

MAHENDRA ARTS & SCIENCE COLLEGE

(AUTONOMOUS)

(Affiliated to Periyar University)

[Accredited by NAAC "A" Grade & Recognized u/s 2(f) and 12(B) of the UGC act 1956]

KALIPPATTI – 637 501.



MASTER OF SCIENCE

SYLLABUS FOR M.Sc. CHEMISTRY

OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

**FOR THE STUDENTS ADMITTED FROM
THE ACADEMIC YEAR 2019 – 2020 ONWARDS**

**MAHENDRA ARTS & SCIENCE COLLEGE
(Autonomous)
(Affiliated to Periyar University)**

Department of Chemistry

M.Sc. Chemistry Degree Programme

I- PREAMBLE

Chemistry is a fundamental science and has contributed immensely to the improvement of the life of human beings by providing many of human requirements and essentialities. The developments in chemistry during last few decades are phenomenal. It is also seen that these developments are crossing the traditional vertical boundaries of scientific disciplines. New branches of chemistry are emerging and gaining importance, such as bioorganic chemistry, materials chemistry, nano - chemistry, computational chemistry, etc. A chemist cannot isolate himself from other disciplines. Thus, after a long span of more and more specialization in post graduate syllabi, a symbiotic interdisciplinary approach now seems to be more relevant. The practice of Chemistry over a span of more than a century has also created concomitant and perhaps unavoidable impacts of human environment. The chemical industry is now pressurized from both the government and the society to develop eco - friendly processes and products which will reduce waste and prevent toxic substances from entering the environment. The principles and applications of chemistry should be learnt on this background.

II- PROGRAMME OBJECTIVES

To develop

1. Human Values and Social Responsibilities in the context of learning Chemistry
2. Positive approach towards Environment and Ecology from the Chemistry perspective
3. Extension of Chemistry in the social context for solving social issues
4. Entrepreneurial Skills to start their own industries / business in core chemistry and applied chemistry fields
5. Analytical and Experimental Skills of the students capable of doing higher-level research works in the emerging fields of chemistry.

III- PROGRAMME OUTCOMES

1. Graduates are prepared to be creators of new knowledge leading to innovation and entrepreneurship employable in various sectors such as private, government, and research organizations.
2. Graduates are trained to evolve new technologies in their discipline.
3. Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently.
4. Graduates are framed to design and conduct experiments /demos/create models to analyze and interpret data.
5. Graduates ought to have the ability of effectively communicating the findings of Chemical sciences; incorporating with existing knowledge.

IV- REGULATIONS

These regulations shall take effect from the academic year 2019-2020, i.e, for students who are to be admitted to the first year of the course during the academic year 2019-20 and thereafter.

1. Eligibility for Admission:

A candidate who has passed B.Sc., Chemistry degree of this University or any other University accepted by the Syndicate equivalent thereto, subject to such condition as may be prescribed therefore are eligible for admission to M.Sc., Degree programme and shall be permitted to appear and qualify for the Master of Science (M.Sc.) Degree Examination in Chemistry of this University.

2. Duration of the Programme:

The candidates shall complete all the courses of the programme in 2 years from the date of admission. The programme of study shall consist of four semesters and a total period of two years with a minimum of 90 credits. The programme of study will comprise the course according to the syllabus.

3. Programme of Study:

The Programme of study for the PG degree courses of all branches shall consist of the following:

- i. Core courses
- ii. Electives courses
- iii. Extra Disciplinary Course
- iv. Project
- v. Enhancement Compulsory Courses

4. Examinations

The Programme of study shall be based on semester pattern with Internal Assessment under Choice Based Credit System.

The examinations for all the papers consist of both Internal (Continuous Internal Assessment - CIA) and External (End Semester) theory examinations. The theory examinations shall be conducted for three hours duration at the end of each semester. The candidates failing in any subject(s) will be permitted to appear for the same in the subsequent semester examinations.

V- STRUCTURE OF THE PROGRAMME

SEMESTER: I

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE-I	STEREOCHEMISTRY AND REACTION MECHANISM	M19PCH01	5	-	4	25	75	100
CORE COURSE-II	CHEMISTRY OF INORGANIC COMPOUNDS	M19PCH02	5	-	4	25	75	100
CORE COURSE-III	CHEMICAL KINETICS AND QUANTUM CHEMISTRY	M19PCH03	5	-	4	25	75	100
ELECTIVE COURSE-I	ELECTIVE-I		5	-	4	25	75	100
CORE PRACTICAL -I	PRACTICAL-I - INORGANIC QUALITATIVE ANALYSIS	M19PCHP01	-	5	3	40	60	100
CORE PRACTICAL-II	PRACTICAL-II - PHYSICAL CHEMISTRY EXPERIMENTS -I	M19PCHP02	-	5	3	40	60	100
Total			20	10	22	180	420	600

SEMESTER: II

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE-IV	ORGANIC SPECTROSCOPY	M19PCH04	5	-	4	25	75	100
CORE COURSE-V	THERMODYNAMICS AND GROUP THEORY	M19PCH05	5	-	4	25	75	100
*ELECTIVE COURSE-II	ELECTIVE-II		4	-	4	25	75	100
CORE PRACTICAL -III	PRACTICAL-III – INORGANIC ESTIMATION AND PREPARATION	M19PCHP03	-	5	3	40	60	100
CORE PRACTICAL-IV	Practical-IV – ORGANIC ESTIMATION AND PREPARATION	M19PCHP04	-	5	3	40	60	100
EXTRA DISCIPLINARY COURSE	EDC		4	-	4	25	75	100
ENHANCEMENT COMPULSORY COURSE	HUMAN RIGHTS	M19PHR01	2	-	2	25	75	100
COMPREHENSIVE EXAMINATION- I		M19PCHC01	-	-	1	100	-	100
Total			20	10	25	305	495	800

***Note:** Open Book examination to be conducted for this course.

SEMESTER: III

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE-VI	ORGANIC SYNTHESIS AND REARRANGEMENTS	M19PCH06	5	-	4	25	75	100
CORE COURSE-VII	ORGANOMETALLIC CHEMISTRY	M19PCH07	5	-	4	25	75	100
CORE COURSE-VIII	ELECTROCHEMISTRY AND PHOTOCHEMISTRY	M19PCH08	5	-	4	25	75	100
ELECTIVE COURSE-III	ELECTIVE-III		5	-	4	25	75	100
CORE PRACTICAL - V	PRACTICAL-V - ORGANIC ANALYSIS	M19PCHP05	-	5	3	40	60	100
CORE PRACTICAL-VI	PRACTICAL-VI - PHYSICAL CHEMISTRY EXPERIMENTS - II	M19PCHP06	-	5	3	40	60	100
Total			20	10	22	180	420	600

SEMESTER: IV

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE-IX	PERICYCLIC REACTION AND NATURAL PRODUCTS	M19PCH09	5	-	4	25	75	100
CORE COURSE-X	SOLID STATE AND NUCLEAR CHEMISTRY	M19PCH10	5	-	4	25	75	100
*CORE COURSE-XI	RESEARCH METHODOLOGY	M19PCH11	5	-	4	25	75	100
CORE PRACTICAL -VII	PRACTICAL-VII - INORGANIC AND ORGANIC PREPARATION	M19PCHP07	-	5	3	40	60	100
PROJECT	PROJECT	M19PCHPR1	-	10	5	40	60	100
COMPREHENSIVE EXAMINATION -II		M19PCHC02	-	-	1	100	-	100
Additional 1 Credit to be provided for SWAYAM / MOOC			-	-	-	-	-	-
Total			15	15	21	255	345	600

***Note:** Open Book examination to be conducted for this course.

Summary of Credits, Hours and Mark Distribution

Course Category	Credits				Total Credits	Total Hours	No. of Courses	Max. Marks
	I	II	III	IV				
Core	18	14	18	15	65	90	18	1800
Elective	4	4	4	-	12	14	3	300
EDC	-	4	-	-	4	4	1	100
Project	-	-	-	5	5	10	1	100
Human Rights	-	2	-	-	2	2	1	100
Comprehensive Examination	-	1	-	1	2	-	2	200
Total	22	25	22	21	90	120	26	2600

ELECTIVE SUBJECTS FOR M.Sc. CHEMISTRY STUDENTS

Semester	ELECTIVE - I	
	Course Title	Course Code
I	Dye Chemistry	M19PCHE01
	Polymer Chemistry	M19PCHE02
	Green Chemistry	M19PCHE03
	Bioorganic & Medicinal Chemistry	M19PCHE04
	ELECTIVE - II	
	Course Title	Course Code
II	Water Chemistry	M19PCHE05
	Nano Chemistry	M19PCHE06
	Applied Catalysis	M19PCHE07
	Computational Quantum Chemistry	M19PCHE08
	ELECTIVE - III	
	Course Title	Course Code
III	Textile Chemistry	M19PCHE09
	Material Science	M19PCHE10
	Nuclear Chemistry	M19PCHE11
	Chemistry of Industrial Products	M19PCHE12

EXTRA DISCIPLINARY COURSES FOR OTHER MAJOR STUDENTS

Semester	Course Title	Course Code
II	EDC - Health Chemistry	M19ECH01
	EDC - Drug Discovery	M19ECH02
	EDC - Chemical Instrumentation	M19ECH03

VI- SCHEME OF EXAMINATION

1. Question Paper Pattern for Theory Examination

Time: Three Hours

Maximum Marks: 75

Part A: (10 x 1 = 10)

Answer ALL Questions

(Objective Type - Two Questions from each unit)

Part B: (5 x 2 = 10)

Answer ALL Questions

(One Question from each unit)

Part C: (5 x 5 = 25)

Answer ALL Questions

(One Question from each unit with internal choice)

Part D: (3 x 10 = 30)

Answer Any Three out of Five Questions

(One Question from each unit)

2. Question Paper Pattern for Practical Examination

QUESTION PATTERN

Practical : 50 Marks

Viva Voce : 05 Marks

Record : 05 Marks

Total : 60 Marks

3. Distribution of Marks:

The following are the distribution of marks for external and internal for End Semester Examinations and continuous internal assessment and passing minimum marks for Theory/Practical / Project course of PG programme.

ESE	EA Total	Passing Minimum for EA	CIA Total	Passing Minimum for CIA	Total Marks Allotted	Passing Minimum for ESE
Theory	75	38	25	12	100	50
Practical	60	30	40	20	100	50
Project	60	30	40	20	100	50

The following are the Distribution of marks for the Continuous Internal Assessment in Theory / Practical courses of PG programme.

THEORY

EVALUATION OF INTERNAL ASSESSMENT

Test : 10 Marks
 Seminar : 05 Marks
 Assignment : 05 Marks
 Attendance : 05 Marks

 Total : 25 Marks

The Passing minimum shall be 50% (12 Marks) out of 25 Marks.

PRACTICAL

EVALUATION OF INTERNAL ASSESSMENT

Test 1 : 15 Marks
 Test 2 : 15 Marks
 Record : 10 Marks

 Total : 40 Marks

The Passing minimum shall be 50% (20 Marks) out of 40 Marks.

PROJECT

EVALUATION OF INTERNAL ASSESSMENT

Review 1 : 10 Marks
 Review 2 : 10 Marks
 Review 3 : 10 Marks
 Pre-Viva : 10 Marks

 Total : 40 Marks

The Passing minimum shall be 50% (20 Marks) out of 40 Marks.

4. Passing Minimum:

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Theory Exam mark) with minimum of 38 marks in the End Semester Theory Examinations.

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Practical Exam mark) with minimum of 30 marks in the End Semester Practical Examinations.

5. Submission of Record Note Books for Practical Examination:

Candidates appearing for practical examinations should submit a bonafide record note books prescribed for practical examinations. The candidates failed to submit the record book shall not be permitted to appear for the practical examinations

6. Project

The following guidelines to be followed for the Project with Viva-voce:

1. The project should be valued for 60 marks by an external examiner; however the Viva-Voce examination should be conducted by both the external examiner appointed by the College and the internal examiner/guide/teacher concerned.
2. The Project report may consist minimum of 60 pages.
3. The candidate has to submit the Project Report 20 days before the commencement of the VI Semester Examinations.
4. A candidate who fails in the Project/Dissertation or is absent may resubmit the report, on the same topic, with necessary modification / correction / improvements in the subsequent Even Semester Examinations for evaluation and shall undergo viva-voce Examination.

VII- NOTE

a) SWAYAM / MOOC – Free Online Education

SWAYAM / MOOC is an instrument for self-actualization providing opportunities for a life-long learning. Here the student can choose from hundreds of courses, virtually every course taught at the college level, offered by the best teachers in India and elsewhere.

The students can choose an online SWAYAM / MOOC course during their period of study which will earn an extra credit and it will be transferred to the academic records of the students.

b) Comprehensive Examination

This examination is conducted at the end of every year. Mode of the examination is online. The questions are of objective type and they cover the entire year's syllabus.

SEMESTER - I

CORE COURSE-I	M.Sc. Chemistry	2019-2020
M19PCH01	STEREOCHEMISTRY AND REACTION MECHANISM	
Credits: 4		

Objectives

This course focuses on the concepts of stereochemistry and organic reaction and their mechanism in organic chemistry.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the stereo chemical orientation of molecules and its relation to reactivity.	K2
CO2	Extract the basic electronic concept of organic chemistry and methods of determination of reaction mechanism.	K1
CO3	Gain the knowledge of aromaticity and electrophilic, nucleophilic substitution organic reactions and their mechanism.	K4
CO4	Sketch the aliphatic and electrophilic, nucleophilic substitution organic reactions and their mechanism.	K3
CO5	Get fundamental idea of addition and elimination reactions and their mechanism in important organic reaction.	K2

UNIT I

Stereochemistry: Interconversion of perspective, Fischer, Sawhorse and Newman structures; Cram's and Prelog's rules. D, L and R, S - notations; Cahn-Ingold-Prelog rules, absolute and relative configurations; configurations of allenes, spiranes, biphenyls, cyclooctene and helicene.

Conformation and reactivity: Conformational analysis of disubstituted cyclohexanes and their stereochemical features - Conformation and reactivity of cyclohexanols (oxidation and acylation), cyclohexanones (reduction) and cyclohexane carboxylic acid derivatives (esterification and hydrolysis). Conformation and stereochemistry of cis and trans decalins.

Geometrical and optical isomerism of disubstituted cyclopropane, cyclobutane and cyclopentanes. Identification of enantiotropic, homotropic, diastereotropic hydrogens and prochiral carbons – Stereospecific and stereoselective synthesis.

UNIT II

Structure, Reactivity and Intermediates: Electron displacement and structure – reactivity correlation: Resonance, field effects, hyperconjugation, steric effects, steric inhibition of resonance. Quantitative treatment of field and resonance effects – Hammett and Taft treatments. Acidity of carboxylic acids and phenols, basicity of aliphatic and aromatic bases.

Study and description of organic reaction mechanisms: Non-kinetic methods – Energy profile diagrams, intermediate versus transition state, identification of products, Cross-over experiments, Stereochemical studies. Kinetic methods – kinetic isotopic effects, salt effects, solvent effect, solvent isotopic effects, kinetic and thermodynamic controlled product. Hammond postulates.

UNIT III

Aromatic Electrophilic substitution: Mechanism, orientation and reactivity – Quantitative treatment of reactivity in the substrate and reactivity of the electrophiles. Mechanistic interpretations of second substitution, the ortho/para ratio, ipso attack, third substitution, orientation and reactivity of other ring systems like polycyclic aromatic hydrocarbons, diazonium coupling, Vilsmeier reaction, Gattermann - Koch reaction.

Aromatic Nucleophilic substitution: S_NAr , S_N1 , benzyne and SR_N1 mechanisms, Reactivity – effect of substrate structure, leaving group and nucleophile. Von Richter and Smiles rearrangements.

UNIT IV

Aliphatic Nucleophilic substitution: Substitution at sp^3 carbon atom: SN_1 and SN_2 mechanisms, ion pair in SN_1 . Factors influencing SN_1 and SN_2 reactions – substrate, leaving group, nucleophile and solvent effects, ambident substrates and nucleophiles – regioselectivity. Border line cases - intermediate mechanism, Mixed SN_1 and SN_2 mechanisms. Neighboring group participation, non-classical carbocations. S_Ni mechanism, Allylic rearrangements. Substitution at a trigonal carbon atom: the tetrahedral mechanism, formation of acid derivatives, cleavage of esters and N-acylation reactions.

Aliphatic Electrophilic substitution: Mechanisms - SE_1 , SE_2 and SE_i
 Substitution by double bond shifts; other mechanism: addition – elimination
 and cyclic mechanism. Electrophilic substitution via enolization, Stork –
 enamine reaction.

UNIT V

Elimination Reactions: E_1 , E_2 and E_1CB mechanisms, competition
 between elimination and substitution, orientation of product formation,
 stereochemistry of E_2 reactions, intermolecular pyrolytic eliminations, the
 Chugaev reaction, Cope elimination.

Addition reactions: Electrophilic addition to alkenes, mechanism, effect
 of structure, isotope effects, orientation and stereochemistry, the nature of
 the intermediates, Ozonolysis, hydroboration, additions to dienes, alkynes
 (halogenation and hydrogenation) and allenes, Diels-Alder reaction, 1,3
 dipolar additions.

Nucleophilic addition to multiple bonds: Mannich reactions, Aldol and
 related reactions, Stobbe, Cannizzaro reaction, Darzens, Thorpe, Wittig
 reaction and benzoin condensation.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Advanced Organic Chemistry, Part A: Structure and Mechanisms.	F. A. Carey & R. A. Sundberg	Springer, New York, 5 th Edn.	2007
2.	Stereochemistry of Organic Compounds. Principles and Applications	D. Nasipuri	Wiley Eastern Limited, New Delhi, 2 nd Edn.	1994
3.	Advanced Organic Chemistry	J. March & M Smith	John-Wiley and sons, 5 th Edn.	2001
4.	Stereochemistry of carbon compounds	P. S. Kalsi	New Age International Publishers, 3 rd Edn.	1995

REFERENCE BOOKS

S.No	Title of the Book	Author	Publishing Company	Year
1.	Stereochemistry of Carbon Compounds.	E. L. Eliel	Tata-McGraw Hill	2000
2.	Organic Chemistry. Vol-1	I. L. Finar	Pearson Education Asia, 5 th Edn.	1975
3.	Organic Chemistry. Vol-2	I. L. Finar	Pearson Education Asia, 6 th Edn.	2004

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	M	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - I

CORE COURSE-II	M.Sc. Chemistry	2019-2020
M19PCH02	CHEMISTRY OF INORGANIC COMPOUNDS	
Credits: 4		

Objectives

This course focuses on the knowledge about the bonding theory, bonding properties and inorganic compounds with Boron, Silicon, Phosphorous, Nitrogen, Sulphur, Noble gases and Halogen compounds.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Recognize the basics of atomic structure and chemical bonding.	K1
CO2	Acquire knowledge on acid base concepts and non aqueous solvent.	K3
CO3	Devise the properties and uses of Boron and silicon compounds.	K3
CO4	Illustrate the properties and uses of Nitrogen, Phosphorous, Sulphur and halogens compounds	K4
CO5	Get idea on the properties and uses of polyanions, clathrates and cage compounds.	K2

UNIT I

Atomic Structure: Atom, orbital electrons, concept of wave-functions, quantum numbers and spin, shape of orbital and their radial distribution functions, electronic configuration of atoms, Aufbau principle, Pauli Exclusion Principle, and Hund's rule.

Bonding and structure: Types of bonds, orbital symmetry and overlaps, concept of MO and VB theory, concept of hybridization, the extent of d orbital participation in molecular bonding, bond energy and covalent radii, concept of resonance, bond moment and molecular dipole moment, polarizing power and polarizability, Fajan's rules, Van der Waals forces, hydrogen bonding.

UNIT II

Acid-base concept: Bronsted acids and bases, Lewis acids and bases, solvent system concept, HSAB principle.

Non- Aqueous Solvents: Classification of solvents – Properties of ionizing solvents – General study of typical reactions - liquid Ammonia, Sulphur dioxide, Dinitrogen tetroxide, Anhydrous Hydrogen fluoride, Sulphuric acid and Acetic acid – Solution in fused salts.

UNIT III

Compounds of Boron: Synthesis, properties and structures of Boron compounds: Boron hydrides (small boranes and their anions, B₁-B₄), boron nitride, borazines, carboranes, metalboranes, metallocarboranes.

Compounds of Silicon: Synthesis, properties and structures of Silicon compounds: silicates, silicones, zeolites.

UNIT IV

Nitrogen, Phosphorous, Sulphur and halogens compounds: Hydrides, oxides and oxy acids of Nitrogen, Phosphorous, Sulphur and halogens; phosphazines, sulphur-nitrogen compounds, inter halogen compounds, pseudo halogens.

UNIT V

Poly anions and isopoly anions of Phosphorous, Vanadium, Chromium, Molybdenum and Tungsten, heteropoly anions of Molybdenum and Tungsten. Clathrates (noble gases, phosphazines) hydrogen bonding in clathrates, Phosphorous and Oxygen cage compounds.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Text book of Inorganic Chemistry	P.L. Soni & M. Katyal	Sulan Chand & Sons.	1986
2	Modern Inorganic Chemistry	S. Satya Prakash	S. Chand and Company Ltd.	2003
3	Advanced Inorganic Chemistry	Gurdeep Raj	Goel Publishing house	1986
4	Selected Topics in Inorganic Chemistry	U. Malik, G.D. Tuli & R.D. Madan	S. Chand and Company Ltd.	2001

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Inorganic Chemistry: Principles, Structure and Reactivity	J. E. Huheey	Harper and Row, 3 rd Edn.	1983
2	Inorganic Chemistry	D. F. Shriver, P.W. Atkins & C.H. Langford	ELBS, 2 nd Edn.	1994
3	Physical chemistry	R.A. Alberty & R.J. Silbey	Wiley	1999
4	Inorganic Chemistry	G.L. Miessler & D.A. Tarr	Pearson Education	2004

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	M	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - I

CORE COURSE-III	M.Sc. Chemistry	2019-2020
M19PCH03	CHEMICAL KINETICS AND QUANTUM CHEMISTRY	
Credits: 4		

Objectives

The aim of this course is to expose the students to the knowledge in chemical kinetics and quantum chemistry.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know about the topic of chemical kinetics and their applications.	K1
CO2	Interpret the reaction concept in chemical kinetics	K2
CO3	Gain the idea of quantum chemistry	K2
CO4	Apply quantum chemistry to physical models.	K3
CO5	Appraise the quantum mechanics to atomic and molecular systems.	K4

UNIT I

Chemical Kinetics: Theories of Reaction rates – Arrhenius theory – effect of temperature on reaction rate – Hard – Sphere collision theory of reaction rates – molecular beams – Reaction cross section – effectiveness of collisions – Probability factor.

Transition state theory of reaction rates – Potential energy surface – Partition functions and activated complex – Eyring equation – Comparison of collision theory and activated complex theory – Estimation of free energy, enthalpy and entropy of activation and their significance.

UNIT II

Kinetics of complex reactions: Reversible reactions, Consecutive reactions, Parallel reactions and Chain reactions – General treatment of chain reaction – Chain length – Rice Herzfeld mechanism – explosion limits.

Study of Fast reactions: Luminescence and energy transfer process – Study of kinetics by relaxation methods - temperature and pressure jump methods - Stopped flow technique, flash photolysis and Crossed molecular beam method.

UNIT III

Kinetics of surface reactions: Physical and chemical adsorption – adsorption isotherms – types of adsorption isotherms – Langmuir adsorption isotherm

B.E.T theory for multilayer adsorption – measurement of surface area – Mechanism of heterogeneous catalytic reactions – the adsorption coefficient and its significance.

UNIT IV

Quantum Chemistry: Black body Radiation – Photoelectric effect – De Broglie equation – Heisenberg's uncertainty principle – Compton Effect. Operators and commutation relations – quantum mechanical postulates.

Schrodinger equation and its solution to the problem of a particle in one and three dimensional boxes – Harmonic oscillator – Rigid rotor.

UNIT V

Schrodinger equation for Hydrogen atom – arriving solution for energy and wave function – origin of quantum numbers and their physical significance – Probability distribution of electrons.

Approximation methods: Perturbation and Variation methods – application of Variation method to Hydrogen and Helium atom – Spin - Orbit interaction – L-S coupling and J-J coupling – Term symbols and spectroscopic states. Ground state term symbols for simple atoms.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Kinetics and mechanism of chemical transformation	J. Rajaram & J.C. Kuriacose	Macmillan India Ltd	1993
2	Chemical Kinetics	K.J. Laidlar	Harper and Row Newyork	1987
3	Quantum chemistry	D.A. McQuarrie	University science books, Mill Valley, California	1983
4	Quantum Chemistry	R.K. Prasad	Wiley Eastern, New Delhi	1992

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Physical Chemistry	W.J. Moore	Orient Longman, London	1972
2.	Kinetics and Mechanism	R. G. Frost & Pearson	Wiley, Newyork	1961
3.	Kinetic systems	C. Capellos & B.H.J. Bielski	Willey Interscience, Newyork	1968
4.	Chemical Kinetics	G. M.Harris	D.C. Heath and Co.	1966
5.	Quantum chemistry	I. N. Levine	Allyn and Bacon, Boston	1983
6.	Contemporary Quantum Chemistry: An Introduction	J. Goodman	Plenum Press, Newyork	1977
7.	Elements of Quantum theory	F.J. Bockhoff	Addison Wesley, Reading, Mass	1976
8.	Physical Chemistry	P.W. Atkins	Oxford University Press, Oxford.	1990

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	M	S	M	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - I

CORE PRACTICAL-I	M.Sc. Chemistry	2019-2020
M19PCHP01	PRACTICAL-I - INORGANIC QUALITATIVE ANALYSIS	
Credits: 3		

Course Outcomes

On successful completion of the course students will be able to

1. Acquire knowledge about the mixture of cations.
2. Create awareness on eco-friendly approach in the analysis.
3. Analyze ions qualitatively even in the mixture.

Qualitative analysis

Qualitative analysis employing semi micro methods and spot tests of mixture containing two familiar and two less familiar cations from the following: W, Pb, Se, Te, Mo, Cu, Bi, Cd, Ce, Zr, V, Mn, Al, Ni, Co, Zn, Ba, Sr, Li, and Mg. (Insoluble and interfering anions may be avoided). – **Minimum 8 mixtures.**

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Vogel's qualitative Inorganic analysis	G. Svehla	Orient Longman, 6 th Edition,	1987
2.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu	Sultan Chand & sons, New Delhi, 2 nd Edn.	1997
3.	Inorganic Semimicro Qualitative analysis.	V.V. Ramanujam	National Publishing Co	1971

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Vogel's Text book of quantitative inorganic analysis	J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS/Longman, England, 4 th Edn.	1986
2.	Experimental Inorganic Chemistry	W.G. Palmer	Van Nostrand Reinhold Co., London	1972
3.	An advanced course in practical Inorganic Chemistry	D.N. Grindley	Butterworths	1964

SEMESTER - I

CORE PRACTICAL-II	M.Sc. Chemistry	2019-2020
M19PCHP02	PRACTICAL-II- PHYSICAL CHEMISTRY EXPERIMENTS-I	
Credits: 3		

Course outcomes

On successful completion of the course students will be able to

1. Study the kinetics of some reactions.
2. Learn the technique of sketching phase diagram of some binary systems.
3. Develop practical skill in conductometric titration experiments.
4. Understand experimental knowledge on kinetics and electro chemistry.

DETAILED LIST OF EXPERIMENTS

1. Study the kinetics of acid hydrolysis of an ester, determination of the temperature coefficient of the reaction and determination of the activation energy of the hydrolysis of ethyl acetate.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half life method and determine the order with respect to iodine and acetone.
3. Study of the rate of saponification of ethyl acetate by sodium hydroxide conductometrically and determine the order of the reaction.
4. Determination of association factor of benzoic acid in benzene by distribution method.
5. Construction of phase diagram for a simple binary system (naphthalene – phenanthrene and benzophenone – diphenylamine)
6. Construction of the phase diagram of the three component of partially immiscible liquid systems (DMSO – Water – Benzene; Water-Benzene –Acetic acid; Ethyl alcohol – Benzene – Water; Acetone-Chloroform – Water; Chloroform – Acetic acid-Water).
7. Determination of equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculation of the dissociation constant of the acid.
8. Determination of equivalent conductivity of a strong electrolyte at different concentrations and examine the validity of the DHO theory as limiting law at high dilutions.

9. Conductometric Acid – Base titrations of a mixture of HCl and CH₃COOH against Sodium hydroxide.
10. Compare the relative strength of acetic acid and monochloro acetic acid by conductivity method.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Advanced Experimental Chemistry, Vol I.	J.N. Gurtu and R.Kapoor	S. Chand & Co. Ltd., New Delhi	1980
2.	College Practical Chemistry	V.K. Ahluwalia, Sunitha Dhingra and Adarsh Gulate	Universities Press (India) Pvt Ltd.	2008
3.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy & A.R. Kulandaivelu	New Delhi, Sultan Chand & sons, 2 nd Edn.	1997

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Findlay's Practical Physical Chemistry	B.P. Levitt	Longman, London, 9 th Edn.	1985
2.	Experimental Physical Chemistry	F. Daniels	New York, McGraw Hill, 7 th Edn.	1970
3.	Practical Physical Chemistry	A. Findlay	London, Longman, 7 th Edn.	1959

SEMESTER - II

CORE COURSE-IV	M.Sc. Chemistry	2019-2020
M19PCH04	ORGANIC SPECTROSCOPY	
Credits: 4		

Objectives

This course focuses on the concepts of spectroscopy and dealt with the applications in the structural elucidation of compounds.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Quote the basic principles and application of UV-Visible, IR spectroscopy.	K2
CO2	Sketch the structure of organic compounds by ^1H NMR spectroscopy.	K3
CO3	Elucidate the structure of organic compounds by ^{13}C , ^{19}F , ^{31}P NMR spectroscopy.	K4
CO4	Identify the basics of advanced NMR and EPR techniques.	K2
CO5	Acquire knowledge on the mass spectroscopy.	K3

UNIT I

UV-Visible spectroscopy: Terminology, classification of electronic transitions. Effect of substituent and conjugation on the spectra of alkenes. Woodward – Fisher rules for polyenes and enones. Electronic spectra of carbonyl compounds. Effect of solvent on $\pi - \pi^*$ and $n - \pi^*$ transitions. Electronic spectra of benzene and its derivatives.

IR spectroscopy: Theory and principle, Vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols amines and carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides). Effect of solvent and hydrogen bonding on the vibrational frequencies in alcohols. Raman spectroscopy: Stokes and anti-Stokes line – Mutual exclusion principle.

UNIT II

Nuclear Magnetic Resonance Spectroscopy: Introduction- Nuclear spin and nuclear parameters - Nuclear spin states. The mechanism of absorption (resonance condition). Calculation of resonance frequency. Population densities of nuclear spin states. Relaxation processes.

Deshielding and shielding. Chemical shift - Factors affecting chemical shift - Magnetic anisotropy. Continuous wave and pulsed Fourier methods of recording NMR spectra. Spin – spin coupling and splitting of NMR signals. Spin – spin interactions – AX, AX₂, AX₃, AMX and AB types. Coupling constant. Intensities of multiplets – Pascal’s triangle.

Geminal and vicinal coupling. Karplus equation and Karplus curve. First and second order coupling of AB systems. Spin decoupling methods. Double resonance. Applications in structural elucidation.

UNIT III

Carbon-13 NMR Spectroscopy: The carbon – 13 nucleus, carbon – 13 chemical shift. Proton coupled and proton decoupled carbon – 13 spectra. Nuclear overhauser effect. Problems with integration in carbon -13 spectra. Off resonance decoupling. Applications. Introduction to ¹⁹F, ³¹P NMR spectra

UNIT IV

Advanced NMR Techniques: Pulse sequences, spins and magnetization vectors. The DEPT experiment. Determining the number of attached hydrogens. Two – dimensional spectroscopic methods. COSY, ROSSY, NOESY technique.

ESR Spectroscopy: Theory – hyperfine interactions – Spin densities – McConnell relationship – selection rules in ESR – ‘g’ value and coupling constants.

UNIT V

Mass Spectrometry: Introduction, principle and instrumentation. Ion production – electron impact, chemical ionization, field desorption and fast atom bombardment techniques. High resolution mass spectrometry – base, molecular ion, parent ion, fragmentation ion, metastable and isotopic-peaks. Factors affecting fragmentation, ion analysis and ion abundance.

Mass spectral fragmentation of organic compounds (hydrocarbons, aromatic compounds, alcohols, carbonyl compounds, acids and esters). McLafferty rearrangement - Determination of molecular weight and molecular formula.

TEXT BOOKS

S.No	Title of the Book	Author	Publishing Company	Year
1.	Vibrational spectroscopy: theory and Applications	D.N. Sathyanarayana	New-Age International Publishers, New Delhi	2000
2.	Electronic Absorption Spectroscopy and related techniques	D.N. Sathyanarayana	Universities Press, Bangalore	2001
3.	Applications of absorption Spectroscopy to Organic Compounds	J.R. Dyer	Prentice – Hall, New Delhi	1969
4.	Organic Mass Spectroscopy	K.R. Dass and E.P. James	IBH New Delhi	1976
5.	Organic Spectroscopy	W. Kemp	ELBS London	1975

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Physical methods in Inorganic chemistry	R.S. Drago	Affiliated East-West Press Pvt. Ltd., New Delhi	1965
2.	Infrared Spectra of Inorganic and co-ordination Compounds	K. Nakamoto	Wiley-Interscience, New York	1970
3.	Spectrometric Identification of Organic Compounds	R.M. Silverstein and W.P. Webster	Wiley & Sons	1999

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|----|---|---|--|------|
| 4. | Principles of Instrumental Analysis | D.A. Skoog,
S.J. Holler,
T.A. Nilman | Saunders College Publishing,
London, 5 th Edn. | 1998 |
| 5. | Introduction To Spectroscopy | Donald L. Pavia,
Gary M. Lampman
and George S. Keiz | Harcourt Brace College Publishers,
2 nd Edn. | 1996 |
| 6. | Physical Methods for Chemists | R.S. Drago | Saunders College Publishing, New York, 2 nd Edn. | 1992 |
| 7. | Mass Spectrometry – Analytical Chemistry By Open Learning | R. Davies, M. Frearson and E. Prichard | John Wiley and Sons, New York | 1987 |

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - II

CORE COURSE-V	M.Sc. Chemistry	2019-2020
M19PCH05	THERMODYNAMICS AND GROUP THEORY	
Credits: 4		

Objectives

The aim of this course is to expose the students with the knowledge in thermodynamics and group theory.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know about the applications of statistical thermodynamic.	K2
CO2	Understand the Thermodynamics concept of ideal, real gases and gas mixtures and partial molar properties.	K1
CO3	Study the various methods of Irreversible Thermodynamics.	K2
CO4	Relate the application of group theory to chemical system.	K3
CO5	Apply the group theory in various spectroscopic prediction and interpretation.	K4

UNIT I

Statistical thermodynamics: Objectives – concept of thermodynamical and mathematical probabilities – Distribution of distinguishable and non – distinguishable particles. Maxwell – Boltzmann, Bose - Einstein and Fermi - Dirac statistics - comparisons

Partition Functions: Evaluation of Translational, Vibrational, Rotational and Electronic partition Function – Thermodynamic Functions in terms of partition Function – Application of partition Function to monoatomic and diatomic gases – Statistical expression for equilibrium constant – Calculation of Equilibrium Constant from Partition Function.

UNIT II

Thermodynamics of ideal and real gases, gas mixtures – Standard states for gases, liquids, solids and components of solutions – Fugacity – definition – Methods of determination of fugacity – Variation of fugacity with temperature and pressure – Determination of activities and activity coefficient.

Partial molar properties – Gibbs – Duhem equation – Partial molar free energy (Chemical Potential) – Determination of chemical potential [Direct Method and Method of Intercepts] and partial molar volume – variation of chemical potential with Temperature and Pressure.

UNIT III

Irreversible Thermodynamics: Postulates of Local equilibrium – Entropy production – Entropy Production in Heat flow – Entropy production in matter flow – Prigogine's principle of minimum entropy production – Forces and Fluxes – Linear force – flux relation – phenomenological equation – microscopic reversibility and Onsager's reciprocity relations.

Electro kinetic phenomena – diffusion – Non – equilibrium stationary states.

UNIT IV

Group Theory: Symmetry elements and symmetry operations – Point groups – Determination of point group – comparison of Molecular symmetry with Crystallographic symmetry. Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences.

Character Table and their uses.

UNIT V

Symmetry selection rules for vibrational, Electronic and Raman Spectra – determination of representation of vibrational modes in non-linear molecules such as H_2O , CH_4 , XeF_4 , SF_6 and NH_3 .

Symmetry of Hybrid orbitals in non-linear molecule (BF_3 , CH_4 , XeF_4 , PCl_5 and SF_6) – Electronic spectra of formaldehyde.

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Physical Chemistry	W.J. Moore	Orient Longman, London	1972
2.	Thermodynamics of Steady state	K.G. Denbeigh	Meklien and Co., London	1951
3.	Elements of Chemical Thermodynamics	L.K. Nash	Addison Wesley	1962
4.	Chemical Application of Group Theory	F.A. Cotton	John Wiley and Sons Inc., Newyork	1971

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Thermodynamics for chemists	S.Glasstone	Affiliated East West press, New Delhi	1960
2.	Thermodynamics for students of chemistry	J. Rajaram & J.C. Kuriacose	Lal Nagin Chand, New Delhi	1986
4.	Group theory in chemistry	V. Ramakrishnan & M.S. Gopinathan	Vishal Publications	1988
5.	Group theory and its application to chemistry	K.V. Raman	Tata McGraw Hill Publishing Co	1990
6.	Advanced Physical Chemistry	Gurudeep Raj	Goel Publishing House, Meerut	2008

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - II

CORE PRACTICAL-III	M.Sc. Chemistry	2019-2020
M19PCHP03	PRACTICAL-III - INORGANIC ESTIMATION AND PREPARATION	
Credits: 3		

Course Outcomes

On successful completion of the course students will be able to

1. Acquire the quantitative skills in volumetric analysis.
2. Estimate the amount of different metals in the given solutions.
3. Develop practical skill in the preparation of complexes.
4. Execute the idea about recrystallisation.

A. Quantitative analysis of the following mixture

- 1) Iron and magnesium
- 2) Iron and nickel
- 3) Copper and nickel
- 4) Calcium and barium
- 5) Calcium and magnesium

B. Preparation of the following compounds

1. Potassium trioxalatoaluminate (III) trihydrate
2. Trithiourea copper (I) chloride
3. Potassium trioxalatochromate (III) trihydrate
4. Sodium bis (thiosulphato) cuprate (I)
5. Tetramminecopper (II) sulphate.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Vogel's qualitative Inorganic analysis	G. Svehla	Orient Longman, 6 th Edition.	1987
2.	Inorganic Semimicro Qualitative analysis.	V.V. Ramanujam	National Publishing Co	1971
3.	Fundamental of Analytical Chemistry	D. A. Skoog, D. M. West & F. J. Holler	Harcourt Asia	2001

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Vogel's Text book of quantitative inorganic analysis	J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS/Longman, England, 4 th Edn.	1986
2.	Experimental Inorganic Chemistry	W.G. Palmer	Van Nostrand Reinhold Co., London	1972
3.	An advanced course in practical Inorganic Chemistry	D.N. Grindley	Butterworths	1964

SEMESTER - II

CORE PRACTICAL-IV	M.Sc. Chemistry	2019-2020
M19PCHP04	PRACTICAL-IV- ORGANIC ESTIMATION AND	
Credits: 3	PREPARATION	

Course outcomes

On the successful completion of the course, student will be able to

1. Know the fundamental strategies of organic estimation.
2. Estimate the amount of organic compound in the given solutions.
3. Learn the determination of physical constants of organic compounds.
4. Develop practical skill in the preparation of complexes.
5. Execute the idea about recrystallisation.

A. Quantitative Analysis

1. Phenol and aniline.
2. Ketones (ethyl methyl ketone).
3. Sugars (Glucose)
4. Ascorbic acid (Vitamin-C tablets)
5. Amino groups (aniline)
6. Nitro groups (aromatic nitro compounds)
7. Amino acids (Glycine)

B. Preparation involving single stage

1. Benzoic acid from ethyl benzoate
2. Acetanilide from aniline
3. Acetyl salicylic acid from salicylic acid
4. 2,4,6-Tribromoaniline from aniline
5. p-Bromoacetanilide from acetanilide
6. m-Dinitro benzene from nitrobenzene
7. Picric acid from phenol
8. 2-Naphthylbenzoate from 2-naphthol.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Organic Chemistry – Lab manual	N.S. Gnanapragasam and G. Ramamurthy	S.Viswanathan Co. Pvt. Ltd	1998
2.	Vogel's Textbook of Practical Organic Chemistry,	B.S. Furniss, A.J.Hannaford, P.W. Smith, A.R.Tatchell	ELBS /Longman, London, 7 th Edn.	1984
3.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu	New Delhi, Sultan Chand & sons, 2 nd Edn.	1997

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Text book of Practical Organic Chemistry	Vogel	ELBS/Longman, England, 2 nd Edn.	1986
2	Organic Chemistry Lab Manual	Ganapragasm and Ramamurthy	S. Vishwanathan Printers and Publishers (P) Ltd., Chennai, 2 nd Edn.	2007
3	Advanced Experimental Chemistry.	J.N. Gurtu and R. Kapoor	S. Chand and Co.	1987

SEMESTER - III

CORE COURSE-VI	M.Sc. Chemistry	2019-2020
M19PCH06	ORGANIC SYNTHESIS AND REARRANGEMENTS	
Credits: 4		

Objectives

This course focuses on the concepts of various types of reactions, rearrangements and their synthetic utility in organic chemistry.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of heterocyclic chemistry	K1
CO2	Learn the basic knowledge in formation of carbon-carbon single bonds and C-C π bonds	K2
CO3	Recognize the basic knowledge in oxidation and reduction reactions	K1
CO4	Connect the details of organic synthesis by disconnection approach.	K4
CO5	Use the details of rearrangement and organic synthesis in organic reactions.	K3

UNIT I

Synthesis and reactions of indole, imidazole, thiazole, pyridines, pyrimidine, pyridazine, pyrazine, chromans, chromons, coumarins, carbazoles, uracil, uric acid and xanthenes.

Addition to carbon-hetero atom multiple bonds: Mechanisms of metal hydride reduction of carbonyl compounds, acids, esters and nitriles; addition of Grignard reagents and organolithium reagents to carbonyl compounds; mechanisms of formation of hydrates, acetals, oximes and hydrazones on carbonyl compounds, Wittig reaction.

UNIT II

Formation of C-C single bonds using organometallic reagents: organolithium, organomagnesium, organocopper, organozinc, organoboron, organosilicon and palladium catalysed coupling reactions.

Formation of carbon-carbon π bonds: Wittig olefination - Horner-Wadsworth-Emmons reactions - Peterson olefination - Julia olefination - The Shapiro reaction - Gilbert's reagent.

UNIT III

Oxidation Reactions: Chromium and manganese reagents (CrO_3 , $\text{K}_2\text{Cr}_2\text{O}_7$, PCC, PDC, Sarret reagent, Jones reagent, MnO_2 , KMnO_4), Oxygen (singlet and triplet), ozone, peroxides and peracids, lead tetraacetate, periodic acid. OsO_4 , SeO_2 , NBS, chloramine-T, Sommelet oxidation, Oppenauer oxidation, Fenton's reagent, Sharpless epoxidation.

Reductions: Catalytic hydrogenation (homogeneous and heterogeneous) catalysts (Pt, Pd, Rh-C, Ni, Ru), Wilkinson catalyst, LiAlH_4 , NaBH_4 , DIBAL-H, Sodium cyanoborohydride, dissolving metal reactions (Birch reduction). Leukart reaction (reductive amination) Diborane as reducing agent, Meerwein-Ponndorf-Verley reduction, Wolff-Kishner reduction, Clemmensen reduction, tributyltinhydride, stannous chloride, Baker's yeast. Suzuki coupling, Heck reaction, Negishi reaction.

UNIT IV

Basic Principles of Synthesis of Aromatic Compounds - Disconnection Approach - Functional Group Inter conversions - Synthons - Aromatic Electrophilic and Nucleophilic Substitutions - Strategy I (The order of Events - Some Guidelines) - One-Group CX Disconnections - Strategy II (Chemoselectivity, some Guidelines) - Two-Group Disconnections- Strategy III (Polarity Reversal, Cyclization) - Amine Synthesis (Salbutamol, Fenfluramine) - Protecting the Functional Groups - synthesis of a sweetening agent (Asp-Phe-OMe). General Strategy of Choosing a Disconnection- Stereoselectivity - Regioselectivity- Alkene synthesis - Use of Acetylenes - Group C-C Disconnections (Alcohols, Carboxylic acids, Carbonyl compounds).

UNIT V

Rearrangements: Types of rearrangements: Nucleophilic; free radical and electrophilic reactions Mechanisms, Nature of migration; migratory ability and memory effects, ring enlargement and ring contraction.

Rearrangements Reactions: Wagner-Meerwin and related reactions, Benzil-benzilic acid, Favorskii, Hoffmann and related rearrangements, Beckmann, Neber, Baeyer-Villiger, Stevens, Claisen rearrangements, boron-carbon migration, Non-1,2-rearrangements, Fischer-indole synthesis, Arndt-Eistert synthesis - expansion and contraction of rings.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Text book of Organic Chemistry	P.L. Soni	Sulan Chandans Son	1986
2	Advanced Organic Chemistry	Arun Bhal, B.S. Bahl	S. Chand and Company Ltd.	2003
3	Principles of Organic Chemistry	M.K. Jain	Vishal Publishing Co.	2017
4	Organic Chemistry	Wade	Pearson Education, 6 th Edn.	2007
5	Organic Chemistry	Morrison and Boyd	Pearson Education, 7 nd Edn. New Delhi.	2014
6	Organic Chemistry	P. Y. Bruice	Pearson Education, 3 rd Edn.	2006

REFERENCE BOOKS

S.No	Title of the Book	Author	Publishing Company	Year
1.	Heterocyclic Chemistry	T. L. Gilchrist	Longman Press	1989
2.	Heterocyclic Chemistry	J. A. Joule and K. Mills	John-Wiley, 4 th Edn.	2010
3.	Modern Methods in Organic Synthesis	Carruthers	Academic Presistry, Vol. 1 and 2	2002
4.	Organic Synthesis: The Disconnection Approach	Stuart Warren	Wiley-India, New Delhi	2007
5.	Advanced Organic Chemistry	J. March and M Smith	John-Wiley and sons, 5 th Edn.	2001
6.	Advanced Organic Chemistry, Vol. 1 and 2	F. A. Carey and R. Sundberg	Springer US	2002

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - III

CORE COURSE-VII	M.Sc. Chemistry	2019-2020
M19PCH07	ORGANOMETALLIC CHEMISTRY	
Credits: 4		

Objectives

This course makes student to know the concepts, theories, mechanism and application of organometallic compound.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Learn the basic concepts of Organometallic chemistry on metal carbonyls and nitrosyl complexes	K2
CO2	Gain knowledge on Metal – alkyl, alkylidene, alkylidyne complexes.	K1
CO3	Summarize the metal - Alkene and alkyne complexes	K2
CO4	Illustrate Cyclopentadienyl and arene complexes and their importance.	K4
CO5	Relate the applications of Organometallic compounds in homogeneous catalytic reactions	K3

UNIT I

Organometallic compound: Definition-18 electron rule - effective atomic number rule - classification of organometallic compounds - the metal carbon bond types - ionic bond – sigma covalent bond - electron deficient bond - delocalised bond - dative bond - Metal carbonyl complexes: Synthesis - structure and reactions of metal carbonyls - the nature of M- CO bonding-binding mode of CO and IR spectra of metal carbonyls - metal carbonyl anions - metal carbonyl hydrides - metal carbonyl halides - metal carbonyl clusters - Wades rule and isolobal relationship. Metal nitrosyls - dinitrogen complexes - dioxygen complexes.

UNIT II

Metal alkyl complexes - stability and structure - synthesis by alkylation of metal halides - by oxidative addition - by nucleophilic attack on

coordinated ligands - metal alkyl and 18 electron rule - reactivity of metal alkyls - M-C bond cleavage reactions - insertion of CO to M-C bonds - double carbonylation - insertions of alkenes and alkynes - insertions of metals with C-H bonds. Alkylidene and alkylidyne complexes: synthesis of alkylidene complexes in low oxidation states and in high oxidation states - bonding in alkylidene complexes - synthesis and bonding in alkylidyne complexes - reactivity of alkylidene and alkylidyne complexes.

UNIT III

Alkene complexes: synthesis by ligand substitution, reduction and metal atom synthesis - bonding of alkenes to transition metals - bonding in diene complexes - reactivity of alkene complexes - ligand substitution - reactions with nucleophiles - olefin hydrogenation - hydrosilation - Wacker process - C-H activation of alkenes. Alkyne complexes: synthesis, bonding and reactivity alkyne complexes - cobalt catalysed alkyne cycloaddition.

UNIT IV

Cyclopentadienyl complexes: metallocenes - synthesis of metallocenes - bonding in metallocenes - reactions of metallocenes - $\text{Cp}_2\text{Fe}/\text{Cp}_2\text{Fe}^+$ couples in biosensors - metallocene halides and hydrides - stereospecific polymerisation of 1-alkenes - cyclopentadiene as a non-spectator ligand - monocyclopentadienyl (half-sandwich) complexes - bent sandwich complexes - bonding in bent sandwich complexes. Allyl complexes: Synthesis and structures of allyl complexes. Arene complexes: synthesis, structure and reactivity of arene complexes - multidecker complexes.

UNIT V

Organometallic compounds in homogeneous catalytic reactions - coordinative unsaturation - acid-base behaviour reaction - migration of atoms or groups from metal to ligand - insertion reaction - reactions of coordinated ligands - catalytic reactions of alkenes - isomerisation of alkenes - hydrogenation - hydroformylation and hydrosilation of alkenes - alkene polymerisation and oligomerisation - fluxional molecules. Asymmetric synthesis - Olefins metathesis in organic synthesis - Palladium catalysed cross coupling reactions in organic synthesis.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Text book of Inorganic Chemistry	P.L. Soni, M. Katyal	Sulan Chandans Son	1986
2	Modern Inorganic Chemistry	S. Satya Prakash	S. Chand and Company Ltd.	2003
3	Advanced Inorganic Chemistry	Gurdeep Raj	Goel Publishing house	1986
5	Selected Topics in Inorganic Chemistry	U. Malik, G.D. Tuli, R.D. Madan	S. Chand and Company Ltd.	2001
6	Concise Coordination Chemistry	R. Gopalan, V. Ramalingam	Vikas Publishing house	2001
7	A New Concise Inorganic Chemistry	J. D. Lee	ELBS, 3 rd Edn.	1987

REFERENCE BOOKS

S.No	Title of the Book	Author	Publishing Company	Year
1.	Organometallics, complexes with transition metal-carbon -bonds	Bockmann	Oxford science publications, Oxford	1996
2.	Basic organometallic chemistry	J. Haiduc and J. J. Zuckerman	Walter de Gruyter, Berlin	1985
3.	Inorganic Chemistry - Principles of structure and reactivity	J. E. Huheey	Harper International Edition, Harper and Rone New York	1978
4.	Advanced Inorganic Chemistry	F. A. Cotton and G. Wilkinson	Fourth Edition	1980

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	M	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - III

CORE COURSE-VIII	M.Sc. Chemistry	2019-2020
M19PCH08	ELECTROCHEMISTRY AND PHOTOCHEMISTRY	
Credits: 4		

Objectives

The aim of this course is to expose the students to understand the electrochemistry and photochemistry and its application.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know about the concept of Ionics and Electrical double layer.	K2
CO2	Understand the concepts of Electrode kinetics and their applications.	K2
CO3	Study the various storage devices Batteries, Fuel cells and corrosion related to real world problems.	K4
CO4	Relate the Photochemistry Laws and applied in Photochemical processes.	K3
CO5	Learn the basic principles of Photochemical Reactions and Radio chemistry and its applications to solar energy applications.	K1

UNIT I

Ionics: Electrochemistry of solution, ionic atmosphere – Ion-solvent and Ion-Ion interaction, Debye – Huckel – Onsagar equation. Ionic migration and diffusion, thermodynamics of galvanic cells, equilibrium electrode potential, thermodynamics of electrochemical cells.

Electrical double layer: theories of double layer structure diffuse double layer theory of Helmholtz, Gouy-Chapmann and the stern model, Electro capillary phenomenon, influence of double layer on charge transfer processes.

UNIT II

Electrode kinetics: types – Reference Electrode, polarizable and Non-polarizable Electrode, working Electrode - types, current potential relationship, Butler-volmer and Tafel equations, overpotential- types, hydrogen evolution and Oxygen reduction reaction.

Theory, principle and Instrumentation and applications of cyclic voltammetry, polarography, amperometry and coulometry.

UNIT III

Batteries: Primary and secondary Batteries – Ni-Cd, Mn-Li Batteries. Fuel cells: H₂-O₂ Fuel cells, direct methanol fuel cells, super capacitor.

Corrosion: Different types, influence of environment, Evans diagram, Pourbaix diagram, corrosion rate measurement, corrosion monitoring techniques and prevention.

UNIT IV

Laws of Photochemistry: Interaction of Electromagnetic radiation with Matter - Types of excitations – Laws of Photochemistry – Grothaus and Draper law – Lambert and Beer's law – Einstein law – Quantum yield.

Photo primary processes, fate of the excited molecule – State energy diagrams – Fluorescence – Fluorescence life times – phosphorescence life times – Quenching – Stern – Volmer equation – Inter molecular processes – Photosensitisation – Predissociation – Fluorescence and Singlet – Triplet state and phosphorescence emission.

UNIT V

Photochemical Reactions: Light absorption – Experimental techniques – Electronic transitions – Frank – Condon principle – Jablonski diagrams – Intersystem crossing – Energy transfer – Molecular orbital view of excitation – The Geometry of excited states.

Radiation chemistry – radioactive and non-radioactive transnsions – properties of photochemically excited states – excited states, acidity constant, excimers and exciplexes – Pulse radiolysis, photovoltaic cells and solar cells, solar energy conversion.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Electrochemistry- Principles and Applications	B.Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan	S. Viswanathan Printers and Publishers Pvt., Ltd	2007
2.	Modern Electrochemistry	J.O.M. Bockris and A.K.N. Reddy	Plenum Press, New York	1970
3.	Fundamentals of Photochemistry	K.K.Rohatgi & Mukherjee	New age International publications, Reprint	2002
4.	Physical Chemistry	Robert A. Alberty	Wiley Eastern Limited Reprint, 6 th Edn.	1987

REFERENCE BOOKS

S.No	Title of the Book	Author	Publishing Company	Year
1.	Principles and Application of Electrochemistry	D.R. Crow	Chapmann Hall, London	1988
2.	Theoretical Electrochemistry	L. Antropov	Mir Publications, Moscow	1972
3.	An Introduction to Electrochemistry	S. Glasstone	East West Press	1967
4.	Modern Molecular photochemistry	N.J. Turro	Benjamin Cummings	1965

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - III

CORE PRACTICAL-V	M.Sc. Chemistry	2019-2020
M19PCHP05	PRACTICAL-V - ORGANIC ANALYSIS	
Credits: 3		

Course Outcomes

On successful completion of the course students will be able to

1. Understand the separation techniques and systematic analysis of organic mixtures.
2. Distinguish between aromatic – aliphatic and saturated – unsaturated compounds.
3. Learn the determination methods of physical constants of organic compound.

Micro Qualitative Analysis of an organic binary mixture

1. Pilot separation
2. Bulk separation
3. Analysis of organic compounds.
4. Derivatization.
5. Determination of melting and boiling points.

(Minimum 8 Mixtures)

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Organic Chemistry – Lab manual	N.S. Gnanapragasam and G. Ramamurthy	S.Viswanathan Co. Pvt. Ltd	1998
2.	Vogel's Textbook of Practical Organic Chemistry, Basic Principles	B.S. Furniss, A.J.Hannaford, P.W.Smith, A.R.Tatchell	ELBS /Longman, London, 7 th Edn.	1984
3.	of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu	New Delhi, Sultan Chand & sons, 2 nd Edn.	1997

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Text book of Practical Organic Chemistry	Vogel	ELBS/Longman, England, 4 th Edn.	1986
2	Organic Chemistry Lab Manual	Ganapragasm and Ramamurthy	S. Vishwanathan Printers and Publishers (P) Ltd., Chennai, 2 nd Edn.	2007
3	Advanced Experimental Chemistry.	J.N. Gurtu and R. Kapoor	S. Chand and Co.	1987

SEMESTER - III

CORE PRACTICAL-VI	M.Sc. Chemistry	2019-2020
M19PCHP06	PRACTICAL-VI- PHYSICAL CHEMISTRY EXPERIMENTS - II	
Credits: 3		

Course outcomes

On successful completion of the course students will be able to

1. Develop practical skill in conductometric and potentiometric titrations.
2. Understand experimental knowledge on kinetics and electro chemistry.
3. Learn the determination methods of physical constants of substances.

LIST OF EXPERIMENTS

1. Determination of the activity coefficient of an electrolyte at different molalities by emf measurements.
2. Determination of the dissociation constant of acetic acid by titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
3. Determination of the strength of a given solution of KCl using differential potentiometric titration technique.
4. Determination of the pH of the given solutions with the help of the indicators using buffer solutions and by colorimetric method.
5. Determination of the pH of a given solution by emf method using hydrogen electrode and quinhydrone electrode.
6. Determination of the composition and instability constant of a complex by mole ratio method.
7. Solubility and solubility products by emf method.
8. Determination of solubility product of Silver bromide and calculate its solubility in water and 0.1 M and 0.01 M KBrO_3 using Debye- Huckel limiting law.
9. Determination of the rate constant and order of reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.
10. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion).

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Advanced Experimental Chemistry, Vol I.	J.N. Gurtu and R.Kapoor	S. Chand & Co. Ltd., New Delhi	1980
2.	College Practical Chemistry	V.K. Ahluwalia, Sunitha Dhingra and Adarsh Gulate	Universities Press (India) Pvt Ltd	2008
3.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu	New Delhi, Sultan Chand & sons, 2 nd Edn.	1997

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Findlay's Practical Physical Chemistry	B.P. Levitt	Longman, London, 9 th Edn.	1985
2.	Experimental Physical Chemistry	F. Daniels	McGraw Hill, New York, 7 th Edn.	1970
3.	Practical Physical Chemistry	A. Findlay	London, Longman, 7 th Edn.	1959

SEMESTER - IV

CORE COURSE-IX	M.Sc. Chemistry	2019-2020
M19PCH09	PERICYCLIC REACTION AND NATURAL PRODUCTS	
Credits: 4		

Objectives

The aim of this course is to expose the students to understand pericyclic reactions and natural products.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know the Conservation of orbital symmetry and Types, principles of Pericyclic reactions	K1
CO2	Categorize the electrocyclic reactions and sigmatropic rearrangements.	K4
CO3	Isolate and classify the synthesis of Terpenes	K3
CO4	Identify the functional groups and analyse the structures of Steroids	K2
CO5	Sketch out the synthesis of Alkaloids	K3

UNIT I

Pericyclic Reactions: Molecular orbital symmetry: frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system; classification of pericyclic reactions. Woodward – Hoffmann correlation diagrams; FMO and transition state aromaticity approach; selection rules.

Cycloaddition reactions: (4+2), (2+2) cycloaddition – selectivity - substituent effect - inverse electron demand Diels-Alder reactions - 1,3-dipolar cycloadditions of ozone, diazomethane and nitrile oxide and chelotropic reactions.

UNIT II

Electrocyclic reactions: conrotatory and disrotatory motions; ring opening and ring closing reactions - $4n$, $4n+2$ and allyl systems.

Sigmatropic rearrangements: (1,3), (1,5), (1,7), (3,3) and (5,5) - carbon migrations, degenerate sigmatropic rearrangements.

UNIT III

Terpenoids: Isolation and classification of terpenoids. Structural elucidation and synthesis of Zingiberine, Camphor, Ascorbic acid, Citral, α -pinene, Cadinene & Squalene.

UNIT IV

Steroids: Introduction - structural elucidation & synthesis of cholesterol, ergosterol, Bile acid. Male sex hormones - androsterone & testosterone, Female sex hormones - estrone, equilenin, Progesterone.

UNIT V

Alkaloids: Introduction - structural elucidation & synthesis of Morphine, Atropine, Piperine, Nicotine, Caffeine & Belladine.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Pericyclic Reactions	S. Sankararaman	Wiley	2005
2.	Organic chemistry	Morrison, Boyd, Bhattacharjee	Pearson	2009
3.	New Trends in Natural Product Chemistry	Atta-Ur-Rahman and M.I. Choudhary	Gordon & Breach Science Publishers	1998
4.	The Natural Pigments	Bentley	Interscience	1960
5.	Organic Chemistry Natural Products	O.P. Agarwal	Goel Publishers	2013

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Chemistry of Alkaloids	S.W. Pelletier, Van Nostrand	Reinhold	1970
2.	Chemistry of Natural Products	V.K. Ahluwalia	Ane Books Pvt. Ltd	2006
3.	Chemistry of Natural Products	P.S. Kalsi	Products Kalyani Publisher	2001
4.	Natural Products Chemistry Vol. I & II	K. Nakanishi	Academic Press, Inc	1975

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M-**Medium.

SEMESTER - IV

CORE COURSE-X	M.Sc. Chemistry	2019-2020
M19PCH10	SOLID STATE AND NUCLEAR CHEMISTRY	
Credits: 4		

Objectives

The aim of this course is to expose the students to understand solid state and nuclear chemistry.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Study the solid state chemistry of inorganic compounds.	K2
CO2	Summarize the types and close packing of atoms of solids and important inorganic compounds.	K2
CO3	Get knowledge about the theories, properties and defect of solid.	K1
CO4	Device the nuclear structure and radioactive nuclei.	K4
CO5	Learn the different type of nuclear reactions and their application	K3

UNIT I

The growth and form of crystals - the crystal systems and Bravais lattices - Miller indices and labelling of planes - symmetry properties - crystallographic point groups and space groups. Fundamentals of X-ray diffraction - powder and rotating crystal methods - systematic absences and determination of lattice types - analysis of X-ray data for cubic system - structure factor and Fourier synthesis. Electron and neutron diffraction and structure determination.

UNIT II

Types of solids - close packing of atoms and ions - BCC, FCC and HCP voids - Goldschmidt radius ratio - derivation - its influence on structures. Structures of rock salt - cesium chloride - wurtzite - zinc blende - rutile - fluoroite - antiferite - diamond and graphite - spinel - normal and inverse

spinels and perovskite. Lattice energy of ionic crystals - Madelung constant - Born-Haber cycle and its applications.

UNIT III

Metallic state - free electron and band theories - electrical properties of solids - conductor, insulators, semiconductors - types and impurity semiconductors (n and P type) and superconductors. Defects in solid: stoichiometry and non-stoichiometry defect - linear defects - dislocations - effects due to dislocations. Elementary study of liquid crystals.

UNIT IV

Nucleus: nuclear structure - stability of nuclei - packing fraction - even - odd nature of nucleons - n/p ratio - nuclear potential - binding energy and exchange forces - shell model and liquid drop model. Decay of radio nuclei: rate of decay - determination of half-life period - secular equilibrium and decay series. Modes of decay: alpha, beta, gamma and orbital electron capture - nuclear isomerism - internal conversions - Q value - nuclear cross section - threshold energy and excitation functions. Particle acceleration and counting techniques: linear accelerator - cyclotron and synchrotron - betatron - G. M. counter - proportional and scintillation counters.

UNIT V

Different type of nuclear reactions with natural and accelerated particles: transmutation - stripping and pick-up - spallation - fragmentation - fission - characteristics of fission reaction - product distribution and theories of fission - fissile and fertile isotopes - U^{235} , U^{238} , Th^{232} and Pu^{239} - atom bomb - nuclear fusion - stellar energy. Uses of radioisotopes: agriculture - industry and medicine - mechanism of chemical reactions - radioisotopes in analytical chemistry - isotopic dilution analysis - neutron activation analysis and dating methods.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Structural principles of Inorganic Chemistry	W.E. Addison	Longman	1961
2.	Solid state chemistry	N.B. Hannay	Prentice-Hall	1967
3.	Physical chemistry	R.A. Alberty		1975
4.	Essentials of Nuclear chemistry	H.J. Arnikar	Wiley-Blackwell, 2 nd Edn.	1987

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Physical Chemistry	W.J. Moore	Longmans Green & Co. Ltd.	1963
2.	Introduction to solids	L.V. Azroff	Mc Graw Hill, New York	2009
3.	Nuclear and Radiochemistry	G. Friedlander, J.W. Kennedy, E.S. Macias, J. M. Miller	Wiley	1981
4.	Source book on atomic energy	S. Glasstone	Van Nostrand	1998

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M-**Medium.

SEMESTER IV

CORE COURSE-XI	M.Sc. Chemistry	2019-2020
M19PCH11	RESEARCH METHODOLOGY	
Credits: 4		

Objectives

On completion of this course student shall know the importance of research, methodology of writing thesis and journal articles and errors involved in chemical analysis.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the meaning of research.	K2
CO2	Acquire knowledge about errors involved in chemical analysis.	K1
CO3	Analyze about sampling techniques.	K2
CO4	Relate ideas regarding research and thesis writing.	K4
CO5	Develop knowledge about the use of tools and softwares in research.	K3

UNIT I

Meaning of Research: The search for knowledge, purpose of research, scientific method, role of theory, characteristics of research. Types of research: fundamental or pure research, applied research, action research, historical research, experimental research, Ethical Considerations.

UNIT II

Errors Involved in Chemical Analysis: Classification, minimization of errors, determination of accuracy of results, reliability of results, rounding numbers -Significant figures - Mean standard deviation.

UNIT III

Sampling: Introduction - Definitions, theory of sampling - techniques of sampling – Statistical criteria of good sampling & required size - Stratified sampling Vs random sampling.

UNIT IV

Nature and purpose, the components of dissertation, overview, title and title page, abstract, preface and table of contents, Introduction, results, discussion, conclusion, experimental section, references and miscellaneous components. Preparation of dissertation.

UNIT V

Writing techniques – Introduction, word processing and page layout, hardware and operating systems, word processing and page layout software, writing and formatting with computer, becoming accustomed to your system.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Research Methodology Methods & Techniques	C.R. Kothari	New AgeInternational Publishers	2011
2.	Research Methodology	Y.K. Singh, R. Nath	APH Publishing Corporation	2005
3.	Methods in Social Research	W.J. Goode, P.K. Hatt	McGraw-Hill, New York	1982

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Basic research methods for librarians	L.S. Connaway & R.R. Powell	Libraries unlimited California.	2010
2.	Research methodology in Library and information science	A. Glootenberg	Uxbridge: Koros	2013

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
C01	S	S	M	M	M
C02	M	S	S	S	M
C03	S	M	S	S	M
C04	M	M	S	S	S
C05	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - IV

CORE PRACTICAL-VII	M.Sc. Chemistry	2019-2020
M19PCHP07	PRACTICAL-VII - ORGANIC AND INORGANIC	
Credits: 3	PREPARATION	

Course outcomes

On successful completion of the course students will be able to

1. Develop practical skill in the preparation of organic and inorganic compounds.
2. Understand the preparation methods of organic and inorganic compounds.
3. Execute the idea about recrystallisation.

A. Organic preparation involving double stage (Minimum 5 Preparations)

1. p-Bromoacetanilide from Aniline
2. p-Nitroaniline from Acetanilide
3. 1,3,5-Tribromobenzene from Aniline
4. Acetyl salicylic acid from Methyl salicylate
5. Benzilic acid from Benzoin
6. m-Nitroaniline from Nitrobenzene
7. β -Naphthol from Naphthalene

B. Preparation of the following Inorganic compounds

1. Sodium hexanitrocobaltate (III)
2. Sodium Trisoxalatoferrate (III)
3. Bis (acetylacetonato) Copper (II)
4. Hexamminecobalt (III) chloride
5. Hexamminenickel (II) chloride
6. Potassium Tetrachlorocuprate (II)

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Organic Chemistry – Lab manual	N.S. Gnanapragasam and G. Ramamurthy	S.Viswanathan Co. Pvt. Ltd	1998
2.	Advanced Experimental Chemistry.	J.N. Gurtu and R. Kapoor	S. Chand and Co.	1987
3.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu	New Delhi, Sultan Chand & sons, 2 nd Edn.	1997

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Text book of Practical Organic Chemistry	Vogel	ELBS/Longman, England, 4 th Edn.	1986
2.	Vogel's Text book of quantitative inorganic analysis	J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS/Longman, England, 4 th Edn.	1986
3.	Experimental Inorganic Chemistry	W.G. Palmer	Van Nostrand Reinhold Co., London	1972
4.	An advanced course in practical Inorganic Chemistry	D.N. Grindley	Butterworths	1964

SEMESTER - IV

PROJECT	M.Sc. Chemistry	2019-2020
M19PCHPR1	PROJECT	
Credits: 3		

Course Outcomes

On successful completion of the course students will be able to

1. Learn research methodologies along with literature survey.
2. Get skills on developing new materials through new synthetic routes.
3. Characterize the material using different techniques.

Make the student to understand and present a research finding on a topic in the subject related to Chemistry under the guidance of a department Staff.

SEMESTER - I

ELECTIVE-I	M.Sc. Chemistry	2019-2020
M19PCHE01	DYE CHEMISTRY	
Credits: 4		

Objectives

On completion of this course student could understand theories of colour and constitution, differentiate the types of dyes and know the process and mechanism of dyeing process.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic concepts dye chemistry	K2
CO2	Classify acid and basic dyes based on structure and mechanism	K3
CO3	Acquire knowledge about mordant, azo and vat Dyes	K1
CO4	Examine the synthesis and applications to various types of dyes - azo, di & triphenyl methane, phthalein dyes	K3
CO5	List out the applications of dyes in different areas	K4

UNIT I

Colour and constitution: Colour of substances - Complementary colours - theories of colour and constitution - Otto - Witt theory - chromophores, auxochromes, bathochromic shift, hypsochromic shift. Quinonoid theory, modern theories - valence bond theory and molecular orbital theory. Names of commercial dyes; Study of raw materials and dyestuff intermediates; Unit operations - nitration, sulphonation, halogenation, amination, diazotisation and alkali fusion; Colour index and its significance; Classification of dyes based on chemical constitution and method of applications; General properties - linearity, coplanarity and fastness.

UNIT II

Direct cotton dyes (substantive dyes) – Classification, properties, structure and mechanism of dyeing, post treatment of dyeing; Acid dyes and Basic dyes – Classification, Characteristics, trade names, Mechanism of dyeing, Nature of affinity on cellulose and protein fibres.

Unit III

Mordant dyes – classification, methods of application; Metal complex dyes – types of bond formation between dye and various fibres; Azo dyes – Principles of azo coupling - Mechanism of diazotization - Coupling with amines & phenols. Monoazo & bisazo dyes - Synthesis & applications. Tautomerism in azo dyes. Vat dyes and solubilised vat dyes – classification, methods of application, trade names, principles and application, Stripping agents and correction of faulty dyeing.

UNIT IV

Di and Triphenyl Methane Dyes: Synthesis and applications of diphenyl methane dyes – Auramin O, Auramin G. Triphenyl methane dyes - leuco bases - pseudo bases - dye salts; amino triphenyl methane dyes - Malachite Green, Rosaniline & Crystal Violet. Hydroxy triphenyl methane dyes - Aurin, Chrome Violet.

Phthalein Dyes: Phenolphthalein, phenosulpho - phthalein. xanthene dyes, acid xanthene dyes - Fluorescein, Eosin, Erythrocin. Xanthhydrol basic xanthene dyes - Rhodamine - B, Rhodamine - G, pyronine - G

UNIT V

Pigments: Requirements of a pigment – Organic / inorganic pigments & their uses in paints. Reactions of dyes with fibre & water. Fluorescent Brightening Agents. Applications of dyes in other areas – Medicine, chemical analysis, cosmetics, colouring agents, foods and beverages.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Synthetic Dyes	Gurdeep R Chatwal	Himalaya Publishing House (Pvt)	2016
2.	A Text Book of Synthetic Dyes	O.D. Thyagi, M. Yadav	Anmol Publication (Pvt) Ltd.	2002
3.	The chemistry of synthetic dyes Part I & II	K. Venkataraman	Academic Press, New York	1952

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Chemistry of Dyes and Principles of Dyeing Vol.-II	V. A. Shenai	Sevak Prakashan, Mumbai	1987
2.	The Dyeing of Synthetic Polymer and Acetate Fibres	D. M. Nunn	Dyers Company, Publication Trust.	1979
3.	Dyes and their Intermediates	E.N. Abrahart	Edward Arnold Publishers	1977
4.	Synthetic Dyes	Pope Sine	Neha Publishers	2016

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M-**Medium.

SEMESTER - I

ELECTIVE-I	M.Sc. Chemistry	2019-2020
M19PCHE02	POLYMER CHEMISTRY	
Credits: 4		

Objectives

At the end of this course student can understand the kinetics of polymerization and know the importance of polymer, technology and the applications of polymers.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Classify the types of polymers and recognize the basic concepts	K2
CO2	Illustrate the mechanisms of polymerization	K2
CO3	Calculate the molecular weight of polymers by various methods	K3
CO4	Understand the different polymer processing techniques	K2
CO5	List the commercial polymers in different areas	K3

UNIT I

Monomers, Plastics, elastomers and fibres. Linear, branched and network Polymers. Degree of polymerization. Polymerization in homogeneous and heterogeneous systems. Condensation Polymerization: Mechanism of stepwise polymerization. Kinetics and statistics of linear stepwise polymerization. Addition polymerization: Free radical, cationic and anionic polymerization. Polymerization conditions.

UNIT II

Co-ordination polymerization: Kinetics, mono and bimetallic mechanism of co-ordination polymers. Zeigler Natta catalyst, Co-polymerization: Block and graft co-polymers, kinetics of co-polymerization. Types of co-polymerization. Reactivity ratio.

UNIT III

Molecular weight and properties: Polydispersion – average molecular weight- number, weight and viscosity average molecular weights. Measurement of molecular weights - Viscosity, light scattering, osmotic and ultracentrifugation methods. Polymer structure and physical properties – Crystalline melting point (T_m). Glass transition temperature (T_g). Determination of T_g. Relationship between T_m and T_g.

UNIT IV

Polymer processing: Processing techniques: Compounding, calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT V

Commercial polymers: Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers - Fire retarding polymers and Electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Text Book of Polymer Science	F.W. Billmeyer	J.Wiley	2003
2.	Polymer Science	Gowariker, N.V. Viswanathan and J. Sreedhar	New Age Int.,	1986
3.	Introduction to Polymer Chemistry	R. B. Seymour	MC Craw Hill, New York.	1971

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Contemporary Polymer Chemistry	H.R. Alcock and F.W. Lamber	Prentice Hall	1981
2.	Principles of Polymer Chemistry	P.J. Flory	Cornell University Press, New York	1953
3.	Principles of Polymerization	G. Odian	John Wiley & Sons, New York	1981

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	S	S	M
CO3	S	M	S	M	S
CO4	M	M	S	M	M
CO5	M	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER - I

ELECTIVE-I	M.Sc. Chemistry	2019-2020
M19PCHE03	GREEN CHEMISTRY	
Credits: 4		

Objectives

This course can give idea about basic principles and importance of green chemistry and its application.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic principles and tools of green chemistry	K2
CO2	Discuss microwave mediated organic synthesis	K2
CO3	Analyze the synthetic applications of ionic liquids	K4
CO4	Relate supported catalysts and bio-catalysts for Green chemistry	K3
CO5	Acquire knowledge of modified bio catalysts	K1

UNIT I

Green chemistry: Introduction - relevance and goals, Anastas' twelve principles of green chemistry - Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

UNIT II

Microwave mediated organic synthesis (MAOS): Microwave activation - advantage of microwave exposure - specific effects of microwave - Neat reactions - solid supports reactions - Functional group transformations - condensations reactions - oxidations - reductions reactions - multi-component reactions.

UNIT III

Ionic liquids: Ionic liquids and PTC Introduction - synthesis of ionic liquids - physical properties - applications in alkylation - hydroformylations - epoxidations - synthesis of ethers - Friedel - craft reactions - Diels-Alder

reactions – Knoevenagel condensations – Wittig reactions – Phase transfer catalyst - Synthesis – applications.

UNIT IV

Supported catalysts and bio-catalysts for Green chemistry
Introduction – the concept of atom economy – supported metal catalysts – mesoporous silicas – the use of Biocatalysts for green chemistry.

UNIT V

Modified bio catalysts: Fermentations and biotransformations – fine chemicals by microbial fermentations – vitamins and amino acids – Baker's yeast mediated biotransformations – Bio-catalyst mediated Baeyer-Villiger reactions – Microbial polyester synthesis.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	New Trends in Green Chemistry	V.K. Ahluwalia, M.Kidwai	Anamaya Publishers	2012
2.	Organic Synthesis - Special Techniques	V.K.Ahluwalia, Renu Aggarwal	Techniques Narosa Publishing House	2012
3.	Environmental Chemistry	A. K. De	Wiley Eastern Ltd., New Delhi.	1989

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Green Chemistry – Environmentally benign reactions	V. K. Ahluwalia	Ane Books India	2006
2.	Green Chemistry – Environment friendly alternatives	Rashmi Sanghi & M. M. Srivastava	Narora Publishing House	2003
3.	Green Chemistry – Frontiers in benign chemical synthesis and processes	Paul T. Anastas & Tracy C. Williamson	Oxford University Press	1998

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	S	S	M
CO3	S	M	S	M	S
CO4	M	M	S	M	M
CO5	M	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER - I

ELECTIVE-I	M.Sc. Chemistry	2019-2020
M19PCHE04	BIOORGANIC & MEDICINAL CHEMISTRY	
Credits: 4		

Objectives

After completion of this course student can know the key role of various elements in the living systems and learn about how enzymes and coenzymes work.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the organic chemistry of biomolecules like amino acids, and protein	K2
CO2	Acquire basic knowledge about the structure and functions of certain metallo enzymes.	K1
CO3	Explain the synthesis of nucleic acids and proteins	K2
CO4	Contribute insight into the small molecules binding and transport mechanism involving living system	K3
CO5	Describe the mechanism of binding interactions of metal complexes with biomolecules and metal based drug action.	K3

UNIT I

Classification, synthesis and properties of amino acids, isoelectric point, biosynthesis of amino acids. Peptides: oligo- and polypeptides, geometry of peptide linkage, N-terminal and C-terminal residue analysis, synthesis of peptides-amino and carboxyl protecting groups-solid phase peptide synthesis. Proteins: classification and properties (denaturation, isoelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins, collagen and triple helix.

UNIT II

Mechanism of enzyme catalysis, Factors influencing enzyme action, Examples of typical enzyme mechanisms: chymotrypsin, ribonuclease and lysozyme, Enzyme - catalyzed addition, elimination, condensation, carboxylation and decarboxylation, isomerisation, group transfer and

rearrangement reactions-structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD⁺ , NADP⁺ , FMN, FAD, lipoic acid and Vitamin B12. Mechanisms of reactions catalysed by the above cofactors.

UNIT III

Nucleotides and nucleosides, DNA: primary and secondary structure-replication of DNA, RNA and protein synthesis: Messenger RNA synthesis-transcription, Ribosomes - rRNA, Transfer RNA, genetic code translation. Determination of base sequence of DNA. Polymerase Chain Reaction (PCR). Antisense technology in chemotherapy and other nucleic acid-targeted drugs-intercalaters, sequence specific drugs. A brief account of ribosome and iRNA.

UNIT IV

Designing organic synthesis - disconnection approach - synthons and synthetic equivalents - one group disconnections: alcohol, olefin, ketone, acids-two group disconnections: 1,2, 1,3, 1,4 and 1,5-difunctional compounds -convergent synthesis - functional group interconversions - functional group additions - carbon hetero atom bonds - methods for 3 to 6membered rings.

UNIT V

Medicinal Chemistry: Lead and Analogue Synthesis - Combinatorial synthesis in medicinal chemistry: Solid phase techniques - methods of parallel synthesis - mix and split techniques - dynamic combinatorial chemistry - screening and deconvolution -limitations of combinatorial synthesis Asymmetric synthesis: basic principles-stereoselective and stereospecific reactions - methods for determining enantiomeric excess - chiral auxiliary, reagents and catalysts and their applications (wherever applicable) in alkylation, hydrogenation, hydroxylation, epoxidation and hydroboration of alkenes, reduction of ketones - Cram and Felkin -ahn models. Noyori's BINAP - Jacobson catalyst - Evans catalyst.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Bioorganic Chemistry: A Chemical approach to Enzyme action	Hermann Dugas and C.Penny	Springer-Verlag	1981
2.	Designing Organic Synthesis: The Disconnection Approach	Stuart Warren	Wiley	1984
3.	Advanced Organic Chemistry: Part-A and Part-B	Francis A. Carey and Richard B. Sundberg	Springer	2007

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Fundamentals of Enzymology	N.C. Price and L.Stevens	Oxford University Press.	2002
2.	Enzymatic Reaction Mechanisms	C. Walsh, W.H.Freeman	Freeman Inc	1978
3.	Introduction to Bio organic Chemistry and Chemical Biology	D.V. Vranken and G.A. Weiss	Garland Science	2012

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	S	S	M
CO3	S	M	S	M	S
CO4	M	M	S	M	M
CO5	M	S	M	S	M

S- Strong; **M-**Medium.

SEMESTER - II

ELECTIVE-II	M.Sc. Chemistry	2019-2020
M19PCHE05	WATER CHEMISTRY	
Credits: 4		

Objectives

Enable the students to have knowledge on physic – chemical properties and the evaluation technique for sewage.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand Physical and chemical characteristics of water	K1
CO2	Discuss drinking water specification with physical and chemical parameters	K2
CO3	Identify physical and chemical treatment of waste water.	K3
CO4	Devise industrial waste water treatment process	K4
CO5	Develop water treatment plant layouts.	K3

UNIT I

Water Treatment: Sources of Water; Physical and chemical characteristics of water; Water analysis; Potable water – WTO standard: uses of water.

UNIT II

Drinking Water Specification: Physical parameters: Color, taste - odour, Turbidity, suspended solids, Temperature; Chemical parameters: TDS Alkalinity, Hardness, salts, acids and alkalis, chlorides, fluorides, proteins, carbohydrates, organics, fats oil & grease, Hazen units, BOD, COD, DO, TDS, Trace metals, Heavy metals, tests on quality parameters.

UNIT III

Waste Water Treatment: Physico - Chemical treatments: Sedimentation, Coagulation-Flocculation, Settling Tanks, Disinfection Systems: Chemicals - Chlorination and other Disinfection methods, UV, Ozonation, Aeration and Gas transfer; Precipitation; Softening; Adsorption and Ion exchange; Reverse Osmosis Technologies Membrane processes, Ultra Filtration.

UNIT IV

Industrial waste water treatment: Activated sludge treatment plants – mass balances, with and without recycle plants; Types of plants – single tank, contact stabilization, biosorption plants.

Biofilters: Hydraulic film diffusion, two component diffusion; Types of plants – trickling filters, submerged filters and rotating disc; removal of particulate organic matter

UNIT V

Treatment Plants: Plants for nitrification – mass balances, nitrifying plants and types of plants. Treatment plant for denitrification - mass balances, denitrifying plants and types of plants; redox zones in the biomass. Aerobic treatment; Suspended growth aerobic treatment processes; Activated sludge process and its modifications; Attached growth aerobic processes;

Tricking filters and Rotating biological contactors; Anaerobic treatment; suspended growth, attached growth, fluidized bed and sludge blanket systems; nitrification, denitrification; Phosphorus removal.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Industrial Chemistry (Including Chemical Engineering)	B.K.Sharma	Goel Publishing House, Meerut	1999
2.	Outlines of Chemical Technology	M.Gopala Rao & Marshall Sittig	East-West Press Pvt Ltd	1997
3.	Environmental Chemistry	A.K. De	Wiley Eastern	1989

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Waste Water Engineering	L.Winther	Polyteknisk Forlag, Lyngby	1978
2.	Water Chemistry	P.Harremoes	Polyteknisk Forlag, Lyngby	1989
3.	Principles of Water treatment	Kerry J. Howe	Wiley	2012

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	S	S	M
CO3	S	M	S	M	S
CO4	M	M	S	M	M
CO5	M	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER - II

ELECTIVE-II	M.Sc. Chemistry	2019-2020
M19PCHE06	NANO CHEMISTRY	
Credits: 4		

Objectives

At the end of the course student learn the synthesis and characterization of nanomaterials and get familiar with nanotechnology and nanodevices.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire knowledge about nano chemistry.	K1
CO2	Discuss synthesis of nano materials by using nanofabrication method	K2
CO3	Discuss on various techniques available for characterizing the nano materials	K2
CO4	Illustrate carbon clusters and nanostructures	K2
CO5	Appraise the role of nanotechnology and nano devices	K4

UNIT I

Introduction to nanoscience and nanotechnology, discussion on various phenomenon at nanoscale, such as size, shape, surface, surface energy, surface stabilization, characteristic length, self-assembly, defects, size quantization, surface plasmon, conductivity, tunneling, magnetism, defects.

UNIT II

Basics of nanofabrication method: top-down, bottom-up approaches, gas phase, liquid phase, solid phase synthesis, self-assembly, templated synthesis, sol-gel electrodeposition, fundamentals of nanoparticle formation, thermodynamic approach, super saturation, nucleation, growth, nucleation.

Synthesis of nanoparticles: metallic, semiconducting, quantum dots, oxides, hybrids, micelles and micro emulsion as templates for synthesis. ⁰D, ¹D and ²D nanoparticles, core-shell nanoparticles, special nanoparticles, shaped nanoparticles

UNIT III

Characterization Techniques for Nanomaterials: Discussion on various techniques available for characterizing the nanomaterials for their size, shape, morphology, crystalline phase, oxidation states, textural properties (surface area, pore volume, pore size), thermal stability, light absorption and band gap.

Electron Microscopy: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning Probe Microscopic Techqnics; Atomic force Microscopy (AFM) and Scanning Tunneling Microscopy. Particle size Analyser (Dynamic light scattering), X-ray Diffraction (XRD), Auger Emission Spectroscopy, Electron Spectroscopy for Chemical analysis (ESCA).

UNIT IV

Carbon Clusters and Nanostructures: Nature of carbon bond – new carbon structures – carbon clusters – discovery of C60 – alkali doped C60–superconductivity in C60–larger and smaller fullerenes. Carbon nanotubes – synthesis –single walled carbon nanotubes – structure and characterization – mechanism of formation – chemically modified carbon nanotubes – doping – functionalizing nanotubes – applications of carbon nanotubes, and carbon nanowire.

UNIT V

Nanotechnology and Nanodevices: DNA as a nanomaterial, DNA – knots and junctions, DNA,nanomechanical device designed by Seeman. Force measurements in simple protein molecules and polymerase – DNA complexes. Molecular recognition and DNA based sensor. Protein nano array, nanopipettes, molecular diodes, self-assembled nano transistors, nanoparticle mediated transfection.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Nanotechnology	Mark Ratner, Daniel Ratne	Pearson Education	2008
2.	Nanotechnology	S .Shanmugam	MJP Publishers	2011
3.	Nanomaterials	B. Viswanathan	Narosa Publishing House	2014

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Nanoscale materials in Chemistry	K. J. Klabunde	Wiley- Interscience, New York	2001
2.	Nano Science and Technology – Novel Structures and Phenomena	T. Tang and P. Sheng	Taylor & Francis, New York	2004
3.	Introduction to Nanotechnology	C. P. Poole, and Jr. F. J. Owens	Wiley Interscience, New Jersey	2003

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	S	S	M
CO3	S	M	S	M	S
CO4	M	M	S	M	M
CO5	M	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER - II

ELECTIVE-III	M.Sc. Chemistry	2019-2020
M19PCHE07	APPLIED CATALYSIS	
Credits: 4		

Objectives

This course provides knowledge in homogenous and heterogeneous catalysis and the completion of this course helps to learn Surface catalysis and mechanism of surface reactions.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic concepts of acid-base catalysis and enzyme catalysis.	K2
CO2	Analyze the benefits of PTC and industrial processes with PTC	K4
CO3	Demonstrate Micellar catalysis and effects on thermal and photochemical reactions	K3
CO4	Identify the electrocatalysis and list out industrial application	K1
CO5	Explain surface catalysis & surface structures for single crystal surface of metals and solids	K4

UNIT I

Catalysis phenomenon – mode of action of catalysts – classification of catalysts – Comparison of Homogeneous and Heterogeneous Catalysis. Homogeneous catalysis – general mechanisms; acid - base catalysis – catalytic activity, mechanisms and salt effects. Enzyme catalysis – influence of substrate concentration, pH, temperature, and enzyme mechanisms. Kinetics of inhibition – chain reaction, enzyme catalyzed reactions.

UNIT II

Catalysis in molecular-scale cavities – structure of crystalline solids – zeolites – families of zeolites; adsorption and diffusion in zeolites – catalysis by zeolites containing metal complexes and clusters; non-zeolite molecular sieves – clays and other layered materials. Catalysis – catalysts for PTC – mechanism and benefits of PTC – PTC reactions – selected industrial processes with PTC.

UNIT III

Micellar catalysis: effects of micelles on chemical reactions, characteristics of enzymatic reactions, micelle-catalyzed reactions, inhibition in micellar solutions; reverse micelles and microemulsions – catalysis in thermal and photochemical reactions.

UNIT IV

Electrocatalysis – introduction to electrocatalysis and fuel cells – industrial application of catalysis – petroleum refining – distillation, cracking, reforming, hydrotreating, Alkylation and isomerization, ethylene-based processes – ethylene oxide and ethylene glycol, polyethylene, vinyl chloride and PVC; Propylene-based processes – acrylic acid and acrylonitrile, Ziegler-Natta chemistry; C-based processes – butadiene, isobutylene.

UNIT V

Surface catalysis – introduction – mechanism of surface reactions: Langmuir Hinshel wood &-Rideal mechanisms; surface structures – single crystal surface of metals, high-surface area amorphous solids; adsorption; functionalized surfaces; catalysis on functionalized surfaces: connection to molecular catalysis; catalysis on metal surfaces, metal oxide surfaces, mixed metal oxides, metal sulfides.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Catalytic Chemistry	B. C. Gates	John Wiley & Sons, Inc.,	1992
2.	Catalysis	J. C. Kuriacose	Macmillan India Ltd., New Delhi	1991
3.	Kinetics and Catalysis in Micro heterogeneous Systems	M. Gratzel, K. Kalyanasundaram	Marcel Dekker, New York	1991

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Chemical Kinetics	K. J. Laidler	Pearson Education Pvt Ltd.	2005
2.	Catalysis, Vol. I and II	P. H. Emmett	Reinhold Corp., New York	1954
3.	Industrial Catalysis: A Practical Approach	J. Hagen	Wiley-VCH, 2nd Edn	2006

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - II

ELECTIVE-II	M.Sc. Chemistry	2019-2020
M19PCHE08	COMPUTATIONAL QUANTUM CHEMISTRY	
Credits: 4		

Objectives

On accomplishment of this course students can understand the quantum mechanics necessary for the description of atoms and molecules and their chemical reaction.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire knowledge about computational chemistry principles and tools.	K1
CO2	State molecular mechanics and its application	K3
CO3	Understand semi empirical methods and abinitio methods and property calculations.	K2
CO4	Discuss basics sets of computational chemistry	K2
CO5	Simplify intrinsic property calculations using computational methods	K3

UNIT I

Computational chemistry: Introduction- scope of computational chemistry - methods- Molecular Mechanics - Semi Empirical Methods - *ab initio* Method - Density Functional Theory Method - Molecular Dynamics. Computational chemistry software tools – introduction - MOPAC - ORCA - GAUSSIAN - ADF - CHARM, INSIGHT Different input formats- Cartesian coordinates - internal coordinates. Applications of computational chemistry.

UNIT II

Molecular Mechanics: Postulates of molecular mechanics - introduction to molecular mechanics, popular force fields, performance of molecular mechanics - the Born - Oppenheimer approximation, potential energy surfaces, local and global minima, transition states and Hessian matrix - Eigen vectors and Eigen values , the Schroedinger equation, orbitals and variational and Perturbational methods. Applications, Examples.

UNIT III

Semiempirical Methods and Optimisation Techniques: Semi empirical Methods – Different methods (MNDO, AMI, PM3) - Geometry optimisation - Transition state location - Frequency calculation-Applications – Examples - Hartree - Fock equations, Hartree - Fock energy expressions for arbitrary spin orbital configurations, spin integration, restricted and unrestricted configuration, Self-Consistent-Field (SCF) procedure - Vibrational frequency analysis - Symmetry analysis, harmonic vs fundamental frequencies, Zero Point Vibrational Energies (ZPVE's), Hessian index, distinguish minima from transition States. Intrinsic reaction co-ordinate (IRC) analysis,

UNIT IV

Computational Methods: *Ab initio* and DFT methods – basics - different methods – TD-DFT- CCSD, Mp(n), G(n), MC-SCF - introduction about basic sets Slater and Gaussian functions, contractions, polarizations and diffuse functions, split valence sets, correlation consistent sets, core valence sets, general contractions, EMSL basis set exchange functional - applications-examples.

UNIT V

Molecular Dynamics and Property Calculations: Molecular dynamics and its applications of modelling biomolecules, Intrinsic property calculations using computational methods. NMR, EPR, IR, UV excited state calculations.

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Molecular Quantum Mechanics	P.W. Atkins and R.S. Friedman,	Oxford University Press, New York	1997
2.	Introduction of Computational chemistry	F. Jensen	John Wily & Sons Ltd	2007
3.	Quantum Chemistry	D.A Quarrie	University Science Book Mill Valley	1983

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Quantum Chemistry	J.P. Lowe	Academic Press, New York	1978
2.	Quantum Chemistry	N. Livine	Prentice Hall, Englewood, Cliffs.	1991
3.	Hand book of Computational Chemistry	Jerzy Leszcznski	Springer	2012

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	S	S	M
CO3	S	M	S	M	S
CO4	M	M	S	M	M
CO5	M	S	M	S	M

S- Strong; **M-**Medium.

SEMESTER - III

ELECTIVE-III	M.Sc. Chemistry	2019-2020
M19PCHE09	TEXTILE CHEMISTRY	
Credits: 4		

Objectives

This course provides knowledge in Fibre, chemical structure, production, properties and uses of the synthetic fibres and Dyeing of wool and silk.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic concepts of Fibre in textile.	K1
CO2	Analyze the synthetic fibres.	K3
CO3	Validate of Impurities in raw materials of textile.	K3
CO4	Classify dyes and their importance in textiles.	K2
CO5	Explain the concepts of Dyeing of fibres	K4

UNIT I

Fibre theory – polymers and polymerization-Morphology of fibres – Molecular arrangements in fibres. General classification of fibres - chemical structure, production, properties and uses of the following natural fibres (a) natural cellulosic fibres (cotton and jute) (b) natural protein fibre (wool and silk).

UNIT II

Chemical structure, production, properties and uses of the following synthetic fibres. (i) Man made cellulosic fibres (Rayon, modified cellulosic fibres) (ii) Man made protein fibres (Azions) (iii) Poly amide fibres (different types of nylons) (iv) Poly ester fibres (v) Acrylic fibres and (vi) Olefin fibres

UNIT III

Impurities in raw cotton and grey cloth, wool and silk- general principles of the removal – Scouring – bleaching – Desizing – Kierboiling- Chemicking Chemical and machinery use- Degumming and Bleaching of silk Scouring and Bleaching of wool..

UNIT IV

Dyeing – Classification of dyes and their properties- applications – direct, basic, sulphur and azoic dyes on cotton. Application of Vat and solubilised vat dyes on cotton and viscose. Mordant mineral colours and black. Application of vegetable and other colour to cotton.

UNIT V

Dyeing of wool and silk – Fastness properties of dyed materials – dyeing of nylon, terylene and other synthetics. Finishes given to fabrics - Mechanical finishes on cotton, wool and silk, method used process of mercerizing – Anti-crease and Anti-shrink finishes – Water proofing.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Chemical Technology of fibrous Materials	F. Sadv, M.Horchagin and A.Matetshy	Mir Publishers	1973
2.	The Identification of Textile Fibres	M M Houck	Woohead Publishing	2009
3.	Text Book of Applied Chemistry	K. Kapur	Macmillan Publisher	2006
4.	A Students Text Book of Textile Science	A. J. Hall	Allman Publisher	1963
5.	Chemistry of dyes & Principles of Dyeing	V. A. Shenai	Sevak Publications	1973

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Textile Chemistry –Vol.II	R.H. Peters	Elserier, Avesterdam	1967
2.	Dyeing and chemical Technology of Textile fibres	E.R. Trotman	Charles Griffin & Co Ltd., 5 th Edn.	1970
3.	Textile Scouring and Bleaching	E.R. Trotman	Charles Griffin & Co Ltd	1968
4.	Industrial Chemistry	B. K. Sharma	Krishna Prakasan	2014

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - III

ELECTIVE-III	M.Sc. Chemistry	2019-2020
M19PCHE10	MATERIAL SCIENCE	
Credits: 4		

Objectives

This course gives an insight into the fascinating area of advanced material tools and characterization techniques for smart materials.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire knowledge about smart materials and nano materials.	K1
CO2	Discuss different techniques for characterization of materials.	K2
CO3	Demonstrate mechanical and thermal properties of metallic, ceramic and polymeric materials	K3
CO4	Understand the concept of energy band diagram for materials	K1
CO5	Illustrate optical and magnetic properties of metallic and ceramic materials	K4

UNIT I

Advanced Materials and Tools: Smart materials, exhibiting ferroelectric, piezoelectric, optoelectric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nanomaterials, synthesis, properties and applications, biomaterials, super alloys, shape memory alloys.

UNIT II

Materials Characterization Techniques: Scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, atomic absorption spectroscopy, differential scanning calorimetry.

UNIT III

Stress-strain diagrams of metallic, ceramic and polymeric materials, modulus of elasticity, yield strength, tensile strength, toughness, elongation,

plastic deformation, viscoelasticity, hardness, impact strength, creep, fatigue, ductile and brittle fracture. Thermal Properties: Heat capacity, thermal conductivity, thermal expansion of materials.

UNIT IV

Electronic Properties: Concept of energy band diagram for materials - conductors, semiconductors and insulators, electrical conductivity effect of temperature on conductivity, intrinsic and extrinsic semiconductors, dielectric properties.

UNIT V

Optical Properties: Reflection, refraction, absorption and transmission of electromagnetic radiation in solids. Magnetic Properties: Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, anti-ferromagnetism, ferromagnetism, ferrimagnetism, magnetic hysteresis.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	The Chemistry of Nano materials	C.N.R. Rao, A. Muller, A.K. Cheetam	Wiley – VCH, Weinheim	2004
2.	Introduction to Nanotechnology	C.P. Poole, F.J. Owens	Wiley Interscience, New Jersey	2003
3.	An Introduction to Nanomaterials & Nano Science	Asimk Das, Mahua Das	CBS Publishers	2017

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Nanoscale materials in Chemistry	Kenneth J. Klabunde	Wiley - Interscience, New York	2001
2.	The Essentials in understanding nanoscience and nanotechnology	T. Pradeep	Tata McGraw Hill, New Delhi	2007
3.	Nanotechnology	Thomas Varghese, K. M. Balakrishna	Atlantic Publishers	2017

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	S	S	M
CO3	S	M	S	M	S
CO4	M	M	S	M	M
CO5	M	S	M	S	M

S- Strong; **M-**Medium.

SEMESTER - III

ELECTIVE-III	M.Sc. Chemistry	2019-2020
M19PCHE11	NUCLEAR CHEMISTRY	
Credits: 4		

Objectives

This course makes the student is knowledgeable in nuclear chemistry and familiarize the students with nuclear and radioisotopes techniques.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic concept of nuclear chemistry	K2
CO2	Acquire knowledge about nuclear reaction and nuclear theory	K1
CO3	Describe the components of nuclear reactors	K2
CO4	Develop knowledge about chemical effects induced in matter by absorption of ionizing radiations	K3
CO5	Discuss the application of radio isotopes in various fields.	K2

UNIT I

Discovery and types of decay – decay kinetics – half - life period, mean life, parent daughter decay – growth relationship – secular and transient equilibrium; Units of radioactivity; alpha, beta and gamma decay; Theory of decay, energies and properties – artificial radioactivity. Detectors: ionization chamber, electron pulse counter, scintillation detectors.

UNIT II

Bathe's notation – types of nuclear reactions: The compound nucleus theory – reaction cross section, transmutation reactions, elastic and inelastic scattering, spallation, fragmentation, stripping and pick-up; fission, fusion, photonuclear reactions and thermonuclear reactions.

UNIT III

The fission energy – reproduction factor; Classification of reactors based on moderators, coolants, phase of fuel and generation. Principle of

thermal nuclear reactors: The four factor formula, reactor power, critical size of a thermal reactor, excess reactivity and control. Breeder reactor India's nuclear energy programmes – reprocessing of spent fuels.

UNIT IV

Radiation chemistry – passage of radiation through matter – units for measuring radiation absorption – radiation dosimetry – radiolysis of water – free radicals in water radiolysis – chemical dosimetry: Radiolysis of Fricke Dosimeter solution – Radiation induced colour centres in crystals – Effects of radiation with matter. Radiolysis of inorganic gases, organic gases, organic compounds, solids and polymers – Annealing of radiation damage.

UNIT V

Application of radioisotopes: probing by isotopes, reactions involved in the preparation of radioisotopes. The Szilard-Chalmers' reaction – Radiochemical principles in the use of Tracers – Applications of radioisotopes as tracers – chemical investigations, analytical applications, agricultural and industrial applications – Neutron activation analysis – Carbon and rock dating.

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Nuclear and Radiochemistry	M.G. Friedlander, J.M. Kennedy, E.S. Macian and J.M. Miller	John Wiley & Sons	1981
2.	Nuclear Chemistry	M.G. Arora and M. Singh	Anmol Publications	1994
3.	Fundamental concepts of Inorganic Chemistry	E.S. Gilreath	McGraw Hill	1986
4.	Basis of nuclear Chemistry	Ram Naresh Malsaling	Anmol pub	2009

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Source book on atomic energy	S. Glasstone	East West press	1967
2.	Essentials of Nuclear Chemistry	H.J. Arniker	New Age International	2009
3	Nuclear chemistry	Seema singh	Sonali publications	2012
4.	Nuclear & Radiation chemical approaches to fullerene science	Tiber Braun & Harold kroto	Kluwer academic publisher	2010
5.	Nuclear & Radiochemistry	Jonsef Konya Noemi M.Nagy	Elsevier science	2018

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	S	S	M
CO3	S	M	S	M	S
CO4	M	M	S	M	M
CO5	M	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER - III

ELECTIVE-III	M.Sc. Chemistry	2019-2020
M19PCHE12	CHEMISTRY OF INDUSTRIAL PRODUCTS	
Credits: 4		

Objectives

This course gives idea in industrial products like Cement, Glass, Pigments, Dyes, Plastic, Fibres and Cosmetics.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Extract Industrial products like cement and glass and their manufacturing processes and their properties.	K2
CO2	Learn about dyes, pigments and paints and their preparation and uses.	K4
CO3	Understand the types and processing of plastics and fibres and their utility.	K3
CO4	Describe the preparation and uses of fertilizers in the agricultural sector.	K1
CO5	Correlate the chemistry of cosmetics used on day today life.	K4

UNIT I

Cement and Glass Cement - Composition, types - Portland cement - Composition, types, manufacture (Wet and Dry process), uses - Setting of cement, Glass - Composition, Types, methods of manufacturing - Melting, Blowing, Pressing, Annealing and finishing- chemical and physical properties of glass.

UNIT II

Pigments, Dyes and Paints Pigments - Classification, Manufacture and uses; Dyes - Classification, preparation, Dyeing processes; Paints - Composition, Types, Manufacture and testing of Paints.

UNIT III

Fibres, Plastics and Rubber – definition-difference between Natural and synthetic fibres-properties of synthetic fibres - Artificial silk, rayon, nylon and Terylene Plastics - composition, Classification, manufacture,

properties and uses recycling of plastics Rubber: types of rubber - synthetic rubber - natural rubber - Vulcanizations of Rubber - properties and uses.

UNIT IV

Fertilizers and Fuels - Organic and Inorganic fertilizers, Preparation and uses.

Fuels Energy resources - Industrial gases, Water gas, Producer gas, Oil gas, natural gas, coal gas, Gobar gas, Indane gas, Petroleum products and coal products.

UNIT V

Cosmetics – Shampoo- composition and its preparation, lipstick - preparation, Face cream and face powder - composition and their preparation. Hair dyes – chemical and herbal dyes. Perfumes and Deodorants.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Industrial Chemistry	B.N. Charkarabarthi	Oxford and IBH Publishing Co., New Delhi, 1 st Edition.	1981
2	Industrial chemistry	Anthony Benvenuto	Degoruyter	2013
3	An Introduction to Industrial Chemistry	Alan heaton	Academic & professional	1996

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Encyclopedia of Chemical Technology	Kirk Othmer	John Wiley & Sons, New York	1999
2	Industrial Chemistry	B.K. Sharma	Goel Publishing House, 1 st Edition, Meerut	2014
3	Engineering chemistry fundamentals & applications	Shikha Agarwal	Cambridge University Press	2016

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - II

EDC	M.Sc. Chemistry	2019-2020
M19ECH01	HEALTH CHEMISTRY	
Credits: 4		

Objectives

This course provides knowledge in Food, Carbohydrates, Protein and vitamins, blood, enzymes, hormones and Toxicants in food and common diseases.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Sketch the importance of basic nutrients and maintenance of good health and classification of carbohydrates, proteins and vitamins	K2
CO2	Relate knowledge on drugs and their mode of action	K4
CO3	Compare the functions of body fluids and blood	K2
CO4	Describe the enzymes and hormones	K2
CO5	Recognize the various Toxicants in food and common diseases.	K1

UNIT I

Definition: Food, Food Pyramid – Health – Hygiene - mal, under and over nutrition - causes and remedies, sanitation, Carbohydrates: Classification, Biological functions, Protein: Classification, Biological functions, vitamins: Classification, Biological functions.

UNIT II

Drugs - Types of drugs – anti depressants, anticonvulsant, narcotics, antipyretics, antibiotics, antiseptics, analgesics, muscle relaxants and cardiovascular and vasodepressants, Steroids.

UNIT III

Blood volume, groups, coagulation, blood pressure, anemia, blood sugar, hemoglobin - chemistry of respiration – urine-electrolyte balance.

UNIT IV

Types of enzymes and enzyme action, Characters of hormones action, examples of essential hormones - digestion in mouth, stomach, intestine and pancreas - mineral metabolism.

UNIT V

Toxicants in food- cancer-types and causes- common diseases- Jaundice, vomiting, fever, rickets, scurvy, beriberi, pellagra, night blindness, ulcer, gout, goiter, diabetes, anemia and their causes.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	A Text book of Pharmaceutical Chemistry	Jayashree Ghosh	S. Chand and Co.Ltd	1999
2.	Food Chemistry	Alex V Ramani	MJP Publishers, Chennai	2009
3.	Fundamentals of Biochemistry	A.C. Deb	New Central Book Agency, Calcutta	1994
4.	Chemistry for Health Science	M Satake and Y Mido	Discovery Publishing House, New Delhi	2003

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Medicinal Chemistry	Ashutosh Kar	Wiley Easterns Limited, New Delhi	1993
2.	Food chemistry	Lillian Hoagland meyer	New York, Reinhold	1960
3.	Drug design & Medicinal chemistry	Erica Helmer	Callisto publisher	2015
4.	Enzyme chemistry & molecular biology of Amylases and related enzymes	Takehiko yamamoto	CRC press	1994

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - II

EDC	M.Sc. Chemistry	2019-2020
M19ECH02	DRUG DISCOVERY	
Credits: 4		

Objectives

This course gives knowledge in drug discovery, drugs derived from Natural Products, Prodrug Design and source of drugs.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic concepts of drug discovery and Structural effects on drug action.	K2
CO2	Analyze drug design approaches.	K4
CO3	Discover enzymes as Targets of Drug design and Rational Design of Enzyme Inhibitors.	K3
CO4	Correlate the Receptor Theory, Receptor Complexes and allosteric Modulators for Receptors as Targets of Drug Design.	K4
CO5	Explain Prodrug Design and list its application.	K4

UNIT I

Introduction - Drug Discovery/Development - Drug Discovery - Drug Development - Source of Drugs - Structural effects on drug action - Approaches to New Drug Discovery.

UNIT II

Drugs Derived from Natural Products - Existing Drugs as a Source for New Drug Discovery - Using Disease Models as Screens for New Drug Leads - Physiological Mechanisms: the Modern "Rational Approach" to Drug Design - Approaches to Lead Optimization.

UNIT III

Bioisosteric replacement - Conformation restriction - Increase selectivity - Increase affinity - Pharmacophore - Molecular dissection - Metabolic stabilization - Enzymes as Targets of Drug Design - Enzyme kinetics - Enzyme inhibition and activation - Approaches to the Rational Design of Enzyme Inhibitors.

UNIT IV

Receptors as Targets of Drug Design - Receptor Theory - Receptor Complexes and Allosteric Modulators - Second and third Messenger Systems - Molecular Biology of Receptors - Receptor Models and Nomenclature - Receptor Binding Assays - Lead Compound Discovery of Receptor agonists and antagonists - Prodrug Design - Definition - Applications.

UNIT V

Prodrug Design Considerations - Prodrug Forms of Various Functional Groups - Ester prodrugs of compounds containing -COOH or -OH - Prodrugs of compounds containing amides, imides, and other acidic NH - Prodrugs of Amines - Prodrugs for compounds containing carbonyl groups - Drug release and activation mechanisms - Simple one-step activation - Cascade release/activation systems. Prodrugs and intellectual property rights.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Drug-Like Properties: Concepts, Structure Design and Methods: from ADME to Toxicity Optimization	Kerns E.H.	Academic Press, Oxford	2008
2	Medicinal Chemistry and Drug Discovery, Vol. 1. Principles and Practice	M. E. Wolff	John Wiley & Sons: New York	2003
3	Medicinal chemistry	Ashutosh Kar	Anshan pub	2006
4	Text book of medicinal chemistry	V. Alagar swamy	CBS Pub	2005

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Medicinal Chemistry	F.F.Blicke and R.H.Cox,	John Wiley & Sons, New York	1959
2	Organic Chemistry of drug synthesis	D.Lednicer and L.A.Mitscher	John Wiley & Sons, New York	1959
3	Chemiinformatics Theory practice & products	Barry A. Bunin, Brian siesel	Springer	2007
4	Organic chemistry of Drug design and drug action	Silverman	Elsevier	2014

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER - II

EDC	M.Sc. Chemistry	2019-2020
M19ECH03	CHEMICAL INSTRUMENTATION	
Credits: 4		

Objectives

This course provides knowledge in signal measurement, operational amplifiers, digital electronics and optical absorption spectrometry and concept of Signal-to-Noise Optimization

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe the nature and choice of measurement methods	K2
CO2	Illustrate the Variables that control the measurements	K4
CO3	Sketch the limits of detection and amplification	K3
CO4	Recognize the concept of operational amplifiers	K1
CO5	Explain the control of spectrometers instrumentation.	K2

UNIT I

Measurement and Instrumentation: Introduction – Nature of a measurement – choice of a method of measurement – control of variables – basic design patterns – general properties of modules – propagation of uncertainty – single channel design – limit of detection and amplification – automatic operation and computer control.

UNIT II

Operational Amplifiers: The operational amplifier – limitations on amplifier performance – mathematical operations – differentiation – integration – measurement of current and voltage – precise control of current and voltage.

UNIT III

Signal-to-Noise Optimization [ONLINE]: Sensitivity and detection limits – noise – minimizing noise in a system – signal averaging – modulation: chopping – demodulation: phase sensitive detection – other methods of optimizing signal-to-noise ratio.

UNIT IV

Digital Electronics: Binary logic concepts – logic gates – multivibrators – counters – wave shaping – analog to digital converters – instruments and digital computers.

UNIT V

Instrumentation for Optical Absorption Spectrometry: Visual photometers (colorimeter) – filter photometer – the spectrophotometer – double beam spectrophotometer – recording spectrophotometers – optimal values of adjustable parameters – multiple internal reflection assembly – rapid scanning spectrometer – non-dispersive photometers – photometric titration equipment – Fourier transform spectrometers.

TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Chemical Instrumentation A systematic approach to Instrumental Analysis	H.A Strobel	Addison-Wesley Publishing Company Inc, Philippines, 2 nd Edn.	1973
2	Instrumental methods of chemical Analysis	H.Kaur	Pragati Prakashan	2010
3	A text book of instrumental method of Analysis	Poonam A Salunke	S.Vikas	2018

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1	Vogel's Textbook of Quantitative Chemical Analysis	G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney	Longman Scientific & Technical, Essex, 5 th Edn.	1989
2.	Principles of Instrumental Analysis	D.A. Skoog, F.J. Holler and S.R. Crouch	Thompson Brooks/Cole, Belmont CA, 6 th Edn.	2007
3	Instrumentation Reference book	H. Walt boyes	Elsevier	2003

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	S	S	M
CO3	S	M	S	S	M
CO4	M	M	S	S	S
CO5	M	S	M	M	S

S- Strong; **M**-Medium.

ENHANCEMENT COMPULSORY COURSE

SEMESTER - II

ECC	M.Sc. Chemistry	2019-2020
M19PHR01	HUMAN RIGHTS	
Credits: 2		

Objectives

This course provides knowledge on the different aspects of human rights and can learn the rights for the duties to be carried out in the days to come.

Course Outcomes

On the successful completion of the course, students will be able to

CO	Statement	Knowledge Level
CO1	Remember the need and types of Human rights	K1
CO2	Understand the Classification of Human Rights	K2
CO3	Apply the Rights of Women and Children	K4
CO4	Aware on the Rights of Labour	K2
CO5	Analyze the National and State level human Rights Commissions and their policies	K3

UNIT I

Introduction to Human Rights: Human Rights: Meaning – Definitions – Origin and Growth of Human Rights in the World – Need and types of Human Rights – UNHRC (United nations Human Rights) – Human Rights in India.

UNIT II

Classification of Human Rights: Right to Liberty – Right to Life – Right to Equality – Right to dignity – Right to against Exploitation – Educational Rights – Cultural Rights – Economic Rights – political Rights – Social Rights.

UNIT III

Rights of Women and Children: Rights of Women – Female feticide and Infanticide and selective abortion – Physical assault and sexual harassment – Domestic Violence – Violence at work place – Remedial Measures. Rights of Children – Protection rights, survival rights – Participation rights – Development rights – Role of UN on convention on rights of children.

UNIT IV

Multi-Dimensional aspects of Human Rights: Labour rights – Bodend Labour – Child Labour – Contract Labour – Migrant Labour – Domestic Women Labour – Gender Equity – Rights of Ethnic refugees – Problems and remedies – Role of trade union in protecting the unorganized labourers.

UNIT V

Grievance and Redressal Mechanism: Redressal Mechanism at national level – Structure and functions of National and State level human Rights Commission – constitutional remedies and directive principles of state policy.

REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Teaching of Human Rights	Barat Sergio and Swaronjali Ghosh	Dominant Publishers and distributors, New Delhi	2009
2.	Human Rights Achievements and Challenges	A.N. Roy	Vista International Publishing House, Delhi	2005
3.	Human Rights in India	Asish Kumar das and Prasant Kumar Monaty	Sarup and Sons, New Delhi	2007
4.	Human Rights Social justice and political change	Bani Bargohain	Kanishka publishers and distributors, New Delhi	2007
5.	Human Rights and Development Issues	G. Velan	Ambala Cantt	2008
6.	Human rights Theory and Practice	P. K. Meena	Murali lal and Sons, New Delhi	2008
7.	Human Rights Development and Environmental Law	Bhavani Prasad Panda	Academic Excellence, Delhi.	2007
8.	Human Rights – Twenty first Century Challenges	V. N. Vishvanathan	Kalpaz Publications, New Delhi.	2008

9. Protecting Human Rights M. R. Ansari Max Ford Books, New Delhi. 2006
10. Social Movements in Indi – Social Movements and Social Transformation in India M. S. A Rao Vol 1& 2: Manohar Publications, New Delhi. 1978

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	M
CO2	M	M	S	M	M
CO3	S	S	M	S	S
CO4	M	M	S	M	S
CO5	S	M	S	S	M

S- Strong; **M-**Medium.