



Masters of Science (Chemistry)

Program Outcome

PO1: Critical Thinking:

Inculcate critical thinking to carry out scientific investigation objectively. Formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. Critically evaluate ideas, evidence and experiences from an open minded and reasoned perspective.

PO2: Knowledge Skill:

Equip the student with skills to analyze problems, formulate a hypothesis, evaluate and validate results, and draw reasonable conclusions thereof. Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge.

PO3: Scientific Communication Skills:

Imbibe effective scientific and / or technical communication in both oral and writing. Ability to show the importance of the subject as precursor to various scientific developments since the beginning of the civilization.

PO4: Ethics:

Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in the subject concerned. Ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adoptive objective, unbiased and truthful actions in all aspects.

PO5: Enlightened Citizenship:

Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges.

PO 6: Analytical Reasoning:

Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

PO 7: Multicultural Competence:

Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity within Universities. Integrating multicultural awareness such as race, gender, physical 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 Mathematical/ Matlab to various scientific investigations, problem solving and interpretation.





Course Outcome

Sl. No.	Course Code	Course Name	Learning Outcomes
SEMESTER-I			
1.	CC 1	Inorganic Chemistry-I	<p>CO1. Identify and understand different the types of chemical bonding and to predict the shape of molecules based on various theories.</p> <p>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.</p> <p>CO3. To determine and predict the stepwise and overall formation constants and interactions in metal complexes.</p> <p>CO4. Explain the reaction mechanism of different Transition metal complexes.</p>
2.	CC 2	Physical Chemistry-I	<p>CO1. Know the fundamentals of polymers and Kinetic and mechanisms of polymerization and determination of the molar mass of polymers by different methods.</p> <p>CO2. Recall the basic concepts in electrochemistry and Evaluate problems based on the Debye – Hückel Limiting Law and apply theories in electrochemistry to analyse electrode kinetics.</p> <p>CO3. Calculate the rate expressions of parallel, opposing reactions and chain reactions. Explain the kinetics of fast reactions using various instrumentation techniques.</p> <p>CO4. Describe the partial molar properties, Chemical Potential, Fugacity and activity and its applications.</p> <p>CO5. Explain and illustrate statistical thermodynamic properties. Relate the role of quantum mechanics in statistical mechanics.</p>
3.	CC 3	Greek and Medieval Philosophy	<p>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.</p>



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			<p>CO2. Explain the concepts related to nomenclature, isomerism and stereochemistry in organic molecule and apply this in stereospecific and stereoselective organic Synthesis reactions.</p> <p>CO3. Describe transition states and reaction intermediates and to explain types of organic reactions and methods of determining reaction mechanisms.</p> <p>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.</p> <p>CO5. Explain the free radical substitution, aromatic electrophilic substitution, and elimination reactions and study the organic name reactions based on these concepts.</p>
4.	CC 4	Practical (Physical Chemistry)	<p>CO1. Outline and recall basic knowledge of fundamentals and application of organic and physical chemistry through chemical and scientific theories.</p> <p>CO2. Apply and justify the principles of chemical kinetics and thermodynamic through experiments.</p> <p>CO3. Perform the experiment and tabulate the observations.</p> <p>CO4. Justify the steps to prepare and standardize different solutions.</p> <p>CO5. Write the experimental results and interpret it.</p> <p>CO6. Use of safety responsibilities residing in working with chemicals. Illustrate safety measures related to experiments carried out.</p>
5.	AECC I	Environmental Sustainability and Swachha Bharat Abhiyaan Activities	<p>CO1. Students will get the knowledge about the environment and its components in which one survives.</p> <p>CO2. Students will learn how to take care of the surroundings in general. The field work during the completion of the course will make student responsible for their ecosystem.</p> <p>CO3. During the course, students will get to know about so many elements of general studies that can really help them in competitive examinations as well as in day to day activities.</p>



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SEMESTER-II			
6.	CC-5	Advances in Chemistry	<p>CO1. Explain different concepts of Nuclear Models and types of Nuclear Reactions and Discuss the applications of radio isotopes and radioactive waste disposal.</p> <p>CO2. Comprehend the types, properties and applications of nanomaterial and design innovative routes for nanomaterial synthesis and its application in green chemistry.</p> <p>CO3. Analyze and characterize the nanomaterial by advanced techniques such as XRD, SEM, and TEM.</p> <p>CO4. Underline basic concepts of solid-state chemistry and Classifications and applications Conductor, Semiconductor, and superconductor materials.</p> <p>CO5. Application of Chemistry in Cement, Paper and Pulp, and petroleum Industries.</p> <p>CO6. Explain Waste Management and application in recycling of plastic.</p>
7.	CC-6	Inorganic Chemistry-II	<p>CO1. Predict the spectroscopic ground states and describe electronic spectra of transition metal complexes.</p> <p>CO2. Identify the elements of symmetry, symmetry operations and point groups of molecules.</p> <p>CO3. Generalize the importance of Orthogonally 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.</p> <p>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.</p> <p>CO5. Describe structure and bonding in metal carbonyls and transition metal nitrosyls.</p> <p>CO6. Compare the structure and bonding in Boranes, Carboranes, metal clusters.</p>



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8.	CC 7	Physical Chemistry-II	<p>CO1. Summarize the understanding of basic concepts of quantum mechanics and concepts related to Quantum mechanical operators and physical quantities, and Schrödinger wave equations.</p> <p>CO2. Derive the expression for rotational and vibrational energy of a rigid diatomic molecule and apply to H-like atoms for the calculations of radial and angular wave functions.</p> <p>CO3. Explain the Approximate Methods in quantum mechanics and apply it to He-atom.</p> <p>CO4. Describe the Chemical Bonding using LCAO-MO theory and V.B. theory and its application to H₂⁺ ion and H₂ molecules.</p> <p>CO5. Explain Hückel Molecular Orbital Theory and apply conjugated systems.</p>
9.	CC 8	Organic Chemistry-II	<p>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.</p> <p>CO2. Explain principles of photochemistry, electronic excitation, hydrogen abstraction, Norrish type I and Norrish type II, reaction, Paterno-Buchi reaction.</p> <p>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.</p> <p>CO4. Comprehend the oxidation of alkenes, aromatic rings, alcohols, diols, ketones with various reagents.</p> <p>CO5. Describe Wegner-Meerwein rearrangements Neber, Curtius, Arndt Eistert reaction, Benzilic acid, Beckmann rearrangements and its application.</p>
10.	CC 9	Practical (Organic Practical)	<p>CO1. Describe mechanism, particulars regarding nature of reactants, reagents, products, safety measures, reaction conditions and work up of the experiment.</p> <p>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.</p> <p>CO3. Determine purity of the product.</p>



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			CO4. Perform experiments based on oxidation, reduction and condensation. Assemble apparatus for setting up the experiment.
11.	SEC 1	Skill Enhancement Course: Yogic Science	CO1. Students will learn the theoretical foundations of Yoga philosophy. CO2. Students will equip themselves with a fair number of yogic practices including meditative techniques. CO3. Yogic knowledge and practices will help the students to revitalise themselves and work with more attention.
SEMESTER-III			
12.	CC 10	Application of Spectroscopy	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.
13.	CC 11	Bio-inorganic Chemistry	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 metalloproteinase and iron-sulphur proteins.



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			<p>CO5. Describe the advantages and side effects of drugs. Compare the toxicity of different metals.</p> <p>CO6. Comprehend the role of coordination compounds in living systems.</p>
14.	CC 12	Environmental Chemistry and Green Chemistry	<p>CO1. Know the Environment and Composition of atmosphere.</p> <p>CO2. Learn the different aspects of pollutants in water and air and their analysis.</p> <p>CO3. Evaluate the industrial pollutants, understand their effects and adopt methods to reduce them.</p> <p>CO4. Describe principals and objectives of Green Chemistry and its applications. Use of renewable raw materials and biosynthesis, organic waste management.</p> <p>CO5. Design and execute organic synthesis using various green synthetic methods to reduce waste and hazardous material for a greener environment.</p> <p>CO6. Assess the impact of environmental pollution by measuring various testing parameters.</p>
15.	CC 13	Bio-organic Chemistry	<p>CO1. Describe concepts of classifications of enzymes, Co-enzyme and its functions.</p> <p>CO2. Explain basic concepts of bioorganic chemistry and bio chemical models and its applications in organic synthesis and industry applications.</p> <p>CO3. Know the classification structure determination and chemical synthesis of Carbohydrates.</p> <p>CO4. Know the classification, occurrence, biological importance, structure determination and synthesis of vitamins.</p> <p>CO5. Classify amino acids, peptides and proteins.</p>
16.	CC 14	Practical (Inorganic Chemistry)	<p>CO1. Separate and estimate the mixture of metal ions.</p> <p>CO2. Prepare inorganic complexes by green methods.</p> <p>CO3. Identify and match IR, electronic spectra of the complexes.</p> <p>CO4. Explain spin systems and propose correct structures from spectral data. Distinguish compounds using spectroscopic methods.</p>



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17.	AECC 2	Human values and professional ethics and gender sensitization	<p>CO1. Students will get the knowledge about values regarding humanity, gender equality and professionalism.</p> <p>CO2. Students will learn how to work together in an empathetic and unbiased way. The field work during the completion about the dignity of a human being.</p> <p>CO3. During the course, students will acquaint themselves with such notions of morality that they will find it more easy to work together in a group in a co-operative and productive way.</p>
SEMESTER-IV			
18.	EC-1a	Inorganic Chemistry Special	<p>CO1. List out various synthesis routes, stability and decomposition pathways of alkyls and aryls transition metals.</p> <p>CO2. Explain the synthesis and structural characteristics of carbenes and carbynes and their roles in organic synthesis.</p> <p>CO3. Discuss Homogeneous Catalysis and its examples and applications.</p> <p>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.</p> <p>CO5. Apply Group Theory in CFT and formation of hybrid orbitals in various transition metal complexes.</p> <p>CO6. Describe D and A process, fluxionally and dynamic equilibrium.</p>
19.	EC-1b	Physical Chemistry Special	<p>CO1. Explain Hartree Fock theory and semi empirical theories and calculations based in it.</p> <p>CO2. Describe Kinetics of catalytic reaction, Oscillatory reactions, condensed phase Reaction, Fast reactions, and electrode reactions and its applications.</p> <p>CO3. Explain molecular orbital theory for homonuclear, heteronuclear and polynuclear molecules using quantum rules.</p>



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			<p>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.</p> <p>CO5. Explain the Specific heat of solids using Einstein and Debye theory.</p> <p>CO6. Derive expressions for the most probable distribution of particles among the various energy levels according to Boltzmann, Bose-Einstein and Fermi- Dirac statistics.</p>
20.	EC-1c	Organic Chemistry Special	<p>CO1. Classify Terpenoids and Alkaloids. Explain structure, stereochemistry and synthesis of Terpenoids and Alkaloids.</p> <p>CO2. Classify the types of drugs and their role. Explain the therapeutic role of different classes of drugs.</p> <p>CO3. Identify the types of anaesthetics and diagnostic agents and describe method of identity lead for drug design.</p> <p>CO4. Define the drug receptor interactions and mode of action of different drugs and plan a retero synthetic strategy to synthesize drug molecules.</p> <p>CO5. Explain the principles involved in analyzing drug molecules and describe the methods to correlate structure to activity of drug candidates.</p> <p>CO6. Elucidate the structure and chemistry of heterocyclic compounds (5, 6, and 7-membered and fused rings).</p>
21.	EC-2a	Inorganic Chemistry Special Practical	<p>CO1. Analyze of Inorganic mixture qualitatively.</p> <p>CO2. Analyze of at least two metal ions in alloys and minerals.</p> <p>CO3. Determine transition metals and anions spectrophotometrically.</p>
22.	EC-2b	Physical Chemistry Special Practical	<p>CO1. Describe the theoretical principles and concepts related to experiments.</p> <p>CO2. Handle electrochemical instruments such as conductometer and potentiometer to carry out qualitative and quantitative estimations.</p> <p>CO3. Standardize/calibrate the apparatus and instrument.</p>



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			<p>CO4. Perform the experiment and tabulate the observations.</p> <p>CO5. Develop skills in procedures and instrumental methods applied in practical tasks. Interpret, conclude and write the experimental results.</p> <p>CO6. Represent the results of scientific work in oral, written, graphical and electronic formats.</p>
23.	EC-2c	Organic Chemistry Special Practical	<p>CO1. Discuss important applications of chemistry.</p> <p>CO2. Identify the functional groups of an organic molecule by characteristic tests.</p> <p>CO3. Identify and analyse the product obtained by different techniques. Demonstrate purification technique.</p> <p>CO4. Use of safety responsibilities residing in working with chemicals.</p> <p>CO5. Describe mechanism, particulars regarding nature of reactants, reagents, products, safety measures, reaction conditions and work up of the experiment.</p> <p>CO6. Examine progress of the reaction, analyse, confirm and tabulate results obtained.</p>
24.	GE	Generic Electives: Human Rights	<p>CO1. Students will get themselves familiar with the various aspects of human rights, their importance and the contribution of various thinkers in the conceptual development of the Human Rights.</p> <p>CO2. Students are expected to emulate whatever they have learned in the course in their daily lives.</p> <p>CO3. This course of human rights is almost inevitable to appear in the question paper of any competitive exams and interviews.</p>