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

(Eligibility : B.Sc. (Chemistry))

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-IChemistry , 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.

Achemistry 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. AjayC. 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-502-MJM: Organic and Inorganic Chemistry-I (Credit 04) CHE-503-MJM: Physical Chemistry Practical (Credit 02) CHE-504-MJM: Organic Chemistry Practical	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-RMResearch Methodology (Credit 04)	--	--	20	PG Diploma (after 3 Year Degree)

			(Credit 02)						
		Sem- II	CHE-551-MJM: Physical and Analytical Chemistry-II (Credit 04) 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)	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/FP Credit 04	--	20	
Cum. Cr. For PG Diploma			**24**	**8**	**4**	**4**	**--**	**40**	

*** 1 credit = 15 Hr.**

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	**:**PSCHE
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. IntroductiontoGoodLaboratoryPracticesanditsapplications
CO7. Managingchemicalwaste
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,opposingreactions,chainreaction-explosion,photochemicalreactions.

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.Workingwith Chemicals and laboratory equipments(8L)

Introduction, careful planning , working with substance of high toxicity, working with bio hazards material, working withflammablechemicals,workingwithhighlyreactiveorexplosivechemicals Introduction,workingwithelectricallypoweredequipment,workingwithcompressedgases,workingwithhighandlowpressureandtemperatures.

(**Self Study** - general procedure for working with hazardous chemicals).

Ref.1Page107-125 ,Ref.1Page137-143

Unit 2.Managingchemicalwaste(5L)

Introduction, identifying waste and its hazards, treatment andhazardreduction,disposaloptions.

(**Self Study**- collecting and storing waste)
Ref.1 Page 152-161.

Unit 3 . Introduction toGoodLaboratoryPracticesanditsapplications(4L)

General introduction, Drug development process , GMP,Introduction to GLP and its applications, Fundamental points ofGLP

(**Self Study** - GLP training).

Ref.2 Page 9-18

Unit 4. Rules forconductof studies(4L)

General aspects, Identification, Approval ofprotocol, protocol amendment, Standard operating procedures, SOP system overview.

(Self study - study plan of protocol,content of the protocol)

Ref.2Page27-36

Unit 5. Use of Computer programs: (3L)
Linear regrression, 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 ManagementEditedbyLisaMoranandTinaMasciangioliAvailableOnlinewww.nap.edu(Free)
2. HandBook,GoodLaboratoryPractice(GLP)AvailableOnline(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 Biogical Sciences by Raymond Change(Universal books) (2000)
7. Physical Chemistry–MarronandProuton
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.

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

Name of the Programme	**:**M.Sc. Chemistry
Program Code	**:** PSCHE
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 steriochemistry by using models
3. To learn advanced steriochemical 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: $D_{2h,}$ D3h D4h , C4v , Td., Oh., normalization of SALC, transformation properties of atomic orbital, MO's for sigma bonding,ABn molecules, tetrahedral AB4 and Oh AB6 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. Bhattarchrya

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

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** PSCHE
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 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 micellzation 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 (E1/2) 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 spectrophtometrically.
4. Determination of indicator constant of given indicator by spectrometric scanning and recording the absorbance in UV-Visible region.

F) Radioactivity:

1. Determination of plateu 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.

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.

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

Name of the Programme	**:** M.Sc. Chemistry
Program Code	**:** PSCHE
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 purifaction 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 able to take melting and boiling point of products.
CO4. Student should able to perform Isolation of products.
CO5. Managingchemicalwaste
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 ($LiOH.H_2O$ 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.

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.

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

Name of the Programme.	**:** M.Sc. Chemistry
Program Code	**:** PSCHE
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'smerits ,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-2Gas 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.SettleJr.,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

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

Name of the Programme	**:**M.Sc. Chemistry
Program Code	**:**PSCHE
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 able to understand and predict periodic properties and chemical reactions of Main Group Elements
5. Students should able to understand organometallic compounds, it's reactivity and organometallic compounds as catalysis
6. Students should 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 able to analyse spectrum
CO4. Students should able to understand organometallic chemistry and organometallic compounds as catalysis
CO5. Students should 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: Hydrogenandits compounds: (2L)

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

Unit 2: Alkaliandalkalineearthmetals: (2L)

Solutions in non-aqueous Media Application of crown ethers in extraction of alkali andalkalineearthmetals, Cryptans.

Unit 3: OrganometallicCompoundsofLi,Mg,Be: (3L)

Classification,Synthesis,Structure,PropertiesandUses.

Unit 4 : BoronGroup: (4L)

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

Unit 5 : CarbonGroup: (2L)

AllotropesofCarbon,C60andcompounds(fullerenes),IntercalationcompoundsofGraphite,Carbonnanotubes,synthesis,properties,structure-singlewalled,multiwalled, Silicates, applications.

Unit 6 : Organometalliccompounds (3L)

OrganometalliccompoundsofSi,Sn,Pb,Ga,As,Sb,Bi.Structures,synthesis,Reactions and uses.

Unit 7 : NitrogenGroup: (3L)

Nitrogenactivation, Boronnitride, Oxidationstatesofnitrogenandtheirinterconversion, PNandSNCompounds,NOxandtheirredoxchemistry.

Unit 8: OxygenGroup: (3L)

MetalSelenidesandTellurides, oxyacids,andoxoanionsofsulphur&nitrogen. Ring,CageandClustercompoundsofp-blockelements. Silicates,includingZeolites

Unit 9: HalogenGroup: (2L)

Interhalogens,pseudo-halogen,Synthesis,Propertiesandapplications,Structure,Oxyacids andOxoanionsofHalogens, 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, fluroescent)

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.InorganicChemistry:Shriver&Atkins(4thedition2003,Oxford)

2.ConciseInorganicChemistry, J. D.Lee, FourthEdn.(ChapmanandHall)

3.Inorganicchemistry:Principleofstructures&reactivity,Hubeey,Keiter,Medhi,PearsonEducation,4thEdn.(2007).

4.InorganicChemistry:CatherineHousecraft

5.InorganicChemistry:Messler&Tarr,PearsonPublishers3rdEdition

6.OrganometallicChemistry-AUnifiedApproach:R. C.Mehrotra&A.Singh

7.Group Theory and its Chemical Application, P.K. Bhattarchrya

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

Name of the Programme	**:**M.Sc. Chemistry
Program Code	**:** PSCHE
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, Benzilbenzilic acid, Fries, Claisen, Cope, Brook, Benzidine, Pummener rearrangement, TiffeneauDemjanov

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, MnO_2, Swern, SeO_2, $Pb(OAc)_4$, OsO_4, tert-Butyl hydroperoxide (tBuOOH), m-CPBA, $NaIO_4$, 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, $NaCNBH_3$

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

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

Name of the Programme	**:**M.Sc. Chemistry
Program Code	**:** PSCHE
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, AdrainThornhiu: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.

Examination Pattern / Evaluation Pattern

Teaching and Evaluation (for Major, Minor, AEC, VEC, IKS courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	4 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Teaching and Evaluation (for VSC, SEC & CC courses)

- Evaluation to be done by Internal & External Experts
- No descriptive end semester written examination
- Evaluation to be done at Department level preferably prior to commencement of Theory /Practical Examinations
- Evaluation to be done on the Skills gained by student