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CO3	Determine transition metals and anions spectrophotometrically.	
Title of the Course and Course Code	**Physical Chemistry SpecialPractical (MSCCHE EC-2b)**	**Number of Credits : 05**
On completion of the course, the students will be able to:		
CO1	Describe the theoretical principles and concepts related to experiments.	
CO2	Handle electrochemical instruments such as conductometer and potentiometer to carry out qualitative and quantitative estimations.	
CO3	Standardize/calibrate the apparatus and instrument.	
CO4	Perform the experiment and tabulate the observations.	
CO5	Develop skills in procedures and instrumental methods applied in practical tasks. Interpret, conclude and write the experimental results.	
CO6	Represent the results of scientific work in oral, written, graphical and electronic formats.	
Title of the Course and Course Code	**Organic Chemistry SpecialPractical (MSCCHE EC-2c)**	**Number of Credits : 05**
On completion of the course, the students will be able to:		
CO1	Discuss important applications of chemistry.	
CO2	Identify the functional groups of an organic molecule by characteristic tests.	
CO3	Identify and analyse the product obtained by different techniques. Demonstrate purification technique.	
CO4	Use of safety responsibilities residing in working with chemicals.	
CO5	Describe mechanism, particulars regarding nature of reactants, reagents, products, safety measures, reaction conditions and work up of the experiment.	
CO6	Examine progress of the reaction, analyse, confirm and tabulate results obtained	

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Title of the Course and Course Code	Physical Chemistry Special (MSCCHE EC-1b)	Number of Credits: 05
CO1	Explain Hartree Fock theory and semi empirical theories and calculations based in it.	
CO2	Describe Kinetics of catalytic reaction, Oscillatory reactions, condensed phase Reaction, Fast reactions, and electrode reactions and its applications.	
CO3	Explain molecular orbital theory for homonuclear, heteronuclear and polynuclear molecules using quantum rules.	
CO4	Comprehend the significance and adverse consequences of various types of corrosions and their environmental factors. Deduce the mechanism of corrosion and suggest measures to prevent it.	
CO5	Explain the Specific heat of solids using Einstein and Debye theory	
CO6	Derive expressions for the most probable distribution of particles among the various energy levels according to Boltzmann, Bose-Einstein and Fermi-Dirac statistics.	

Title of the Course and Course Code	Organic Chemistry Special (MSCCHE EC-1c)	Number of Credits: 05
On completion of the course, the students will be able to:		
CO1	Classify Terpenoids and Alkaloids. Explain structure, stereochemistry and synthesis of Terpenoids and Alkaloids.	
CO2	Classify the types of drugs and their role. Explain the therapeutic role of different classes of drugs.	
CO3	Identify the types of anaesthetics and diagnostic agents and describe method of identity lead for drug design.	
CO4	Define the drug receptor interactions and mode of action of different drugs and plan a retero synthetic strategy to synthesize drug molecules.	
CO5	Explain the principles involved in analyzing drug molecules and describe the methods to correlate structure to activity of drug candidates.	
CO6	Elucidate the structure and chemistry of heterocyclic compounds (5, 6, and 7-membered and fused rings).	

Title of the Course and Course Code	Inorganic Chemistry Special Practical (MSCCHE EC-2a)	Number of Credits: 05
On completion of the course, the students will be able to:		
CO1	Analyze of Inorganic mixture qualitatively.	
CO2	Analyze of at least two metal ions in alloys and minerals	

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Title of the Course and Course Code	Bio-organic Chemistry (MSCCHE CC-13)	Number of Credits : 04
On completion of the course, the students will be able to:		
CO1	Describe concepts of classifications of enzymes, Co-enzyme and its functions	
CO2	Explain basic concepts of bioorganic chemistry and bio chemical models and its applications in organic synthesis and industry applications.	
CO3	Know the classification structure determination and chemical synthesis of Carbohydrates.	
CO4	Know the classification, occurrence, biological importance, structure determination and synthesis of vitamins.	
CO5	Classify amino acids, peptides and proteins.	

Title of the Course and Course Code	Practical (Inorganic Chemistry) (MSCCHE CC-14)	Number of Credits : 05
On completion of the course, the students will be able to:		
CO1	Separate and estimate the mixture of metal ions.	
CO2	Prepare inorganic complexes by green methods.	
CO3	Identify and match IR, electronic spectra of the complexes.	
CO4	Explain spin systems and propose correct structures from spectral data. Distinguish compounds using spectroscopic methods.	

M.Sc. Semester IV

Title of the Course and Course Code	Inorganic Chemistry Special (MSCCHE EC-1a)	Number of Credits : 05
CO1	List out various synthesis routs, stability and decomposition pathways of alkyls and aryls transition metals.	
CO2	Explain the synthesis and structural characteristics of carbenes and carbynes and their roles in organic synthesis.	
CO3	Discuss Homogeneous Catalysis and its examples and applications.	
CO4	Review the concept of SALC, spectrochemical and Nephelauxetic series. Develop the ability to generate a representation of SALC and to reduce it to its irreducible components. Evaluate numerical based on crystal field parameters.	
CO5	Apply Group Theory in CFT and formation of hybrid orbitals in various transition metal complexes.	
CO6	Describe D and A process, fluxionality and dynamic equilibria.	

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Title of the Course and Course Code	Bio-inorganic Chemistry (MSCCHE CC-11)	Number of Credits : 04
On completion of the course, the students will be able to:		
CO1	List out the functions and fate of metals in biology.	
CO2	Describe the Bioenergetics and ATP Cycle.	
CO3	Explain the structure and function of haemoglobin, myoglobin, hemicyanics.	
CO4	Describe the Structure and function of metalloproteins and iron-sulphur proteins.	
CO5	Describe the advantages and side effects of drugs. Compare the toxicity of different metals.	
CO6	Comprehend the role of coordination compounds in living systems.	

Title of the course and Course Code	Environmental Chemistry and Green Chemistry (MSCCHE CC-12)	Number of Credits : 05
On completion of the course, the students will be able to:		
CO1	Know the Environment and Composition of atmosphere.	
CO2	Learn the different aspects of pollutants in water and air and their analysis.	
CO3	Evaluate the industrial pollutants, understand their effects and adopt methods to reduce them.	
CO4	Describe principals and objectives of Green Chemistry and its applications. Use of renewable raw materials and biosynthesis, organic waste management.	
CO5	Design and execute organic synthesis using various green synthetic methods to reduce waste and hazardous material for a greener environment.	
CO6	Assess the impact of environmental pollution by measuring various testing parameters.	

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Title of the Course and Course Code	Practical (Organic Practical) (MSCCHE CC-9)	Number of Credits : 05
On completion of the course, the students will be able to:		
CO1	Describe mechanism, particulars regarding nature of reactants, reagents, products, safety measures, reaction conditions and work up of the experiment.	
CO2	Outline experiment involving two stage conversion of starting material into the products and examine the progress of reaction. Separate the binary mixture of organic components.	
CO3	Determine purity of the product.	
CO4	Perform experiments based on oxidation, reduction and condensation. Assemble apparatus for setting up the experiment.	
	M.Sc. Semester III	
Title of the Course and Course Code	**Application of Spectroscopy (MSCCHE CC-10)**	**Number of Credits : 05**
On completion of the course, the students will be able to:		
CO1	Recall and define basic terminologies in spectroscopy. Illustrate, classify and compare theoretical and instrumental aspects for various spectroscopic	
CO2	Interpret Raman and IR spectroscopy and describe application to chemical analysis.	
CO3	Describe the working principles of Mass Spectrometry, UV-Visible Spectroscopy, nuclear magnetic resonance (NMR), and Photoelectron Spectroscopy	
CO4	Elucidate structure of inorganic and Organic compounds from nuclear magnetic and electron spin resonance spectroscopy data.	
CO5	Solve and work with numerical based on spectroscopic data. Interpret different types of molecular spectra and structure to evaluate valuable data from it.	
CO6	Formulate and solve scientific problems based on the advanced physical chemistry concepts. Specify the applications of spectroscopy in chemistry and interdisciplinary fields.	

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Title of the Course and Course Code	Physical Chemistry-II (MSCCHE CC-7)	Number of Credits : 05
On completion of the course, the students will be able to:		
CO1	Summarize the understanding of basic concepts of quantum mechanics and concepts related to Quantum mechanical operators and physical quantities, and Schrödinger wave equations.	
CO2	Derive the expression for rotational and vibrational energy of a rigid diatomic molecules and apply to H-like atoms for the calculations of radial and angular wave functions.	
CO3	Explain the Approximate Methods in quantum mechanics and apply it to He-atom.	
CO4	Describe the Chemical Bonding using LCAO-MO theory and V.B. theory and its application to H_2^+ ion and H_2 molecules.	
CO5	Explain Hückel Molecular Orbital Theory and apply conjugated systems	

Title of the Course and Course Code	Organic Chemistry-II (MSCCHE CC-8)	Number of Credits : 05
On completion of the course, the students will be able to:		
CO1	Describe mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals and explain nucleophilic addition of carbonyl compounds and name reactions based on it.	
CO2	Explain principles of photochemistry, electronic excitation, hydrogen abstraction, Norrish type I and Norrish type II, reaction, Paterno-Buchi reaction.	
CO3	Classify pericyclic reactions and apply to the 4n, 4n+2 and allyl systems through Woodward-Hoffmann principle FMO and PMO approach. Explain the rearrangements pericyclic reactions.	
CO4	Comprehend the oxidation of alkenes, aromatic rings, alcohols, diols, ketones with various reagents.	
CO5	Describe Wegner-Meerwein rearrangements Neber, Curtius, Arndt Eistert reaction, Benzilic acid, Beckmann rearrangements and its application.	

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	M.Sc. Semester II	
Title of the Course and Course Code	**Advances in Chemistry (MSCCHE CC-5)**	**Number of Credits: 05**
On completion of the course, the students will be able to:		
CO1	Explain different concepts of Nuclear Models and types of Nuclear Reactions and Discuss the applications of radio isotopes and radioactive waste disposal.	
CO2	Comprehend the types, properties and applications of nanomaterials and design innovative routes for nanomaterial synthesis and its application in green chemistry.	
CO3	Analyze and characterize the nanomaterials by advanced techniques such as XRD, SEM, and TEM.	
CO4	Underline basic concepts of solid-state chemistry and Classifications and applications Conductor, Semiconductor, and superconductor materials.	
CO5	Application of Chemistry in Cement, Paper and Pulp, and petroleum Industries.	
CO6	Explain Waste Management and application in recycling of plastic.	
Title of the Course and Course Code	**Inorganic Chemistry-II (MSCCHE CC-6)**	**Number of Credits : 05**
On completion of the course, the students will be able to:		
CO1	Predict the spectroscopic ground states and describe electronic spectra of transition metal complexes.	
CO2	Identify the elements of symmetry, symmetry operations and point groups of molecules.	
CO3	Generalize the importance of Orthogonality Theorem and learn the rules for constructing character tables. Outline the fundamental requirement for interpretation of electronic spectra of metal compounds for prediction of their properties.	
CO4	Explain molecular structure by the use of character tables. Specify and correlate the application of symmetry to spectroscopy to find out which modes are IR and Raman active.	
CO5	Describe structure and bonding in metal carbonyls, and transition metal nitrosyls.	
CO6	Compare the structure and bonding in Boranes, Carboranes, metal clusters.	

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CO6	To establish and develop the principles those are used to explain and interpret many of the physical and chemical observations.

Title of the Course and Course Code	Organic Chemistry-I (MSCCHE CC-3)	Number of Credits : 05
On completion of the course, the students will be able to:		
CO1	Recall the nature of bonding in organic molecules and concept of aromaticity and its application to identify various organic compounds. Predict and cite examples of aromaticity of heterocyclic and non-heterocyclic compounds.	
CO2	Explain the concepts related to nomenclature, isomerism and stereochemistry in organic molecule and apply this in stereospecific and stereoselective organic synthesis reactions.	
CO3	Describe transition states and reaction intermediates and to explain types of organic reactions and methods of determining reaction mechanisms.	
CO4	Classify aliphatic and aromatic nucleophilic substitution reactions and investigate the effect of substrate structure, leaving group and attacking nucleophile of various organic rearrangement reactions.	
CO5	Explain the free radical substitution, aromatic electrophilic substitution, and elimination reactions and study the organic name reactions based on these concepts.	

Title of the Course and Course Code	Practical (Physical Chemistry) MSCCHE CC-4	Number of Credits : 05
On completion of the course, the students will be able to:		
CO1	Outline and recall basic knowledge of fundamentals and application of organic and physical chemistry through chemical and scientific theories.	
CO2	Apply and justify the principles of chemical kinetics and thermodynamic through experiments.	
CO3	Perform the experiment and tabulate the observations.	
CO4	Justify the steps to prepare and standardize different solutions.	
CO5	Write the experimental results and interpret it.	
CO6	Use of safety responsibilities residing in working with chemicals. Illustrate safety measures related to experiments carried out.	

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Course Outcomes (COs)		
M.Sc. Semester I		
Title of the Course and Course Code	**Inorganic Chemistry-I (MSCCHE CC-I)**	**Number of Credits : 05**
On completion of the course, the students will be able to:		
CO1	Identify and understand different the types of chemical bonding and to predict the shape of molecules based on various theories.	
CO2	Understand the effect of various ligand field strengths on d-metal ions and find out ground state terms with their energies, microstates, degeneracy and microstate table for different transition metal ions and complexes.	
CO3	To determine and predict the stepwise and overall formation constants and interactions in metal complexes.	
CO4	Explain the reaction mechanism of different Transition metal complexes	
Title of the Course and Course Code	**Physical Chemistry-I (MSCCHE CC-2)**	**Number of Credits : 05**
On completion of the course, the students will be able to:		
CO1	Know the fundamentals of polymers and Kinetic and mechanisms of polymerization and determination of the molar mass of polymers by different methods.	
CO2	Recall the basic concepts in electrochemistry and Evaluate problems based on the Debye – Hückel Limiting Law and apply theories in electrochemistry to analyze electrode kinetics.	
CO3	Calculate the rate expressions of parallel, opposing reactions and chain reactions. Explain the kinetics of fast reactions using various instrumentation techniques.	
CO4	Describe the partial molar properties, Chemical Potential, Fugacity and activity and its applications.	
CO5	Explain and illustrate statistical thermodynamic properties. Relate the role of quantum mechanics in statistical mechanics.	

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Program Specific Outcomes(PSOs) and Course Outcomes (COs) 2020-21

Programme: M.Sc. Chemistry

PSO No.	Program Specific Outcomes (PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Understand fundamental principles and advanced concepts of organic, inorganic and physical chemistry. (ii) Demonstrate understanding of various types of reactions, reaction mechanisms, stereochemistry, photochemistry, rearrangements, heterocyclic and medicinal chemistry. (iii) Interpret analytical data for structure elucidation obtained using NMR, IR, UV and Mass spectroscopy.
PSO2	**Personal and Professional Competence:** (i) Develop analytical skills such as synthesizing, separating, characterizing chemical compounds and chemical reaction with the help of sophisticated instruments. (ii) Evaluate results obtained, observations and conclusion of experiments. Documentation of results. (iii) Formulate ideas, scientific writing and authentic reporting, effective presentation and communication skills.
PSO3	**Research Competence:** (i) Develop research skills through dissertation/Project work in different fields of chemistry such as organic, nanoscience, analytical, physical etc. (ii) Review scientific literature and findings in systematic manner and processing of information obtained to understand scope for novelty. (iii) Design novel synthetic routes using a retrosynthetic approach for development of elegant, economic and eco-friendly schemes.
PSO4	**Entrepreneurial and Social competence:** (i) Demonstrate importance of industrial applications of organic chemistry in various fields. (ii) Devise chemical processes with Green approach having advantage in safe operations.

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ability, age, income and other social variables, and by creating an environment that is , "welcoming for all students" .

PO 8: Lifelong Learning:

Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning throughout life, through self- paced and self- directed learning aimed at personal development, and adapting to changing academic demands of work place through knowledge/ skill development/ reskilling .

PO9: Leadership Qualities:

Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination in a smooth and efficient way.

PO 10: Research Skills:

Prepare students for pursuing research or careers in industry in concerned subject and allied fields. Capability to use appropriate software to solve various problems and to apply programming concepts of C++ and Mathematica/ Matlab to various scientific investigations, problem solving and interpretation.

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