternary mixtures of organic compounds,
3. Identify and characterize individual components within a ternary mixture based on their physical and chemical properties, utilizing separation and identification methods effectively.
4. To utilize separation and identification methods based on their physical and chemical properties effectively.
5. To apply quantitative analysis methods to determine the relative proportions of each component in a ternary mixture,
6. Evaluate the limitations and challenges associated with analyzing ternary mixtures of organic compounds, and propose strategies to overcome potential obstacles in the analytical process.
7. Apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

Course Outcomes

Course Outcomes:

CO1. Student should get comprehensive knowledge about the principles used in the analysis of ternary mixtures of organic compounds,

CO2. Student should learn the techniques used in the analysis of ternary mixtures of organic compounds.

CO3. Student should identify and characterize individual components within a ternary mixture based on their physical and chemical properties, utilizing separation and identification methods effectively.

CO4. Student should utilize separation and identification methods based on their physical and chemical properties effectively.

CO5. Student should apply quantitative analysis methods to determine the relative proportions of each component in a ternary mixture,

CO6. Student should evaluate the limitations and challenges associated with analyzing ternary mixtures of organic compounds, and propose strategies to overcome potential obstacles in the analytical process.

CO7. Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

Topics and Learning Points

Separation of ternary mixture using micro-scale technique

1. Separation of solid / liquid components of a ternary mixture based upon differences in the physical and the chemical properties of the components.
2. Type determination of the three components
3. Purification of the three components,
4. Determination of their physical constants.
5. Complete Identification of any two organic compounds

References:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall
3. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.

5. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
6. 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.
7. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.

Choice Based Credit System Syllabus
(NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**:Organic Chemistry
Course: Ternary Mixture Analysis **Course Code**: CHO-603-MJM

Weightage: 1=weak or low relation, 2= moderate or partial relation, 3=strong or direct relation

Program Outcomes (POs) and Course Outcomes (COs) Matrix with Weightage:

	Program Outcomes(POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	0	3	0	0	0	0	3	3
CO2	3	3	0	2	1	3	3	2	0	0
CO3	2	3	2	0	0	0	0	0	0	0
CO4	1	3	0	3	0	0	0	0	0	2
CO5	2	2	0	3	0	0	0	0	3	0
CO6	0	1	0	1	2	0	0	0	0	0
CO7	0	1	3	0	3	2	3	3	0	3

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:

CO1. Student should get comprehensive knowledge about the principles used in the analysis of ternary mixtures of organic compounds,
CO2. Student should learn the techniques used in the analysis of ternary mixtures of organic compounds.
CO3. Student should identify and characterize individual components within a ternary mixture based on their physical and chemical properties, utilizing separation and identification methods effectively.
CO4. Student should utilize separation and identification methods based on their physical and chemical properties effectively.
CO5. Student should apply quantitative analysis methods to determine the relative proportions of each component in a ternary mixture,

PO2 Practical, Professional, and Procedural Knowledge:

CO1. Student should get comprehensive knowledge about the principles used in the analysis of ternary mixtures of organic compounds,
CO2. Student should learn the techniques used in the analysis of ternary mixtures of organic compounds.
CO3. Student should identify and characterize individual components within a ternary mixture based on their physical and chemical properties, utilizing separation and identification methods effectively.
CO4. Student should utilize separation and identification methods based on their physical and chemical properties effectively.
CO5. Student should apply quantitative analysis methods to determine the relative proportions of each component in a ternary mixture,
CO6. Student should evaluate the limitations and challenges associated with analyzing ternary mixtures of organic compounds, and propose strategies to overcome potential obstacles in the analytical process.
CO7. Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:
CO3. Student should identify and characterize individual components within a ternary mixture based on their physical and chemical properties, utilizing separation and identification methods effectively.
CO7. Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

PO4 Specialized Skills, Critical Thinking, and Problem-Solving:
CO 1. Student should learn the techniques used in the analysis of ternary mixtures of organic compounds.
CO 2. Student should evaluate the limitations and challenges associated with analyzing ternary mixtures of organic compounds, and propose strategies to overcome potential obstacles in the analytical process.
CO 4. Student should utilize separation and identification methods based on their physical and chemical properties effectively.
CO 5. Student should apply quantitative analysis methods to determine the relative proportions of each component in a ternary mixture,
CO 6. Should evaluate the limitations and challenges associated with analyzing ternary mixtures of organic compounds, and propose strategies to overcome potential obstacles in the analytical process.

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO2. Student should learn the techniques used in the analysis of ternary mixtures of organic compounds.

CO6. Student should evaluate the limitations and challenges associated with analyzing ternary mixtures of organic compounds, and propose strategies to overcome potential obstacles in the analytical process.

CO7. Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

PO6 Communication, Collaboration, and Leadership:
CO2. Student should learn the techniques used in the analysis of ternary mixtures of organic compounds.

CO7. Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

PO7 Digital Proficiency and Technological Skills:
CO2. Student should learn the techniques used in the analysis of ternary mixtures of organic compounds.

CO7. Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO1. should apply quantitative analysis methods to determine the relative proportions of each component in a ternary mixture,

CO5 Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:

CO5. Student should apply quantitative analysis methods to determine the relative proportions of each component in a ternary mixture,

CO7. Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices.

PO10 Autonomy, Responsibility, and Accountability:

CO4. Student should utilize separation and identification methods based on their physical and chemical properties effectively.

CO 5. Student should apply quantitative analysis methods to determine the relative proportions of each component in a ternary mixture,

CO7. Student should apply theoretical knowledge and practical skills to solve real-world problems related to the analysis of ternary mixtures, showcasing the ability to apply analytical techniques effectively in complex sample matrices

CBCS Syllabus as per NEP 2020 for M.Sc. II Organic chemistry (NEP Pattern)

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** CHO
Class	**:** M.Sc. II
Semester	**:** III
Course Type	**:** Mandatory Practical
Course Name	**:** Double Stage Preparations
Course Code	**:** CHO-604-MJM
No. of Lectures	**:** 30
No. of Credits	**:** 02 credits

Course Objective

Course Objective:

1) To teach students to break down complex target molecules into simpler, readily available starting materials using retrosynthetic principles. This involves identifying key functional groups and strategic disconnections.
2) To familiarize students with a wide range of reactions and techniques for the conversion of one functional group into another.
3) Understanding reaction mechanisms, regioselectivity, and stereoselectivity.
4) To develop students' skills in designing multi-step synthetic routes based on the selection of appropriate reactions and reagents.
5) To introduce students to practical laboratory techniques commonly used in multi-step organic synthesis, including purification methods, separation techniques, and characterization techniques (such as spectroscopy).
6) To enhance students' problem-solving skills and critical thinking abilities by providing them with opportunities to analyze complex synthetic problems and propose efficient solutions.
7) To emphasize the importance of safety protocols and ethical considerations in the practice of organic chemistry, particularly in multi-step synthesis involving potentially hazardous reagents or reactions.

Course Outcomes

Course Outcomes : On completion of the course, the student should be able to;

CO1. Understanding the principles and mechanisms of nitration, sulphonation, oxidation, reduction, and hydrolysis reactions in double stage preparation.

CO2. Acquiring knowledge of the various reagents, catalysts, and conditions used in these reactions for the synthesis.

CO3. Developing skills in designing and planning synthetic routes for the preparation of heterocyclic compounds using the mentioned reactions.

CO4. Gaining proficiency in performing laboratory techniques and procedures involved in the double stage preparation.

CO5. Analyzing and interpreting experimental data obtained from the reactions to assess the success and purity of the synthesized compounds.

CO6. Enhancing problem-solving abilities by troubleshooting and optimizing reaction conditions to improve the yield and selectivity of the desired compounds.

CO7. Developing critical thinking skills to evaluate the advantages and limitations of different synthetic approaches for the preparation of organic compounds.

Topics and Learning Points

A) Double stage preparation (any 8)

1) Benzaldehyde to benzalacetophenone to epoxide
2) Cyclohexanone to phenylhydrazone to 1,2,3,4-tetrahydrocarbazole
3) Phthalic anhydride to phthalimide to anthranilicacid
4) Acetanilide to 4-nitroacetanilide to 4-nitroaniline
5) Benzyl cyanide to 4-nitro benzyl cyanide to 4-nitro phenyl acetic acid
6) Nitrobenzene to m-dinitrobanzene to m-nitro aniline
7) Benzanilide from benzophenone by Beckmann rearrangement.
8) P-nitro actanilide to p-nitroaniline to p-iodonitrobenzene
9) Phthalimide to n-benzyl Phthalimide to benzylamine
10) Preparation of P-amino benzoic acid
11) acetophenone to 2- amino 4-phenyl thiazole to substituted Schiff base
12) Preaparation of N-Bromosuccinamide
13) Interpretation of given FTIR spectral data.
14) Interpretation of given ^{1}HNMR spectral data

15) Interpretation of given ^{13}C NMR spectral data

16) Interpretation of given Mass spectral data.

References:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller,
   Prentice Hall
3. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
6. 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.
7. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.

Choice Based Credit System Syllabus
(NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**:Organic Chemistry
Course: Double Stage Preparations **Course Code**: CHO-604-MJM

Weightage: 1=weak or low relation, 2= moderate or partial relation, 3=strong or direct relation

Program Outcomes (POs) and Course Outcomes (COs) Matrix with Weightage:

	Programme Outcomes(POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0
CO3	3	0	3	3	2	1	0	0	2	0
CO4	2	0	0	3	0	0	0	0	0	0
CO5	3	2	0	0	0	0	0	0	0	1
CO6	0	1	2	1	0	2	0	0	0	0
CO7	1	0	0	2	3	0	1	1	0	2

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:
CO1. Understanding the principles and mechanisms of nitration, sulphonation, oxidation, reduction, and hydrolysis reactions in double stage preparation.
CO2. Acquiring knowledge of the various reagents, catalysts, and conditions used in these reactions for the synthesis.
CO3. Developing skills in designing and planning synthetic routes for the preparation of heterocyclic compounds using the mentioned reactions.
CO4. Gaining proficiency in performing laboratory techniques and procedures involved in the double stage preparation.
CO5. Analyzing and interpreting experimental data obtained from the reactions to assess the success and purity of the synthesized compounds.
CO7. Developing critical thinking skills to evaluate the advantages and limitations of different synthetic approaches for the preparation of organic compounds.

PO2 Practical, Professional, and Procedural Knowledge:
CO1. Understanding the principles and mechanisms of nitration, sulphonation, oxidation, reduction, and hydrolysis reactions in double stage preparation.
CO2. Acquiring knowledge of the various reagents, catalysts, and conditions used in these reactions for the synthesis.
CO5. Analyzing and interpreting experimental data obtained from the reactions to assess the success and purity of the synthesized compounds.
CO6. Enhancing problem-solving abilities by troubleshooting and optimizing reaction conditions to improve the yield and selectivity of the desired compounds.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:
CO1. Understanding the principles and mechanisms of nitration, sulphonation, oxidation, reduction,

and hydrolysis reactions in double stage preparation.
CO2. Acquiring knowledge of the various reagents, catalysts, and conditions used in these reactions for the synthesis.
CO3. Developing skills in designing and planning synthetic routes for the preparation of heterocyclic compounds using the mentioned reactions.
CO6. Enhancing problem-solving abilities by troubleshooting and optimizing reaction conditions to improve the yield and selectivity of the desired compounds.

PO4 Specialized Skills, Critical Thinking, and Problem-Solving:
CO1. Understanding the principles and mechanisms of nitration, sulphonation, oxidation, reduction, and hydrolysis reactions in double stage preparation.
CO3. Developing skills in designing and planning synthetic routes for the preparation of heterocyclic compounds using the mentioned reactions.
CO4. Gaining proficiency in performing laboratory techniques and procedures involved in the double stage preparation.
CO6. Enhancing problem-solving abilities by troubleshooting and optimizing reaction conditions to improve the yield and selectivity of the desired compounds.
CO7. Developing critical thinking skills to evaluate the advantages and limitations of different synthetic approaches for the preparation of organic compounds.

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO3. Developing skills in designing and planning synthetic routes for the preparation of heterocyclic compounds using the mentioned reactions.
CO7. Developing critical thinking skills to evaluate the advantages and limitations of different synthetic approaches for the preparation of organic compounds.

PO6 Communication, Collaboration, and Leadership:
CO3. Developing skills in designing and planning synthetic routes for the preparation of heterocyclic compounds using the mentioned reactions.
CO6. Enhancing problem-solving abilities by troubleshooting and optimizing reaction conditions to improve the yield and selectivity of the desired compounds.

PO7 Digital Proficiency and Technological Skills:
CO7. Developing critical thinking skills to evaluate the advantages and limitations of different synthetic approaches for the preparation of organic compounds.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO7. Developing critical thinking skills to evaluate the advantages and limitations of different synthetic approaches for the preparation of organic compounds.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO3. Developing skills in designing and planning synthetic routes for the preparation of heterocyclic compounds using the mentioned reactions.

PO10 Autonomy, Responsibility, and Accountability:
CO5. Analyzing and interpreting experimental data obtained from the reactions to assess the success and purity of the synthesized compounds.
CO7. Developing critical thinking skills to evaluate the advantages and limitations of different synthetic approaches for the preparation of organic compounds.

CBCS Syllabus as per NEP 2020 for M.Sc. II Organic chemistry (NEP Pattern)

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** CHE
Class	**:** M.Sc. II
Semester	**:** III
Course Type	**:** Major Elective Theory
Course Name	**:** Pericyclic reactions and Heterocyclic Chemistry
Course Code	**:** CHO-611-MJE (A)
No. of Lectures	**:** 30
No. of Credits	**:** 02 credits

Course Objective

Course Objectives:

1) To provide students with a solid foundation in the principles and concepts of heterocyclic chemistry, including the classification, nomenclature, and synthesis of heterocyclic compounds.
2) To explore the reactivity patterns of different heterocyclic systems and their synthetic methods, including both traditional and modern approaches.
3) To enhance students' problem-solving skills and critical thinking abilities by providing them with opportunities to analyze and solve complex problems related to heterocyclic chemistry.
4) To provide students with a thorough understanding of the principles and strategies involved in retrosynthetic analysis, including the identification of key functional groups, disconnections, and the selection of appropriate synthetic pathways.
5) Students will develop a solid understanding of the theoretical principles and concepts that govern pericyclic reactions, including orbital symmetry, frontier molecular orbital theory, and the Woodward-Hoffmann rules.
6) Students will learn to recognize and differentiate between various types of pericyclic reactions, such as cycloadditions, electrocyclic reactions, sigmatropic rearrangements.
7) Students will learn to analyze and interpret the mechanisms of pericyclic reactions using molecular orbital theory

Course Outcomes

Course Outcomes : On completion of the course, the student should be able to;

CO1. Student should understand the principles and mechanisms of Heterocyclic reactions,

CO2. Student should apply the concepts of photochemistry to analyze and predict the outcomes of photo substitution reactions, such as the Barton reaction.

CO3. Student should Utilize photochemical reactions in synthesis, specifically the Isocomene synthesis.

CO4. Student should Describe the characteristics and reactions of free radicals, including free radical substitution and addition to multiple bonds.

CO5. Student should apply free radicals in various synthetic reactions,

CO6. Student should understand the principles and applications of pericyclic reactions, including cycloaddition reactions, chelotropic reactions, and 1,3-dipolar additions.

CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

Topics and Learning Points

1. Pericyclic reactions [15 L]

Recapitulation of Molecular Orbitals, their symmetry properties, Woodward –Hoffmann's Conservation of orbital symmetry property rule.

Cycloaddition reactions, Chelotropic reactions, Sigmatropic reactions, and 1,3-dipolar additions, Analysis by correlation diagrams, Mobius Huckel theory and ATS concept. **Application of pericyclic reactions**: Ene reaction, Sommelet Hauser rearrangement, Claisen and Cope rearrangements, fluxional molecules, synthesis of Endiandric acid.

Ref.1- 7

2. Heterocyclic chemistry [15 L]

Synthesis, reactivity, aromatic character and importance of following heterocyclic compounds:

a) Condensed five and six membered heterocycles: Indole, Quinoline, Benzofuran,Coumarins.

b) Benzofused five membered heterocycles: Benzoxazole, Benzthiazole, Benzimidazole.

c) Synthesis of ranitidine, papavarine, amlodipine, bromouridine, tryptophan, thiamine, chloroquine, methyldopa.

Ref.10-13

References:

1) Photochemistryand Pericyclicreactions-Jagdamba Singh, Jaya Singh 3rdEd.
2) Conservation of orbital symmetry – R. B. Woodward and R. Hoffmann; VerlagChemie,Academic press(1971).
3) Orbital Symmetry : A problem solving approach- R. E. Lehr and A. P.Marchand;Academic (1972)
4) Organicreactionsandorbitalsymmetry,2nd Ed.T. L.GilchristandR.C.Storr
5) Organic Chemistry–J.Clayden,N. Greeves,S.WarrenandP. Wothers
6) Pericyclicreactions:Atextbook–S.Sankararaman
7) Pericyclicreactions-Gilland Willis
8) Frontierorbitals andorganicchemicalreactions-Ian Fleming,John Wiley& sons7
9) Heterocyclic Chemistry- R.K. Bansal
10) Designing of organic synthesis– S.Warren (Wiley)
11) Some modern methods of organic synthesis–W.Carruthers (Cambridge)
12) Advanced organic chemistry,PartB–F.ACareyandR.J.Sundberg,5thedition(2007)
13) Guide book to organic synthesis-RKMeckie,D MSmithand RAAtken

Choice Based Credit System Syllabus
(NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**:Organic Chemistry
Course: Pericyclic reactions and Heterocyclic Chemistry **Course Code**: CHO-611-MJE (A)
Weightage: 1=weak or low relation, 2= moderate or partial relation, 3=strong or direct relation

Program Outcomes (POs) and Course Outcomes (COs) Matrix with Weightage:

	Programme Outcomes(POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	1	0	3	1	0	0	0	0	3
CO2	2	0	0	2	3	0	0	0	0	2
CO3	1	2	0	0	2	3	3	0	0	2
CO4	1	0	2	0	0	0	0	0	0	0
CO5	0	0	3	1	0	0	0	0	0	0
CO6	2	0	0	0	0	2	0	0	0	0
CO7	3	3	0	0	0	1	2	2	2	1

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:
Student should understand the principles and mechanisms of Heterocyclic reactions,
CO2. Student should apply the concepts of photochemistry to analyze and predict the outcomes of photo substitution reactions, such as the Barton reaction.
CO3. Student should Utilize photochemical reactions in synthesis, specifically the Isocomene synthesis.
CO4. Student should Describe the characteristics and reactions of free radicals, including free radical substitution and addition to multiple bonds.
CO6. Student should understand the principles and applications of pericyclic reactions, including cycloaddition reactions, chelotropic reactions, and 1,3-dipolar additions.
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

PO2 Practical, Professional, and Procedural Knowledge:
CO1 Student should understand the principles and mechanisms of Heterocyclic reactions,
CO3. Student should Utilize photochemical reactions in synthesis, specifically the Isocomene synthesis.
CO6. Student should understand the principles and applications of pericyclic reactions, including cycloaddition reactions, chelotropic reactions, and 1,3-dipolar additions.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:
CO4. Student should Describe the characteristics and reactions of free radicals, including free radical substitution and addition to multiple bonds.
CO5. Student should apply free radicals in various synthetic reactions,

PO4 Specialized Skills, Critical Thinking, and Problem-Solving:
CO1 Student should understand the principles and mechanisms of Heterocyclic reactions,

CO2. Student should apply the concepts of photochemistry to analyze and predict the outcomes of photo substitution reactions, such as the Barton reaction.
CO5. Student should apply free radicals in various synthetic reactions,

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO1 Student should understand the principles and mechanisms of Heterocyclic reactions,
CO2. Student should apply the concepts of photochemistry to analyze and predict the outcomes of photo substitution reactions, such as the Barton reaction.
CO3. Student should Utilize photochemical reactions in synthesis, specifically the Isocomene synthesis.

PO6 Communication, Collaboration, and Leadership:
CO3. Student should Utilize photochemical reactions in synthesis, specifically the Isocomene synthesis.
CO6. Student should understand the principles and applications of pericyclic reactions, including cycloaddition reactions, chelotropic reactions, and 1,3-dipolar additions.
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

PO7 Digital Proficiency and Technological Skills:
CO3. Student should Utilize photochemical reactions in synthesis, specifically the Isocomene synthesis.
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

PO10 Autonomy, Responsibility, and Accountability:
CO1 Student should understand the principles and mechanisms of Heterocyclic reactions,
CO2. Student should apply the concepts of photochemistry to analyze and predict the outcomes of photo substitution reactions, such as the Barton reaction.
CO3. Student should Utilize photochemical reactions in synthesis, specifically the Isocomene synthesis.
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

CBCS Syllabus as per NEP 2020 for M.Sc. II Organic chemistry (NEP Pattern)

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** CHE
Class	**:** M.Sc. II
Semester	**:** III
Course Type	**:** Major Elective Theory
Course Name	**:** Photochemistry and free radical
Course Code	**:** CHO-611-MJE (B)
No. of Lectures	**:** 30
No. of Credits	**:** 02 credits

Course objective

Course objective:

1. Students will know about the nature, properties, and reactivity of free radicals in organic chemistry.

2. Students will gain knowledge of advanced reagents and their applications in chemo and stereo-selective transformations

3. Students get comprehensive understanding of the fundamental principles underlying free radical reactions in organic chemistry.

4. Students will learn the advanced concepts of photochemistry such as electronic excitation, energy transfer, and reactions involving singlet and triplet excited states.

5. Students will able to apply fundamental concepts in organic synthesis.

6. Students will understand photo rearrangement reactions, photochemistry of vision in humans.

7. Know about the various photochemical oxidation and reduction reactions.

Course outcomes

Course Outcomes:

CO1. At the end of this course the students will understand how light can interact with organic molecules and what the possible outcomes are.

CO2. The students will be able to distinguish between a photo induced reaction and a photo catalyzed process.

CO3. They will gain in depth knowledge of photo oxidation and photo reduction reactions

CO4. Understand and apply knowledge of the interaction of SOMO with frontier molecular

orbital of molecule

CO5. Understand Inter and intra molecular C-C bond formation reaction via radical mechanism.

CO6. Describe the characteristics and reactions of free radicals, including free radical Substitution and addition to multiple bonds.

CO7. Apply free radicals in various synthetic reactions, such as the Hunsdiecker reaction and Barton Nitrite Photolysis reaction.

Topics and Learning Points

1. **Photochemistry** **[15 L]**

Photo rearrangements of cyclopentanone , cyclohexanone, dienones, β-ɣ unsaturated ketones, Aza-Di-**π**–Methane rearrangement, Di-**π**–Methane rearrangement, Photo rearrangements in aromatic compounds such as photo fries ,Dienone –Phenone etc. photo reduction and photo oxidation , photo substitution reaction at sp^3 carbon having one hydrogen - Barton reaction.

Photochemistry in nature- chemistry of vision, Application of photochemical reactions in synthesis – Isocomene Ref. 1,2,3,4

2. F*ree radicals:* **[15 L]**

Recapitulation, Interaction of SOMO of radical with frontier orbital of molecule, Radical initiators, Characteristic reactions - Free radical substitution, addition to multiple bonds, free radical halogenations – bromination by NBS, Thermal decomposition of hydro peroxides, autoxidation, Radicals in synthesis: Hunsdiecker reaction, Barton Decarboxylation, Intermolecular C-C bond formation via tin hydride, Metal induced radical reaction: Phenolic Oxidative coupling, pinacol coupling. Intramolecular radical reaction: Carbocyclic ring system, Heteroatom ring system, SNAr reactions-Sandmeyer reaction

Ref. 1,2, 3, 6

References

1. Advanced Organic Chemistry, Part A – F. A. Carey and R. J. Sundberg, 5th Ed.Springer(2007)
2. Organic Synthesis second edition - Michael B. Smith, McGraw hill publication
3. Excited States In Organic Chemistry-J.A.Barltrop andJ.D.Coyle, JohnWiley&sons
4. Photochemistry and Pericyclic reactions-Jagdamba Singh, Jaya Singh 3rdEd.
5. Organic Photochemistry: A visual approach-Jan Kopecky, VCH publishers (1992).
6. Conservation of orbital symmetry – R. B. Woodward and R. Hoffmann; Verlag Chemie, Academic press(1971).

Choice Based Credit System Syllabus
(NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**:Organic Chemistry
Course: Photochemistry and free radical **Course Code**: CHO-611-MJE (B)
Weightage: 1=weak or low relation, 2= moderate or partial relation, 3=strong or direct relation

Program Outcomes (POs) and Course Outcomes (COs) Matrix with Weightage:

	Programme Outcomes(POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	0	0	0	0	0	3	0	2	3
CO2	3	2	0	3	3	0	2	0	2	2
CO3	2	0	0	0	0	0	3	0	3	2
CO4	2	3	3	3	3	0	2	0	0	0
CO5	0	3	0	2	0	0	1	0	0	0
CO6	0	0	2	2	2	2	1	0	0	0
CO7	0	2	2	2	2	1	2	2	1	1

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:
CO1. At the end of this course the students will understand how light can interact with organic molecules and what the possible outcomes are.
CO2. The students will be able to distinguish between a photo induced reaction and a photo catalyzed process.
CO3. They will gain in depth knowledge of photo oxidation and photo reduction reactions
CO4. Understand and apply knowledge of the interaction of SOMO with frontier molecular orbital of molecule

PO2 Practical, Professional, and Procedural Knowledge:
CO2. The students will be able to distinguish between a photo induced reaction and a photo catalyzed process.
CO4. Understand and apply knowledge of the interaction of HOMO with frontier molecular orbital of molecule
CO5. Understand Inter and intra molecular C-C bond formation reaction via radical mechanism.
CO7. Apply free radicals in various synthetic reactions, such as the Hunsdiecker reaction and Barton Nitrite Photolysis reaction.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:
CO4. Understand and apply knowledge of the interaction of SOMO with frontier molecular orbital of molecule
CO6. Describe the characteristics and reactions of free radicals, including free radical Substitution and addition to multiple bonds.
CO7. Apply free radicals in various synthetic reactions, such as the Hunsdiecker reaction and Barton Nitrite Photolysis reaction.

PO4 Specialized Skills, Critical Thinking, and Problem-Solving:

CO2. The students will be able to distinguish between a photo induced reaction and a photo catalyzed process.
CO5. Understand Inter and intra molecular C-C bond formation reaction via radical mechanism.
CO6. Describe the characteristics and reactions of free radicals, including free radical Substitution and addition to multiple bonds.
CO7. Apply free radicals in various synthetic reactions, such as the Hunsdiecker reaction and Barton Nitrite Photolysis reaction.

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO2. The students will be able to distinguish between a photo induced reaction and a photo catalyzed process.
CO4. Understand and apply knowledge of the interaction of SOMO with frontier molecular orbital of molecule
CO6. Describe the characteristics and reactions of free radicals, including free radical Substitution and addition to multiple bonds.
CO7. Apply free radicals in various synthetic reactions, such as the Hunsdiecker reaction and Barton Nitrite Photolysis reaction.

PO6 Communication, Collaboration, and Leadership:
CO6. Describe the characteristics and reactions of free radicals, including free radical Substitution and addition to multiple bonds.
CO7. Apply free radicals in various synthetic reactions, such as the Hunsdiecker reaction and Barton Nitrite Photolysis reaction.

PO7 Digital Proficiency and Technological Skills:
CO1. At the end of this course the students will understand how light can interact with organic molecules and what the possible outcomes are.
CO2. The students will be able to distinguish between a photo induced reaction and a photo catalyzed process.
CO3. They will gain in depth knowledge of photo oxidation and photo reduction reactions
CO4. Understand and apply knowledge of the interaction of SOMO with frontier molecular orbital of molecule
CO7. Apply free radicals in various synthetic reactions, such as the Hunsdiecker reaction and Barton Nitrite Photolysis reaction.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

PO10 Autonomy, Responsibility, and Accountability:
CO1 Student should understand the principles and mechanisms of Heterocyclic reactions,
CO2. Student should apply the concepts of photochemistry to analyze and predict the outcomes of photo substitution reactions, such as the Barton reaction.
CO3. Student should Utilize photochemical reactions in synthesis, specifically the Isocomene synthesis.
CO7. Student should able to explain the chemistry of vision and the role of photochemical reactions in natural processes.

CBCS Syllabus as per NEP 2020 for M.Sc. II organic chemistry (NEP Pattern)

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** CHE
Class	**:** M.Sc. II
Semester	**:** III
Course Type	**:** Major Elective Practical
Course Name	**:** Preparation of analogue
Course Code	**:** CHO-612-MJE (A)
No. of Lectures	**:** 30
No. of Credits	**:** 02 credits

Course Objective:

Course Objective:

1) Develop proficiency in performing analogue organic synthesis and purification techniques, including the use of appropriate laboratory equipment and methods for the synthesis and purification
2) Acquire hands-on experience in performing various synthetic methods functional group transformations.
3) Gain knowledge about the principles and mechanisms of analogue reactions
4) Understand the principles and mechanisms of Nitration, esterification reactions and gain practical experience through experiments.
5) Develop an understanding of the fundamental principles and concepts of the purification methods for organic synthesis of analogue.
6) Develop practical skills in handling and manipulating organic compounds, including proper techniques for weighing, measuring, and transferring reagents, as well as safe handling and disposal of hazardous materials
7) Develop practical skills in handling and synthetic analogue.

Course Outcome

Course Outcomes : On completion of the course, the student should be able to;

CO1. Develop proficiency in performing analogue organic synthesis and purification techniques, including the use of appropriate laboratory equipment and methods for the synthesis and purification

CO2. Acquire hands-on experience in performing various synthetic methods functional group transformations.

CO3. Gain knowledge about the principles and mechanisms of analogue reactions

CO4. Understand the principles and mechanisms of Nitration, esterification reactions and gain practical experience through experiments.

CO5. Develop an understanding of the fundamental principles and concepts of the purification methods for organic synthesis of analogue.

CO6. Develop practical skills in handling and manipulating organic compounds, including proper techniques for weighing, measuring, and transferring reagents, as well as safe handling and disposal of hazardous materials

CO7. Develop practical skills in handling and synthetic analogue.

Topics and Learning Points

The preparation should be carried out on micro scale.

A) Advance organic practical

1) Aldehydes and Ketones to:
   i) Semicarbazone
   ii) 2:4Dinitrophenyl hydrazone
   iii) Phenyl hydrazones

2) Carbohydrates to
   i) Osazones
   ii) Acetates

3) Acids to :
   i) Anilides
   ii) Esters
   iii) Anhydrides
   iv) Amides

4) Phenols to:
   i) Benzoate
   ii) Picrate
   iii) Nitro derivatives

5) Esters to

i) Hydrolysis products

6) Hydrocarbons to
   i) Nitro derivatives
   ii) Picrates

7) Compounds containing nitro groups
   Nitrophenol, Nitroacids, nitrohydrocarnbons to
   i) Amino compounds
   ii) Polynitro compound

8) Compound Containing Amino groups
   Amini acids, Amines and Nitroanilines to
   i) Acetyl derivatives
   ii) Picrates
   iii) Benzoyl derivatives

9) Amide to
   i) Hydrolysis products

References:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller,
   Prentice Hall
3. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
6. 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.
7. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.

Choice Based Credit System Syllabus
(NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**:Organic Chemistry
Course: Preparation of analogue **Course Code**: CHO-612-MJE (A)
Weightage: 1=weak or low relation, 2= moderate or partial relation, 3=strong or direct relation

Program Outcomes (POs) and Course Outcomes (COs) Matrix with Weightage:

	Programme Outcomes(POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	0	0	0	0	0	0	0	2	3
CO2	3	2	0	3	0	0	3	0	2	2
CO3	2	0	0	0	3	0	3	0	3	2
CO4	0	3	3	3	3	0	2	0	0	0
CO5	3	3	0	2	2	0	0	0	0	0
CO6	0	0	2	2	2	2	0	0	0	0
CO7	0	2	2	2	0	1	2	2	1	7

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:
CO1. Develop proficiency in performing analogue organic synthesis and purification techniques, including the use of appropriate laboratory equipment and methods for the synthesis and purification
CO2. Acquire hands-on experience in performing various synthetic methods functional group transformations.
CO3. Gain knowledge about the principles and mechanisms of analogue reactions
CO5. Develop an understanding of the fundamental principles and concepts of the purification methods for organic synthesis of analogue.

PO2 Practical, Professional, and Procedural Knowledge:
CO2. Acquire hands-on experience in performing various synthetic methods functional group transformations.
CO4. Understand the principles and mechanisms of Nitration, esterification reactions and gain practical experience through experiments.
CO5. Develop an understanding of the fundamental principles and concepts of the purification methods for organic synthesis of analogue.
CO7. Develop practical skills in handling and synthetic analogue.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:
CO4. Understand the principles and mechanisms of Nitration, esterification reactions and gain practical experience through experiments.
CO5. Develop an understanding of the fundamental principles and concepts of the purification methods for organic synthesis of analogue.
CO6. Develop practical skills in handling and manipulating organic compounds, including proper techniques for weighing, measuring, and transferring reagents, as well as safe handling and disposal of hazardous materials
CO7. Develop practical skills in handling and synthetic analogue.

PO4 Specialized Skills, Critical Thinking, and Problem-Solving:
CO2. Acquire hands-on experience in performing various synthetic methods functional group

transformations.CO4. Understand the principles and mechanisms of Nitration, esterification reactions and gain practical experience through experiments.
CO5. Develop an understanding of the fundamental principles and concepts of the purification methods for organic synthesis of analogue.
CO6. Develop practical skills in handling and manipulating organic compounds, including proper techniques for weighing, measuring, and transferring reagents, as well as safe handling and disposal of hazardous materials
CO7. Develop practical skills in handling and synthetic analogue.

PO5 Research, Analytical Reasoning, and Ethical Conduct:

CO3. Gain knowledge about the principles and mechanisms of analogue reactions
CO4. Understand the principles and mechanisms of Nitration, esterification reactions and gain practical experience through experiments.
CO5. Develop an understanding of the fundamental principles and concepts of the purification methods for organic synthesis of analogue.
CO6. Develop practical skills in handling and manipulating organic compounds, including proper techniques for weighing, measuring, and transferring reagents, as well as safe handling and disposal of hazardous materials

PO6 Communication, Collaboration, and Leadership:

CO6. Develop practical skills in handling and manipulating organic compounds, including proper techniques for weighing, measuring, and transferring reagents, as well as safe handling and disposal of hazardous materials
CO7. Develop practical skills in handling and synthetic analogue.

PO7 Digital Proficiency and Technological Skills:

CO2. Acquire hands-on experience in performing various synthetic methods functional group transformations.
CO3. Gain knowledge about the principles and mechanisms of analogue reactions
CO4. Understand the principles and mechanisms of Nitration, esterification reactions and gain practical experience through experiments.
CO7. Develop practical skills in handling and synthetic analogue.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:

CO7. Develop practical skills in handling and synthetic analogue.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:

CO7. Develop practical skills in handling and synthetic analogue.

PO10 Autonomy, Responsibility, and Accountability:

CO1 Develop proficiency in performing analogue organic synthesis and purification techniques, including the use of appropriate laboratory equipment and methods for the synthesis and purification
CO2. Acquire hands-on experience in performing various synthetic methods functional group transformations.
CO3. Gain knowledge about the principles and mechanisms of analogue reactions
CO7. Develop practical skills in handling and synthetic analogue.

CBCS Syllabus as per NEP 2020 for M.Sc. II Organic chemistry (NEP Pattern)

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** CHE
Class	**:** M.Sc. II
Semester	**:** III
Course Type	**:** Major Elective Practical
Course Name	**:** Single Stage Preparations
Course Code	**:** CHO-612-MJE (B)
No. of Lectures	**:** 30
No. of Credits	**:** 02 credits

Course Objective:

Course Objective:

1) Develop proficiency in performing organic synthesis and purification techniques, including the use of appropriate laboratory equipment and methods for the synthesis and purification
2) Acquire hands-on experience in performing various synthetic methods and techniques specific to the synthesis of heterocyclic compounds, such as cyclization reactions, functional group transformations.
3) Gain knowledge about the principles and mechanisms of reduction reactions
4) Understand the principles and mechanisms of formylation reactions and gain practical experience through formylation experiments,
5) Develop an understanding of the fundamental principles and concepts of the isolation of natural products, including extraction techniques, purification methods,
6) Develop practical skills in handling and manipulating organic compounds, including proper techniques for weighing, measuring, and transferring reagents, as well as safe handling and disposal of hazardous materials
7) Develop practical skills in handling and synthesizing organic compounds

Course Outcome

Course Outcomes : On completion of the course, the student should be able to;

CO1. Students will gain proficiency in performing organic synthesis and purification techniques.

CO2. Students will acquire hands-on experience in performing various synthetic methods and techniques specific to the synthesis of heterocyclic compounds.

CO3. Students will gain knowledge about the principles and mechanisms of reduction reactions and performing reduction reactions using various reducing agents, such as metal hydrides.

CO4. Through formylation experiments, students will understand principles and mechanisms of formylation reactions.

CO5. Enhancing communication skills by effectively documenting experimental procedures and results.

CO6. Understanding the fundamental principles and concepts of isolation of natural products.

CO7. Developing practical skills in handling and manipulating organic compounds.

Topics and Learning Points

At least nine single stage and five isolation of Natural products and two quantitative analysis should be carried out. The preparation should be carried out on micro scale.

A) Advance organic practical

Synthesis, purification and characterization of:

1) 2-phenyl indole by Fischer indole synthesis
2) Benzyl alcohol and benzoic acid from benzaldehyde (Canninzaro reaction)
3) 2-chlorobenzoic acid from anthranillic acid (Sandmeyer reaction)
4) Cyclohexanol from cyclohexanone ($NaBH_4$ reduction)
5) 4-Nitro Benzonitrile from 4-Nitrobenzaldehyde
6) Imidazole from orthophenylene diamine
7) Osazone from glucose
8) Schiff base synthesis from substituted benzaldehyde
9) 4-amino benzoic acid from 4-Nitro benzoic acid
10) Synthesis of chalcone from substituted benzaldehyde
11) 2- amino 4-phenyl thiazole from acetophenone and thiourea
12) O-Benzoyloxyacetophenone from O-hydroxyacetophenone (Flavone)

B) Isolation of Natural products

1) Piperine from pepper
2) Eugenol from clove
3) Cinnmaldehyde from cinnamon

References:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller,
   Prentice Hall
3. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
6. 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.
7. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.

Choice Based Credit System Syllabus
(NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**:Organic Chemistry
Course: Single stage preparations **Course Code**: CHO-612-MJE (B)

Weightage: 1=weak or low relation, 2= moderate or partial relation, 3=strong or direct relation

Course Outcomes (COs) and Program Outcomes (POs) Matrix with Weightage:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	0	3	0	0	2	0
CO2	3	3	0	0	2	3	0	0	2	0
CO3	3	3	3	2	0	0	0	0	0	0
CO4	3	3	2	3	2	0	0	0	2	3
CO5	3	3	2	3	0	3	0	0	2	3
CO6	0	3	0	2	2	3	3	3	2	2
CO7	3	0	2	0	0	3	2	2	0	0

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:

CO1. Students will gain proficiency in performing organic synthesis and purification techniques.
CO2. Students will acquire hands-on experience in performing various synthetic methods and techniques specific to the synthesis of heterocyclic compounds.
CO3. Students will gain knowledge about the principles and mechanisms of reduction reactions and performing reduction reactions using various reducing agents, such as metal hydrides.
CO4. Through formylation experiments, students will understand principles and mechanisms of formylation reactions.
CO5. Enhancing communication skills by effectively documenting experimental procedures and results.
CO7. Developing practical skills in handling and manipulating organic compounds.

PO2 Practical, Professional, and Procedural Knowledge:

CO2. Students will acquire hands-on experience in performing various synthetic methods and techniques specific to the synthesis of heterocyclic compounds.
CO3. Students will gain knowledge about the principles and mechanisms of reduction reactions and performing reduction reactions using various reducing agents, such as metal hydrides.
CO4. Through formylation experiments, students will understand principles and mechanisms of formylation reactions.
CO5. Enhancing communication skills by effectively documenting experimental procedures and results.
CO6. Understanding the fundamental principles and concepts of isolation of natural products.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:

CO3. Students will gain knowledge about the principles and mechanisms of reduction reactions and performing reduction reactions using various reducing agents, such as metal hydrides.

CO4. Through formylation experiments, students will understand principles and mechanisms of formylation reactions.
CO5. Enhancing communication skills by effectively documenting experimental procedures and results.
CO7. Developing practical skills in handling and manipulating organic compounds.

PO4 Specialized Skills, Critical Thinking, and Problem-Solving:
CO3. Students will gain knowledge about the principles and mechanisms of reduction reactions and performing reduction reactions using various reducing agents, such as metal hydrides.
CO4. Through formylation experiments, students will understand principles and mechanisms of formylation reactions.
CO5. Enhancing communication skills by effectively documenting experimental procedures and results.
CO7. Developing practical skills in handling and manipulating organic compounds.

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO1. Students will gain proficiency in performing organic synthesis and purification techniques.
CO2. Students will acquire hands-on experience in performing various synthetic methods and techniques specific to the synthesis of heterocyclic compounds.
CO3. Students will gain knowledge about the principles and mechanisms of reduction reactions and performing reduction reactions using various reducing agents, such as metal hydrides.
CO6. Understanding the fundamental principles and concepts of isolation of natural products.

PO6 Communication, Collaboration, and Leadership:
CO1. Students will gain proficiency in performing organic synthesis and purification techniques.
CO2. Students will acquire hands-on experience in performing various synthetic methods and techniques specific to the synthesis of heterocyclic compounds.
CO5. Enhancing communication skills by effectively documenting experimental procedures and results.
CO6. Understanding the fundamental principles and concepts of isolation of natural products.
CO7. Developing practical skills in handling and manipulating organic compounds.
PO7 Digital Proficiency and Technological Skills:
CO6. Understanding the fundamental principles and concepts of isolation of natural products.
CO7. Developing practical skills in handling and manipulating organic compounds.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO6. Understanding the fundamental principles and concepts of isolation of natural products.
CO7. Developing practical skills in handling and manipulating organic compounds.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO1. Students will gain proficiency in performing organic synthesis and purification techniques.
CO2. Students will acquire hands-on experience in performing various synthetic methods and techniques specific to the synthesis of heterocyclic compounds.
CO4. Through formylation experiments, students will understand principles and mechanisms of formylation reactions.
CO5. Enhancing communication skills by effectively documenting experimental procedures and results.
CO6. Understanding the fundamental principles and concepts of isolation of natural products.
PO10 Autonomy, Responsibility, and Accountability:
CO4. Through formylation experiments, students will understand principles and mechanisms of formylation reactions.
CO5. Enhancing communication skills by effectively documenting experimental procedures and results.
CO6. Understanding the fundamental principles and concepts of isolation of natural products.

CBCS Syllabus as per NEP 2020 for M.Sc. II Organic chemistry (NEP Pattern)

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** CHE
Class	**:** M.Sc. II
Semester	**:** III
Course Type	**: Research project**
Course Name	**:** Project Report
Course Code	**:** CHO-621-RP
No. of Lectures	**:** 60
No. of Credits	**:** 04 credits

Course Objective:

Course Objective: On completion of the course, the student will be able to:

1. Learn various synthesis techniques, including reaction mechanisms, retrosynthesis, and functional group interconversions.
2. Practice designing and planning synthetic routes for the targeted molecules.
3. Develop skills in laboratory techniques and procedures for organic synthesis.
4. Gain hands-on experience in performing multi-step syntheses of complex organic molecules.
5. Learn about the different types of reagents, catalysts, and reaction conditions used in organic synthesis.

Course Outcomes

Course Outcomes : On completion of the course, the student should be able to:

CO1. Develop skills in equipment operation and handling, including the use of laboratory techniques and procedures specific to organic synthesis.

CO2. Apply principles of organic chemistry to identify suitable reaction pathways and strategies for the synthesis of complex molecules.

CO3. Demonstrate an understanding of the properties and behavior of different organic functional groups and their impact on reaction selectivity and efficiency.

CO4. Develop proficiency in the characterization of synthesized compounds using various spectroscopic and analytical techniques.

CO5. Learn how to interpret and analyze experimental data to evaluate reaction yields, purity, and efficiency of synthesis.

CO6. Knowledge of purification techniques for organic compounds, such as column chromatography or recrystallization.

CO7. Proficiency in performing organic reactions and handling reagents safely

Topics and Learning Points

- Project shall be started at the beginning of Sem – III and will be accessed bimonthly for its progress and continuous evaluation will be made. High standard research work is expected from the project and students are encouraged to publish it in national or international journals of high repute. External and internal examiners will examine the project jointly at the time of practical examination.

Choice Based Credit System Syllabus
(NEP Pattern)
Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM III) **Subject**: Organic Chemistry
Course: Project **Code**: CHO-621-RP
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes (COs) and Program Outcomes (POs) Matrix with Weightage:

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	0	2	0	1	0	0	0	0	0
CO 2	2	3	2	0	0	0	0	0	0	0
CO 3	2	0	3	0	0	0	0	0	0	0
CO 4	2	0	2	3	2	0	0	0	0	0
CO 5	2	0	2	0	3	0	0	0	0	0
CO6	0	0	0	0	0	0	3	3	3	3
CO7	0	0	0	0	0	0	3	3	3	3

Justification for the mapping

PO 1 Comprehensive Knowledge and Understanding::

CO1. Students will apply the theoretical and practical knowledge acquired during their academic coursework to real-world research, demonstrating the practical application of academic knowledge.

CO2. Apply principles of organic chemistry to identify suitable reaction pathways and strategies for the synthesis of complex molecules.

CO3. Demonstrate an understanding of the properties and behavior of different organic functional groups and their impact on reaction selectivity and efficiency.

CO4. Develop proficiency in the characterization of synthesized compounds using various spectroscopic and analytical techniques.

CO5. Learn how to interpret and analyze experimental data to evaluate reaction yields, purity, and efficiency of synthesis.

PO 2 Practical, Professional, and Procedural Knowledge:

CO 2: Students will demonstrate their research skills by planning, conducting, and managing independent research, including experimental work, data collection, and analysis.

PO 3 Entrepreneurial Mindset, Innovation, and Business Understanding:

Students will apply the theoretical and practical knowledge acquired during their academic coursework to real-world research, demonstrating the practical application of academic

knowledge.

CO1. Apply principles of organic chemistry to identify suitable reaction pathways and strategies for the synthesis of complex molecules.

CO2. Demonstrate an understanding of the properties and behavior of different organic functional groups and their impact on reaction selectivity and efficiency.

CO3. Develop proficiency in the characterization of synthesized compounds using various spectroscopic and analytical techniques.

CO4. Learn how to interpret and analyze experimental data to evaluate reaction yields, purity, and efficiency of synthesis.

PO 4: Specialized Skills, Critical Thinking, and Problem-Solving:

CO 4: Students will contribute to the existing body of knowledge in their chosen area of study by conducting original research and making meaningful findings, thereby advancing knowledge.

PO 5: Research, Analytical Reasoning, and Ethical Conduct:

CO1. Students will apply the theoretical and practical knowledge acquired during their academic coursework to real-world research, demonstrating the practical application of academic knowledge

CO4. Develop proficiency in the characterization of synthesized compounds using various spectroscopic and analytical techniques.

CO5. Learn how to interpret and analyze experimental data to evaluate reaction yields, purity, and efficiency of synthesis.

PO6: Communication, Collaboration, and Leadership:

CO 4 Student will gain knowledge of mechanisms involved in biological chemistry.

CO 6 Ability to troubleshoot common issues and challenges that may arise during extraction processes.

CO 7 Awareness of current advancements and trends in extraction technologies

PO7 Digital Proficiency and Technological Skills:

CO 6 Ability to troubleshoot common issues and challenges that may arise during extraction processes.

CO 7 Awareness of current advancements and trends in extraction technologies

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:

CO 6 Ability to troubleshoot common issues and challenges that may arise during extraction processes.

CO 7 Awareness of current advancements and trends in extraction technologies

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices:

CO 6 Knowledge of purification techniques for organic compounds, such as column chromatography or recrystallization.

CO 7 Proficiency in performing organic reactions and handling reagents safely

PO10 Autonomy, Responsibility, and Accountability:

CO 6 Ability to troubleshoot common issues and challenges that may arise during extraction processes.

CO 7 Awareness of current advancements and trends in extraction technologies