SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)

SCHOOL OF ARTS AND SCIENCE

MASTER OF SCIENCE
IN
CHEMISTRY

ACADEMIC REGULATIONS
(R 2023)
CURRICULUM AND SYLLABI

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

Mission

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: **Research and Innovation:**

To foster value based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

Department of Chemistry

Vision and Mission

Vision

To develop the department as world class centre of excellence in all aspects of higher education and research with an expertise in chemical sciences.

Mission

M1: Quality Education:

To inculcate quality inter-disciplinary training to improve the welfare of humanity.

M2: Practical knowledge:

To provide laboratory training in the field of chemistry in both public and private sectors.

M3: Research:

To educate our students for research to meet the global environmental issues

M4: Knowledge:

To produce graduates of International distinction, committed to integrity, professionalism and lifelong learning by widening their knowledge horizons in range and depth.

STRUCTURE FOR POSTGRADUATE PROGRAMME

Sl. No	Course Category	Breakdown of Credits
1	Discipline Specific Core Courses (DSC)	64
2	Discipline Specific Elective Courses (DSE)	16
3	Skill Enhancement Courses (SEC)	08
4	Internship	02
Total		**90**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	Course Category	Credits per Semester				Total Credits
		I	II	III	IV	
1	Discipline Specific Core Courses (DSC)	16	16	16	16	64
2	Discipline Specific Elective Courses (DSE)	4	4	4	4	16
3	Skill Enhancement Courses (SEC)	2	2	2	2	8
4	Internship	-	-	2	-	2
Total		**22**	**22**	**24**	**22**	**90**

SEMESTER – I										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	A23PCHT101	Inorganic Chemistry – I	**DSC**	4	0	0	4	25	75	100
2	A23PCHT102	Organic Chemistry – I	**DSC**	4	0	0	4	25	75	100
3	A23PCHT103	Physical Chemistry – I	**DSC**	4	0	0	4	25	75	100
4	A23PCHE10X	DSE - I*	**DSE**	4	0	0	4	25	75	100
Practical										
5	A23PCHL101	Organic Chemistry Lab -I	**DSC**	0	0	4	2	50	50	100
6	A23PCHL102	Inorganic Chemistry Lab – I	**DSC**	0	0	4	2	50	50	100
Skill Enhancement Course										
7	A23PCMS102	Professional Skills	**SEC**	2	0	0	2	100	-	100
			First Semester Total				22	300	400	700

SEMESTER – II										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	A23PCHT204	Inorganic Chemistry – II	**DSC**	4	0	0	4	25	75	100
2	A23PCHT205	Organic Chemistry – II	**DSC**	4	0	0	4	25	75	100
3	A23PCHT206	Physical Chemistry – II	**DSC**	4	0	0	4	25	75	100
4	A23PCHE20X	DSE - II*	**DSE**	4	0	0	4	25	75	100
Practical										
5	A23PCHL203	Physical Chemistry Lab –I	**DSC**	0	0	4	2	50	50	100
6	A23PCHL204	Inorganic Chemistry Lab – II	**DSC**	0	0	4	2	50	50	100
Skill Enhancement Courses										
7	A23PMAS201	Quantitative Reasoning and Research Aptitude	**SEC**	2	0	0	2	100	-	100
Second Semester Total							22	300	400	700

Discipline Specific Electives are to be selected from the list given in Annexure I

SEMESTER – III										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	A23PCHT307	Inorganic Chemistry – III	**DSC**	4	0	0	4	25	75	100
2	A23PCHT308	Organic Chemistry – III	**DSC**	4	0	0	4	25	75	100
3	A23PCHT309	Physical Chemistry – III	**DSC**	4	0	0	4	25	75	100
5	A23PCHE30X	DSE - III*	**DSE**	4	0	0	4	25	75	100
Practical										
6	A23PCHL305	Organic Chemistry Lab - II	**DSC**	0	0	4	2	50	50	100
7	A23PCHL306	Physical Chemistry Lab - II	**DSC**	0	0	4	2	50	50	100
Skill Enhancement Courses										
8	A23PCHS302	Advance Research Methodology In Chemistry	**SEC**	2	0	0	2	100	0	100
Internship										
9	A23PCHN301	Internship	DSC	0	0	4	2	40	60	100
			Third Semester Total				24	340	460	800

Discipline Specific Electives are to be selected from the list given in Annexure I

SEMESTER – IV										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
PROJECT										
1	A23PCHT410	Organic Chemistry – IV	**DSC**	4	0	0	4	25	75	100
2	A23PCHT411	Physical Chemistry – IV	**DSC**	4	0	0	4	25	75	100
3	A23PCHE40X	DSE - IV*	**DSE**	4	0	0	4	25	75	100
Practical										
4	A23PCHL407	Industrial Chemistry Lab - II	**DSC**	0	0	4	2	50	50	100
PROJECT										
5	A23PCHP401	Project Work	**DSC**	0	0	10	6	40	60	100
SKILL ENHANCEMENT COURSES										
6	A23PCHS403	Health Science	**SEC**	2	0	0	2	100	-	100
			Fourth Semester Total				22	265	335	600

Discipline Specific Electives are to be selected from the list given in Annexure I

Annexure I

DISCIPLINE SPECIFIC ELECTIVE COURSES*

Discipline Specific Elective – I (Offered in Semester I)		
Sl. No.	**Course Code**	**Course Title**
1	A23PCHE101	Industrial Products
2	A23PCHE102	Material Science
3	A23PCHE103	Chemistry Of Heterocyclic And Natural Products

Discipline Specific Elective – II (Offered in Semester II)		
Sl. No.	**Course Code**	**Course Title**
1	A23PCHE204	Cheminformatics
2	A23PCHE205	Asymmetric Synthesis
3	A23PCHE206	Green Chemistry

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: DSC			*End Semester Exam Type: **TE**			
Course Code	**A23PCHT101**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INORGANIC CHEMISTRY - I**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To study the periodic table and atomic structure. • To know the chemistry of covalent bond. • To study the cement, glass and ceramics. • To analyze the transition and inner transition elements. • To acquire knowledge about the different nuclear reactions and applications							

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the electronic structure of atoms and periodic properties of elements	**K3**
	CO2	Apply the concepts of VB, MO and VSEPR theory to determine the structure of molecules	**K3**
	CO3	Illustrate acid-base concepts, its measures and to evaluate various effects on acid base strength	**K3**
	CO4	Students should able to learn about the chemistry of inner transition elements and their applications.	**K3**
	CO5	Understand nuclear Chemistry	**K3**

UNIT-I	**ATOMIC STRUCTURE AND PERIODIC TABLE**	**Periods: 12**	
Modern views on atomic structure: wave mechanical description of electron and orbitals, radial density functions and orbital energies, angular functions and orbital shapes. Quantum numbers - Theories of quantum numbers– Aufbau principle – Zeeman Effect - Stability of half-filled and completely filled orbitals– Electronic configuration - Electron Angular momentum in atoms Effective nuclear charge- Slater rule and their uses: computation of and radii of atoms anions. Modern periodic table: periodic properties, trends and the underlying reasons.			**CO1**
UNIT-II	**COVALENT BOND**	**Periods: 12**	
Molecular topologies: shared and lone pairs and Lewis structures, isoelectronic and isolable relationships, hybridization and geometry, VSEPR model, and Bent's rule. Molecular Orbital Theory: Symmetry of molecular orbitals formed from atomic orbital overlap, Extended Huckel theory of Hartree-Fock approximation (SCF), LCAO- MO model, TASO, LUMO, and HOMO concepts in bonding. MO energy level diagrams of homo diatomic and hetero dinuclear molecules (CO, NO, and HCI). Bonding in metals: packing of atoms in metals, band theory of metals and metallic properties, insulators, and semiconductors			**CO2**
UNIT-III	**ACID- BASE THEORY AND SOLVENT SYSTEMS**	**Periods: 12**	
Acid-Base theories: Bronsted-Lowry, Lux-Flood, Usanovich, Lewis and solvent system definitions,measures of acid-base strength, Factors affecting the strength of acids and bases Common ion effect and Henderson's equation-Hard and Soft acids and bases – symbiosis – theoretical basis of hardness and softness. Classification, properties and uses of solvents – protic, aprotic, superacids, molten salts as solvents,ionic liquids (gel effects) properties of ionizing solvents. Typical reactions in non–aqueous solvents- liquid HF, liquid SO_2, liquid NH_3, and Sulphuric acid.			**CO3**
UNIT-IV	**TRANSITION & INNER TRANSITION ELEMENTS**	**Periods: 12**	
Transition elements - general characteristics - Inner transition elements - position in the periodic table - electronic configuration, oxidation states, solubility, colour and spectra, magnetic properties - separation of lanthanides -			

lanthanide contraction: causes and consequences - gadolinium break, shift reagents - extraction of thorium and uranium- comparison of actinides and lanthanides.	**CO4**
UNIT-V **NUCLEAR CHEMISTRY** **Periods: 12**	
Radioactive decay and equilibrium- Different types of nuclear reaction – spallation –fission and fusion. Theories of fission. Fissile and Fertile isotopes. -Nuclear fusion – stellar Energy-Nuclear forces: Liquid drop model, shell Model- Calculation of Q-values – Cross section. Detectors: Scintillation counter, Gas Ionisation chamber. Proportional Counter, Cerenkov Counter- Accelerators: Cyclotron, Synchrocyclotron, Betatron. Radio isotopes and their Applications: Activation analysis, Isotopic dilution technique-radiometric titration. Nuclear reactors: Types (Thermo nuclear and breeder reactors) feed materials production. Reprocessing of nuclear materials waste disposal.	**CO5**

Lecture Periods: 60	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:60**

Text Books

1. Huheey, J. E.; Keiter, E. A. Keiter, R. L. "Inorganic Chemistry", Harper and Row:New York, 4th Edition,1983.
2. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M. "Advanced Inorganic Chemistry", Wiley Interscience: New York, 6th Edition, 1988.
3. Purcell, K. F.; Kotz, J. C. "Inorganic Chemistry" Saunders: Philadelphia, 2nd Edition, 1976

Reference Books

1. Moeller, T. "Inorganic Chemistry, A Modern Introduction", John Wiley: New York, 1982.
2. Shriver, D. F.; Atkins, P. W.; Langford, C. H. "Inorganic Chemistry", 3rd ed.; Oxford University Press: London, 2001.
3. Stout, G. H.; Jenson, L. H. X-Ray Structure Determination, 2nd ed.; John Wiley & Sons: NewYork,1989.
4. West, A. R. Solid State Chemistry and its Applications, John Wiley & Sons: New York,1989.
5. Rhodes, G. Crystallography Made Crystal Clear; Academic Press, Inc.: New York,1993.

Web References

1. https://nptel.ac.in/
2. https://ocw.mit.edu/courses/chemistry/
3. https://swayam.gov.in

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: **DSC**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHT102**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ORGANIC CHEMISTRY - I**	**4**	**-**	**-**	**4**	**25**	**75**	**100**

Prerequisite	Basic Knowledge studied in the UG Level	
Course Objectives	• To learn basic organic mechanism and study the rate law	
	• To analyze various types of rearrangement reactions	
	• To understand about oxidation and reduction reaction in the organic compounds	
	• To study the stereochemistry with configuration	
	• To evaluate the design and synthesis of new organic compounds.	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
	CO1 Recall the basic principles of organic reaction mechanism and rate law	**K3**
	CO2 Understand the various types of rearrangement reaction	**K3**
	CO3 Categorize the reaction based on oxidation and reduction.	**K3**
	CO4 predict the reaction mechanism of organic reactions and stereochemistry of organic compounds	**K3**
	CO5 Design and synthesize new organic compounds by correlating the stereochemistry of organic compounds	**K3**

UNIT-I	**MECHANISMS AND METHODS**	**Periods: 12**
Types of mechanism; Reagents and reactions. Thermodynamic and kinetic requirements of reactions; Baldwin rules for ring closure; Hammond postulate; microscopic reversibility and Marcus theory Methods of determining mechanism: Non-kinetic methods: identification of products and intermediates; isotopic labelling; stereo chemical evidences; isotopic effects; cross-over experiments, trapping of intermediates. Kinetic methods- determination of rate law and rate constants; relation of rate with the mechanism of reaction.		**CO1**
UNIT-II	**REARRANGEMENT REACTIONS**	**Periods: 12**
Types of rearrangements: Nucleophilic; free radical and electrophilic reactions. Mechanisms: Nature of migration; migratory aptitude and memory effects, ring enlargement and ring contraction rearrangements. Reactions: Wagner-Meerwin and related reactions, Benzil- benzilic acid, Favorskii, Hofmann and related rearrangements, Beckmann, Neber, Baeyer-Williger, Stevens. Claisen rearrangements, boron-carbon migration, Non- 1,2-rearrangements, Fischer- indole synthesis, Arndt- Eistert synthesis.		**CO2**
UNIT-III	**OXIDATION AND REDUCTION REACTIONS**	**Periods: 12**
Mechanisms: direct electron transfer, hydride transfer, displacement_ addition- elimination and formation of ester intermediates. Oxidation Reactions: Aromatization of six membered rings; dihydro elimination; oxidation of alcohols and dehydrogenation of amines; Reactions involving cleavage of C- C bonds; ozonolysis; cleavage of double bonds; oxidative decarboxylation. Reduction Reactions involving replacement of oxygen by hydrogen: - Wolff Kishner and Clemmenson reductions; Removal of Oxygen from substrate; Reduction with cleavage; Reductive coupling.		**CO3**
UNIT-IV	**STEREOCHEMISTRY-I**	**Periods: 12**
Optical isomerism due to asymmetric carbon atoms Racemic modifications; racemization; thermal, anion, cation, reversible formation Epimerisation; mutarotation; I and II order asymmetric transformations Resolution of racemic modifications; asymmetric transformations; asymmetric synthesis destruction; Cram's and Prelog's rules; absolute asymmetric synthesis. Criteria for optical purity; D, L, R, S- notations; Cahn- Ingold- Prelog rules, absolute		**CO4**

and relative configuration; configurations of allenes ,spiranes, and biphenyls.			
UNIT-V	**STEREOCHEMISTRY-II**	**Periods: 12**	
Conformation and reactivity of acyclic systems; intramolecular rearrangement; neighbouring group participation; Curtin-Hammet principle. Stability of six and seven-membered rings; mono and disubstituted cyclohexanes; conformation and reactivity in cyclohexane systems. Fused and bridged rings; bicyclic and polycyclic systems; decalins and Brett'srule. optical rotation and optical rotatory dispersion; conformational asymmetry, ORD curves; octant rule; configuration and conformation; Cotton effect; axial haloketone rule; Determination of configuration. Stereo selective synthesis: Synthesis of yohimbine, reserpine			**CO5**
Lecture Periods: 60	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:60**

Text Books

1. J. March and M. Smith, Advanced Organic Chemistry, 5th edn, John-Wiley and Sons.2001.
2. E.S. Gould, Mechanism and Structure in Organic Chemistry Holt, Rinehart and Winston Inc.,1959.
3. E.L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, (2000)

Reference Books

1. P.S. Kalsi, Stereochemistry, 3rd edition, New Age International Publishers,1995.
2. I.L. Finar, Organic chemistry, Vol-1, 6th edition, Pearson Education Asia.2004
3. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 4th edition, Kluwer Academic/Plenum Publishers. 2000.

Web References

1. https://bit.ly/3zT4PUq
2. https://www.organic-chemistry.org/
3. https://www.studyorgo.com/summary.php 4

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: **DSC**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHT103**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PHYSICAL CHEMISTRY - I**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To study the fundamental principles of Quantum Chemistry, Schrodinger wave equation and its applications • To expose the ideas on theories of reaction rate • To give an in-depth knowledge on thermodynamics • To understand the concepts of statistical thermodynamics • To give insight into the applications of the M-B, B-E and F-D statistics.							

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping(Highest Level)
	CO1	Identify the limitations of classical mechanics	**K3**
	CO2	Apply the quantum chemistry to solve the Schrödinger wave equation for one, two and three dimensional box	**K3**
	CO3	Gain knowledge on theories of reaction rates and applications of reaction kinetic chemistry	**K3**
	CO4	Illustrate the relationship between microscopic properties of individual atoms and molecules with macroscopic thermodynamic observables and derive the different types of distribution laws.	**K3**
	CO5	Derive thermodynamic functions in terms of partition functions	**K3**

UNIT-I	**QUANTUM CHEMISTRY**	**Periods: 12**
Inadequacy of classical mechanics, Black body radiation, Planck's quantum concepts, Photoelectric effect. Bohr's theory of hydrogen atom: Hydrogen spectra, de Broglie principle, Uncertainty principle, Inadequacy of Bohr theory. Wave equation, Derivation of time dependent and independent Schrodinger equation- Postulates of quantum mechanics, well behaved function- orthogonality and normalization. Operator algebra: operator, linear and hermitian, Verification of operators Hamiltonian - Eigen functions and Eigen values, angular momentum operator, communication relations, related theorems. Applications of wave mechanics to simple systems – particle in a box, one, two and three – dimensional, distortion of the box, quantum numbers, zero – point energy, finite potential barrier.		**CO1**

UNIT-II	**CHEMICAL KINETICS – I**	**Periods: 12**
Theories of reaction rates and reaction mechanism - Arrhenius equation -Potential energy surfaces and reaction coordinates - Collision theory – ARRT(thermodynamic treatment only)–Applications of ARRT to unimolecular, bimolecular and termolecular reactions - Kinetic isotope effect, iso kinetic relation and temperature - Theories of unimolecular reactions – Lindemann and RRK - Principle of microscopic reversibility-Steady state approximation Chain reactions. Thermal and photochemical reactions between hydrogen and halogens – Explosions and hydrogen – oxygen reactions.		**CO2**

UNIT-III	**CHEMICAL KINETICS – II**	**Periods: 12**
Application of ARRT to solution kinetics - Factors affecting reaction rate in solution-. Internal pressure - Solvent dielectric constant - Ionic strength -Hydrostatic pressure - Ion-dipole and dipole-dipole reactions – van't Hoff equation and volume of activation - Catalysis Characterics of a catalyst –Factors affecting Catalytic reactions - Types of Catalysis- homogeneous catalysis – Acid base catalysis – Van't Hoff and Arrhenius intermediates- Mechanism - protolytic and prototropic catalysis laws - Acidity functions -Hammett - Zucker hypothesis - Catalysis in biological systems. Michaelis -menten equation – Lineweaver - Burk and Eadie-Hofstee plots - influency of substrate concentration, pH, and temperature on rate - Influence of substituent's on reaction rates – Hammett and Taft equations - Linear free energy relations.		**CO3**

UNIT-IV	FUNDAMENTALS OF STATISTICAL THERMODYNAMICS	Periods: 12	
Statistical method - microstates- macro states - permutations and combinations – combinatory rule - probability theorems - ensembles - phase space - thermodynamic probability - statistical equilibrium - Maxwell Boltzmann statistics - derivation of M.B. statistics - relationship between entropy and probability - heat capacity of solids - Einstein and Debye models - statistical meaning of third law of thermodynamics.			**CO4**
UNIT-V	**APPLICATIONS OF STATISTICAL THERMODYNAMICS**	**Periods: 12**	
Partition functions - molar- translational- rotational and vibrational partition functions of diatomic and polyatomic molecules - separation of partition function according to forms of energy-partition function and vibrational energy - total partition function - electronic partition function-derivation of thermodynamic quantities E, S, A, H, G, K and Cp, Cv using partition function-Sackur-Tetrode equation - Bose - Einstein statistics - Fermi - Dirac statistics -electronic heat capacity of gases - equipartition of energy - classical and quantum statistical theory of heat capacities - heat capacities for diatomic molecule - rotational heat capacity of hydrogen molecule - nuclear spin statistics - nuclear spin entropy- quantum statistics			**CO5**
Lecture Periods: 60	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:60**

Text Books

1. R.K.Prasad - Quantum Chemistry - New Age International (P) Ltd. Publishers, New Delhi,3rd Edition 2006.
2. Puri, B.R. and Sharma, L.R. and Madan S.Pathania, “Principles of Physical Chemistry”, Vishal Publishing 48th Edition, 2021
3. B.G.Kyle - Chemical and Process Thermodynamics - Prentice Hall of India, 3rd Edition, 2004.

Reference Books

1. Ira N. Levine - Quantum Chemistry - Prentice Hall of India, New Delhi, 5th Edition, 2006
2. KeithJ.Laidler - Chemical Kinetics - Pearson Edition Company Pvt. Ltd.,Third Edition, 2005.
3. M.C.Gupta - Statistical Thermodynamics - New Age International, 2nd Edition, 2003.
4. R.C.Srivatsava, Subit K. Saha, Abhay K. Jain - Thermodynamics: A Core Course -PHC Pvt. Ltd., 2nd Edition, 2005.

Web References

1. https://chem.libretexts.org/Courses/MountRoyalUniversity/Chem1201/Unit1%3AQuantumChemistry
2. http://www.yorku.ca/stynes/kindvs309.pdf
3. https://sites.krieger.jhu.edu/jared-kaplan/files/2018/11/StatisticalMechanicsNotes.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: **DSE**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHE101**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INDUSTRIAL PRODUCTS**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To acquire the knowledge on cement and glass manufacturing • To study the paints manufacturing and various constituents • To know chemistry of fiber, plastic and rubber • To study the industrial gasses and petroleum products • To analyze the various cosmetics products.							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
	CO1 Understand the manufacture processes of cement, glass their physicochemical properties	**K3**
	CO2 Able to classify dyes, pigments and paints.	**K3**
	CO3 Understand the importance of plastic and fibers.	**K3**
	CO4 Explain the petroleum and fuel gases and applications of fertilizers.	**K3**
	CO5 Illustrate the preparation and uses of shampoo, dye, soap and detergents.	**K3**

UNIT-I	**CEMENT AND GLASS**	**Periods: 12**
Cement - analysis of major constituents, Composition, different methods of manufacturing and uses - Portland cement - Composition, different methods of manufacturing (Wet and Dry process), uses – Setting and hardening of cement, Glass- Composition, Types of glasses, method of manufacturing - Melting, Blowing, Pressing, Annealing and finishing- chemical and physical properties of glass.		**CO1**
UNIT-II	**PIGMENTS, DYES AND PAINTS**	**Periods: 12**
Paints - Primary constituents of paints, Composition, Types, Manufacture and testing of Paints. Dispersion medium (solvent), binder Pigments, formulation of paints. Requirements of a good paint. Pigments - Classification, Manufacture and uses. Dyes - Classification, preparation, dyeing processes.		**CO2**
UNIT-III	**FIBERS, PLASTICS AND RUBBER**	**Periods: 12**
Fibres – 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 of rubber.		**CO3**
UNIT-IV	**FERTILIZERS AND FUELS**	**Periods: 12**
Fertilizers -Types of Fertilizers: Organic and Inorganic fertilizers, Preparation and uses, Fuel Gases: coal gas, water gas, producer gas, and oil gas. Petroleum: synthetic petrol manufacturing, refining, cracking, reforming, knocking and octane number, LPG.		**CO4**
UNIT-V	**COSMETICS**	**Periods: 12**
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. Soaps: manufacture of soaps by hot and cold process, classification of soap, cleansing of soap and classification of detergents (anionic and cationic).		**CO5**

Lecture Periods: 60	Tutorial Periods:-	Practical Periods:-	Total Periods:60

Text Books

B.K. Sharma, —Industrial Chemistryll, Goel publishing house, 6th Edition, 2011.
2. Joseph Henry Stephenson, —Industrial Chemistry—, Leopold Classic Library, 1st Edition, 2015.
3. M Kelway Bambe, —A Text Book on the Chemistry and Agriculture of Teall, Franklin Classics Trade Press, 1st Edition, 2018.

Reference Books

B.N.Chakrabarty, "Industrial Chemistry", Oxford & IBH Publishing Co, New Delhi, 4th Edition, 1981.
2. P.P.Singh, T.M.Joseph, R.G.Dhavale, "College Industrial Chemistry", Himalaya Publishing House, Bombay, 4th Edition., 1983.
3. O.P. Veramani, A.K. Narula, "Industrial Chemistry", Galgotia publication Pvt. Ld, 1st Edition, 2004.

Web References

1. https://www.toppr.com/guides/business-environment/scales-of-business/small-scale-industries/
2. https://www.britannica.com/science/pollution-environment
3. http://www.falzongroup.com/our-products-and-services/fuel-for-industry

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: **DSE**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHE102**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MATERIAL SCIENCE**	**4**	**-**	**-**	**4**	**25**	**75**	**100**

Prerequisite	Basic Knowledge studied in the UG Level	
Course Objectives	• To understand the crystal structure, growth methods and X-ray scattering	
	• To explain the optical, dielectric and diffusion properties of crystals	
	• To recognize the basis of semiconductors, superconductivity materials and magnets	
	• To study the synthesis, classification and applications of nanomaterials	
	• To learn about the importance of super conductors	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
	CO1 Understand X-ray structure determination and identification of lattice structure	**K3**
	CO2 Analyze the magnetic properties of the materials	**K3**
	CO3 Apply the x-ray diffraction in the study	**K3**
	CO4 Utilize ceramics and nanomaterials in the scientific applications	**K3**
	CO5 Harvest solar energy in the energy production.	**K3**

UNIT-I	**STRUCTURE OF SOLIDS**	**Periods: 12**
Introduction to solids – Crystalline and Amorphous unit cell – Bravais lattice and x-ray structure determination (NaCl and KCl only), Powder and single crystal – methods and its application with NLO properties – Identification of the cubic lattice and indexing of the x-ray diffraction lines Radius ratio rules – co-ordination number packing arrangement – different structure types in Solid – rock salt, Zinc blende wurzite, fluorite and antifluorite, spinel and inverse – spinel and perovskite structures.		**CO1**
UNIT-II	**MAGNETIC PROPERTIES**	**Periods: 12**
Types of Magnetism – Dia – Para – Ferro and anti-ferromagnetism. Magnetic properties of free ions – First order second order Zeeman Effect – states KT – States, KT Determination of Magnetic moments and their application to elucidation of structures of inorganic compounds temperature – temperature independent paramagentism. Magnetic properties of lanthanides and actinides – orbital contribution to magnetic moment, range of μeff for various complexes Guoy's method spin crossover in co-ordination compounds		**CO2**
UNIT-III	**X-RAY DIFFRACTION**	**Periods: 12**
X-ray diffraction by single crystal, space groups – systematic absences in x-ray data and identification of lattice types, glid planes and screw axis- x-ray intensities, structure factor (R-value) and its relation to intensity and electron density – phase problem. Electron diffraction by gases – scattering intensity vs scattering angle, wierl equation, measurement technique. Neutron diffraction by crystals – magnetic scattering – measurement techniques.		**CO3**
UNIT-IV	**CERAMICS**	**Periods: 12**
Ceramics – types and application – composites – classification – processing of fiber Reinforced plastics – metallic glasses types, glass – glass forming ability of alloys – melt spinning process – applications – shape memory effect – Nano material preparation (bottom up and top down approaches) proportion and its application – carbon – nano tubes.		**CO4**

UNIT-V	SUPER CONDUCTORS	Periods: 12	
Super conductors – materials – Basic concept – types characteristics - application solar energy materials – Photo thermal conversion , Solar electric coating enhanced solar thermal energy collection – photovoltic conversion – solar cells, silicon, Cadmium sulphide and Gallium arsenic – organic solar cells.			CO5
Lecture Periods: 60	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:60**

Text Books

. 1. S. Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.
2. Arumugam, Materials Science, Anuradha Publications, 2007.
3. Giacavazzoet. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010

Reference Books

1. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.
2. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
3. P.K. Palanisamy, Materials Science, Scitech Publications, India, 2002.
4. T. Balachandran, Materials Science, Charulatha Publications, India, 2003.

Web References

1. http://xrayweb.chem.ou.edu/notes/symmetry.html.
2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.
3. https://bit.ly/3QyVg2R

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: **DSE**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHE103**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CHEMISTRY OF HETEROCYCLICS AND NATURAL PRODUCTS**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To Classify heterocyclic - nomenclature, structure, biosynthesis, occurrence, analysis and pharmaceutical perspectives of natural products • To elucidate the structure of alkaloids • To study the biological importance of terpenes • To learn about steroids with biological importance • To know the structure and synthesise of anthocyanins							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
CO1	Understand the basic concepts of biomolecules and natural products.	**K3**
CO2	Integrate and assess the different methods of preparation of structurally different natural products.	**K3**
CO3	Illustrate the applications of biomolecules and their functions in the metabolism of livingorganisms.	**K3**
CO4	Analyse and rationalise the structure determination of steroids	**K3**
CO5	Analyze nature and structure of anthocyanins	**K3**

UNIT-I	**HETEROCYCLIC CHEMISTRY**	**Periods: 12**
Nomenclature – reactivity – aromaticity – spectral properties.Elementary study of the following systems only – indole, isoindole – oxazole, imidazole, thiazole, pyridines, pyrimidine, pyridazine, pyrazine, chromans, chromons, coumarins, carbazoles, uracil, uric acid, xanthiones and flavonoids.		**CO1**
UNIT-II	**ALKALOIDS**	**Periods: 12**
General methods of structural elucidation of alkaloids – a general survey. The structural elucidation of Belladine, Papaverine, Cocaine, Atropine, Heptaphylline, Peepuloidin, Morphine.		**CO2**
UNIT-III	**TERPENES**	**Periods: 12**
General methods of determination of structure. Structural elucidation of Camphor, Cadinene, Vitamin A, Abietic acid, Gibberelic acid, Zinziberine and Squalene		**CO3**
UNIT-IV	**STEROIDS**	**Periods: 12**
Conformations of stereoids - molecular rearrangements (acid and base catalysed, photochemical). Synthesis of steroids – ring forming reaction and control of ring junction stereochemistry. Synthesis of cholestrol, androgens, oestrone, progesterone and cortisone. (questions on complete synthesis is not included for examination)		**CO4**

UNIT-V	ANTHOCYANINS	Periods: 12	
General nature of anthocyanins – structure of the anthocyanidins. General methods of synthesizing anthocyanidins. Structural elucidation of cyanidin chloride, pelargolidin chloride, Hirsutidin chloride. Flavones – flavonols – isoflavones. Biosynthesis of flavonoids – depsides – tannins.			CO5
Lecture Periods: 60	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:60**

Text Books

1. . O.P. Agarwal, Chemistry of Organic Natural Products, Vol.1, Goel Publishing House,Meerut, 1997.
2. .L. Finar, Organic Chemistry Vol-2, 5th edn, Pearson Education Asia, 1975.
3. M. P. Singh and H. Panda, Medicinal Herbs with their formulations, Daya Publishing House, Delhi,2005. 6. V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi, 2009.

Reference Books

1. I. L. Finar, Organic Chemistry Vol-1, 6thedition, Pearson Education Asia, 2004.
2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co, 2000.
3. Shoppe, Chemistry of the steroids, Butterworthes, 1994.
4. I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol10, Ukkaz Publications, Hyderabad, 2004.

Web References

1. https://bit.ly/39LXStz
2. https://www.organic-chemistry.org/
3. https://www.studyorgo.com/summary.php

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Commerce and Management**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: SEC			*End Semester Exam Type:			
Course Code	**A23PCMS102**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PROFESSIONAL SKILLS**	**2**	**-**	**-**	**2**	**100**	**-**	**100**
Prerequisite	Intra- personal skills and basic for communication skills							

Course Objectives	• To enable the students to understand the importance of Interpersonal and Team skills. • To Acquire Different Interpersonal and Team skills to be an employable person. • To know how to communicate in an emotionally intelligent way. • To identify needed information and/or eliminate extraneous information towards solving • To achieve the desired result of a good employability through Team work.

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Remember the various Interpersonal skill requirements in organizational entry level	**K3**
	CO2	Understand the need for different communication skill requirement at different occasions	**K3**
	CO3	Understand what Emotional Intelligence is and why it is important	**K3**
	CO4	Demonstrate a good Problem solving skill in work environment	**K3**
	CO5	Demonstrate their ability in team work to achieve desired result	**K3**

UNIT-I	**INTRODUCTION TO INTERPERSONALSKILL**	**Periods: 6**	
Introduction to Interpersonal skills – definition – Importance of interpersonal skills - Developing Your Interpersonal Skills – Types of Interpersonal relationships – uses of Interpersonal relationships skills – Factors affecting Interpersonal Relationships – How to accommodate different styles – consequences of Interpersonal relationships			**CO1**
UNIT-II	**COMMUNICATION SKILLS**	**Periods: 6**	
Introduction – Meaning – Process of communication – Tools for communication – Verbal communication –Non – Verbal communication– Dealing with Conflict– Communication Barriers.			**CO2**
UNIT-III	**EMOTIONAL INTELLIGENCE**	**Periods: 6**	
Emotional intelligence, emotional quotient, ability to understand, use manage own emotions, positive ways to relieve stress, empathy and resolving conflict.			**CO3**
UNIT-IV	**PROBLEM SOLVING**	**Periods: 6**	
Introduction – Need for problem Solving – Skills for Problem Solving –Process of Problem solving – Stages of problem solving –Methods of Problem solving.			**CO4**
UNIT-V	**TEAM SPIRIT AND GROWTH**	**Periods: 6**	
Team spirit, growth mindset, high performing teams, trust and mind alignment, focus, target achievement and time compliance.			**CO5**

Lecture Periods: 30	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:30**

Text Books

1. 1. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press,Oxford:2011.
2. Richards,C.Jack.&DavidBholke. SpeakNowLevel3.OxfordUniversityPress,Oxford:2010

Reference Books

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson:New Delhi,2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press:Oxford,2014.
3. Vargo,Mari. SpeakNowLevel4.OxfordUniversityPress:Oxford, 2013.

Web References

1. **https://mrcet.com/downloads/MBA/Professional%20Communication%20Skills.pdf**
2. **https://www.drishtiias.com/pdf/emotional-intelligence.pdf**

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	CAT 3	Assignment*	Attendance		
Marks	70			20	10	-	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: **DSC**			*End Semester Exam Type: **PE**			
Course Code	**A23PCHL101**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ORGANIC CHEMISTRY LABORATORY - I**	**-**	**-**	**4**	**2**	**50**	**50**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To know the basic knowledge of the separation of organic mixture							
	• To Develop the skill on the identification of functional group							
	• To improve practical knowledge on the preparation of organic compounds							
	• To implement the Oxidation and reduction in the chemical reactions							
	• To learn the method to introduce acyl group in the organic compounds							

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping(Highest Level)
	CO1	Develop the knowledge on the separation of organic mixture	**K3**
	CO2	Identify the functional groups in the organic compounds	**K3**
	CO3	prepare organic compounds	**K3**
	CO4	Understand Oxidation and reduction in the chemical reactions	**K3**
	CO5	Add acyl group in the organic compounds	**K3**

List of Experiments

1. Identification of components in a two component mixture and preparation of their derivatives.

2. Preparations

(i) p-Nitrobenzoic acid from p-Nitrotoluene (Oxidation)

(ii) Anthroquinone from Anthracene (Oxidation)

(iii) 1,2,3,4 – Tetrahydrocarbazole from Cyclohexanone (Reduction)

(iv) Methyl orange from Sulphanilic acid

(v) Acetyl Salicylic acid (Aspirin) from Salicylic acid (Acetylation)

(vi) m-nitro aniline from m-dinitrobenzene(Reduction)

Lecture Periods: -	**Tutorial Periods:-**	**Practical Periods:-30**	**Total Periods:30**

Reference Books

1. S. Furniss Brain - Vogel's Textbook of Practical Organic Chemistry – Pearson Publication, 5th Edition, Reprint 2004.
2. N.S. Gnanapragasam &G.Ramamurthy - Organic Lab Manual (Semi-Micro Qualitative Analysis and Separation) - S. Viswanathan (Printers & Publishers), Pvt., Ltd, Reprint 2002.

Web References

1. **https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/2/PG_M.Sc._Chemistry_344%2024_Practical%20Organic%20Chemistry_MSc%20Chemistry.pdf**
2. **https://www.vedantu.com/chemistry/salicylic-acid**

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	Observation	Model Exam	Viva Voce	Attendance		
Marks	15	15	10	10	50	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**First**	Course Category Code: **DSC**			*End Semester Exam Type: **PE**			
Course Code	**A23PCHL102**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INORGANIC CHEMISTRY LABORATORY - I**	**-**	**-**	**4**	**2**	**50**	**50**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To know the basic principles of semi micro qualitative analysis							
	• To learn to indentify the common ions present in the mixture							
	• To develop the practical knowledge on the preparation of inorganic complex							
	• To know the method of estimation of metal ion							
	• To improve the knowledge on the colorimetric method							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
CO1	Demonstrate group separation and analysis of inorganic mixtures	**K3**
CO2	Identify rare and common ions present in the inorganic mixtures	**K3**
CO3	Prepare selected inorganic complexes	**K3**
CO4	Estimate the metal ions present in the sample by colorimetric method	**K3**
CO5	Identify the metal ion present in the solution	**K3**

List of Experiments

1. Semi micro qualitative analysis of mixture containing two common and two rare cations. (The following are the rare cations to be included. W, Te, Se, Ce, Th, Zr, Be, V, Mo, L.,)
2. Colorimetric Analysis using photoelectric method: Estimation of Iron, Nickel, Copper and Manganese.
3. Preparations:
   i. Potassium tris(oxalato)aluminate(III) trihydrate
   ii. Tris(thiourea)copper(I) chloride
   iii. Sodium hexanitrocobaltate (III)
   iv. Tetrammine copper(II) sulphate
   v. Sodium cuprousthiosulphate

Lecture Periods: -	**Tutorial Periods:-**	**Practical Periods:-30**	**Total Periods:30**

Reference Books

1. V.V.Ramanujam, Inorganic Semi Micro Qualitative Analysis, The National Publication, 3rd Edition, Reprint 2004.
2. G. Svehila, Vogel's Qualitative Inorganic Analysis, Pearson Publication, 5th Edition, Reprint 2004.

Web References

1. **https://iscnagpur.ac.in/study_material/dept_chemistry/4.1_MIS_and_NJS_Manual_for_Inorganic_semi-micro_qualitative_analysis.pdf**
2. **https://archive.int.washington.edu/users/bertsch/articles/176.pdf**
3. **https://www.scribd.com/document/250411802/SKT1013-Experiment-4**

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	Observation	Model Exam	Viva Voce	Attendance		
Marks	15	15	10	10	50	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**Second**	Course Category Code: **DSC** *End Semester Exam Type: **TE**						
Course Code	**A23PCHT204**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INORGANIC CHEMISTRY II**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• Advanced theories of bonding in complexes along with their stereochemistry • Mechanisms of inorganic redox reactions involving coordination compounds • Electronic spectroscopy and magnetic properties of coordination compounds.							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
	CO1 Know the different kinds of compounds of the main group elements	**K3**
	CO2 Understand the structure and bonding in inorganic chains, rings, and cages.	**K3**
	CO3 Identify ligands of main group elements and complexing agents for main group metals.	**K3**
	CO4 Analyse the synthetic techniques in inorganic chemistry.	**K3**
	CO5 Know about organo metallic compounds-	**K3**

UNIT-I	**NATURE OF BONDING IN MAIN GROUP ELEMENTS**	**Periods: 12**
Structures of Main group compounds, Geometric Distortions, Jahn Teller Distortions, MOT to explain shapes of AH_n compounds and A_2H_n compounds. Hyperconjugation, Multiple Bonding, Multicentre bonding, Electron deficient, electron precise, and electron rich compounds of main group elements. Catenation, polyacetylene, Pierls Distortion, Zintl clusters, Wade's Rule, structure of polyhedral boranes, 2-D aromaticity, 3-D aromaticity.		**CO1**

UNIT-II	**INORGANIC CHAINS, RINGS, AND CAGES**	**Periods: 12**
Chemistry of simple boranes, silanes, phosphanesand sulphanes–Boranes: synthesis of neutral boron hydrides, polyhedral borane anions and dianions.Carboranes: synthesis and polyhedral geometries, metalloboranes, and metallocarboranes - Boron – nitrogen compounds: azaboranes, borazines. Silicates: classification - orthosilicates, noncyclic silicate anions, cyclic silicate anions, infinite chain anions, infinite sheet anions, Structure of cyclic siloxanes and cyclopolysilanes.		**CO2**

UNIT-III	**COORDINATION CHEMISTRY - I**	**Periods: 12**
Stereochemical aspects, Stereoisomerism in inorganic complexes: Isomerism arising out of ligand distribution and ligand conformation; chirality and nomenclature of chiral complexes; optical rotatory dispersion and circular dichroism. Macrocyclic ligands; types; porphyrins; corrins, Schiff bases; crown ethers and cryptates.		**CO3**

UNIT-IV	**HALOGEN AND NOBLE GAS CHEMISTRY**	**Periods: 12**
Halogen oxides and oxocompounds: dichlorinemonooxide, chlorine dioxide, dibrominemonooxide, and iodine pentaoxide-preparation and properties; halogen oxyfluoridesand ionic oxyhalogenspecies. Xenon oxides and fluorides: xenon trioxide, xenon difluoride, xenon tetrafluoride. Halogen compounds of nitrogen: nitrogen trifluoride, tetrafluorohydrazine, dinitrogen difluoride, haloamines, oxohalides, andnitrogen trifluorideoxide. Sulfurfluorides: Synthesis and reactivity of disulfur difluoride, sulfurtetrafluoride.		**CO4**

UNIT-V	ORGANO METALLIC COMPOUNDS	Periods: 12
Organometallic compounds: synthesis, bonding and structure, and reactivity. The role of organometallic chemistry in catalysis, Co-ordinative unsaturation, oxidative addition, addition reactions of specific molecules- Hydrogen addition- HX addition- Addition of X2, Addition reactions of Si-H Bonds, addition of C-C , C-Si and Si-Si bonds- Elimination reactions – α and β elimination.		CO5

Lecture Periods: 45	Tutorial Periods:-15	Practical Periods:-	Total Periods:60

Text Books

1. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry; 6th ed.; Wiley Interscience: New York,1988.
2. J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: New York,1983.
3. K. F. Purcell, and J. C. Kotz, Inorganic Chemistry; Saunders: Philadelphia,1976.

Reference Books

1. D. F. Shriver, P. W. Atkins, and C. H. Langford, Inorganic Chemistry; 3rd ed.; Oxford University Press: London,2001.
2. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York,1982.
3. W. L. Jolly, Modern Inorganic Chemistry, 2nd Edn, McGraw-Hill International Edition,1991.
4. G. S. Girolami, T. B. Rauchfuss, and R. J. Angelici, Synthesis and Technique in Inorganic Chemistry, 3rded., University Science Books, Sausalito,1999.
5. W. L. Jolly, The Synthesis and Characterization of Inorganic Compounds, Prentice Hall, New Jercy,1970

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1. https://bit.ly/3OtepkR
2. https://bit.ly/3QyVg2R
3. https://bit.ly/3zSu8pu

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	2	3	3	2
2	2	2	2	2	3	1	3	3
3	3	2	3	3	2	3	2	1
4	3	2	2	3	2	2	3	2
5	3	3	3	3	3	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**Second**	Course Category Code: **DSC** *End Semester Exam Type: **TE**						
Course Code	**A23PCHT205**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ORGANIC CHEMISTRY II**	**4**	**-**	**-**	**4**	**25**	**75**	**100**

Prerequisite	Basic Knowledge studied in the UG Level		
Course Objectives	• Mechanisms and evidences for aromatic electrophilic and nuleophilic substitutions, addition reactions, elimination reactions and rearrangements		
	• Effect of substrate structure, leaving group and attacking species in the above reactions.		
	• Understand the concept of aromaticity		
	• Synthesis and applications of selected reagents used for various organic transformations.		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping(Highest Level)
	CO1	Recall the basic principles of Electrophilic Substitution.	**K3**
	CO2	Recall the basic principles of Nucleophilic Substitution	**K3**
	CO3	Understand the mechanism of free radical reaction	**K3**
	CO4	Describe the concept of aromaticity.	**K3**
	CO5	Utilize the selected reagents used for various organic transformations.	**K3**

UNIT-I	**AROMATIC AND ALIPHATIC ELECTROPHILIC SUBSTITUTION**	**Periods: 12**
Aromatic electrophilic substitution: Mechanism, orientation and reactivity-Quantitative treatment of reactivity in the substrates and reactivity of the electrophiles - Selectivity relationship Hammett and Taft equations. Reactions involving- Nitrogen electrophiles: nitrationand diazonium coupling. Sulphur electrophiles: sulphonation - Halogen electrophiles: chlorination and bromination -Carbon electrophiles: Friedel-Crafts alkylation and acylation reactions. Mechanisms: S_E2 and S_E1, Substitution by double bond shifts - other mechanism: addition- elimination and cyclic mechanism with various electrophiles – Hydrogen, Nitrogen, Sulphur and Carbon.		**CO1**
UNIT-II	**ELIMINATION AND FREE RADICAL REACTIONS**	**Periods: 12**
Mechanisms: E2, E1, E1cB and E2C syn eliminate ions. Orientation of the double bond: Hoffmann and Saytzeff rules and applications. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Mechanisms and orientation in pyrolytic eliminations. Long - lived and short-lived radicals - Production of radicals - thermal and photochemical reactions, methods of detection, stability. Reactions - polymerization, addition, halogenations, aromatic substitutions and rearrangements.		**CO2**
UNIT-III	**ADDITION TO CARBON-CARBON MULTIPLE BONDS**	**Periods: 12**
Addition reactions – Mechanisms - electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms. Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and nitrogen. Addition to carbon-hetero atom multiple bonds - Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig and Prins reactions. Stereochemical aspects of addition reactions - Addition to carbon-hetero atom multiple bonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds.		**CO3**
UNIT-IV	**AROMATICITY**	**Periods: 12**
Aromaticity of benzenoid – non-benzenoid and heterocyclic compounds-Huckel's rule- aromatic, non- aromatic and anti- aromatic systems .- System of two (cyclopropenyl cation, cyclobutadienyl cation etc,), four(cyclopropenyl anion, cyclobutadiene, cyclopentadienyl cation etc,), six (benzene, pyridine, pyrrole, thiophene, furan etc,) eight (cyclooctatetraene etc,) and ten electrons (annulene [10] etc,). System with more than 10 pi electrons (4n+2 & 4n system)- Annulene up to C-18. Aromaticity Azulene- homoaromatic compounds.		**CO4**

UNIT-V	ORGANIC TRANSFORMATION AND REAGENTS	Periods: 12

Preparation and synthetic applications of Lithium aluminum hydride, sodium Borohydride, Tri-n-butyl tin hydride,9-BBN,NBS,Trimethylsillyl iodide, n-Butyl Lithium, Grignard reagent, Gilmann reagent, LDA, DCC, PCC, DDQ, 1,3-Dithiane, SeO2,OsO4, KMnO4. Phase transfer catalyst, Crown ethers and Merrifield resins. Chemoselective reaction-regioselective reaction - strereoselective reactions. **CO5**

Lecture Periods: 60	Tutorial Periods:-	Practical Periods:-	Total Periods:60

Text Books

1. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee Organic Chemistry, 7th edition, Pearson Education, 2010.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P. S. Kalsi, Organic Reactions and their mechanism, 5th edition, New Age International Publishers, 2021.
4. V.K.Ahluwalia, R.K Parashar, Organic reaction mechanisms, Ane Books India Publications, 3rd edition, 2009.

Reference Books

1. P. Y. Bruice, Organic Chemistry, 7th edition, Prentice Hall, 2013.
2. S. M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, 3rd edition, Macmillan India Ltd.1984.
3. Jonathan Clayden, Nick Greeves and Stuart Warren, Organic Chemistry, Oxford University Press, 2nd edition, 2016.4.
4. Francis A.Carey and Richard J.Sunberg, Advanced Organic Chemistry, Springer Science & Business Media, 3rd Edition,2013.
5. J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001.

Web References

1. https://bit.ly/3HMlFWX
2. https://www.organic-chemistry.org/
3. https://www.studyorgo.com/summary.php

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**Second**	Course Category Code: **DSC**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHT206**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PHYSICAL CHEMISTRY II**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To understand the behaviour of electrolyte solutions • To know about the partial molar thermodynamics properties and fugacity • To categorize the molecules based on the symmetry and group. • To solve Schrodinger equation for multi electron systems and know about approximation methods • To study about molecular spectroscopy							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
CO1	Understand the behaviour of electrolyte solutions	**K3**
CO2	Know about the partial molar thermodynamics properties and fugacity	**K3**
CO3	Categorize the molecules based on the symmetry and group.	**K3**
CO4	Solve Schrodinger equation for multi electron systems and know about	**K3**
CO5	Study about molecular spectroscopy	**K3**

UNIT-I	**ELECTROCHEMISTRY - I**	**Periods: 12**
Conductance, equivalent molar conductance - Conductometric titarions-Oswald Dilution law -Mean ionic activity and mean ionic acitivity coefficient - activity coefficient of strong electrolytes –Ionic strength -Debye Huckel limiting law – qualitative and quantitive verification – limitation – Deybe Huckel limiting law appreciable concentrations of electrolytes – Debye – Huckel – Bronsted equation.		**CO1**
UNIT-II	**THERMODYNAMICS**	**Periods: 12**
Partial molar properties – partial molar free energy (Chemical Potential), Gibbs-Duhem Equation- Variation of chemical potential with temperature and pressure. Partial molar volume and Partial molar heat content – Their significance and determination of these quantities. Definition of fugacity - Determination of fugacity by graphical method –variation of fugacity with temperature and pressure- The concept of activity and activity coefficient – determination of activity and activity coefficient by emf method – determination of activity and activity coefficient for non- electrolytes.		**CO2**
UNIT-III	**GROUP THEORY - I**	**Periods: 12**
Symmetry elements and symmetry operations- groups-Abelian and non- abelian groups- cyclic groups- order of group-sub group-similarity transformation and conjugate elements- class-point groups (C1,C2,C3,C4,C2V,C3V,C∞V,C2h,D2h,D3h,D4h,D6h,Td, Oh). Reducible and Irreducible representations – Direct product representation.		**CO3**
UNIT-IV	**QUANTUM MECHANICS**	**Periods: 12**
Solution of Schrodinger equation for multi electron systems (Approximation methods)- perturbation theory-Nondegenerate perturbation theory- first order correction to the energy and wave function. Application of first order perturbation theory to Helium atom. Variation method-Application of variation method to Helium atom. Huckel Molecular orbital theory of conjugated systems-ethylene, butadiene, cyclobutadiene and benzene. Calculation of electron density, bond order and delocalization energy.		**CO4**
UNIT-V	**MOLECULAR SPECTROSCOPY - I**	**Periods: 12**
Electromagnetic radiation- types of molecular spectra. Rotational spectroscopy- selection rule-rotational spectra of diatomic molecules (Rigid rotator)- Types of poly atomic molecules. Vibrational spectroscopy- selection rule-vibrational spectra of diatomic molecules (SHO)-Anharmonic oscillator. Rotation- Vibration of diatomic molecules-		**CO5**

fundamental vibration of linear and non- linear molecules- overtones-fermi resonance. Raman spectroscopy-selection rule-Rayleigh and Raman Scattering-Rotational Raman spectrum of a diatomic Molecule-Rotational – Vibrational Raman spectrum. Mutual Exclusion principle. Electronic spectroscopy- Absorption and intensity shifts-selection rule.Frank- Condon principle for the electronic transition for a diatomic molecule.

Lecture Periods: 60	Tutorial Periods:-	Practical Periods:-	Total Periods:60

Text Books

1. B.R.Puri , L.R Sharma Madan S Pathania, Principles of Physical Chemistry, 2022, Vishal Publishing co, 48th edition.
2. Gupta M. C., 1993, Statistical Thermodynamics, Wiley Eastern limited, New Delhi.
3. Lee, Sears, Tercotte, 1973, Statistical Thermodynamics, Addision Wesley Publishing Co., London – 1st Edition.
4. R.K.Prasad, Quantum Chemistry, New age international publishers, 4th revised edition , 2020.
5. P.K.Bhattacharya, Group Theory and its applications, Himalaya Publeshers. 3rd edition. 2014.

Reference Books

1. Antropov L., 1999, Theoretical electrochemistry, MIR Publications, New Delhi.
2. Glasstone S., 2002, An Introduction to Electrochemistry, Von Nostrand Co. Inc., Toronto.
3. Kuriakose J. C., Rajaram, J. 1999, Thermodynamics, III edition, Shobanlal Nagin Chand, New Delhi, India.
4. H.W. Hanna, 1993, Quantum Mechanics in Chemistry-Benjamin –CummizaLondon Publishing Company, New Delhi, India.
5. Chandra A. K., 1988, Introductory Quantum Chemistry, 3rd edition, Tata McGraw-Hill Publishing Co, New Delhi, India

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1. https://nptel.ac.in/courses/104/103/104103112/
2. https://bit.ly/3tL3GdN
3. **https://www.whfreeman.com/pchem8**

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**Second**	Course Category Code: **DSE**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHE204**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CHEMINFORMATICS**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To apply a range of computational tools to address toxicological questions • To give students skills in the retrieval, processing, dissemination, and use of information systems for chemical/biological information and structures • To prepare for a career in in-silico toxicity prediction in the pharma, industryetc.							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
	CO1 Learn about the information of cheminformatics and its applications	**K3**
	CO2 Know about the Representation of Molecules and Chemical Reactions.	**K3**
	CO3 Identify about the Searching Chemical Structure.	**K3**
	CO4 Understand about the Computer Assisted Virtual screening design.	**K3**
	CO5 Learn about the Application of Cheminformatics in Drug Design	**K3**

UNIT-I	**INTRODUCTION TO CHEMINFORMATICS**	**Periods: 12**
Introduction to cheminformatics, History and Evolution of cheminformatics, Use of cheminformatics, Prospects of cheminformatics, Molecular Modeling.		**CO1**
UNIT-II	**REPRESENTATION OF MOLECULES AND CHEMICAL REACTIONS**	**Periods: 12**
Nomenclature; Different types of Notations; SMILES coding; Matrix Representations; Structure of Molfiles and Sdfiles; Libraries and toolkits; Different electronic effects; Reaction classification		**CO2**
UNIT-III	**SEARCHING CHEMICAL STRUCTURE**	**Periods: 12**
Full structure search; sub structure search; basic ideas; similarity search; Three dimensional search methods; Basics of Computation of Physical and Chemical Data and structure descriptors; Data visualization.		**CO3**
UNIT-IV	**COMPUTER ASSISTED VIRTUAL SCREENING DESIGN**	**Periods: 12**
Structure Based Virtual Screening- Protein Ligand Docking, Scoring Functions for Protein Ligand docking, Practical aspects of structure based Virtual Screening; Prediction of ADMET Properties, 2 D and 3D data searching, Chemical databases, Role of computers in Chemical Research.		**CO4**
UNIT-V	**APPLICATION OF CHEMINFORMATICS IN DRUG DESIGN**	**Periods: 12**
Quantitative Structure-Property Relations; Descriptor Analysis; Computer Assisted Structure elucidations; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Design of Combinatorial Libraries; Ligand Based and Structure Based Drug design.		**CO5**

Lecture Periods: 60	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:60**

Text Books

1. Andrew R. Leach, Valerie J. Gillet, Cluwer, Introduction to Cheminformatics, Academic Publisher, Netherlands, 2003.
2. Johann Gasteiger& Thomas Engel, A Textbook of Chemoinformatics, Wiley Publisher, 2003.
3. Johann Gasteiger& Thomas Engel, Basic Concepts and Methods, Wiley Publisher, 2018.

Reference Books

1. Lisa B. English (Editor), Combinatorial Library Methods and Protocols, Humana Press Inc, Volume:201, 2002.
2. Frank Jensen, Introduction to Computational Chemistry, Wiley Publisher, Second Edition, 2006.
3. FideleNtie – Kang, Chemoinformatics of Natural Products, De Gruyter Publisher, 2022.
4. Jagjeet Singh, Cheminformatics, Random House Publisher, 2020.
5. JurgenBaiorath, Chemoinformatics for Drug Discovery, Wiley Publisher, 2013.

Web References

1. https://chem.libretexts.org
2. https://en.wikibooks.org/wiki/Chemical_Information_Sources
3. https://guides.loc.gov/chemistry-resources

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	2	3	3	3	3	3	3	3
2	3	2	3	2	1	3	2	2
3	2	2	2	3	2	1	3	3
4	2	3	2	2	2	2	3	2
5	3	2	3	3	3	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**Second**	Course Category Code: **DSE**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHE205**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ASYMMETRIC SYNTHESIS**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To create awareness about the importance of chirality for organic synthesis and for biological activity • Apply the important principles of stereochemistry and understand them.							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
	CO1 Understand the basic concept of asymmetric Synthesis	**K3**
	CO2 Able to synthesize on chiral substrate	**K3**
	CO3 Use chiral substrate to synthesize asymmetric compounds	**K3**
	CO4 Utilysze chiral auxiliary to synthesize asymmetric compounds	**K3**
	CO5 handle chiral catalyst to synthesize asymmetric compounds	**K3**

UNIT-I	**INTRODUCTION TO ASYMMETRIC SYNTHESIS**	**Periods: 12**
Basic principles of Asymmetric synthesis – Definition - Stereospecific, Stereo selectiveenantioselective and diastereoselective. Importance of asymmetric synthesis, conditions for an efficient asymmetric synthesis, energetic considerations, strategies for asymmetric synthesis- advantages and limitations of each strategy, analytical methods for determining enantiomeric excess. Resolving agents and resolution of racemic compounds having common functional groups for e.g. alcohol, amine, acid. Resolution of chiral ligands - BINOL, trans 1,2-diaminocyclohexane. Interaction between chiral substrate and chiral reagent. Kinetic resolution of racemic mixtures.		**CO1**

UNIT-II	**ASYMMETRIC SYNTHESIS ON CHIRAL SUBSTRATE**	**Periods: 12**
Nucleophilic addition to α–chiral carbonyl compounds; Prediction of stereochemistry Cram's rule and related modifications. Double stereo differentiation; matched pair and mismatched pair; examples from aldol condensation and hydroboration reactions. Electrophilic addition to α – chiral olefins - epoxidation, cyclopropanation, hydroboration – oxidation, alkylation of enolates of β-chiral carbonyl compounds.		**CO2**

UNIT-III	**ASYMMETRIC SYNTHESIS USING CHIRAL REAGENTS**	**Periods: 12**
Chiral organo boranes -Application of chiral organ boranes, reduction (Ipc_2BCl) and allylation and crotylation reactions, T.S models; Chiral modification of lithium aluminum hydride, BINAL-H - application in reduction of prochiral ketones; oxazaborolidines. T.S model; Asymetric Michael addition to α, β – unsaturated carbonyl compounds T.S model; chiral lithium amides – enantioselective deprotonation.		**CO3**

UNIT-IV	**ASYMMETRIC SYNTHESIS USING CHIRAL AUXILIARY**	**Periods: 12**
Chiral auxiliaries derived from proline, champhor, menthol and other chiral pool sources. SAMP / RAMP hydrazines, and other pyrrolidines, oxithiane, oxazolidine-2- one, thiazolidine-2-one, phenylethylamine, 2- phenylcyclohexanol, 8-phenyl menthol.		**CO4**

UNIT-V	**ASYMMETRIC SYNTHESIS USING CHIRAL CATALYSTS**	**Periods: 12**
Asymmetric alkylation and allylation of carbonyl compounds, chirality amplification, non-linear effects: Selected reactions: DAIB, Keck's allylation, TADDOLs and other privileged ligands. Asymmetric hydrogenation: early advances DIPAMP, DIOP and Noyori's BINAP - selected reactions &examples. Proline mediated aldol reactions and further expansion in the field of organo catalysis. Sharpless epoxidation, dihydroxylation, aminohydroxylation of alkenes; Utility metal-semicorrinato complexes and Jacobson catalysts – Evans catalyst - Aziridination.		**CO5**

Lecture Periods: 60	Tutorial Periods:-	Practical Periods:-	Total Periods:60

Text Books

1. Asymmetric Synthesis: Morrison, J. D. Vol 1- 5, Academic press,1983.
2. Stereochemistry of Carbon compounds: E. L. Eliel, Wiley, 1992.
3. Comprehensive Asymmetric Catalysis (Jacobsen, E. N,Pfaltz, A. Yamamoto, H. Eds.) Springer 2000.

Reference Books

1. Asymmetric Catalysis in Organic synthesis: Noyori, R. Wiley-NY 1994.
2. Catalytic Asymmetric Synthesis: Ojima, I.VCH-NY, Pergamon, 1998.
3. Methods for the Asymmetric Synthesis of Complex Organic Molecules, Daniel J. O'Leary, Lecture Notes 2001.
4. Principles of Asymmetric Synthesis (Tetrahedron series in Organic Chemistry), R.
5. E. Gawley, J Aube, Pergman, 1996 Aymmetric Synthesis, H. B. Kagan, Thieme Medical Publishers, IstEdn., 2003. Asymmetric Synthesis, G. Proctor, Oxford University Press, USA, 1997.

Web References

1. https://chem.libretexts.org
2. https://en.wikibooks.org/wiki/Assymetric _Synthesis Sources
3. https://guides.loc.gov/chemistry-resources

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	3	3
3	3	3	3	3	2	3	2	2
4	2	3	2	1	3	2	3	2
5	2	2	3	3	3	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**Second**	Course Category Code: **DSE**			*End Semester Exam Type: **TE**			
Course Code	**A23PCHE206**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**GREEN CHEMISTRY**	**4**	**-**	**-**	**4**	**25**	**75**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To Understand about Green Chemistry • To learn about Ultrasound and Microwave usage in the Green Chemistry • To know about Green Catalyst • To learn about phase transfer mechanism in the Green Chemistry • To use green chemistry concept in the various organic reactions							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping(Highest Level)
CO1	Learn about Green Chemistry	**K3**
CO2	Understand usage of Ultrasound and Microwave in the Green Chemistry	**K3**
CO3	Learn about usage various catalyst in the green chemistry	**K3**
CO4	Learn about phase transfer mechanism in the Green Chemistry	**K3**
CO5	Apply green chemistry concept in the various organic reactions	**K3**

UNIT-I	**BASIC PRINCIPLES OF GREEN CHEMISTRY**	**Periods: 12**
Introduction, Principles of Green chemistry, prevention of waste, maximum Incorporation of the Reactants (starting materials and reagents) into the final product, prevention or minimization of hazardous products, designing safer chemicals, energy requirements for synthesis, selection of appropriate solvent, selection of starting materials, use of protecting group, use of catalyst and products designed should be biodegradable.		**CO1**

UNIT-II	**ULTRASOUND AND MICROWAVE ASSISTED GREEN SYNTHESIS**	**Periods: 12**
Ultrasound: Introduction, instrumentation, the phenomenon of cavitation. Sonochemical esterification, substitution, addition, alkylation, oxidation, reduction and coupling reactions. Microwaves: introduction- concept- reaction vessel / medium- specific effects, atom efficiency (% atom utilization), advantages and limitations. Alkylation and N-alkylation of active methylene compounds and Diels –Alder reactions. Reactions in water and reactions in organic solvents. Solvent free reactions and deprotection of esters.		**CO2**

UNIT-III	**GREEN REAGENT AND GREEN CATALYSTS**	**Periods: 12**
Green Reagent - Polymer supported reagents – polymeric thioanisolyl Resin, polymeric Carbodiimide, Polystyrene Anhydride, Polystyrene wittig Reagent, Sulfonazide polymer. Green Catalyst - Acid catalysts- base catalysts- oxidation catalysts - polymer supported catalysts- polystyrene-aluminum chloride – polymeric super acid catalysts- polymer supported photosensitizers		**CO3**

UNIT-IV	**PHASE TRANSFER CATALYST IN GREEN SYNTHESIS**	**Periods: 12**
Introduction- mechanism of phase transfer catalyst reaction- types and advantages of phase transfer catalyst – applications of phase transfer catalyst in organic synthesis- nitriles from alkyl or acyl halides, alkyl fluorides from alkyl halides, generation of dichlorocarbenes, elimination reaction, alkylation reaction –Williamson Ether synthesis, Darzen reaction, Wittig reaction – Oxidation using hydrogen peroxide under PTC condition.		**CO4**

UNIT-V	**ORGANIC SYNTHESIS IN GREEN CHEMISTRY**	**Periods: 12**
Aqueous phase reactions- oxidation of aldehydes and ketones- oxidation of amines into nitro compounds – oxidation of nitriles- Knoevenagel reaction. Michael reaction.Organic synthesis in solid state-Solid phase organic synthesis without using any solvent- aldol condensation-Reformatsky reaction, witting reaction - solid supported organic synthesis-pyrrole, furons - Synthesis of paracetamol.		**CO5**

Lecture Periods: 60	Tutorial Periods:-	Practical Periods:-	Total Periods:60

Text Books

1. Organic Synthesis: Special Techniques, V.K.Ahluwalia and R. Aggarwal, Narosa Publications, New Delhi, 4th Edition, 2003
2. R.Sanghi, M.M Srivastava, Green Chemistry Environment Friendly alternatives, Narosa Publications New Delhi 2003.
3. Green Chemistry – An Introduction text, Royal Society of Chemistry, UK 2002.

Reference Books

1. P.T.Anastas and JJ.C Warner, Green Chemistry theory and Prctices, Oxford University press, Oxford 1988.
2. E.V. Dehmlov, S.S Dehmlov, Phase Transfer Catalysis, 2nd edition Verlagchemie, Wienhein, 1983.

Web References

1. https://www.hansrajcollege.ac.in/hCPanel/uploads/elearning/elearning_document/Twelve_principle_of_GC.pdf
2. https://fccollege.ac.in/Admin/Files/StudyMaterials/MICROWAVE%20&%20US%20GREEN%20SYNTHESIS(REVIEW)-2022.pdf
3. https://fccollege.ac.in/Admin/Files/StudyMaterials/MICROWAVE%20&%20US%20GREEN%20SYNTHESIS(REVIEW)-2022.pdf.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3
3	3	2	3	3	2	3	3	3
4	2	3	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**Second**	Course Category Code: **DSC**			*End Semester Exam Type: **PE**			
Course Code	**A23PCHL203**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PHYSICAL CHEMISTRY LAB –I**	**-**	**-**	**4**	**2**	**50**	**50**	**100**

Prerequisite	Basic Knowledge studied in the UG Level
Course Objectives	• To learn about critical solution system and distribution coefficient
	• To understand rate constant of the reaction and Comparison of acid strengths
	• To Analyse the activation and frequency factor
	• To learn about Molecular weight of the compound
	• To analyze phase diagram of compound

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Learn about critical solution system and distribution coefficient	**K3**
	CO2	Understand rate constant of the reaction and Comparison of acid strengths	**K3**
	CO3	Analyse the activation and frequency factor	**K3**
	CO4	Learn about Molecular weight of the compound	**K3**
	CO5	Analyze phase diagram of compound	**K3**

List of Experiments

1. Determination of CST and study of the effect of impurity on CST
2. Determination of distribution coefficient and determination of equilibrium Constant for the formation of KI_3(Demonstration only)
3. Determination of the rate constant for Persulphate oxidation both by titrimetry and Colorimetry.
4. Comparison of acid strengths by Kinetics.
5. Determination of the energy of activation and frequency factor.
6. Association factor of benzoic acid between benzene and water
7. Determination of molecular weight by Rast macro method
8. Phase diagram – simple eutectic system
9. Phase diagram – three component system
10. Adsorption of oxalic acid on charcoal.
11. Determination of molecular weight by Transition Temperature Method

Lecture Periods: -	**Tutorial Periods:-**	**Practical Periods:-30**	**Total Periods:30**

Reference Books

1. Venkateswaran, V., Veeraswamy, R. &Kulandaivelu, A. R. (1997). Basic Principles of Practical Chemistry, (2nd Ed.). Sultan Chand & Sons.
2. Daniels, Mathews, F., Howard, J. & John Warren, W. (1970). Experimental Physical Chemistry, (7th Ed.). Mc Graw Hill.
3. Findlay, A., (1959). Practical Physical Chemistry, (7th Ed.).

Web References

1. https://egyankosh.ac.in/bitstream/123456789/15870/1/Unit-12.pdf
2. https://www.chem.uci.edu/~lawm/11-2.pdf
3. https://www2.tulane.edu/~sanelson/eens212/ternaryphdiag.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	2	3	3	3
2	3	2	3	2	3	2	2	2
3	3	2	2	3	2	3	3	3
4	2	2	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	Observation	Model Exam	Viva Voce	Attendance		
Marks	15	15	10	10	50	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Chemistry**	Programme: M.Sc. Chemistry						
Semester	**Second**	Course Category Code: **DSC**			*End Semester Exam Type: **PE**			
Course Code	**A23PCHL204**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INORGANIC CHEMISTRY LAB – II**	**-**	**-**	**4**	**2**	**50**	**50**	**100**
Prerequisite	Basic Knowledge studied in the UG Level							
Course Objectives	• To Learn practical knowledge on the binary mixture analysis • To understand and develop the practical experience on the complex preparation							

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Gain knowledge on the binary analysis	**K3**
	CO2	Develop skill on the iron and copper analysis	**K3**
	CO3	Improve practical experience I on the calcium and magnesium analysis	**K3**
	CO4	Understand the complex formation in different methods	**K3**
	CO5	Learn the various complex making process	**K3**

List of Experiments

I) Estimations of Metal Ions in a Binary Mixture

1. Quantitative analysis of a mixture of iron (volumetry) and copper (gravimetry)
2. Quantitative analysis of a mixture of copper (volumetry) and nickel (gravimetry)
3. Quantitative analysis of a mixture of calcium (volumetry) and magnesium (gravimetry)
4. Quantitative analysis of a mixture of calcium and magnesium (both by volumetry)
5. Quantitative analysis of a mixture of iron (volumetry) and zinc (gravimetry)
6. Quantitative analysis of a mixture of copper (volumetric) and zinc (gravimetry)

II) Preparation of Selected Complexes

1. Hexmannine cobalt (III) chloride.
2. Potassium bisoxalatodiaquo chromate (III)
3. Hexathiourea lead (II) nitrate
4. Lead tetra acetate
5. Bis (pyridiniumhexachloroplumbate)

Lecture Periods: -	**Tutorial Periods:-**	**Practical Periods:-30**	**Total Periods:30**

Reference Books

1. V.V.Ramanujam, Inorganic Semi Micro Qualitative Analysis, The National Publication, 3rd Edition, Reprint 2004.
2. G. Svehila, Vogel's Qualitative Inorganic Analysis, Pearson Publication, 5th Edition, Reprint 2004.

Web References

1. https://egyankosh.ac.in/bitstream/123456789/15906/1/Experiment-17.pdf
2. https://egyankosh.ac.in/bitstream/123456789/15906/1/Experiment-17.pdf
3. https://chemistry.iyte.edu.tr/wp-content/uploads/sites/48/2019/06/CHEM-332-Anorganik-Kimya-Lab.Kitap%C3%A7%C4%B1%C4%9F%C4%B1.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)					Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
1	3	3	3	3	2	3	3	3
2	3	2	3	2	3	2	2	2
3	3	2	2	3	2	3	3	3
4	2	2	2	1	2	2	3	2
5	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	Observation	Model Exam	Viva Voce	Attendance		
Marks	15	15	10	10	50	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mathematics**	Programme: M.Sc. Chemistry						
Semester	**Second Semester**	Course Category Code: SEC			*End Semester Exam Type:			
Course Code	**A23PMAS201**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**QUANTITATIVE REASONING AND RESEARCH APTITUDE**	**2**	**-**	**-**	**2**	**100**	**-**	**100**
Prerequisite	Basic mathematical and reasoning knowledge							
Course Objectives	• To know the simple interest and compound interest. • To know the Permutation and Combination. • To gain the knowledge of Time and Work Problems. • To gain the knowledge the of percentage, profit and loss. • To know the concept of coding and decoding.							
Course Outcome	**On completion of the course, the students will be able to**						BT Mapping (Highest Level)	
	CO1 Learn about the simple interest and compound interest.						**K3**	
	CO2 Understand the Problems on Trains.						**K3**	
	CO3 Solve the Time and Distance Problems.						**K3**	
	CO4 Know about the ratio and proportion						**K3**	
	CO5 Understand the Alphanumeric series.						**K3**	
UNIT-I							**Periods: 6**	
Simple interest and Compound interest.								**CO1**
UNIT-II							**Periods: 6**	
Permutations and Combinations - Problems on Trains								**CO2**
UNIT-III							**Periods: 6**	
Time and Work Problems - Time and Distance Problems.								**CO3**
UNIT-IV							**Periods: 6**	
Percentage-Profit and Loss - Ratio and Proportion								**CO4**
UNIT-V	.						**Periods: 6**	
Input and Output – Coding and Decoding – Alphanumeric series – Ranking								**CO5**

Lecture Periods: 30	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:30**

Reference Books

1. Quantitative Aptitude for competitive Examination-AbhijitGuha-TMH.
2. Mathematics for life-M. Immaclate-Nanjil offsetPrinters.
3. Objective Arithmetic's-R. S-Aggarwal-S. Chand &Co.

Text Books

1. Quantitative Aptitude for competitive Examination, R.S. Aggarwal. S. Chand and company Ltd,152, Anna salai, Chennai.(2001)
2. Quantitative Aptitude and Reasoning Praveen PHIP.Ltd.
3. Scope and treatment as in "Quantitative Aptitude" by R.S. Aggarwal. S. Chand and company Ltd.,Ram Nagar, New Delhi(2007).

Web References

1. https://www.careerbless.com/aptitude/qa/home.php
2. https://www.javatpoint.com/aptitude/quantitative
3. https://www.letsstudytogether.co/quantitative-aptitude-topic-wise-questions-and-answers-pdf-download/

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	CAT 3	Assignment*	Attendance		
Marks	70			20	10	-	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus