Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science, Commerce, Baramati

(Autonomous)

DEPARTMENT OF CHEMISTRY

(Faculty of Science and Technology)

Two Year MSc Degree Program Chemistry

MSc Inorganic Chemistry
MSc Organic Chemistry
MSc Analytical Chemistry

(2022 Pattern)

Choice Based Credit System Structure and Syllabus

(To be implemented from June 2022)

Structure of the course:

S N	Subject	Paper Code.	Paper Code.	Paper tittle
Semester I				
1	Fundamentals of Physical Chemistry- I	CHP-4101	PSCH111	Physical Chemistry I
2.	Molecular Symmetry and Chemistry of P- block elements	CHI-4102	PSCH112	Inorganic Chemistry I
3.	Basic Organic Chemistry	CHO-4103	PSCH113	Organic Chemistry I
4.	Safety in Chemical Laboratory and Good Laboratory Practices	CHA-4104	PSCH114	Safety in Chemical Laboratory and Good Laboratory Practices
5	Physical Chemistry Practical	CHP-4105	PSCH115	Physical Chemistry Practical
6	Organic Chemistry Practical	CHO-4106	PSCH116	Organic Chemistry Practical
7	Human right I	HR 101	HR1	Human right I
8	Introduction to cyber security I	CYS 101	CYS1	Introduction to cyber security I
Semester II				
1	Fundamentals of Physical Chemistry- II	CHP-4201	PSCH121	Physical Chemistry II
2.	Coordination and Bioinorganic Chemistry	CHI-4202	PSCH122	Inorganic Chemistry II
3.	Synthetic organic chemistry and Spectroscopy	CHO-4203	PSCH123	Organic Chemistry II

4.	General chemistry (Any two parts)	CHA-4204	PSCH124	General chemistry
5	Inorganic Chemistry Practical	CHI-4205	PSCH125	Inorganic Chemistry Practical
6	Analytical Chemistry Practical	CHA-4106	PSCH126	Analytical Chemistry Practical
8	Introduction to cyber security II	CYS 102	CYS2	Introduction to cyber security II

SYLLABUS FOR CERTIFICATE COURSE

(2 Credits, 12 theory lectures and 18 hours practical)

TITLE: - INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS (Any Three)

1) Introduction of principle of UV –Visible Spectroscopy, Instrumentation and applications

2) Introduction of principle of FTIR Spectroscopy, Instrumentation and applications.

3) Introduction of principle of HPLC, Instrumentation and applications

4) Introduction of principle of Atomic Absorption Spectroscopy, Instrumentation and applications

5) Introduction of principle of Flame Emission Spectroscopy, Instrumentation and applications

6) Introduction of principle of Magnetic Susceptibility

7) Introduction of principle of Thermogravimetric analysis

Evaluation: MCQ Test and practical examination.

PSCH 111 Physical Chemistry I
(4 Credits, 48 L)

Course Objectives:

Students will be, After completion of course,

1. Laws of thermodynamics
2. Basic concepts of thermodynamics, changes in state, phase diagrams
3. Basics of quantum Chemistry
4. Terms related to polymer chemistry
5. Chemical kinetics and reaction dynamics
6. Molecular thermodynamics
7. Solve numerical problems.

Course Outcome:

CO1. Student should understand the thermodynamic concepts in detail
CO2. Student should understand Basic concepts of quantum chemistry concepts.
CO3. Student should understand chemical kinetics of complex reactions.
CO4. Student should understand the polymerization process & to find out molecular weight of polymer.
CO5. Student should know the concepts of statistical thermodynamics in detail.
CO6. Student should solve the numerical based on all the topics included in this course.
CO7. Student should be able to create the solution to avoid excess use of energy in chemicalreaction by applying to their knowledge of thermodynamics and chemical kinetics.

SECTION-I
Thermodynamics, Quantum Chemistry and Polymer Chemistry (24L)

1. **Thermodynamics:**
   Recapitulation: **(2L)**
   System and types of system, surrounding, state functions, path functions, Heat, work, Laws of thermodynamics-Zeroth law, First law, Work of compression & expansion, free expansion, expansion against constant pressure, reversible expansion. Heat: -heat capacity, enthalpy. changes in internal energy, temperature dependence of the internal energy, temperature dependence of the enthalpy. Work of adiabatic expansion –Irreversible adiabatic expansion, reversible adiabatic expansion.(Self study)

2. **The second law of Thermodynamics**: **(3L)**
   Definition of Entropy, Measuring the dispersal the entropy. The second law, the entropy changes in the system, Entropy changes in the universe – The entropy change when a system is heated. Entropy changes in surroundings, The entropy of phase transition. The entropy of irreversible changes

3. **Combining First & Second law:** **(5L)**
Recapitulation: The Helmholtz and Gibbs function, Significances of Helmholtz function, Maximum work, Significance of Gibbs function. Evaluating the entropy & Gibbs function. The third law of thermodynamics, absolute entropies, standard molar Gibbs function. Properties of Gibbs energy, The temperature dependence of the Gibbs energy. The pressure dependence of the Gibbs energy. Chemical potential of a perfect gas. The open system & changes of composition.

4. **Changes of State I:** **(2L)**
phase, phase rule (Self study)Physical Transformation of pure materials, The stabilities of phases, Phase equilibrium & phase diagrams. The solid–liquid boundary. The liquid-vapor boundary. The solid-vapor boundary.

5. **Changes of State II :** **(2L)**
Physical transformation of simple mixtures, partial molar quantities –Partial molar volume, Partial molar Gibbs function. The thermodynamics of mixing – the Gibbs function of mixing, thermodynamics mixing functions. The chemical potential of liquid-liquid mixture.

6. **Colligative properties** **(2L)**
Recapitulation: The common features, the elevation in boiling point, the depression in freezing point, solubility, osmosis and osmotic pressure. Mixtures of volatile liquids-vapor pressure diagram. Raoult's law, van't Hoffs factor, problems

A. **Quantum Chemistry:**
Recapitulation: **(5L)**
Failures of classical mechanics, Historical development of quantum theory, black body radiation, photo electric effect, atomic spectra, wave particle duality, uncertainty principle, Schrodinger equation: particle in one dimensional boxSchrodinger equation for particle in 2-D box, Degeneracy, hydrogen like atoms (No derivation), Postulates, HMOT-Ethylene, Butadiene, problems

B. **Polymer Chemistry:** **(3L)**
monomer, polymer, homopolymer, heteropolymer, processes of polymerization: addition and condensation. Molecular weight of polymer: number average molecular weight, weight average molecular weight. Some important polymers

SECTION-II
Chemical kinetics and molecular thermodynamics(24L)

1. **Recapitulation**: **(2L)**
The rate of reaction, rate laws and rate constants, the determination of rate, order, molecularity, zero order, first order, second order reactions, half-lives, fractional order reactions, order and molecularity, factors affecting the rate of reaction. (Self-study)

2. **Complex and simple reaction**: **(2L)**
Reactions approaching equilibrium, consecutive reactions, opposing reactions, chain reaction- explosion, photochemical reactions.

3. **Methods to solve complex reactions**: **(3L)**
The steady state approximations, pre-equilibria approximation, Lindeman mechanism for unimolecular reactions.

4. **Molecular reaction dynamics** **(5L)**
   Collision theory, the steric requirements, Diffusion control reactions. Diffusion and reactions, details of diffusion, activated complex theory- the reaction coordinate and the transition state, the formation and decay of the activated complex, how to use the Eyring equation,thermodynamics aspects, reactions between ions in solution state.

5. **Enzyme catalysts**: **(4L)**
   Michaelis-Menten mechanism, limiting rate, problems, Lineweaver Burk and Eadie plots, enzyme inhibition, competitive and non-competitive inhibition.

6. **Methods of studying fast reactions:** **(2L)**
   Flash photolysis,temperature jump relaxation methods

7. **Molecular Thermodynamics**: **(6L)**
   Molecular energy levels, Boltzmann distribution law,partition functions and ensembles, translational partition function, rotational partition function and vibrational partition function of diatomic molecules, Obtaining energy, heat capacity, entropy free energy, equilibrium constants from partition functions, equipartition of energy, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics.

References

1. Physical Chemistry-P.W.Atkin and De Paule 8th edition(2010)
2. Physical Chemistry-T.Engel and P.Reid,Pearson Education(2006)
3. Physical Chemistry and molecular approach- D. Mcquarie and J. Simon (University Science)(2000)
4. Physical Chemistry for Biogical Sciences by Raymond Change (Universal books)
5. Physical Chemistry–MarronandProuton
6. Physical Chemistry-G.M.Barrow,Tata McGraw Hill 1988
7. Quantum Chemistry-I. Levine 5th edition, Prentice Hall, 1999.
8. Quantum Chemistry-R.K.Prasad.
9. Physical Chemistry-Puri,Sharma, Pathania.
10. Chemical Kinetics-K.J.Laidler

Choice Based Credit System Syllabus
(2022 Pattern)

Class: M.Sc. I (SEM I) **Subject**: Chemistry
Course: Physical Chemistry-I **Course Code**: PSCH111
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

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

Justification of Mapping

PO1: Disciplinary Knowledge
CO1: Student should understand the thermodynamic concepts in detail
CO2: Student should understand Basic concepts of quantum chemistry concepts.
CO3: Student should understand chemical kinetics of complex reactions.
CO4: Student should understand the polymerization process & to find out molecular weight of polymer.
CO5: Student should know the concepts of statistical thermodynamics in detail.
CO6: Student should solve the numerical based on all the topics included in this course.
CO7: Student should be able to create the solution to avoid excess use of energy in chemical reaction by applying to their knowledge of thermodynamics and chemical kinetics.

PO2: Critical Thinking and Problem Solving
CO2: Student should understand Basic concepts of quantum chemistry concepts.
CO6: Student should solve the numerical based on all the topics included in this course.

PO3: Social Competence
CO3: Student should understand chemical kinetics of complex reactions.
CO6: Student should solve the numerical based on all the topics included in this course.
CO7: Student should be able to create the solution to avoid excess use of energy in chemical reaction by applying to their knowledge of thermodynamics and chemical kinetics.

PO4: Research-related skills and Scientific Temper
CO4: Student should understand the polymerization process & to find out molecular weight of polymer.
CO7: Student should be able to create the solution to avoid excess use of energy in chemical reaction by applying to their knowledge of thermodynamics and chemical kinetics.

PO5: Trans-disciplinary Knowledge
CO1: Student should understand the thermodynamic concepts in detail
CO5: Student should know the concepts of statistical thermodynamics in detail.

PO6: Personal and Professional Competence
CO1: Student should understand the thermodynamic concepts in detail
CO2: Student should understand Basic concepts of quantum chemistry concepts.
CO3: Student should understand chemical kinetics of complex reactions.
CO4: Student should understand the polymerization process & to find out molecular weight of polymer.
CO5: Student should know the concepts of statistical thermodynamics in detail.
CO6: Student should solve the numerical based on all the topics included in this course.

PO7: Effective Citizenship and Ethics
CO1: Student should understand the thermodynamic concepts in detail
CO3: Student should understand chemical kinetics of complex reactions.
CO7: Student should be able to create the solution to avoid excess use of energy in chemical reaction by applying to their knowledge of thermodynamics and chemical kinetics.

PSCH112: Inorganic Chemistry I, Semester I

(4 Credits, 48 L)

Course Outcomes:

1. To apply the concept of point group for determining optical activity and dipolemoment.
2. Student should understand the importance of orthogonality theorem.
3. Student should know the concept of SALC and find out character for reduciblerepresentation.
4. Student should imagine molecules in 3 dimensions.
5. To understand the concepts and various symmetry elements.
6. Understand the concept and point group and apply it to molecule
7. Student should understand the detail chemistry of S and P block elements.

To learn the advanced chemistry.

Course Outcomes:

CO1: To understand the concepts and various symmetry elements
CO2: Developing critical thinking and problem-solving skills through the application of symmetry principles to real-world scenarios.
CO3: Applying group theory to solve symmetry-related problems in inorganic chemistry.
CO4: Investigating the applications of p-block elements in various fields such as materials science, environmental chemistry, and pharmaceuticals.
CO5: Analyzing the environmental impact and sustainability aspects of p-block elements and their compounds.
CO6: Student should know the concept of SALC and find out character for reducible representation, importance of orthogonality theorem
CO7: Understanding the role of p-block elements in biological systems

SECTION - I

Molecular Symmetry & Its Application **(24 L)**

A) Definitions & Theorems of Group Theory: (2L)

Introduction, defining properties of a group, Group multiplication table, some examples ofgroup, Subgroups, Classes

Molecular Symmetry and Symmetry Groups: **(6L)**

Symmetry elements and operations, Symmetry planes and reflections, the inversion centre, proper axes and proper rotations, improper axes and improper rotation, products of symmetryoperations, equivalent symmetry,symmetry elements and optical isomerism, elements and equivalent atoms, general relations symmetry elements and symmetry operations, symmetry elements and optical isomerism, symmetry point groups, classes of symmetry operations, Group multiplication table, classification of molecular point groups.

B) Representation of Group: (4L)

Matrix representation and matrix notation for geometric transformation.The great Orthogonality theorem and its consequence, character table. (No mathematical part)

C) Group Theory & Quantum Mechanics: (4L)

Wave function as the basis for irreducible representation.

D) Symmetry Adapted Linear Combination: - (4L)

a) Projection operator & their use of construct SALC (Construction of SALC for sigma bonding for molecules belonging point groups: D_{2h}, D_{3h},D_{4h} ,C_{4v},Td,Oh , normalizationof SALC) .

E) Applications of Group theory to infrared spectroscopy (4L)

Introduction, selection rules, polyatomic molecules, possible vibrations in a linear, molecule, bending modes, symmetry of vibrations and their IR activity, Group vibration concept, and its limitations, IR spectra of complex compound

SECTION-II

Chemistry of Main group elements (24 L)

1. Hydrogen and its compounds: (2L)

Hydrides: Classification, electron deficient, electron precise and electron rich hydrides. PH_3 ,SbH_3 , AsH_3 , Selenides, Tellurides

2. Alkali and alkaline earth metals: (2L)

Solutions in non-aqueous MediaApplication of crown ethers in extraction of alkali and alkaline earth metals ,Cryptans.

3. Organometallic Compounds of Li, Mg, Be: (3L)

Classification, Synthesis, Structure, Properties and Uses.

4. Boron Group: (4L)

Boron Hydrides (Closo,Nido,Arachno,Hypo) , preparation, structure and Bonding with reference to LUMO,HOMO, interconversion of lower and higher boranes, Metalloboranes, Carboranes, Reactions of organoboranes .

5. Carbon Group: (2L)

Allotropes of Carbon, C60 and compounds (fullerenes), Intercalation compounds of Graphite,Carbon nanotubes, synthesis, properties, structure-single walled, multi walled, Silicates, applications.

6. Organometallic compounds: (3L)

Organometallic compounds of Si, Sn, Pb, Ga, As, Sb, Bi. Structures, synthesis, Reactions and uses.

7. Nitrogen Group: (3L)

Nitrogen activation, Boron nitride, Oxidation states of nitrogen and their interconversion, PNand SN Compounds, NOx and their redox chemistry.

8. Oxygen Group: **(3L)**

Metal Selenides and Tellurides, oxyacids, and oxoanions of sulphur & nitrogen. Ring, Cageand Cluster compounds of p-block elements. Silicates, including Zeolites

9. Halogen Group: **(2L)**

Interhalogens, pseudo-halogen, Synthesis, Properties and applications, Structure, Oxyacidsand Oxoanions of Halogens, Bonding

References:

1. Inorganic Chemistry: Shriver & Atkins (4th edition 2003, Oxford)
2. Concise Inorganic Chemistry, J. D. Lee, Fourth Edn.(Chapman and Hall)
3. Inorganic chemistry: Principle of structures & reactivity, Hubeey, Keiter, Medhi, PearsonEducation, 4th Edn.(2007).
4. Inorganic Chemistry: Catherine Housecroft
5. Inorganic Chemistry: Messler & Tarr, Pearson Publishers 3rd Edition
6. Organometallic Chemistry-A Unified Approach: R. C. Mehrotra & A. Singh Symmetry in Chemistry: H. Jaffe' and M. Orchin (2002)
7. Inorganic Chemistry: Shriver and Atkins, 4th edn. (2003) Oxford.
8. Inorganic Chemistry: Veera Reddy.
9. Concise Inorganic Chemistry by J.D. Lee
10. Inorganic chemistry :Principle of structures and reactivity by Huheey, Keiter
11. Concise inorganic Chemistry: F.A.Cotton.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem I) **Subject**: Chemistry

Course: **Molecular Symmetry & Chemistry of P-Block Elements** **Course Code**: PSCH112

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

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: To understand the concepts and various symmetry elements

CO5: Analyzing the environmental impact and sustainability aspects of p-block elements and their compounds.

CO6: Student should know the concept of SALC and find out character for reducible representation, importance of orthogonality theorem

CO7: Understanding the role of p-block elements in biological systems

PO2:Critical Thinking and Problem Solving

CO3: Applying group theory to solve symmetry-related problems in inorganic chemistry.

CO4: Investigating the applications of p-block elements in various fields such as materials science, environmental chemistry, and pharmaceuticals.

CO5: Analyzing the environmental impact and sustainability aspects of p-block elements and their compounds.

PO4: Research related skills and scientific temper

CO2: Developing critical thinking and problem-solving skills through the application of symmetry principles to real-world scenarios.

CO3: Applying group theory to solve symmetry-related problems in inorganic chemistry.

CO4: Investigating the applications of p-block elements in various fields such as Materials science, environmental chemistry, and pharmaceuticals.

CO5: Analyzing the environmental impact and sustainability aspects of p-block elements and their compounds.

CO6: Student should know the concept of SALC and find out character for reducible representation, importance of orthogonality theorem

PO5:Trans-disciplinaryKnowledge

CO3: Applying group theory to solve symmetry-related problems in inorganic chemistry.

CO4: Investigating the applications of p-block elements in various fields such as Materials science, environmental chemistry, and pharmaceuticals.

CO5: Analyzing the environmental impact and sustainability aspects of p-block elements and their compounds

CO7: Understanding the role of p-block elements in biological systems

PO6:Personal and Professional Competence

CO4: Investigating the applications of p-block elements in various fields such as Materials science, environmental chemistry, and pharmaceuticals.

CO7: Understanding the role of p-block elements in biological systems

PO7: Effective citizenship and ethics

CO4: Investigating the applications of p-block elements in various fields such as Materials science, environmental chemistry, and pharmaceuticals.

CO7: Understanding the role of p-block elements in biological systems

PO8: Environment and sustainability

CO4: Investigating the applications of p-block elements in various fields such as Materials science, environmental chemistry, and pharmaceuticals.

CO7: Understanding the role of p-block elements in biological systems

PO9: Self-directedandLife-longLearning

CO1: To understand the concepts and various symmetry elements

CO5: Analyzing the environmental impact and sustainability aspects of p-block elements and their compounds

CO4: Investigating the applications of p-block elements in various fields such as Materials science, environmental chemistry, and pharmaceuticals.

CO7: Understanding the role of p-block elements in biological systems

PSCH113: Organic Chemistry I, Semester I (4 credits, 48L)

Course Objectives:

CO1. To recall and understand rules of IUPAC nomenclature of organic compounds.
CO2. To understand basic principles and applications of steriochemistry by using models
CO3. To learn advanced steriochemical concepts like; chirality, biphenyls, Allenes, spiranes.
CO4. Students will be able to recall reactivity and synthesis of heterocyclic aromatic compounds.

Course Outcomes:

CO1. Students will be able to give correct nomenclature to organic compounds
CO2. They will differentiate between aromatic and non-aromatic compounds.
CO3. They will learn new concept like qazi and Homo aromatic compounds.
CO3. Students will be able to apply stereochemical concepts in organic synthesis.
CO4. They can gain knowledge of stereospecificity and stereoselectivity
CO5. Students will apply stereochemical concepts in asymmetric synthesis.
CO6. Students will be able give nomenclature to Heterocyclic compounds
CO7. Students will gain knowledge of reactivity and synthesis of various heterocyclic compounds.
CO8. Students will learn what is rearrangement reactions

SECTION I

1. **IUPAC Nomenclature of Simple Organic Compounds.** **(2L)**
   Aldehydes, Ketones, Alcohols, Esters, Cyclic, Bicyclic, Aromatic and heterocyclic compounds (Self study: Nomenclature of alkane, alkene, alkyne)
2. **Aromaticity** **(6L)**
   Benzenoid and non-benzenoid compounds, Huckels rule, Aromaticity, antiaromaticity, Non-Aromaticity, Quasi and Homo aromatic compounds.
   Application to carbocyclic and heterocyclic systems, annulenes, azulenes.

3. **Stereochemistry**
   Recapitulation: Stereochemical principles, enantiomeric relationship, diastereomeric relationship, R-S nomenclature, E-Z isomerism, Interconversion of Fischer, Newman and Sawhorse projections. **(2L)**
   Diastereoisomerism in acyclic and cyclic-systemsProchiral relationship, stereospecific and stereoselective reactions, optical activity in biphenyls, spiranes, allenes. **(8L)**

4. **Heterocyclic Compounds** **(6L)**
   Five and six membered heterocycles with one and two hetero atoms:
   Synthesis, reactivity, aromatic character and biological importance of following heterocyclic rings: Furan, Pyrrole, Thiophene, Pyrazole, Imidazole, Pyridine

SECTION II

1. **Organic reaction intermediates: (4 L)**
   Structure, formation, stability and reactions of reactive intermediates, carbenes, nitrenes, carbocations, carbanions and free radicals.

2. **Molecular Rearrangements: (6L)**
   Beckmann, Schmith, Wolff, Lossen, Bayer-villiger, Sommelet, Favorskii, Benzilbenzilic acid, Fries, Claisen, Cope, Brook, Benzidine, Neber reaarrengment, Pummener rearrangement, Tiffeneau Demjanov

3. **Ylides: (4L)**
   Phosphorus, Nitrogen and Sulphur ylides- synthesis and their reactions (Wittig reaction, Corey-Chaykovsky Reaction, Stevens rearrangement)

4. **Oxidation reactions: (6 L)**
   CAN, Dess Martin, PCC, MnO_2, Swern, SeO_2, $Pb(OAc)_4$, OsO_4, tert-Butyl hydroperoxide (tBuOOH), m-CPBA, $NaIO_4$, DDQ, Ozonolysis, Oppenauer oxidation.

5. **Reduction reactions: (4 L)**
   Boranes and hydroboration reactions, MPV reduction, reduction with H2/Pd-C, Willkinsons catalyst, DIBAL, Wolff Kishner reduction, Birch reduction, $NaCNBH_3$

References:

1. Organic Chemistry–by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)
2. Advanced Organic Chemistry –by J. March 6th Edition
3. Advanced Organic Chemistry (part A) –by A. Carey and R.J. Sundberg
4. Stereochemistry of carbon compound-by E.L. Eliel
5. Stereochemistry of organic compound-by Nasipuri
6. Guide book to Reaction Mechanism –Peter Sykes

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem I) **Subject**: Chemistry

Course:Organic chemistry I **Course Code**: PSCH-113

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

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Students will be able to give correct nomenclature to organic compounds
CO2. They will differentiate between aromatic and non-aromatic compounds.
CO3. They will learn new concept like qazi and Homo aromatic compounds.
CO4. Students will be able to apply stereochemical concepts in organic synthesis.
CO5. They can gain knowledge of stereospecificity and stereoselectivity
CO6. Students will apply stereochemical concepts in asymmetric synthesis.
CO7. Students will be able to recall reactivity and synthesis of heterocyclic aromatic compounds.

PO2: Critical Thinking and Problem Solving

CO2. They will differentiate between aromatic and non-aromatic compounds.
CO3. They will learn new concept like qazi and Homo aromatic compounds.
CO4. Students will be able to apply stereochemical concepts in organic synthesis.
CO6. Students will apply stereochemical concepts in asymmetric synthesis.

PO4: Research relatated skills and Scientific temper

CO1. Students will be able to give correct nomenclature to organic compounds
CO4. Students will be able to apply stereochemical concepts in organic synthesis.
CO5. They can gain knowledge of stereospecificity and stereoselectivity
CO6. Students will apply stereochemical concepts in asymmetric synthesis.
CO7. Students will be able to recall reactivity and synthesis of heterocyclic aromatic compounds.

PO5: Trans-disciplinary Knowledge

CO2. They will differentiate between aromatic and non-aromatic compounds.
CO3. They will learn new concept like qazi and Homo aromatic compounds.
CO5. They can gain knowledge of stereospecificity and stereoselectivity
CO6. Students will apply stereochemical concepts in asymmetric synthesis.

PO8: Environment and sustainability

CO6. Students will apply stereochemical concepts in asymmetric synthesis.
CO7. Students will be able to recall reactivity and synthesis of heterocyclic aromatic compounds.

PO9: Self-directed and Life-long Learning

CO4. Students will be able to apply stereochemical concepts in organic synthesis.
CO5. They can gain knowledge of stereospecificity and stereoselectivity
CO6. Students will apply stereochemical concepts in asymmetric synthesis.
CO7. Students will be able to recall reactivity and synthesis of heterocyclic aromatic compounds.

PSCH 114
Safety in Chemical Laboratory and Good Laboratory Practices
(4 Credits, 48 L)

Course Objectives:

1. Understand the historical development and significance of safety and health in laboratory practices.
2. Implement principles for establishing effective chemical safety and security management in a laboratory.
3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
4. Proficiently assess routes of exposure for toxic chemicals and administer appropriate first aid measures.
5. Develop skills in assessing and managing hazards and risks in the laboratory environment.
6. Apply skills in managing chemicals, incorporating principles of green chemistry and ensuring safe practices.
7. Apply safe working practices when handling various types of chemicals in a laboratory setting.

Course Outcomes (COs):

CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.
CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.

SECTION-I

1. **Recapitulation** **(3L)**
   Why chemical safety and security important for your institution? different types of hazards, ten steps to improve chemical safety and security, personnel protective and safety equipment, routes of exposure for toxic chemicals, dose-response relationship, most common classes of toxic substances encountered in laboratory, twelve principles of green chemistry, storage of chemicals.

2. **History and importance of safety and health in Laboratory** **(4L)**
   Responsibility and accounting for safety, types of hazards and risk in chemical laboratory,Moral legal and financial reasons. Introduction to different types of Hazards (**Self study**- Importance of Safety and security)

3. **Establishing Effective chemical safety and security management** **(2L)**
   Introduction, responsibility of laboratory safety and security, ten step to creating an effective laboratory chemical safety and security management safety(**Self study**- Responsibilities of the CSSO)

4. **Personnel protective and other safety equipment (3L)**
   Personnel clothing, foot protection, eye and face protection, safety shield, heat and smoke detector, respirators, (**Self study**- Fire safety equipment, safety showers, eye wash unit**)**

5. **Assessing routes of exposure for toxic chemicals (3L)**
   Inhalation, contact with skin and eye, ingestion, assessing risk with acute toxicology, First aid for contact of different chemicals on skin, eyes, Ingestion and Injection (**Self study**– Specific chemical hazards of select gases)

6. **Assessing hazards and risk in the laboratory (6L)**
   Introduction, consulting source of information, assessing flammable, reactive and explosive hazards, assessing physical hazards, assessing bio hazards**Self study**- Evaluating the toxic risk of laboratory chemicals)

7. **Managing Chemicals (3L)**
   Introduction, purchasing chemicals, inventory and tracking of chemicals, storage of chemicals, transfer, transport, shipment of chemicals.(**Self study**- Green chemistry for every laboratory)

SECTION-II

1. **Working with Chemicals and laboratory equipment (8L)**
   Introduction, careful planning, working with substance of high toxicity, working with bio hazards material, working with flammable chemicals, working with highly reactive or explosive chemicals Introduction, working with electrically powered equipment, working with compressed gases,working with high and low pressure and temperatures.(**Self-Study** - General procedure for working with hazardous chemicals)

2. **Managing chemical waste (5L)**
   Introduction, identifying waste and its hazards, treatment and hazard reduction, disposal options.(**Self Study**- collecting and storing waste)

3. **Introduction to Good Laboratory Practices and its applications (4L)**
   General introduction, Drug development process, GMP, Introduction to GLP and its applications,Fundamental points of GLP (**Self Study** - GLP training)

4. **Rules for conduct of studies (4L**)
   General aspects, Identification, Approval of protocol, protocol amendment, Standard operating procedures, SOP system overview.**(Self study -** study plan of protocol, content of the protocol)

5. **Use of Computer programs (3L)**
   Linear regression, XY Plots, numerical integration & Use of MSWORD, Power point & Excel in chemistry, Use of Internet**.**

References:

1) Chemical Laboratory Safety and Security, A Guide Prudent Chemical Management Edited by Lisa Moran and Tina Masciangioli Available Online www.nap.edu (Free)
2) Hand Book, Good Laboratory Practice (GLP) Available Online (Free)
3) Computational Chemistry, G.Grant and W.Richards, Oxford University press

Choice Based Credit System Syllabus
(2022 Pattern)

Class: M.Sc. I (SEM I) **Subject:** Chemistry
Course: Safety in chemical laboratory and Good laboratory Practices **Course Code:**PSCH114
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of program outcomes with course outcomes

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

PO1: Disciplinary Knowledge
CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.
CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.
PO2: Critical Thinking and Problem Solving
CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.
CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.
PO3: Social Competence
CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.

CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.

PO4: Research-related Skills and Scientific Temper

CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.
CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.

PO5: Trans-disciplinary Knowledge

CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.
CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.

PO6: Personal and Professional Competence

CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.
CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.

PO7: Effective Citizenship and Ethics

CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.

CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.
PO9: Self-directed and Lifelong Learning CO1. Demonstrate mastery of the historical development and importance of safety and health in laboratory practices.
CO2. Successfully implement principles for establishing effective chemical safety and security management in a laboratory.
CO3. Demonstrate competence in using various safety equipment and protective measures in a laboratory setting.
CO4. Demonstrate proficiency in assessing routes of exposure for toxic chemicals and administering first aid.
CO5. Effectively assess and manage hazards and risks in the laboratory environment.
CO6. Demonstrate proficiency in managing chemicals, applying green chemistry principles and ensuring safe practices.
CO7. Apply safe working practices when handling various types of chemicals in a laboratory setting.

PSCH 115 Physical Chemistry Practical
(4 Credits)

Course Objectives:
1. Master various analytical techniques including conductometry, potentiometry, pH metry, polarography, colorimetry/spectrophotometry, radioactivity, and chemical kinetics.
2. Develop practical skills in experimental design, setup, and analysis across diverse analytical methods.
3. Gain a strong conceptual understanding of fundamental principles underlying analytical chemistry.
4. Foster awareness of safety protocols and ethical considerations in laboratory practices.
5. Acquire proficiency in interpreting data generated from complex analytical experiments.
6. Develop the capability to solve analytical problems and troubleshoot experimental challenges.
7. Enhance communication skills by articulating experimental procedures, results, and conclusions.

Course Outcomes (COs):
CO1. Demonstrate versatility in applying a range of analytical skills to solve diverse chemical problems.
CO2. Apply practical skills to design, set up, and execute experiments, ensuring accurate data collection and analysis.
CO3. Exhibit a strong grasp of fundamental concepts in analytical chemistry and their practical implications.
CO4. Adhere to safety protocols and ethical guidelines, ensuring responsible laboratory practices.
CO5. Demonstrate competence in interpreting complex data obtained from analytical experiments.
CO6. Proficiently apply analytical skills to solve problems and address challenges encountered in experiments.
CO7. Effectively communicate experimental procedures, results, and conclusions through written and oral presentations.

A) Conductometry: (Any Two)
1. Study the Hydrolysis of aniline hydrochloride.
2. Determination of equivalent conductance at infinite dilution and dissociation constant of acetic acid.
3. Determination of critical micelle concentration (CMC) and □G of micellzation of sodium dodecyl sulphate (SDS).
4. Determination of □G, □H, and □S of silver benzoate by conductometry.

B) Potentiometry: (Any Two)
1. Determination of concentrations of reductant or oxidant by redox titration.
2. Determination of stability Constant of a Silver-ammonia complex
3. Estimation of amount of halides present in the mixture.
4. Vinegar estimation from commercial vinegar sample.

C) pH-metry: (Any Two)
1. Determination of the acidic and basic dissociation constant of an amino acid and hence isoelectric point of the amino acid.
2. Determination of dissociation constants of tribasic acid(phosphoric acid)
3. Determination of Hammett constant of o-,m-,p-amino/nitrobenzoic acid.

D) Polarography:(Any One)

1. Determination of half wave potential (E1/2) and unknown concentration of anion.
2. Amperometric titration of Pb(NO3)2 with K2Cr2O7.

E) Colorimetry/Spectrophotometry:(Any Three)

1. Simultaneous determination of cations from the mixture.
2. Determination of amount of copper by photometric titration with EDTA.
3. Study the kinetics of iodination of acetone spectrophtometrically.
4. Determination of indicator constant of given indicator by spectrometric scanning and recording the absorbance in UV-Visible region.

F) Radioactivity:(Any One)

1. Determination of plateu voltage, dead time and counting errors of G.M.Counter.
2. Determination of Emax of the β radiation and absorption coefficients in Aluminum.

G) Chemical Kinetics:(Any Three)

1. Study of Kinetic decomposition of diacetone alcohol by dilatometry.
2. Determination of individual orders of iodide and persulphate ions and overall orderof oxidation reaction of iodide ion by persulphate ion.
3. Investigation of influence of ionic strength on rate constant (Brönsted primary salt effect).
4. Determination of temperature coefficient and energy of activation of acid catalyzedester hydrolysis reaction.

H) Non-Instrumental: (Any Three)

1. Determination of glycerol radius by viscosity.
2. Determination of partial Molar Volume and the densities of a series of solutions and to calculate the molar volumes of the components.
3. Determination of molecular weight by steam distillation.
4. Determination of freezing point curve and composition of mixture of naphthalene and biphenyl.
5. Some experiments will be conducted based on new instrumental techniques.

I) Report on Industrial Visit

References:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Greenand Co.)
2. Experiments in Physical Chemistry, Wilson, Newcombe, Denko.Richett (Pergamon Press)
3. Senior Practical Physical Chemistry, B.D.Khoslaand V.S. Garg (R. ChandandCo.,Delhi.).
4. Experimental Physical Chemistry by D. P.Shoemaker,Mc.Growhill,7thEdition,2003.
5. Physical chemistry by Wien (2001)
6. Practical physical chemistry, B. Vishwanathan and P.S. Raghavan, 2nd edition,(2012)
7. Practical Physical Chemistry, J.B.Yadav
8. Essentials of practical Physical Chemistry, Rajboj and Chandhekar
9. Practical Physical Chemistry, Athawale and Mathur

Choice Based Credit System Syllabus
(2022 Pattern)

Class: M.Sc. I (SEM I) **Subject:** Chemistry
Course: Physical Chemistry Practical **Course Code:** PSCH115
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of program outcomes with course outcomes

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

Justification of mapping

PO1: Disciplinary Knowledge
CO1. Demonstrate versatility in applying a range of analytical skills to solve diverse chemical problems.
CO2. Apply practical skills to design, set up, and execute experiments, ensuring accurate data collection and analysis.
CO3. Exhibit a strong grasp of fundamental concepts in analytical chemistry and their practical implications
CO5.Demonstrate competence in interpreting complex data obtained from analytical experiments.
CO6.Proficiently apply analytical skills to solve problems and address challenges encountered in experiments.

PO2: Critical Thinking and Problem Solving
CO1. Demonstrate versatility in applying a range of analytical skills to solve diverse chemical problems.
CO2. Apply practical skills to design, set up, and execute experiments, ensuring accurate data collection and analysis.
CO3. Exhibit a strong grasp of fundamental concepts in analytical chemistry and their practical implications
CO5.Demonstrate competence in interpreting complex data obtained from analytical experiments.
CO6.Proficiently apply analytical skills to solve problems and address challenges encountered in experiments.

PO3: Social competence
CO7.Effectively communicate experimental procedures, results, and conclusions through written and oral presentations.

PO4: Research-related skills and Scientific temper
CO4. Adhere to safety protocols and ethical guidelines, ensuring responsible laboratory practices.
CO5. Demonstrate competence in interpreting complex data obtained from analytical experiments.
CO6. Proficiently apply analytical skills to solve problems and address challenges encountered in experiments.

PO6: Personal and professional competence
CO3. Exhibit a strong grasp of fundamental concepts in analytical chemistry and their practical implications
CO4. Adhere to safety protocols and ethical guidelines, ensuring responsible laboratory practices.
CO6.Proficiently apply analytical skills to solve problems and address challenges encountered in experiments.
CO7.Effectively communicate experimental procedures, results, and conclusions through written and oral presentations.

PO7: Effective Citizenship and Ethics
CO4. Adhere to safety protocols and ethical guidelines, ensuring responsible laboratory practices.
CO7.Effectively communicate experimental procedures, results, and conclusions through written and oral presentation

PSCH116: Organic Chemistry Practicals (4 Credits)

Course objective:

1. Student should understand reaction conditions and reagent used.
2. Student should understand workup of the reaction.
3. Student should able to take melting and boiling point of products.
4. Student should able to perform Isolation of natural products.
5. Student should able to monitor the reaction progress.
6. Student should able to do purification by different techniques.
7. Students should to be acquainted with major and minor product formation.

Course outcome:

CO1. Student will understand reaction conditions and reagent used.
CO2. Student will understand workup of the reaction.
CO3. Student will able to take melting and boiling point of products.
CO4. Student will able to perform Isolation of natural products.
CO5. Student will able to monitor the reaction progress.
CO6. Student will able to do purification by different techniques.
CO7. Students will be acquainted with major and minor product formation.

A) Qualitative analysis (Minimum 6 mixtures including amino acid)

Separation and, purification of ternary mixture

(Note: a) Identification of any one compound using **semi-microanalysis,** b) Zn dust,sodium carbonate can be used as alternative for sodium metal)

B) Synthesis, Purification and Characterization (minimum 6 preparations)

1) 2-Methoxy naphthalene to 1-formyl-2- methoxy naphthalene

2) Knoevenagel condensation reaction – Reaction between aldehyde and malononitrile

3) Fisher indole synthesis – Reaction of phenyl hydrazine and cyclohexanone

4) Preparation of acetanilide from aniline and acetic acid using zinc dust.

5) Benzil to benzilic Acid

6) Benzyl cyanide to phenyl acetic acid

7) Benzaldehyde to chalcones using green method ($LiOH.H_2O$ Catalyst)

8) Preparation of Schiff bases in aqueous media

9) Nitrobenzene to m-di-nitrobenzene

10) m-di-nitrobenzene to m-nitroaniline

11) Benzoic acid to ethylbenzoate

12) Diel's Alder reaction of anthracene and maleic anhydride

13) 4-nitrotoulene to 4-nitrobenzoic acid

14) Report on industrial visit or study tour.

Reference:

1. Textbook of practical organic chemistry – A.I. Vogel

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem I) **Subject**: Chemistry

Course: Organic chemistry practical **Course Code**: PSCH-116

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

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Student will understand reaction conditions and reagent used.
CO2. Student will understand workup of the reaction.
CO3. Student will able to take melting and boiling point of products.
CO4. Student will able to perform Isolation of natural products.
CO5.Student will able to monitor the reaction progress.
CO6.Student will able to do purification by different techniques.
CO7. Students will be acquainted with major and minor product formation.

PO2: Critical Thinking and Problem Solving

CO1. Student will understand reaction conditions and reagent used.
CO4. Student will able to perform Isolation of natural products.
CO5.Student will able to monitor the reaction progress.
CO6.Student will able to do purification by different techniques.
CO7. Students will be acquainted with major and minor product formation.

PO4: Research relatated skills and Scientific temper

CO1. Student will understand reaction conditions and reagent used.
CO2. Student will understand workup of the reaction.
CO4. Student will able to perform Isolation of natural products.
CO5.Student will able to monitor the reaction progress.
CO6.Student will able to do purification by different techniques.
CO7. Students will be acquainted with major and minor product formation.

PO5: Trans-disciplinary Knowledge

CO1. Student will understand reaction conditions and reagent used.
CO4. Student will able to perform Isolation of natural products.

PO6: Personal and Professional Competence

CO1. Student will understand reaction conditions and reagent used.
CO7. Students will be acquainted with major and minor product formation.

PO8: Environment and sustainability

CO1. Student will understand reaction conditions and reagent used.
CO2. Student will understand workup of the reaction.
CO7. Students will be acquainted with major and minor product formation.

PO9: Self-directed and Life-long Learning

CO1. Student will understand reaction conditions and reagent used.
CO2. Student will understand workup of the reaction.
CO4. Student will able to perform Isolation of natural products.
CO5.Student will able to monitor the reaction progress.
CO6.Student will able to do purification by different techniques.
CO7. Students will be acquainted with major and minor product formation.