



Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year Degree Program in Chemistry

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Chemistry) Part-I Semester -I

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. (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-I 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.

Programme Specific Outcomes (PSOs)

- PSO1:** Establish and apply the fundamental knowledge of the basic principles in various fields of Chemistry
- PSO2:** Student will propose novel ideas and providing new solutions to the problems
- PSO3:** Create consciousness and sense of responsibilities towards environment and apply knowledge to solve the issues related to Environmental pollution.
- PSO4:** Apply knowledge to build up small scale industry for developing endogenous product.
- PSO5:** Apply various aspects of chemistry in natural products isolations, pharmaceuticals, dyes, textiles, polymers, petroleum products, forensic etc. and also to develop interdisciplinary approach of the subject.
- PSO6:** Collaborate effectively on team-oriented projects in the field of Chemistry or other related fields.
- PSO7:** Communicate scientific information in a clear and concise manner both orally and in Writing.
- PSO8:** Inculcate logical thinking to address a problem and become result oriented with a positive attitude.

Anekant Education Society's
Tuljaram Chaturchand College, Baramati
(Autonomous)

Board of Studies (BOS) in Chemistry

From 2022-23 to 2024-25

| Sr. No. | Name | Designation |
|---------|-----------------------------------|------------------------------|
| 1. | Prof Dr. Sanjay R. Kale | Chairman |
| 2. | Mr. Shrikrishna T. Salunke | Member |
| 3. | Mr. Bhimrao T. Torane | Member |
| 4. | Mr. Maharudra . A. Dudhe | Member |
| 5. | Mr. Ravikiran R. Gandhi | Member |
| 6. | Dr. Vaibhav P. Landage | Member |
| 7. | Dr. Yogesh N. indulkar | Member |
| 8. | Dr. Rahul S. Bhondwe | Member |
| 9. | Dr. Nilam C Dige | Member |
| 10. | Dr. Namdev M. Bhujbal | Vice chancellor nominee |
| 11. | Dr. Vijay. T Vader | Expert from other University |
| 12. | Dr. Dattaprasad M. Pore | Expert from other University |
| 13. | Mr. Nitin m Gawade | Industry Expert |
| 14. | Dr. Hanumant Gurav | Meritorious Alumni |
| 15. | Mr. Ajay C. Pomane | Student Representative |
| 16. | Mr. Prathamesh P. Bhosale | Student Representative |

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Autonomous)

Credit Distribution Structure for (M.Sc. Chemistry) Part-I (2023 Pattern)

| Year (2 Year PG) | Level | Sem. (2 Yr.) | Major | | Research Methodology (RM) | OJT/ FP | RP | Cum. Cr. | Degree |
|---------------------------|-------|-----------------|---|---|--|------------|----|-------------|--|
| | | | Mandatory | Electives | | | | | |
| I | 6.0 | Sem-I | CHE-501-MJM : Physical and Analytical Chemistry-I (Credit 04) | CHE-511-MJE : A. Advance topics in Analytical Chemistry-I B. Advance topics in Inorganic Chemistry-I C. Advance topics in Organic Chemistry-I (Credit 04) | CHE-521-RM Research Methodology (Credit 04) | -- | -- | 20 | PG Diploma (after 3 Year Degree) |
| | | | CHE-502-MJM: Organic and Inorganic Chemistry-I (Credit 04) | | | | | | |
| | | | CHE-503-MJM: Physical Chemistry Practical (Credit 02) | | | | | | |
| | | | CHE-504-MJM: Organic Chemistry Practical | | | | | | |

| | | | | | | | |
|------------------------------------|---------|---|--|----------|--|-----------|-----------|
| | | (Credit 02) | | | | | |
| | | | | | | | |
| | Sem- II | CHE-551-MJM: Physical and Analytical Chemistry-II (Credit 04) | CHE-561-MJE : A. Advance topics in Analytical Chemistry-II B. Advance topics in Inorganic Chemistry-II C. Advance topics in Organic Chemistry-II (Credit 04) | -- | CHE- 581- OJT/F P Credit 04 | -- | 20 |
| | | CHE-552-MJM: Organic and Inorganic Chemistry-II (Credit 04) | | | | | |
| | | CHE-553-MJM: Inorganic Chemistry Practical (Credit 02) | | | | | |
| | | CHE-554-MJM: Analytical Chemistry Practical (Credit 02) | | | | | |
| Cum. Cr. For PG Diploma | | 24 | 8 | 4 | 4 | -- | 40 |

Course Structure for (M.Sc. Chemistry) Part-I (2023 Pattern)

| Sem | Course Type | Course Code | Course Title | Theory/ Practical | No. of Credits |
|--|--|-----------------------------------|---|----------------------|----------------|
| I | Major (Mandatory) | CHE-501-MJM | Physical and Analytical Chemistry-I | Theory | 04 |
| | Major (Mandatory) | CHE-502-MJM | Organic and Inorganic Chemistry-I | Theory | 04 |
| | Major (Mandatory) | CHE-503-MJM | Physical Chemistry Practical | Practical | 02 |
| | Major (Mandatory) | CHE-504-MJM | Organic Chemistry Practical | Practical | 02 |
| | Major (Elective) | CHE-511-MJE (A) | Advance topics in Analytical Chemistry-I | Theory | 04 |
| | | CHE-511-MJE (B) | Advance topics in Inorganic Chemistry-I | | |
| | | CHE-511-MJE (C) | Advance topics in Organic Chemistry-I | | |
| Research Methodology (RM) | CHE-521-RM | Research Methodology in Chemistry | Theory | 04 | |
| Total Credits Semester I | | | | | 20 |
| II | Major (Mandatory) | CHE-551-MJM | Physical and Analytical Chemistry-II | Theory | 04 |
| | Major (Mandatory) | CHE-552-MJM | Organic and Inorganic Chemistry-II | Theory | 04 |
| | Major (Mandatory) | CHE-553-MJM | Analytical Chemistry Practical | Practical | 02 |
| | Major (Mandatory) | CHE-554-MJM | Inorganic Chemistry Practical | Practical | 02 |
| | Major (Elective) | CHE-561-MJE (A) | Advance topics in Analytical Chemistry-II | Theory | 04 |
| | | CHE-561-MJE (B) | Advance topics in Inorganic Chemistry-II | | |
| | | CHE-561-MJE (C) | Advance topics in Inorganic Chemistry-II | | |
| | On Job Training (OJT)/Field Project (FP) | CHE-581-OJT/FP | On Job Training/Field Project relevant to the major course. | Training/ Project | 04 |
| Total Credits Semester II | | | | | 20 |
| Cumulative Credits of Semester I and II | | | | | 40 |

**CBCS Syllabus as per NEP 2020 for M.Sc. I chemistry
(2023 Pattern)**

| | |
|------------------------------|---------------------------------------|
| Name of the Programme | : M.Sc. Chemistry |
| Program Code | : PSCH |
| Class | : M.Sc. I |
| Semester | I |
| Course Type | : Mandatory Theory |
| Course Name | : Physical and Analytical Chemistry I |
| Course Code | : CHE-501-MJM |
| No. of Lectures | : 60 |
| No. of Credits | : 4 credits |

Course Objectives:

1. Laws of thermodynamics
2. Basic concepts of thermodynamics, changes in state, phase diagrams
3. Basics of quantum Chemistry
4. Chemical kinetics and reaction dynamics
5. Molecular thermodynamics
6. To develop effective laboratory practices.
7. Aware about use of flammable and hazardous chemicals.

Course Outcomes:

By the end of the course, students will be able to:

- 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 know the concepts of statistical thermodynamics in detail.
- CO5. Student should solve the numerical based on all the topics included in this course.
- CO6. Introduction to Good Laboratory Practices and its applications
- CO7. Managing chemical waste

CO8. Precautions of hazardous chemicals

CO9. Effects of hazards on human body.

Topics and Learning Points

SECTION-I

Chemical kinetics & molecular thermodynamics

Unit 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)

Unit 2. Complex and simple reaction: (2L)

Reactions approaching equilibrium, consecutive reactions, opposing reactions, chain reaction-explosion, photochemical reactions.

Unit 3. Methods to solve complex reactions: (3L)

The steady state approximations, pre equilibria approximation, Lindeman mechanism for unimolecular reactions.

Unit 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.

Unit 5. Enzyme catalysts: (4L)

Menten mechanism, limiting rate, problems, Lineweaver Burk and Eadie plots, enzyme inhibition, competitive and non-competitive inhibition.

Unit 6. Methods of studying fast reactions: (2L)

flash photolysis, temperature jump relaxation methods

Unit 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.

SECTION-II**Unit 1.Working with Chemicals and laboratory equipments (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).

Ref. 1 Page 107-125 ,Ref. 1 Page 137-143

Unit 2.Managing chemical waste (5L)

Introduction, identifying waste and its hazards, treatment and hazard reduction, disposal options.

(Self Study- collecting and storing waste)

Ref. 1 Page 152-161.

Unit 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).

Ref. 2 Page 9-18

Unit 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)

Ref. 2 Page 27-36

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

Choice Based Credit System Syllabus
(NEP Pattern)

Class: M.Sc. I (SEM. I)

Subject: Chemistry

Course: Physical chemistry and Analytical -I

Course Code: CHE-501-MJM

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 |
|-----|-----|-----|-----|-----|-----|-----|-----|
| CO1 | 3 | 2 | 0 | 3 | 3 | 0 | 0 |
| CO2 | 3 | 2 | 0 | 3 | 3 | 0 | 0 |
| CO3 | 3 | 2 | 0 | 3 | 3 | 0 | 0 |
| CO4 | 3 | 2 | 0 | 3 | 3 | 0 | 0 |
| CO5 | 3 | 2 | 0 | 3 | 3 | 0 | 0 |
| CO6 | 3 | 2 | 0 | 3 | 0 | 3 | 3 |
| CO7 | 3 | 2 | 0 | 0 | 0 | 3 | 3 |

Analyze Alignment:**1. PO1: Disciplinary Knowledge**

CO1. **studentswillbeableto** Student should understand the thermodynamic concepts in detail

CO2. **studentswillbeableto** Student should understand Basic concepts of quantum chemistry concepts.

CO3. **studentswillbeableto** Students should understand chemical kinetics of complex reactions.

CO4. **studentswillbeableto** Students should know the concepts of statistical thermodynamics in detail.

CO5. **studentswillbeableto** Students should solve the numerical based on all the topics included in this course.

CO6. **studentswillbeableto** Introduction to Good Laboratory Practices and its applications

PO2: Critical Thinking and Problem Solving

2. CO1. **studentswillbeableto** Student should understand the thermodynamic concepts in detail

3. CO2. **studentswillbeableto** Student should understand Basic concepts of quantum chemistry concepts.

4. CO3. **studentswillbeableto** Students should understand chemical kinetics of complex reactions.

5. **CO4. students will be able to**
Students should know the concepts of statistical thermodynamics in detail.
6. **CO5. students will be able to** Students should solve the numerical based on all the topics included in this course.
7. **CO6. students will be able to** Introduction to Good Laboratory Practices and its applications

8. **PO4: Research-related skills and Scientific temper**

CO1. students will be able to Student should understand the thermodynamic concepts in detail

CO2. students will be able to Student should understand Basic concepts of quantum chemistry concepts.

CO3. students will be able to Students should understand chemical kinetics of complex reactions.

CO4. students will be able to
Students should know the concepts of statistical thermodynamics in detail.

CO5. students will be able to Students should solve the numerical based on all the topics included in this course.

CO6. students will be able to Introduction to Good Laboratory Practices and its applications

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9. **PO5: Trans-disciplinary knowledge**

CO1. students will be able to Student should understand the thermodynamic concepts in detail

CO2. students will be able to Student should understand Basic concepts of quantum chemistry concepts.

CO3. students will be able to Students should understand chemical kinetics of complex reactions.

CO4. students will be able to
Students should know the concepts of statistical thermodynamics in detail.

CO5. students will be able to Students should solve the numerical based on all the topics included in this course.

10. **PO6: Personal and professional competence**

CO6. students will be able to Introduction to Good Laboratory Practices and its

applications

CO7. students will be able to Managing chemical waste

11. PO7: Effective Citizenship and Ethics

- Possible alignment with CO6, CO7

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

| | |
|------------------------------|-------------------------------------|
| Name of the Programme | : M.Sc. Chemistry |
| Program Code | : PSCH |
| Class | : M.Sc. I |
| Semester | I |
| Course Type | : Mandatory Theory |
| Course Name | : Organic and Inorganic Chemistry I |
| Course Code | : CHE-502-MJM |
| No. of Lectures | : 60 |
| No. of Credits | : 4 credits |

Course Objectives:

1. To recall and understand rules of IUPAC nomenclature of organic compounds.
2. To understand basic principles and applications of stereochemistry by using models
3. To learn advanced stereochemical concepts like; chirality, biphenyls, Allenes, spiranes.
4. Students will be able to recall reactivity synthesis of heterocyclic aromatic compounds.
5. To apply the concept of point group for determining optical activity and dipole moment.
6. Student should understand the importance of orthogonality theorem.
7. Student should know the concept of SALC and find out character for reducible representation.
8. Student should imagine molecules in 3 dimensions.

Course Outcomes:

By the end of the course, students will be able to:

- 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. Student should understand the detail chemistry of S and P block elements.
- CO6. Students will be able to learn the advanced chemistry.
- CO7. Students will be able to understand the various symmetry elements.
- CO8. Students will be able to understand the concept and point group and apply it to molecule

Topics and Learning Points

SECTION I

Unit 1: IUPAC Nomenclature of Organic Compounds. (02L)

Aldehydes, Ketones, Alcohols, Esters, Cyclic, Bicyclic, Aromatic and heterocyclic compounds (Self study: Nomenclature of alkane, alkene, alkyne)

Unit 2: Aromaticity (10L)

Benzenoid and non-benzenoid compounds, Huckels rule, Aromaticity, antiaromaticity, Non-Aromaticity, Quasi and Homo aromatic compounds. Application to carbocyclic and heterocyclic systems, annulenes, azulenes.

Unit 3: Stereochemistry (12 L)

Stereochemical principles, enantiomeric relationship, diastereomeric relationship, R-S nomenclature, E-Z isomerism, Interconversion of Fischer, Newman and Sawhorse projections.

Diastereoisomerism in acyclic and cyclic-systems, Prochiral relationship, stereospecific and stereoselective reactions, Atropoisomerism, optical activity in biphenyls, spiranes, allenes.

SECTION II**Unit 1: Molecular Symmetry and Symmetry Groups (10L)**

Symmetry elements and operations, Symmetry planes and reflections, the inversion centre, proper axes and proper rotations, improper axes and improper rotation, products of symmetry operations, equivalent symmetry elements and equivalent atoms, general relations among symmetry elements and symmetry operations, classes of symmetry operations, symmetry elements and optical isomerism, symmetry point groups, classification of molecular point groups. Defining properties of a group, group multiplication table, some examples of group, subgroups and classes.

Unit 2: Representations of Groups (06 L)

Matrix representation and matrix notation for geometric transformation, The Great Orthogonality Theorem and its consequence, character tables (No mathematical part), wave function as basis for irreducible representations.

Unit 3: Symmetry Adapted Linear Combinations (04L)

Projection operators and their use of construct SALC (Construction of SALC for sigma bonding for molecules belonging point groups: D_{2h} , D_{3h} , D_{4h} , C_{4v} , T_d , O_h , normalization of SALC, transformation properties of atomic orbital, MO's for sigma bonding, AB_n molecules, tetrahedral AB_4 and O_h AB_6 cases.

Unit 4: Application of Group theory to Infrared Spectroscopy (04L)

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 related to symmetry of some compounds,

IR spectra of complex compounds.

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
7. Chemical Applications of Group Theoryby F. A. Cotton
8. Symmetry and spectroscopy of molecules by K. VeeraReddy
9. Group Theory and its Chemical Application, P.K. Bhattachrya

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem I)

Subject: Chemistry

Course: Organic chemistry & Inorganic chemistry

Course Code: CHE 502 MJM

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

| Course Outcomes | Programme Outcomes (POs) | | | | | | | | |
|-----------------|--------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| CO2 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO3 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| CO4 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| CO5 | 3 | 2 | 0 | 2 | 2 | 0 | 0 | 0 | 2 |
| CO6 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 2 | 2 |
| CO7 | 3 | 2 | 0 | 0 | 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: Demonstrating knowledge of symmetry elements and operations.

CO5: From the previous knowledge of symmetry student must able to find out which mode are IR , Raman Active, possible modes of vibrations

CO6: Student should understand the detail chemistry of S and P block elements w.r. t. their compounds, their reactions and applications

CO7: Developing problem solving skills through the applications of p block chemistry principles to real world scenarios.

PO2: Critical Thinking and Problem Solving

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.

CO5: From the previous knowledge of symmetry student must able to find out which mode are IR , Raman Active, possible modes of vibrations

CO7: Developing problem solving skills through the applications of p block chemistry principles to real world scenarios.

PO4: Research related skills and Scientific temper

CO1. Students will be able to give correct nomenclature to organic compounds

CO3. They will learn new concept like qazi and Homo aromatic compounds.

CO5: From the previous knowledge of symmetry student must able to find out which mode are IR , Raman Active, possible modes of vibrations

CO6: Student should understand the detail chemistry of S and P block elements w.r. t. their compounds, their reactions and applications

PO5: Trans-disciplinary Knowledge

CO4: Demonstrating knowledge of symmetry elements and operations.

CO5: From the previous knowledge of symmetry student must able to find out which mode are IR , Raman Active, possible modes of vibrations

PO9: Self-directed and Life-long Learning

CO1. Students will be able to give correct nomenclature to organic compounds

CO5: From the previous knowledge of symmetry student must able to find out which mode are IR , Raman Active, possible modes of vibrations

CO6: Student should understand the detail chemistry of S and P block elements w.r. t. their compounds, their reactions and applications

CO7: Developing problem solving skills through the applications of p block chemistry principles to real world scenarios.

**CBCS Syllabus as per NEP 2020 for M.Sc. I
(2023 Pattern)**

| | |
|------------------------------|--------------------------------|
| Name of the Programme | : M.Sc. Chemistry |
| Program Code | : PSCH |
| Class | : M.Sc. I |
| Semester | I |
| Course Type | : Mandatory Practical |
| Course Name | : Physical Chemistry Practical |
| Course Code | : CHE-503-MJM |
| No. of Lectures | : 60 |
| No. of Credits | : 2 credits |

Course Objectives:

The students are expected to learn,

1. Basic principles of instruments.
2. Basic concepts of chemical kinetics
3. Handling of different instruments.
4. Inculcate scientific knowledge.
5. Applications of instruments in sample analysis.
6. Strengthen basic concepts.
7. Develop critical thinking.

Course Outcomes:

By the end of the course, students will be able to:

- CO1. Student should understand the principles & applications of instruments in detail
- CO2. Student should understand handling of UV Visible spectrophotometer.
- CO3. Student should know handling of G. M. Counter, pH meter, potentiometer, conductometer, etc.
- CO4. Student should be able to find out minerals by using Flame photometer from soil, water.
- CO5. Student should be able to verify concepts of chemical kinetics through experiments.
- CO6. Students should understand handling & applications of all instruments.

Topics and Learning Points**A) Conductometry:**

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 ΔG of micellization of sodium dodecyl sulphate (SDS).
4. Determination of ΔG , ΔH , and ΔS of silver benzoate by conductometry.

B) Potentiometry:

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:

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(phosphoricacid)
3. Determination of Hammett constant of o-,m-,p-amino/nitrobenzoic acid.

D) Polarography:

1. Determination of half wave potential ($E_{1/2}$) and unknown concentration of anion.
2. Amperometric titration of $Pb(NO_3)_2$ with $K_2Cr_2O_7$.

E) Colorimetry/Spectrophotometry:

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 spectrophotometrically.
4. Determination of indicator constant of given indicator by spectrometric scanning and recording the absorbance in UV-Visible region.

F) Radioactivity:

1. Determination of plateau voltage, dead time and counting errors of G.M.Counter.

G) Determination of E_{\max} of the β radiation and absorption coefficients in Aluminum. 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 order of 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 catalyzed ester 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.

D) 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.Khosla and V.S. Garg (R. Chandand Co.,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.

Class: M.Sc. I(SEM I)

Subject: Chemistry

Course: Physical Chemistry Practical

Course Code: CHE-503-MJM

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

Mapping Matrix of COs to Pos

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

Justification

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 presentations.

**CBCS Syllabus as per NEP 2020 for M.Sc. I chemistry
(2023 Pattern)**

| | |
|------------------------------|-------------------------------|
| Name of the Programme | : M.Sc. Chemistry |
| Program Code | : PSCH |
| Class | : M.Sc. I |
| Semester | I |
| Course Type | : Practical |
| Course Name | : Organic Chemistry Practical |
| Course Code | : CHE-504-MJM |
| No. of Lectures | : 60 |
| No. of Credits | : 2 credits |

Course Objectives:

The students are expected to learn,

1. Handling of single step reactions.
2. separation and purification techniques
3. Perform physical constant of product.
4. Isolation of product
5. Monitoring by TLC
6. To develop effective laboratory practices.
7. Aware about use of flammable and hazardous chemicals.

Course Outcomes:

By the end of the course, students will be able to:

- CO1. Student should understand reaction conditions and reagent used.
- CO2. Student should understand workup of the reaction and purification by different techniques.
- CO3. Student should be able to take melting and boiling point of products.
- CO4. Student should be able to perform Isolation of products.
- CO5. Managing chemical waste
- CO6. Precautions of hazardous chemicals
- CO7. Effects of hazards on human body.

Topics and Learning Points**A) Separations and purification techniques**

- 1) Thin layer chromatography (TLC)
- 2) Column Chromatography
- 3) Recrystallization
- 4) Distillation techniques
- 5) Melting/Boiling Point

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.H₂O 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.

References:

1. Textbook of practical organic chemistry – A.I. Vogel
2. Practical Physical Chemistry, J.B. Yadav
3. Essentials of practical organic Chemistry, Rajboj and Chandhekar
4. Practical Chemistry, Athawale and Mathur.

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

Course: Organic chemistry Practical

Course Code: CHE-504 MJM

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

Mapping Matrix of COs to Pos

| CO/PO | 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 |

PO1: Disciplinary Knowledge

- CO1. students will be able to Importance of safety and health in Laboratory
- CO2. students will be able to security management
- CO3. students will be able to Managing chemical waste
- CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
- CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
- CO6. students will be able to Students will be able to know various fundamentals of chromatography and its classification. basic
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO2: Critical Thinking and Problem Solving

- CO2. students will be able to security management
- CO6. students will be able to Students will be able to know various fundamentals of chromatography and its classification. basic

PO3: Social Competence

- CO3. students will be able to Managing chemical waste
- CO6. students will be able to Students will be able to know various fundamentals of chromatography and its classification. basic
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO4: Research-related skills and Scientific Temper

- CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation

of surface morphology of solid from SEM

CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO5: Trans-disciplinary Knowledge

CO1. students will be able to Importance of safety and health in Laboratory

CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical

PO6: Personal and Professional Competence

CO1. students will be able to Importance of safety and health in Laboratory

CO2. students will be able to security management

CO3. students will be able to Managing chemical waste

CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM

CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical

CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.

PO7: Effective Citizenship and Ethics

CO1. students will be able to Importance of safety and health in Laboratory.

CO3. students will be able to Managing chemical waste

CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

**CBCS Syllabus as per NEP 2020 for M.Sc. I
(2023 Pattern)**

| | |
|-------------------------------|--|
| Name of the Programme. | : M.Sc. Chemistry |
| Program Code | : PSCH |
| Class | : M.Sc. I |
| Semester | I |
| Course Type | : Elective Theory |
| Course Name | : Advance topics in Analytical Chemistry |
| Course Code | : CHE-511-MJE (A) |
| No. of Lectures | : 60 |
| No. of Credits | : 4 credits |

Course Objectives:

1. To develop effective laboratory practices.
2. Aware about use of flammable and hazardous chemicals.
3. Aware about use of personnel protective and other safety equipments.
4. To understand basic principles and applications of surface characterization techniques.
5. To know characterisation techniques.
6. Acquire knowledge about the widely used analytical instruments
7. Select instrument for a particular analysis with come idea of it's merits ,demerits and limitations
8. Student should know about principal and applications of GC & HPLC

Course Outcomes:

By the end of the course, students will be able to:

- CO1. Importance of safety and health in Laboratory
- CO2. security management
- CO3. Managing chemical waste

- CO4. Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
- CO5. Principle of TEM, instrumentation of TEM and interpretation of TEM images,
- CO6. quantitative analysis, numerical
- CO7. Students will be able to know various basic fundamentals of chromatography and its classification.
- CO8. Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

Topics and Learning Points

SECTION –I

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 equipments, 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.

Unit-1. 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

Unit-2. 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

Unit-3. Personnel protective and other safety equipments (3L)

Clothing, foot protection, eye and face protection, safety shield, heat and smoke detector, respirators,

Unit-4. 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

Unit-5. Assessing hazards and risk in the laboratory

Introduction, consulting source of information, assessing flammable, reactive and explosive hazards, Assessing physical hazards, assessing bio hazards
(6L)

Unit-6. Managing Chemicals (3L)

Introduction, purchasing chemicals, inventory and tracking of chemicals, storage of chemicals, transfer, transport, shipment of chemicals.

SECTION-II**Unit-1: Material Characterization Techniques. (12L)**

Principle, instrumentation, working and applications of following spectroscopic techniques:

1. TEM
2. SEM
3. XPS
4. STEM

Unit-2 Gas Chromatography (06L)

Introduction, Basic principle of GC, Instrumentation of GC, Sample injection–Split and splitless injection, Column types, Solid/Liquid Stationary phases, Column switching techniques, Basic and specialized detectors, elemental detection, Chiral separations, Gas chromatographs and chemical analysis, Application of GLC, Gas solid chromatography and Problems

Unit-3 High Performance Liquid Chromatography (06L)

Theory and instrumentation of HPLC, Optimization of column performance, Gradient elution and related procedure, Derivatization, Mobile phase Delivery System, Sample injection,

Separation column, Detector, Interfacing HPLC With Mass spectrometry, Structure types of column packing, Adsorption Chromatography, Bonded phase chromatography, Reversed phase chromatography, Ion Pair Chromatography, Ion exchange Chromatography, Size Exclusion Chromatography and problem.

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. Yang Leng. Materials Characterization Introduction in Microscopic Spectroscopic Methods, Second Ed, Wiley-VCH,
4. R. D. Braun. Introduction to Instrumental Analysis, Second Ed
5. Instrumental Methods of chemical Analysis ,H. H. Willard, L.L. Merrite Jr., J.A. Dean &
6. F.A. Settle Jr., 6th Edition, Wadsworth Publishing Company, USA, 1986
7. Hand book of Instrumental Techniques for Analytical Chemistry, F.A. Settle editor, Prentice Hall Inc. A Simon and Schuster Company, New Jersey, 1997
8. Fundamentals of Analytical Chemistry ,D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, 7th Edition, Thomson Asia Pte. Ltd, Singapore, 2004

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

Course: Advanced topics in Analytical Chemistry

Course Code: CHE-511-MJE(A)

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

Mapping Matrix of COs to Pos

| CO/PO | 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 |

PO1: Disciplinary Knowledge

- CO1. students will be able to Importance of safety and health in Laboratory
- CO2. students will be able to security management
- CO3. students will be able to Managing chemical waste
- CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
- CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
- CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO2: Critical Thinking and Problem Solving

- CO2. students will be able to security management
- CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.

PO3: Social Competence

- CO3. students will be able to Managing chemical waste
- CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO4: Research-related skills and Scientific Temper

- CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO5: Trans-disciplinary Knowledge

- CO1. students will be able to Importance of safety and health in Laboratory
- CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical

PO6: Personal and Professional Competence

- CO1. students will be able to Importance of safety and health in Laboratory
- CO2. students will be able to security management
- CO3. students will be able to Managing chemical waste
- CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
- CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
- CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.

PO7: Effective Citizenship and Ethics

- CO1. students will be able to Importance of safety and health in Laboratory.
- CO3. students will be able to Managing chemical waste

CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

**CBCS Syllabus as per NEP 2020 for M.Sc. I
(2023 Pattern)**

| | |
|------------------------------|--|
| Name of the Programme | : M.Sc. Chemistry |
| Program Code | : PSCH |
| Class | : M.Sc. I |
| Semester | I |
| Course Type | : Elective Theory |
| Course Name | : Advanced topics in Inorganic Chemistry |
| Course Code | : CHE-511-MJE (B) |
| No. of Lectures | : 60 |
| No. of Credits | : 4 credits |

Course Objectives:

The students are expected to learn,

1. To develop knowledge of organometallic compounds
2. To develop scientific attitude
3. To develop knowledge about Main group elements.
4. Students should be able to understand and predict periodic properties and chemical reactions of Main Group Elements
5. Students should be able to understand organometallic compounds, its reactivity and organometallic compounds as catalysis
6. Students should be able to understand applications of instrumental techniques
7. To learn analysis of spectra

Course Outcomes:

By the end of the course, students will be able to:

- CO1. Student should understand the detail chemistry of S and P block elements.
- CO2. To learn the advanced chemistry.
- CO3. Students should be able to analyse spectrum
- CO4. Students should be able to understand organometallic chemistry and organometallic compounds as catalysis
- CO5. Students should be able to understand applications of instrumental techniques
- CO6. To develop knowledge about Periodic properties and organometallic

chemistry

CO7. Students will be able to distinguish between homogenous and heterogeneous catalysis.

Topics and Learning Points

SECTION I

Unit 1: Hydrogen and its compounds: (2L)

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

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

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

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

Classification, Synthesis, Structure, Properties and Uses.

Unit 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 .

Unit 5 : Carbon Group: (2L)

Allotropes of Carbon, C_{60} and compounds (fullerenes), Intercalation compounds of Graphite, Carbon nanotubes, synthesis, properties, structure-single walled, multi walled, Silicates, applications.

Unit 6 : Organometallic compounds (3L)

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

Unit 7 : Nitrogen Group: (3L)

Nitrogen activation, Boron nitride, Oxidation states of nitrogen and

their interconversion, PN and SN Compounds, NO_x and their redox chemistry.

Unit 8: Oxygen Group: (3L)

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

Unit 9: Halogen Group: (2L)

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

SECTION II

Unit 1: Organometallic Reactions and Catalysis (12L)

Isolable pair, Bond order (M-M), Metal carbonyl reactions, Oxidation addition, elimination, Insertion, Beta hydride elimination, wades rule, M-C bond length, Fischer and Schrock carbene, Wacker process, Shape, geometry of complexes Wilkinson, Monsanto, oxo process, Grubb's catalysis.

Spectral Analysis and characterization of organometallic complexes- IR, NMR, Examples of Characterization, Applications of Pincer ligands.

Unit 2: Instrumental Techniques: (12L)

A) UV Visible/Near IR: (4L)

Emission, adsorption, Fluorescence and photoacoustic, Excitation Sources, Wavelength dispersion (prisms, laser, resolution), Single and double beam instruments, Interpretation (Quantification, photoacoustic, fluorescent)

B) Infrared Spectroscopy: (4L)

Interactions with molecules, absorption and scattering, light sources, Separation of spectrum (wavelength dispersion, time resolution), detection of signals (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), Advantages.

C) Applications of Raman / XRD (4L)

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, Pearson Education, 4th Edn. (2007).
4. Inorganic Chemistry: Catherine Housecraft
5. Inorganic Chemistry: Messler & Tarr, Pearson Publishers 3rd Edition
6. Organometallic Chemistry-A Unified Approach: R. C. Mehrotra & A. Singh
7. Group Theory and its Chemical Application, P.K. Bhattacharya

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

Course: Advanced topics in Inorganic Chemistry **Course Code:** CHE-511-MJE(B)

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

Mapping Matrix of COs to Pos

| CO/PO | 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 |

PO1: Disciplinary Knowledge

- CO1. students will be able to Importance of safety and health in Laboratory
- CO2. students will be able to security management
- CO3. students will be able to Managing chemical waste
- CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
- CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
- CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO2: Critical Thinking and Problem Solving

- CO2. students will be able to security management
- CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.

PO3: Social Competence

CO3. students will be able to Managing chemical waste

CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.

CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO4: Research-related skills and Scientific Temper

CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM

CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO5: Trans-disciplinary Knowledge

CO1. students will be able to Importance of safety and health in Laboratory

CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical

PO6: Personal and Professional Competence

CO1. students will be able to Importance of safety and health in Laboratory

CO2. students will be able to security management

CO3. students will be able to Managing chemical waste

CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM

CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical

CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.

PO7: Effective Citizenship and Ethics

CO1. students will be able to Importance of safety and health in Laboratory.

CO3. students will be able to Managing chemical waste

CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

**CBCS Syllabus as per NEP 2020 for M.Sc. I chemistry
(2023 Pattern)**

| | |
|------------------------------|--|
| Name of the Programme | : M.Sc. Chemistry |
| Program Code | : PSCH |
| Class | : M.Sc. I |
| Semester | I |
| Course Type | : Elective Theory |
| Course Name | : Advanced topics in Organic Chemistry |
| Course Code | : CHE-511-MJE (C) |
| No. of Lectures | : 60 |
| No. of Credits | : 4 credits |

Course Objectives:

1. To recall and understand different reaction intermediates and their reactivity.
2. To understand different oxidising reagent and their use
3. To learn different rearrangement reactions
4. To understand the stability and reactivity of reaction intermediates
5. To learn ylides properties and the reactions related with them
6. To recall different reducing reagent and their use in reactions
7. Aware about use of flammable and hazardous chemicals.

Course Outcomes:

By the end of the course, students will be able to:

- CO1. Students will able to differentiate different reaction intermediates formed during chemical reactions
- CO2. Students will learn what is rearrangement reactions
- CO3. Students will be able to identifying the different reactions along with formation of intermediate and reaction mechanism.
- CO4. Able to draw mechanism
- CO5. Identify the use of appropriate catalyst in organic synthesis
- CO6. Students will devise a new synthetic route for tedious organic synthesis.
- CO7. Effects of hazards on human body.

Topics and Learning Points

SECTION - I**Unit 1. Organic reaction intermediates: (6 L)**

Structure, formation, stability and reactions of reactive intermediates, carbenes, nitrenes, carbocations, carbanions and free radicals.

Unit 2. Molecular Rearrangements: (12L)

Beckmann, Schmith, Wolff, Lossen, Bayer-villiger, Sommelet, Favorskii, Benzilbenzolic acid, Fries, Claisen, Cope, Brook, Benzidine, Pummener rearrangement, Tiffeneau Demjanov

Unit 3. Ylides: (6L)

Phosphorus, Nitrogen and Sulphur ylides- synthesis and their reactions (Wittig reaction, Corey-Chaykovsky Reaction, Stevens rearrangement)

SECTION - II**Unit 4. Oxidation reactions: (12 L)**

CAN, Dess Martin, PCC, MnO₂, Swern, SeO₂, Pb(OAc)₄, OsO₄, tert-Butyl hydroperoxide (tBuOOH), m-CPBA, NaIO₄, DDQ, Ozonolysis, Oppenauer oxidation.

Unit 5. Reduction reactions: (12 L)

Boranes and hydroboration reactions, MPV reduction, reduction with H₂/Pd-C, Willkinsons catalyst, DIBAL, Wolff Kishner reduction, Birch reduction, NaCNBH₃

References:

1. Organic Chemistry–by J. Clayden, N. Greeves, S. Warren and P. Wothers
2. Advanced Organic Chemistry –by J. March 6th Edition
3. Advanced Organic Chemistry (part A) –by A. Carey and R.J. Sundberg
4. Guide book to Reaction Mechanism –Peter Sykes

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

Course: Advancetopicsin organic Chemistry **Course Code:** CHE-511-MJE(C)

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

Mapping Matrix of COs to Pos

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
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| 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 |

PO1: Disciplinary Knowledge

- CO1. students will be able to Importance of safety and health in Laboratory
- CO2. students will be able to security management
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- CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
- CO6. students will be able to Students will be able to know various fundamentals of chromatography and its classification. basic
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO2: Critical Thinking and Problem Solving

- CO2. students will be able to security management
- CO6. students will be able to Students will be able to know various fundamentals of chromatography and its classification. basic

PO3: Social Competence

- CO3. students will be able to Managing chemical waste
- CO6. students will be able to Students will be able to know various fundamentals of chromatography and its classification. basic
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO4: Research-related skills and Scientific Temper

- CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

PO5: Trans-disciplinary Knowledge

- CO1. students will be able to Importance of safety and health in Laboratory
- CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical

PO6: Personal and Professional Competence

- CO1. students will be able to Importance of safety and health in Laboratory
- CO2. students will be able to security management
- CO3. students will be able to Managing chemical waste
- CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
- CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
- CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.

PO7: Effective Citizenship and Ethics

- CO1. students will be able to Importance of safety and health in Laboratory.
- CO3. students will be able to Managing chemical waste
- CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis

**CBCS Syllabus as per NEP 2020 for M.Sc. I
(2023 Pattern)**

| | |
|------------------------------|------------------------|
| Name of the Programme | : M.Sc. Chemistry |
| Program Code | : PSCH |
| Class | : M.Sc. I |
| Semester | I |
| Course Type | : Mandatory Theory |
| Course Name | : Research Methodology |
| Course Code | : CHE-521- RM |
| No. of Lectures | : 60 |
| No. of Credits | : 4 credits |

Course Objectives:

1. understand some basic concepts of research and its methodologies
2. identify appropriate research topics
3. select and define appropriate research problem and parameters
4. prepare a project proposal (to undertake a project)
5. organize and conduct research (advanced project) in a more appropriate manner
6. write a research report and thesis
7. write a research proposal (grants)

Course Outcomes:

By the end of the course, students will be able to:

- CO1. Equip themselves with ethical issues related to Research and Publication.
- CO2. Build a strong foundation for future research work in a systematic manner by applying notions of Research Methodology.
- CO3. Gain ability to apply knowledge of chemistry to research in real-world issues.
- CO4. Get familiar with current research trends in various core areas of chemistry
- CO5. Learn to handle softwares for research

Topics and Learning Points**Unit 1: Introduction to Research Methods :** (08 L)

Definition of research, role and objectives of research, applications and types of research, research process and steps in it. Collecting and reviewing the literature, conceptualization and Formulation of a research problem, Identifying variables, constructing hypothesis, Synopsis.

Unit 2: Research Design (08L)

Selecting and defining a research problem, need for research design, features of a good research design, different research designs (exploratory, descriptive experimental and diagnostic research).

Unit 3: Data Collection & Analysis (08L)

: Primary & secondary data, Validity and Reliability of data collection procedures, data preparation, exploratory data analysis

Unit 4: Report Writing (12L)

Discussions, Conclusion, referencing and various formats for reference writing, Bibliography,

Thesis Writing, Project writing, Formats of publications in research journals including subject classification,

Impact factor, Citation index.

Unit 5: Computer Applications: (12 L)

Web tools for research, Use of softwares such as Chemdraw, Origin, Endnote, ortep3,

(XRD, NMR softwares), word processing, Data processing and graphical processing by using computer.

References:

1. Krishna Swamy K.N., Siva Kumar A.I., Mathirajan M., "Management Research Methodology (2006), Pearson Education, New Delhi.
2. Kothari C.R., "Research Methodology, Methods and Techniques, Second edition, (2008), New Age International Publication.
3. Ranjit Kumar : Research Methodology, A step by step guide for beginners, Pearson Education, Sixth Edition 2009.
4. Mark Saunders, Philip Lewis, Adrain Thornhiu: Research Methods for Business Students, Pearson Education.
5. Ram Ahuja, "Research Methods", (2001), Rawat Publications, New Delhi.
6. Cooper D., Schindler P., Business research methods", (2003) Tata Mc-Graw Hill, New Delhi.

8.

Class: M.Sc. I(SEM I) **Subject:** Chemistry**Course:** Research Methodology**Course Code:** CHE-521-RM

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

10. Mapping Matrix of COs to Pos

| CO/PO | 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 |

11. PO1: Disciplinary Knowledge

12. CO1. students will be able to Importance of safety and health in Laboratory

13. CO2. students will be able to security management

14. CO3. students will be able to Managing chemical waste

15. CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of

- surface morphology of solid from SEM
16. CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
17. CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.
18. CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis
19. **PO2: Critical Thinking and Problem Solving**
20. CO2. students will be able to security management
21. CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.
22. **PO3: Social Competence**
23. CO3. students will be able to Managing chemical waste
24. CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.
25. CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis
26. **PO4: Research-related skills and Scientific Temper**
27. CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
28. CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis
29. **PO5: Trans-disciplinary Knowledge**
30. CO1. students will be able to Importance of safety and health in Laboratory
31. CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
- 32.
33. **PO6: Personal and Professional Competence**
34. CO1. students will be able to Importance of safety and health in Laboratory
35. CO2. students will be able to security management
36. CO3. students will be able to Managing chemical waste
37. CO4. students will be able to Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM
38. CO5. students will be able to Principle of TEM, instrumentation of TEM and interpretation of images, quantitative analysis, numerical
39. CO6. students will be able to Students will be able to know various basic fundamentals of chromatography and its classification.
40. **PO7: Effective Citizenship and Ethics**
41. CO1. students will be able to Importance of safety and health in Laboratory.
42. CO3. students will be able to Managing chemical waste
43. CO7. students will be able to Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis