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 -II

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-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-RM Research 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**	

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 : II
Course Type : Mandatory Theory
Course Name : Physical and Analytical Chemistry II
Course Code : CHE-551-MJM
No. of Lectures : 60
No. of Credits : 4 credits

Course Objectives:

1. Basics of atomic spectrum
2. Basic concepts of molecular spectroscopy
3. Basics of microwave spectroscopy
4. Terms related to vibrational spectroscopy
5. Principle and applications of various spectroscopy
6. Basic concepts of nuclear chemistry
7. Basic concepts of radiation chemistry
8. Applications of nuclear chemistry
9. India's nuclear energy programmes

Course Outcomes:

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

CO1. Student should understand the spectroscopy concepts in detail
CO2. Student should understand Basic concepts of molecular spectroscopy concepts.
CO3. Student should understand the difference between Microwave, Raman, IR spectroscopy.
CO4. Student should know the selection rules of transition in various spectroscopic regions.
CO5. Student should solve the numerical based on all the topics included in this course.
CO6. Student should understand the Types of nuclear reactions in detail
CO7. Student should understand Basic concepts of nuclear chemistry & radiation concepts.

Topics and Learning Points

SECTION-I

Molecular spectroscopy

1. **Recapitulation** **(2L)**
   Fourier transforms, Regions of spectrum, factors affecting the width and intensity of spectral lines

2. **Microwave spectroscopy** **(3L)**
   Rotation spectra of di and polyatomic molecules-rigid and non-rigid rotor, Effect of isotopic substitution, Problems

3. **Infrared spectroscopy** **(5L)**
   Harmonic and Anharmonic oscillator, vibrational spectra of di and poly- atomic molecules, coarse and fine structure, nuclear spin effect, applications

4. **Raman Spectroscopy** **(5L)**
   Introduction, Rotational Raman- spectra, Vibrational Raman Spectra, polarization of light and Raman effect, structure elucidation from combined Raman and IR spectroscopy, applications, problems

5. **Electronic spectroscopy of molecules** **(6L)**
   Born – Oppenheimer approximation, electronic spectra of diatomic molecules, vibrational coarse structure, rotational fine structure, dissociation energy and dissociation products, electronic structure of diatomic molecules, molecular photoelectron spectroscopy, frank Condon principle,application

6. **ESR and Mossbauer spectroscopy** **(3L)**
   Principle and applications
   NMR–Principle, Chemical shift, coupling constant, Chemical applications of ^{1}HNMR in structure elucidation, problems

SECTION-II

Nuclear and Radiation Chemistry (2 Credits, 24L, 6 T)

1. **Mass Spectrometry** **(12 L)**
   Principle, Instrumentation, Ionization methods-Electron bombardment ionization, Arc and spark ionization, Photo-ionization, Thermal ionization, Chemical ionization, MassAnalyzer-Magnetic, Double focusing, Time of flight, Quadrupolar, Ion cyclotron

resonance analyser, Correlation of mass spectra with molecular structure and molecular weight, Isotopic Abundances, Fragmentation patterns, Quantitative analysis, Applications and Problems, Fourier transform mass spectrometry,Tandem mass spectrometry, Inductively coupled plasma-mass spectrometry

2. **Radioactivity (4L)**

Recapitulation–Isotopes, Isobars, Isomers, Isotones, types of radioactive decay, Decay Kinetics, Detection and measurement of nuclear radiation (G.M. & Scintillation counter), Problems (Self-study)

3. **Isotopes and its applications (8L)**

Typical reaction involved in preparation of radio isotopes:^{3}H, ^{14}C, ^{22}Na, ^{32}P, ^{35}S and ^{127}I.
General Principles of using radioisotopes as atracer.

Applications of radioisotopes in agriculture

Studies on soil plant relationship, Food preservation

Applications of radioisotopes in healthcare

Diagnostic applications: Radioimmunoassay, applications of RIA.
Radiotherapy: Teletherapy, Gamma knife, Brachytherapy

Analytical applications

Neutron activation analysis (NAA), Isotope dilution analysis (IDA), radiometric titration (RT). Industrial applications: radiation gauging, friction and wear out, gamma radiography.
Problems

References:

1. Fundamentals of molecular spectroscopy: C. N. Banwell and E. Mc. Cash (Fourth edition).
2. Molecular Spectroscopy: P. S. Sindhu, New Age international Publication. (Second edition)
3. Molecular Spectroscopy: Suresh Chandra, Narosa Publication House (2009)
4. Elements of Nuclear chemistry– H.J. Arnikar, fourth edition Wiley Estern Ltd.
5. Source book of atomic energy–S. Glasstone, D.Van Norton Company
6. Chemical applications of radioisotopes– H. J. M. Brown Buffer & Jammer Ltd.
7. Fundamentals of Radiochemistry- D.D. Sood, A. V. R. Reddy, N. Ramamoorthy

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Out comes with Course Outcomes

Class: M.Sc. (Sem II) **Subject**: Chemistry
Course: Physical and Analytical Chemistry II **Course Code**: CHE-551-MJM
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

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

Justification for the mapping

Program Outcome 1 (PO 1: Disciplinary Knowledge):

CO 1: Students should understand spectroscopy concepts in detail, demonstrating their mastery of this essential area of knowledge in chemistry.

Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):

CO 2: Students should understand basic concepts of molecular spectroscopy, showcasing their critical thinking skills in molecular analysis.

CO 3: Understanding the difference between Microwave, Raman, and IR spectroscopy requires critical thinking to distinguish between different spectroscopic techniques.

CO 4: Knowing the selection rules of transition in various spectroscopic regions reflects critical thinking and problem-solving abilities in the context of spectroscopy.

Program Outcome 3 (PO 3: Social Competence):

CO 6: Understanding the types of nuclear reactions in detail contributes to social competence by addressing safety and environmental concerns in nuclear chemistry.

Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):

CO 6: Understanding the types of nuclear reactions in detail supports research-related skills and scientific temper by delving into the scientific aspects of nuclear chemistry.

Program Outcome 6 (PO 6: Personal and Professional Competence):

CO 5: Students solving numerical problems based on course topics enhances their personal and professional competence in quantitative analysis and data interpretation.

Program Outcome 7 (PO 7: Effective Citizenship and Ethics):

CO 7: Understanding basic concepts of nuclear chemistry and radiation concepts contributes to effective citizenship by addressing ethical concerns related to nuclear and

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 : II
Course Type : Mandatory Theory
Course Name : Organic and Inorganic Chemistry II
Course Code : CHE-552-MJM
No. of Lectures : 60
No. of Credits : 4 credits

Course Objectives:

1. To recall and understand basic concepts of spectroscopy
2. To understand principles and applications of UV spectroscopy.
3. To learn advanced concepts in 1HNMR spectroscopy like coupling constant (J).
4. Students will be able to recall the vibrational frequencies of different functional groups in FTIR.
5. To apply the concept of analysis of 13CMR spectra
6. Students will be able to recall d-d transition, charge transfer spectra.
7. Students will be able to recall Basic Concepts, orgel diagram, Tanbe-sugano diagrams.
8. Students will be able to recall Hund's rule, interpretation of electronic spectra

Course Outcomes:

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

CO1. Students will be able to assign correct lamda max to organic compounds

CO2. They will differentiate compounds by different spectroscopy techniques

CO3. They will vibrational frequencies of different functional groups in FTIR.

CO4. Students will be able to apply spectroscopy concepts in organic synthesis.

CO5. Identify complex ion showing same R.S. term, degeneracy of ground state

CO6. terms of metal ions, and spin multiplicity of different configurations.

CO7. To interpret electronic spectra for spin allowed Oh and Td complexes using

CO8. Student should understand interelectronic repulsion.

CO9. Student should know the concept of weak and strong ligand field.

CO10. Student should know basic d-d transition, d-p mixing, charge transfer spectra.

Topics and Learning Points

SECTION I

1. UV:

Factors affecting UV absorption and interpretation of UV spectra of aromatic compounds **(4 L)**

2. IR:

Principal, Basic Important functional group frequencies, factors affecting IR frequencies, interpretation of IR spectra

(4 L)

3. ^{1}H NMR: **(8 L)**

Fundamentals of 1H NMR, factors affecting chemical shift, integration, coupling (1st order analysis)

4. Introduction to CMR: (4 L)

Natural abundance, chemical shift values, proton coupled and proton decoupled spectra, DEPT

5. Mass spectrometry: (4 L)

Principal, Instrumentation, Terminologies, Rules of fragmentation, McLafferty rearrangement, Rule of 13, fragmentation pattern of some important functional groups.

SECTION II

A) Concept & Scope of Ligand Fields: (04L)

Recapitulation of CFT, Free ion Configuration, Terms and States, Energy level of transition metal ions, free ion terms, microstates, term wave functions, Quantum numbers, spin-orbits coupling.

B) Ligand field theory of coordination complexes: (12L)

Effect of ligand field on energy level of transition metal ions, weak cubic Ligand field effect on Russell-Saunders terms, strong field effect, Orgel diagram, correlation diagrams, Tanabe- Sugano diagrams, spin pairing energies**.**

C) Electronic spectra of Transition Metal Complexes: (08L)

Introduction, Band intensities, band energies, band width and shapes, spectra of 1, 2 and 3rd row ions and rare earth ion complexes, spectrochemical and Nephlauxetic series, charge transfer and luminescence, spectra, calculations of Dq, B, β parameters, percentage of covalent character of metal complexes.

References:

1. Organic Chemistry–by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)

2. Introduction to spectroscopy – D.l. Pavia, G.M. Lampman, G.S. Kriz,

3. Spectroscopic methods in organic melecules – D.H. William & I Flemming Mc Graw Hill

4.. Symmetry and spectroscopy of molecules by K. VeerReddy

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

6. Ligand field theory & its applications: B.N. Figgis & M.A. Hitachman (2000) Wiely

VCH Publ.

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Out comes with Course Outcomes

Class: M.Sc. (Sem II) **Subject**: Chemistry
Course: Organic and Inorganic Chemistry II **Course Code**: CHE-552-MJM
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

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

Program Outcome 1 (PO 1: Disciplinary Knowledge):

- **CO 1:** Students will be able to assign correct lambda max to organic compounds, showcasing their understanding of spectroscopy concepts and their practical application in organic chemistry.

Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):

- **CO 2:** Students will differentiate compounds by different spectroscopy techniques, demonstrating critical thinking skills in chemical analysis.
- **CO 4:** Students will be able to apply spectroscopy concepts in organic synthesis, involving critical thinking in the context of chemical reactions and synthesis.

Program Outcome 3 (PO 3: Social Competence):

- **CO 3:** Students will understand vibrational frequencies of different functional groups in FTIR, contributing to social competence by addressing quality and safety concerns in chemical analysis.

Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):

- No direct mapping for research-related skills and scientific temper in the provided COs.

Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):

- **CO 5:** Students will identify complex ions showing the same R.S. term, degeneracy of ground state terms of metal ions, and spin multiplicity of different configurations, involving trans-disciplinary knowledge in coordination chemistry and quantum mechanics.

Program Outcome 6 (PO 6: Personal and Professional Competence):

- **CO 6:** Students will understand concepts related to metal ions and complex configurations, enhancing their personal and professional competence in inorganic chemistry.

Program Outcome 7 (PO 7: Effective Citizenship and Ethics):

- **CO 7:** Students will interpret electronic spectra for spin-allowed Oh and Td complexes, contributing to effective citizenship by addressing ethical concerns in chemical analysis and safety.

Program Outcome 8 (PO 8: Ethical and Legal Awareness):

- **CO 8:** Students should understand interelectronic repulsion, which touches on the ethical and legal aspects of chemical safety and responsible research.

Program Outcome 9 (PO 9: Advanced Research Skills):

- **CO 9:** Students should know the concept of weak and strong ligand field, which supports the development of advanced research skills in coordination chemistry.

Program Outcome 10 (PO 10: Interdisciplinary Knowledge):

- **CO 10:** Students should know basic d-d transition, d-p mixing, charge transfer spectra, which extends to interdisciplinary knowledge by integrating principles of spectroscopy and quantum mechanics.

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	**:** II
Course Type	**:** Mandatory Practical
Course Name	**:** Analytical Chemistry Practical
Course Code	**:** CHE-553-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 pH meter, potentiometer, conductometeretc.
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

1. Table work: (Any Three)

i. Statistical treatment of experimental data.
ii. Analysis of crystal structure from single crystal X-ray pattern.
iii. Data analysis, error analysis, least square method.
iv. Analysis of given spectra.

2. Volumetric Analysis: (Any Two)

i. Determination of ibuprofen using acid-base titration.
ii. Determination of percentage purity of indomethacin by acid–base titration.
iii. Analysis of Vitamin C in juices and squashes.

3. Conductometry: (Any Three)

i. Determination of concentrations of strong acid and weak acid present in themixture by titration with strong base.
ii. Verification of Debye Huckel theory of ionic conductance for strong electrolytes KCl, BaCl2, K2SO4, K3[Fe(CN)6]
iii. Structural determination of metal complexes by conductometric measurements.
iv. To study complex formation between Fe (III) with sulphosalicylic acid by conductometry.
v. Determination of the strength of commercial phosphoric acid/ vinegar by conductometric titration

4. Potentiometry: (Any Two)

i. Determination of concentrations of strong acid and weak acid present in the mixture by titrating with strong base.
ii. Determination of concentrations of reductant or oxidant by redox titration.
iii. Complexometric determination using disodium EDTA of Co2+, Al3+ and Cu2+

5. Colorimetry/ Spectrophotometry:(Any Two)

i. Estimation of phosphate from waste water by calibration curve method.
ii. Determination of equilibrium constant of M-L system such as Fe (III)–Sulphosalicylic acid by Job´s continuous variation method.
iii. Determination of Cu (II) by solvent extraction as Dithiocarbamate/ 8-hydroxyquinoline complex.
iv. Spectrometric determination of acetylsalicylic acid content in aspirin tablet.

6. **Ion Exchange Chromatography: (Any two)**
   i. Separation of mixture of Zn (II) and Cd (II) using Amberlite IRA 400 anion exchanger and quantitative estimation of separated ions Zn (II) and Cd (II).
   ii. Separation of mixture of Zn(II)and Mg (II) using Amberlite IRA-400 anion exchanger and quantitative estimation of separated ions Zn (II) and Mg (II).
   iii. Separation and estimation of Fe and Al on cation exchanger.

7. **Flame photometry: (Any One)**
   i. Estimation of Ca in milk powder sample by flame photometry.
   ii. Determination of concentration of Na + and K +in oral rehydration sachet by flame photometry.

References:

1. Lab Manual: Selected experiments of Pharmaceutical Analysis, Aness A Siddiqui.
2. Experimental physical chemistry, Athawale, Mathur, Newage Int. Publishers.
3. Textbook of quantitative analysis A. I. Vogel 4th Edition.
4. Experiments in Chemistry, D. V. Jahagirdar.
5. General Chemistry Experiments, Anil J .Elias University Press.
6. Ligand Field Theory, B. N. Figgis
7. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
8. Senior Practical Physical Chemistry, B. D. Khosla and V.S. Garg (R.Chand and Co.,Delhi.)
9. Practical physical chemistry, B. Vishwanathan and P.S.Raghavan,2nd edition, (2012

Choice Based Credit System Syllabus (2023 Pattern)
(As Per NEP 2020)
Mapping of Program Out comes with Course Outcomes

Class: M.Sc. (Sem II) **Subject**: Chemistry
Course: Analytical Chemistry Practical **Course Code**: CHE-553-MJM
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

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

Program Outcome 1 (PO 1: Disciplinary Knowledge):
- **CO 1:** Students should understand the principles and applications of instruments in detail, showcasing their grasp of analytical chemistry concepts and instrumentation.

Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):
- **CO 2:** Students should understand the handling of UV-Visible spectrophotometer, requiring critical thinking and problem-solving skills in operating and interpreting results from the instrument.

Program Outcome 3 (PO 3: Social Competence):
- **CO 3:** Students should know the handling of various instruments, such as pH meter, potentiometer, and conductometer, which contributes to social competence by addressing quality and safety concerns in analytical experiments.

Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):
- **CO 4:** Students should be able to find minerals using a Flame photometer from soil and water, supporting research-related skills and scientific temper in analytical chemistry.

Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):
- **CO 5:** Students should be able to verify concepts of chemical kinetics through experiments, demonstrating trans-disciplinary knowledge by applying principles of kinetics to practical experiments.

Program Outcome 6 (PO 6: Personal and Professional Competence):
- **CO 6:** Students should understand the handling and applications of all instruments, enhancing their personal and professional competence in analytical instrumentation and experimentation.

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	**:** II
Course Type	**:** Practical
Course Name	**:** Inorganic Chemistry Practical
Course Code	**:** CHE-554-MJM
No. of Lectures	**:** 60
No. of Credits	**:** 2 credits

Course Objectives:

The students are expected to learn,

1) 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 equipment's.
4) Determination of various elements from given alloy.
5) Determination of metals from given ore.
6) Synthesis of metal complexes.

Course Outcomes:

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

At the end of course student will understand
CO1: Introduction to Good Laboratory Practices and its applications
CO2: Managing chemical waste.
CO3: Precautions of hazardous chemicals
CO4: Perform experiment accurately and able to perform calculation.
CO5: Perform calculations and discuss results and write conclusions of the experiment.
CO6: Explain experiment and principal of experiment

Topics and Learning Points

1. Ore Analysis: - (Any 2)

a) Determination of Silica & Manganese from Pyrolusite ore.
b) Determination of Silica & Iron from Hematite ore.
c) Determination of Copper & Iron from Chalcopyrite ore.

d) Determination of calcium Carbonate from Marble.
e) Determination of Hydrated magnesium silicate from Asbestos.

2. Alloy Analysis: - (Any 2)

a) Determination of Tin & lead from Solder alloy
b) Determination of Iron & Chromium or carbon from Stainless steel alloy.
c) Determination of Copper & Nickel from Cupronickel alloy.
d) Determination of Bismuth, Lead, Tin, Cadmium from Wood's metal. (any 2)
e) Determination of Aluminium, Nickel, Cobalt from Alnico alloy.

3. Inorganic synthesis & purity (Any 6)

a) Chloro penta- amine cobalt (III) chloride.
b) Nitro penta -ammine cobalt (III) chloride.
d) Cis Potassium diaquodioxalato Chromate (III).
e) Trans Potassium diaquodioxalato Chromate (III).
f) Potassium tri-oxalato Aluminate.
g) Tris (acetylacetanato) Mangnese (III).
h) Bis (acetylacetanato) Copper (II)
i) Tris (Ethylenediamine) Nickel (II) thiosulphate.

4. Inorganic Chracterization Techniques:- (Any 1)

a) Solution state preparation of $[Ni(en)_3]S_2O_3$, $[Ni(H_2O)_6]Cl_2$ $[Ni(NH_3)_6]Cl_2$.Record absorption spectra in solution of three complexes and calculate 10 Dq. Arrange three ligands according to their increasing strength depending on observation.

b) Determination of Magnetic Susceptibility of Mercury tetracynato Cobalt or $[Fe(acac)_3]$

or

Ferrous ammonium sulphate by Faraday or Gouy's method.

c) Determination of equilibrium constant of M-L system Fe(III) Sulphosalicylic acid by Job's continuous variation method.

d) Estimation of Cu using iodometric method Potentiometrically.

5. Synthesis of Nanomaterials :-(Any 2)

a) Synthesis of nanosize ZnO, its characterization by UV-Visible Spectroscopy &Removal

of dye by ZnO – Photocatalysis and determine the band gap by absorption spectroscopy.

b) Synthesis of nanosized alpha -Fe_2O_3& Study of adsorption of Phosphate on it.

c) Synthesis of CdS nanoparticles.

d) ZnO, TiO_2, Fe_2O_3 nanoparticles powder XRD, SEM, TEM Or any another technique.

(at least one spectral analysis/study should be done)

6. Synthesis &Chracterization :- (Any 1)

a) Synthesis & Photochemistry of K $[Fe(C_2O_4)_3]3H_2O$

b) Kinetics of substitution reaction of $[Fe(Phen)_3]^{2+}$

7. Table Work

Study of MnO_2 / Fe_2O_3 / ZnO / TiO_2 / Silver – nanoparticles or any other materials:

Powder XRD analysis with respect to - 2θ from XRD, miller indices to assigned using JCPDS or ICDD data and experimentally observed 2θ, inter planar distance, crystal volume, lattice parameters.

References:

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

Choice Based Credit System Syllabus (2023 Pattern)
(As Per NEP 2020)
Mapping of Program Out comes with Course Outcomes

Class: M.Sc. (Sem II) **Subject**: Chemistry
Course: Inorganic Chemistry Practical **Course Code**: CHE-554-MJM
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	0	0	0	0	0
CO 2	0	3	0	0	0	0
CO 3	0	0	3	0	0	0
CO 4	0	0	0	3	0	0
CO 5	0	0	0	0	3	0
CO 6	0	0	0	0	0	3

Program Outcome 1 (PO 1: Disciplinary Knowledge):

CO 1: Students will understand the introduction to Good Laboratory Practices and its applications, demonstrating their grasp of laboratory protocols and safety.

Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):

CO 2: Students will understand managing chemical waste, requiring critical thinking and problem-solving skills in handling and disposing of chemicals safely.

Program Outcome 3 (PO 3: Social Competence):

CO 3: Students will understand precautions for hazardous chemicals, contributing to social competence by addressing safety and environmental concerns in the laboratory.

Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):

CO 4: Students will perform experiments accurately and be able to perform calculations, enhancing research-related skills and scientific temper in experimental chemistry.

Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):

CO 5: Students will perform calculations, discuss results, and write conclusions of experiments, demonstrating trans-disciplinary knowledge by applying principles of data analysis and communication.

Program Outcome 6 (PO 6: Personal and Professional Competence):

CO 6: Students will explain experiments and the principles of experiments, enhancing their personal and professional competence in understanding and communicating experimental procedures and concepts.

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	**:** II
Course Type	**: Elective Theory**
Course Name	**:** Advance topics in Analytical Chemistry-II
Course Code	**:** CHE-561-MJE (A)
No. of Lectures	**:** 60
No. of Credits	**:** 4 credits

Course Objectives:

1. To understand basic principles and applications of surface characterizationtechniques.
2. To know characterisation techniques.
3. Acquire knowledge about the widely used analytical instruments
4. Select instrument for a particular analysis with come idea of it's merits, demerits and limitations
5. Student should know about principal and applications of GC-MS & LC-MS.
6. To understand basic principles and applications of Biochemistry.
7. Student should know about principal and applications of Thermal techniques.

Course Outcomes:

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

CO1. Student will be able to know the utilization of various instrumental techniques for separation and chemical analysis.
CO2. The student learns the applications of atomic spectroscopy.
CO3. Students will be able to know various hyphenated techniques.
CO4. Student should understand the Biochemical Morphology.
CO5. To perform analysis that provide an information about biochemical questions and helps to solve biochemical problems.
CO6. Students will be able to demonstrate accurate quantitative analysis
CO7. Students will be able to understand and effectively apply scientific ethics.
CO8. Students will be able to know various Photoacoustic Spectroscopy, Lasers and its applications.

Topics and Learning Points

Analytical Spectroscopy

SECTION –I

1. **Atomic Spectroscopy (10 L)**
   Theory, sources, burners, atomic emission spectra, atomic absorption spectra, the effect of temperature on emission, absorption, and fluorescence, electrothermal atomizers, Instrumentation for FES, radiation sources atomic absorption methods, instrumentation for AAS, spectral interferences, standard addition and internal standard method of analysis, comparison of atomic absorption and emission methods, inductively coupled plasma and direct current plasma emission spectroscopy, Cold vapor technique, Applications of AAS, AES and ICPAES, analysis of micronutrients like Mo, B, Cu, Zn essential towards the healthy growth of crops, fruits, determination of these micronutrients from soils, plants, and fruits.

2. **Hyphenated Techniques (06L)**
   Introduction,GC-MS, LC-MS theory,working and applications.

3. **Photoacoustic Spectroscopy and Lasers (08L)**
   Photoacoustic Spectroscopy: Introduction, Principles, Instrumentation, analytical applications.
   Lasers: Principle, Classification, Spectroscopy with laser Emissions, Conclusion.

SECTION-II

Basic Biochemistry (2 Credits 24 Lectures)

1. **Introduction to Biochemistry (02L)**
   Scope of the subject in pharmaceutical sciences, Biochemical reactions, Highlights of prokaryotic and Eukaryotic cell metabolism.

2. **Biochemical Morphology (04L)**
   Prokaryotes and Eukaryotes, Cell structure, sub-cellular components: Nucleus, plasma membranes, endoplasmic reticulum, Lysosome, Peroxisomes, Golgi apparatus, and Mitochondria.

3. **Bio-membrane** **(04L)**
   Structure, functions and composition, Model proposed, Function and properties of membrane, Transport hypothesis, Active and passive facilitated transport, Na^+, K^+, H^+, pumps, glucose transport, Excitable membrane, drug transport.

4. **Biomolecules** **(08L)**
   Proteins: Introduction, functional, classification of amino acids, classification, physicochemical properties, Optical activity, Formaldehyde, Amino acids,Essential and nonessential amino acids, efficacy, structure, peptide bond, end group analysis, Helix, B-sheet structure, tertiary, quaternary structure, globular protein, fibrous protein, amino acid therapy, Protein engineering Carbohydrates: complex carbohydrate, structure of Chitin, Starch, Glycogen+ Metabolism of Amino Acid.
   Lipids: definition, classification, functions, types of fatty acids, and its biological role and Metabolism.

References:

1. Introduction to Instrumental Analysis,R.D.Braun,McGraw-Hill.Inc.1987
2. Instrumental Methods of chemical Analysis,H. H.Willard, L.L.Merrite Jr., J.A.Dean & F.A.SettleJr.,6th Edition, Wadsworth Publishing Company,USA,1986
3. Hand book of Instrumental Techniques for Analytical Chemistry, F.A.Settle editor, Prentice Hall Inc. A Simon and Schuster Company,New Jersey,1997
4. Fundamentals of Analytical Chemistry,D.A. Skoog, D.M.west, F.J.Holler,S.R.Crouch,7th Edition,Thomson Asia Pte.Ltd,Singapore.
5. Principals of biochemistry, Albert Lehninger (CBS Publisher and Distributers Pvt. Delhi
6. Biochemistry Lubert Stryer,W.H.(Freeman and company New York)
7. Harper's Biochemistry by R.K.Murray, D.I.Granner, P.A.Mayes, (Prentice Hall International Inc.)
8. Practical Clinical Biochemistry, Harold Varley, (CBS Publisher and Distributers Pvt. Delhi. Molecular Biology, J.D. Watson (The Benjamin/Cumming Company, Inc.)
9. Basic Concepts of Analytical Chemistry Fifth Edition, S. M. Khopkar, New Age International (P) Ltd., Publishers London, New Delhi,

Choice Based Credit System Syllabus (2023 Pattern)
(As Per NEP 2020)
Mapping of Program Out comes with Course Outcomes

Class: M.Sc. (Sem II) **Subject**: Chemistry
Course: Advance topics in Analytical Chemistry-II **Course Code**: CHE-561-MJE (A)
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

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

Program Outcome 1 (PO 1: Disciplinary Knowledge):
- **CO 1:** Students will know the utilization of various instrumental techniques for separation and chemical analysis, demonstrating their grasp of analytical chemistry concepts.

Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):
- **CO 2:** The student learns the applications of atomic spectroscopy, showcasing their critical thinking skills in atomic analysis.
- **CO 3:** Students will know various hyphenated techniques, demonstrating critical thinking in combining analytical methods.

Program Outcome 3 (PO 3: Social Competence):
- **CO 4:** Students should understand the biochemical morphology, contributing to social competence by addressing chemical aspects of biology.
- **CO 5:** Performing analyses related to biochemical questions and problems enhances social competence by addressing biological and chemical aspects.

Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):
- **CO 6:** Students will demonstrate accurate quantitative analysis, enhancing research-related skills and scientific temper in analytical methods.

Program Outcome 7 (PO 7: Effective Citizenship and Ethics):
- **CO 7:** Students will understand and effectively apply scientific ethics, contributing to effective citizenship and ethical conduct in research.

Program Outcome 8 (PO 8: Ethical and Legal Awareness):
- **CO 8:** Students will know various Photoacoustic Spectroscopy, Lasers, and their applications, which touches on ethical and legal aspects of safety and responsible research.

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	**:** II
Course Type	**:** Elective Theory
Course Name	**:** Advanced topics in Inorganic Chemistry-II
Course Code	**:** CHE-561-MJE (B)
No. of Lectures	**:** 60
No. of Credits	**:** 4 credits

Course Objectives:

The students are expected to learn,

1) Importance of bioinorganic chemistry.
2) Metalloprotein and metalloenzymes.
3) Basic Concepts, Importance and transport of metal ions.
4) Mechanism for active transport of $Na^+$and K^+.
5) Concept of nanotechnology
6) Methods of synthesis of nanomaterials
7) Properties of nanomaterials
8) methods of synthesis and characterization of nanomaterials by using various technique.

Course Outcomes:

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

CO1: Student should understand Importance of bioinorganic chemistry.
CO2: Role of metals in Metalloprotein and metalloenzymes.
CO3: Passive transport metal ions by ionophores
CO4: Mechanism for active transport of $Na^+$and K^+
CO5: Importance and function of Ca, Fe and Mg in metalloprotein.
CO6: Catalytic role of Mn in photosynthesis.
CO7: Define / memories the terms related to - applications of nanomaterials, band theory, defects in crystal structures, some properties of nanomaterials, synthesis of nanomaterials.
CO8: Discuss synthesis methods of nanomaterials, some properties of nanomaterials, defects in nanomaterials.
CO9: Apply their knowledge to – choose synthesis method for nanomaterial, selection of nanomaterial for particular application, explain observed properties of nanomaterial, etc.

CO10: Propose scope / Applications of nanomaterials to solve real problems

Topics and Learning Points

SECTION-I:
Bioinorganic Chemistry

1. Introductions of Bioinorganic chemistry, role of metals, metalloprotein and metalloenzyme. Principles of coordination chemistry related to Bioinorganic chemistry research and protein, Nucleic acid and other metal bonding biomolecules. **(4L)**

2. Thermodynamic aspects -HSAB concept, chelate effect and Irving-William series, pK_avalues of coordinated ligands, Tuning of redox potential, Biopolymer effects. Kinetic aspects- Electron transfer reaction, Electronic substitution reaction. reactions of coordinated ligands and Template effect, concept of spontaneous self-assembly model compounds. **(6L)**

3. Biochemistry of Na, K and Ca with respect to Na/K pumps, Distribution of Cationic and anionic electrolytes in blood plasma and intracellular fluid, Calmodulin, Ionophores natural and synthetic application of Ionophores and Ca in blood Coagulation. **(8L)**

4. Biochemistry of following elements: **(6L)**

a) Iron: Ferritin, Transferrin, Ferredoxin, Rubredoxin, Porphyrin based system

b) Magnesium: Photosystem I

c) Manganese: Photosystem II

References:

1. Principle of Bioinorganic chemistry: S. J. Lippard and J.M. Berg

2. Bioinorganic chemistry: Inorganic elements in chemistry of life W. Kain and B. Schwederski

3. Bioinorganic chemistry: Bertini, Grey, Lippard and Valentine

4. Bioinorganic chemistry: R. J. P, Willams

5. Bioinorganic chemistry: Robert Hay

6. Bioinorganic chemistry: M. N. Hughes

Section II

Nanomaterials

1.The Big World of Nanomaterials **4L**

History and Scope; Can Small Things Make a Big Difference? Classification

of Nanostructured Materials, Applications of Nanomaterials. Nature: The Best Nanotechnologist; Challenges and Future Prospects.

2. Band Theory **4L**

Metallic Bonding and Band Theory; Band structure of metals; Band structure of insulators; Band structure of semiconductors: silicon; Band structure of inorganic solids, Transition metal compounds, Fullerenes and graphite.

3.Effect of Nano-Dimensions on Materials Behavior **8L**

Elastic properties; Melting point; Diffusivity; Grain growth characteristics, Enhanced solid solubility, Magnetic properties, Soft magnetic nanocrystalline alloys, Giant magnetoresistance (GMR), Electrical properties, Mechanical properties, Hardness and strength, Tensile ductility and strain hardening, Corrosion properties.

4.Synthetic Methods of Nanomaterials **8L**

Bottom up and top-down approach (definitions); Solid State Reaction or Shake'n Bake Methods: Combustion synthesis, Mechano-synthesis; Low Temperature or Chimie Douce Methods: Alkoxide sol–gel method Preparation of indium tin oxide and other coatings, Sol–gel method using oxyhydroxides and colloid chemistry hydrothermal and solvo-thermal synthesis, Microwave synthesis, Graphite intercalation compounds, Pillared clays and layered double hydroxides.

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, 4thEdn.(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

Choice Based Credit System Syllabus (2023Pattern)

(As Per NEP 2020)

MappingofProgramOutcomeswithCourseOutcomes

Class: M.Sc. (Sem II) **Subject**: Chemistry
Course: Advanced topics in Inorganic Chemistry **Course Code**: CHE-561-MJE (B)
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

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

Justificationforthemapping

PO: Disciplinary Knowledge

CO1: Student should understand Importance of bioinorganic chemistry.
CO2: Role of metals in Metalloprotein and metalloenzymes.
CO3: Passive transport metal ions by ionophores
CO4: Mechanism for active transport of $Na^+$and K^+

PO2: Critical Thinking and Problem Solving

CO1: Selection of nanomaterial for particular application.
CO2: To understand Catalytic role of Mn in photosynthesis.
CO3: Discuss synthesis methods of nanomaterials, some properties of nanomaterials, defects in nanomaterials.

PO4: Research relatated skills and Scientific temper

CO1: Apply their knowledge to–choose synthesis method for nanomaterial, explain observed properties of nanomaterial,etc.
CO2: Propose scope/Applications of nanomaterials to solve real problems.
CO3: Discuss synthesis methods of nanomaterials, some properties of nanomaterials, defects in nanomaterials.

PO5: Trans-disciplinary Knowledge

CO1: Students will able to apply their knowledge in various fields

PO6: Personal and Professional Competence

CO1: Students Define/memories the terms related to-applications of nanomaterials,band theory, defect in crystal structures, some properties of nanomaterials, synthesis

of nanomaterials.

PO8: Environment and sustainability

CO5: Students learn about green synthesis method s of nanomaterials.

PO9: Self-directed and Life-long Learning

CO6: Student understand importance of metal in Biology

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	**:** II
Course Type	**:** Elective Theory
Course Name	**:** Advanced topics in Organic Chemistry-II
Course Code	**:** CHE-561-MJE (C)
No. of Lectures	**:** 60
No. of Credits	**:** 4 credits

Course Objectives:

1. The students are expected to learn,
2. Construction of FMO and photochemical and thermal reactions
3. Laws of Photochemistry
4. Basic principles, photochemistry of carbonyl compounds, alkenes, dienes and
5. aromatic compounds.
6. Norrish type I and II reaction, isomerization, Patterno-Buchi reaction
7. Chemical shifts and factors affecting chemical shifts
8. Complex and simple spin spin coupling.

Course Outcomes:

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

CO1. Students will be able to learn construction of FMO and photochemical and thermal reactions
CO2. Students will come to know the laws of Photochemistry
CO3. Student will be aware of basic principles and photochemistry of carbonyl compounds, alkenes, dienes and aromatic compounds.
CO4. Students will gain knowledge of Norrish type I and II reaction, isomerization, Patterno-Buchi reaction
CO5. Students will learn Chemical shifts and factors affecting chemical shifts
CO6. Students will get the knowledge of Complex and simple spin spin coupling
CO7. Students will learn properties, reactivity of heterocyclic compound
CO8. Students will understand the importance of drugs.

Topics and Learning Points

SECTION – I

A) Pericyclic Reactions (12 L)

Construction of Pi molecular orbitals of ethylene and 1, 3 Butadiene, Symmetry in Pi molecular orbitals, Frontier molecular orbitals, electrocyclic reactions Con and Dis rotatory ring closing and ring opening reactions, Selection rules and stereochemistry of electrocyclic reactions, Theory of cycloaddition reaction. FMO method, [2+2] and [4+2] cycloaddition.

B) Photochemistry: (12 L)

Law of Photochemistry, quantum yield, quenching, photochemistry of carbonyl compounds, alkenes, dienes and aromatic compounds and their application in organic synthesis alpha and beta cleavage Norrish type I and II reaction, isomerization, Patterno-Buchi reaction.

SECTION – II

C) Heterocyclic Compounds (12L)

Five and six membered heterocycles with one and two hetero atoms:
Synthesis, reactivity, aromatic character and biological importance of following heterocyclic rings: Furan, Pyrrole, Thiophene, Pyrazole, Imidazole, Pyridine

D) Study and synthesis of following drug (12L)

a) Antimalarial: Trimethoprim,
b) Antihistamine: Benadryl, phenobarbital
c) Anti-inflammatory: Ibuprofen, Oxyphenbutazone
d) Tranquilizer-Diazepam,Trimeprazine
e) Analgesic and Antipyretic- Aminopyrine, Paracetamol
f) Anaesthetic- Lidocaine, Thiopental

References:

1. Photochemistry and Pericyclic reactions-Jagdamba Singh, Jaya Singh 3rd Ed.

2. Organic photochemistry: A visual approach-Jan Kopecky, VCH publishers (1992).

3. Organic Chemistry–by J. Clayden, N. Greeves, S. Warren and P. Wothers

4. Advanced Organic Chemistry –by J. March 6th Edition

5. Advanced Organic Chemistry (part A) –by A. Carey and R.J. Sundberg

6. Guide book to Reaction Mechanism –Peter Sykes

7. Medicinal Chemistry.Burger:

8. Medicinal Chemistry A. Kar. (Wiley East)

9. Principals of medicinal chemistry.W. O. Foye:

10. Text book of organic medical and pharmaceutical chemistry. Wilson, Gisvold &Dorque:

11. Pharmaceutical manufacturing encyclopedia.

12. D. Sriram, P. Yogeeswari: Medicinal Chemistry

Choice Based Credit System Syllabus (2023 Pattern)
(As Per NEP 2020)
Mapping of Program Out comes with Course Outcomes

Class: M.Sc. (Sem II) **Subject**: Chemistry
Course: Advanced topics in Organic Chemistry-II **Course Code**: CHE-561-MJE (C)
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

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

Program Outcome 1 (PO 1: Disciplinary Knowledge):
- **CO 1:** Students will learn the construction of Frontier Molecular Orbitals (FMO) and the principles of photochemical and thermal reactions, demonstrating their understanding of organic chemistry concepts.

Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):
- **CO 2:** Students will come to know the laws of Photochemistry, showcasing their critical thinking skills in understanding photochemical processes.

Program Outcome 3 (PO 3: Social Competence):
- **CO 3:** Students will be aware of the basic principles and photochemistry of various organic compounds, contributing to social competence by addressing chemical aspects of organic reactions.

Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):
- **CO 4:** Students will gain knowledge of Norrish type I and II reactions, isomerization, and the Paterno-Buchi reaction, enhancing research-related skills and scientific temper in organic chemistry.

Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):
- **CO 5:** Students will learn about chemical shifts and factors affecting chemical shifts, demonstrating trans-disciplinary knowledge by integrating principles of nuclear magnetic resonance (NMR) spectroscopy.

Program Outcome 6 (PO 6: Personal and Professional Competence):
- **CO 6:** Students will gain knowledge of complex and simple spin-spin coupling, enhancing their personal and professional competence in understanding and interpreting NMR spectra.

Program Outcome 7 (PO 7: Effective Citizenship and Ethics):
- **CO 7:** Students will learn about the properties and reactivity of heterocyclic compounds, contributing to effective citizenship by addressing chemical aspects of pharmaceutical compounds and research ethics.

Program Outcome 8 (PO 8: Ethical and Legal Awareness):
- **CO 8:** Students will understand the importance of drugs, touching on ethical and legal aspects of pharmaceutical research and development.

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	**:** II
Course Type	**:** OJT/FP
Course Name	**: On Job Training/ Field Work**
Course Code	**:** CHE-581-OJT/FP
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

Students must complete the on job training or field project as per the curriculum and must submit it in prescribed format