JSS COLLEGE FOR WOMEN (AUTONOMOUS)

Saraswathipuram, Mysuru - 570009

PG DEPARTMENT OF CHEMISTRY

Course Outcomes (COs) for MSc in Chemistry

CHI HCT: 1.1. CONCEPT AND MODELS OF INORGANIC CHEMISTRY

Course Outcomes (COs)

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

CO1: Explain periodic trends, crystal structures, lattice energetics, molecular orbital theory, and molecular geometry using modern theoretical models.

CO2: Analyze acid-base behavior using contemporary theories and evaluate the role of non-aqueous solvents, ionic liquids, and supercritical fluids in inorganic reactions.

CO3: Interpret the chemistry of lanthanoids and actinoids, including extraction, separation, electronic properties, oxidation states, and their applications in advanced materials and nuclear science.

CHO HCT: 1.2. STEREOCHEMISTRY AND REACTION MECHANISM

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain stereochemistry, conformational analysis, optical and geometrical isomerism, and apply stereochemical principles to determine molecular configuration and reaction stereochemistry.

CO2: Interpret bonding in organic molecules using molecular orbital theory, explain aromaticity and reactive intermediates, and evaluate factors influencing the structure and reactivity of organic compounds.

CO3: Analyze the mechanisms and stereochemical aspects of nucleophilic substitution, electrophilic substitution, addition, and elimination reactions using kinetic and thermodynamic principles.

CHP HCT: 1.3. BASIC PHYSICAL CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the principles of chemical thermodynamics, including entropy, free energy, chemical potential, fugacity, activity, and thermodynamic properties of solutions.

CO2: Analyze reaction kinetics by applying theories of reaction rates, mechanisms of complex and fast reactions, and evaluate the influence of experimental parameters on reaction rates.

CO3: Interpret the behavior of electrolytic solutions and electrochemical systems using theories of ionic conductance, electrode processes, and electrochemical thermodynamics.

CHA HCT: 1.4. FUNDAMENTALS OF ANALYTICAL CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the principles of analytical chemistry, statistical data analysis, error evaluation, and method validation for reliable chemical measurements.

CO2: Apply acid-base, precipitation, complexometric, and redox titrimetric methods for quantitative analysis and interpret titration data accurately.

CO3: Analyse the principles, instrumentation, and applications of chromatographic techniques, including GC, HPLC, and ion-exchange chromatography, for the separation and identification of chemical species.

CHA SCP: 1.1/2.1. ANALYTICAL CHEMISTRY PRACTICALS-1

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Perform acid-base, non-aqueous, precipitation, complexometric, and redox titrations accurately for the quantitative analysis of pharmaceutical, environmental, and industrial samples.

CO2: Apply instrumental analytical techniques such as pH-metry, conductometry, potentiometry, spectrophotometry, flame photometry, gas chromatography, HPLC, and ion-exchange chromatography for qualitative and quantitative analysis.

CO3: Analyze and interpret experimental data using appropriate calculations, evaluate analytical accuracy and precision, and prepare laboratory reports following good laboratory practices.

CO4: Demonstrate competency in analytical method selection, safe handling of chemicals and instruments, and quality control procedures for solving real-world analytical problems.

CHi SCP: 1.2/2.2. INORGANIC CHEMISTRY PRACTICALS-I

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Perform quantitative inorganic analysis using volumetric, gravimetric, and complexometric methods for the determination of metals and inorganic ions in ores, alloys, and commercial samples.

CO2: Apply spectrophotometric and chromatographic techniques for the quantitative estimation and separation of inorganic species in industrial and environmental samples.

CO3: Systematically identify cations and anions in unknown inorganic mixtures using semimicro qualitative analysis and interpret analytical observations accurately.

CO4: Demonstrate proficiency in laboratory techniques, data analysis, quality assurance, and safe laboratory practices while preparing scientific laboratory records and reports.

CHO SCP: 1.3/2.3. ORGANIC CHEMISTRY PRACTICALS-I

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Perform multistep organic syntheses involving important organic reactions and demonstrate proficiency in purification and isolation of organic compounds.

CO2: Apply qualitative analytical methods to separate binary organic mixtures, identify functional groups, and prepare suitable solid derivatives for compound characterization.

CO3: Interpret experimental observations, calculate percentage yield, evaluate purity, and maintain accurate laboratory records following Good Laboratory Practices (GLP).

CO4: Demonstrate safe handling of chemicals, laboratory equipment, and waste disposal practices while developing problem-solving and experimental skills relevant to organic chemistry research and industry.

CHP SCP: 1.4/2.4. PHYSICAL CHEMISTRY PRACTICALS -1

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Perform experiments in chemical kinetics, thermodynamics, and phase equilibrium to determine reaction rates, activation energy, thermodynamic parameters, and physicochemical properties.

CO2: Apply electrochemical techniques such as conductometry, potentiometry, pH-metry, and coulometry for quantitative analysis and determination of equilibrium and dissociation constants.

CO3: Utilize spectrophotometric and physicochemical methods to analyze molecular systems, verify theoretical principles, and interpret experimental data with accuracy and precision.

CO4: Demonstrate proficiency in laboratory techniques, data analysis, scientific reporting, and safe laboratory practices while solving problems relevant to physical chemistry, materials science, and environmental research.

SOFT CORE PAPERS

CHA SCT: 1.1/2.1.APPLIED ANALYSIS

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Apply analytical techniques for the determination of physicochemical properties, nutrients, and contaminants in soil samples and evaluate their significance in agriculture and environmental management.

CO2: Analyze the properties and quality of solid, liquid, and gaseous fuels using standard analytical methods and interpret combustion and calorific value data for industrial applications.

CHI SCT: 1.2/2.2. CHEMISTRY OF SELECTED ELEMENTS

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the chemistry of hydrogen, hydrides, and the Group 1 and Group 2 elements, including their occurrence, extraction, properties, compounds, and industrial applications.

CO2: Analyze the chemistry of Group 15, Group 17, and Group 18 elements with emphasis on their structures, bonding, oxidation states, redox behavior, and reactivity.

CHO SCT: 1.3/2.3. CHEMISTRY OF NATURAL PRODUCTS-I

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the classification, structure, synthesis, and biological significance of lipids, prostaglandins, and terpenoids, and relate their chemical properties to biological functions.

CO2: Analyze the chemistry, biosynthesis, and structural elucidation of terpenoids, flavonoids, and iso flavonoids using established organic chemistry principles.

CHP SCT: 1.4/2.4. BIOPHYSICAL CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the physicochemical principles governing biological systems, including electrophoresis, membrane transport, osmotic phenomena, viscosity, surface tension, and sedimentation techniques.

CO2: Analyze the role of biophysical properties in biological functions such as protein separation, diffusion, respiration, muscle contraction, blood flow, and cellular membrane transport.

SECOND SEMESTER

CHI HCT: 2.1. COORDINATION CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the synthesis, geometries, stability, and bonding of coordination compounds using Crystal Field Theory and Molecular Orbital Theory.

CO2: Analyze the electronic spectra, magnetic properties, and infrared spectral characteristics of coordination compounds to interpret their electronic structure and bonding.

CO3: Evaluate substitution reactions, stereochemical changes, electron transfer processes, and reaction mechanisms in coordination complexes using kinetic and mechanistic principles.

CHO HCT: 2.2. SYNTHETIC ORGANIC CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the mechanisms, selectivity, and synthetic applications of oxidation and reduction reactions using classical and modern organic reagents.

CO2: Apply the principles of organoboron chemistry, advanced synthetic reagents, and transition metal-catalyzed reactions for functional group transformations and carbon-carbon bond formation.

CO3: Evaluate green chemistry principles and sustainable synthetic methodologies for developing environmentally benign organic reactions and industrial processes.

CHP HCT:2.3. PRINCIPLES OF PHYSICAL CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the fundamental principles of quantum mechanics, solve Schrödinger wave equations for simple systems, and interpret quantum mechanical models of atoms and molecules.

CO2: Apply the concepts of statistical thermodynamics and phase rule to evaluate thermodynamic properties, molecular distributions, equilibrium phenomena, and phase equilibria in chemical systems.

CO3: Analyze polymerization mechanisms, molecular weight determination methods, thermal behavior, and solution properties of polymers and relate them to material performance and industrial applications.

CHG HCT: 2.4. MOLECULAR SYMMETRY AND SPECTROSCOPY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain molecular symmetry, point groups, group representations, and character tables, and apply group theory to chemical bonding, molecular orbitals, crystal field theory, and vibrational spectroscopy.

CO2: Analyze rotational, vibrational, infrared, and Raman spectra to determine molecular structure, bonding, symmetry, and molecular properties.

CO3: Interpret UV-Visible and resonance Raman spectra for qualitative and quantitative analysis, electronic transitions, and structural characterization of chemical compounds.

OPEN ELECTIVE (FOR NON-CHEMISTRY STUDENTS ONLY)

CH OET: 2.1/3.1- CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the fundamental concepts of chemical periodicity, chemical bonding, molecular structure, acids and bases, and relate them to the properties and behavior of chemical substances.

CO2: Describe the structure, properties, and applications of important natural and synthetic compounds, and recognize the significance of chemistry in biological systems, healthcare, agriculture, and industry.

CO3: Apply the principles of thermodynamics, chemical kinetics, ionic equilibria, solutions, and electrochemistry to interpret simple chemical processes and solve basic quantitative problems.

THIRD SEMESTER

CHI HCT: 3.1. ADVANCED INORGANIC CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the preparation, structure, bonding, and reactivity of organometallic compounds, transition metal carbonyls, ferrocene, metal-carbene complexes, and complexes containing π-bonded ligands.

CO2: Analyze the principles and mechanisms of homogeneous and heterogeneous catalysis and evaluate the applications of organometallic catalysts in industrial, biological, and medicinal chemistry.

CO3: Interpret the structure, bonding, electron counting, and applications of boranes, carboranes, phosphazenes, metal carbonyl clusters, silicates, and silicones using modern concepts of inorganic chemistry.

CHO HCT: 3.2. ORGANOMETALLIC AND PHOTOCHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the principles, mechanisms, and stereochemical aspects of photochemical and pericyclic reactions, and predict the outcome of these reactions using orbital symmetry and frontier molecular orbital concepts.

CO2: Analyze the preparation, reactivity, and synthetic applications of organometallic reagents in carbon-carbon bond formation, functional group transformations, and natural product synthesis.

CO3: Apply the concepts of asymmetric synthesis, chiral auxiliaries, chiral reagents, and asymmetric catalysts to design enantioselective synthetic pathways and evaluate stereochemical outcomes in modern organic synthesis.

CHP HCT: 3.3. ADVANCED PHYSICAL CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the principles of homogeneous catalysis, enzyme kinetics, linear free energy relationships, and kinetic isotope effects, and interpret their applications in chemical and biochemical processes.

CO2: Analyse electrochemical systems, batteries, electroplating, and corrosion mechanisms, and evaluate methods for corrosion prevention and electrochemical energy conversion.

CO3: Apply the principles of X-ray crystallography and crystal defect analysis to determine crystal structures and correlate crystal imperfections with the physical properties of materials.

CHG HCT: 3.4. CHEMICAL SPECTROSCOPY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the principles, instrumentation, and spectral features of NMR, ESR, NQR, Mössbauer, photoelectron, IR, and mass spectroscopic techniques for molecular characterization.

CO2: Interpret and correlate spectroscopic data to determine molecular structure, bonding, stereochemistry, functional groups, oxidation states, and conformational behavior of organic, inorganic, and coordination compounds.

CO3: Integrate information obtained from multiple spectroscopic techniques to solve complex structural elucidation problems and evaluate their applications in chemical research, pharmaceuticals, materials science, and analytical chemistry.

CHA SCP: 3.1/4.1. ANALYTICAL CHEMISTRY PRACTICALS-II

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Perform quantitative chemical analyses using classical and instrumental analytical techniques, including titrimetry, spectrophotometry, potentiometry, conductometry, polarography, and coulometry, following standard laboratory procedures.

CO2: Analyze environmental, pharmaceutical, biological, and agricultural samples, interpret experimental results, evaluate analytical accuracy and precision, and prepare scientific laboratory reports.

CHI SCP:3.2/4.2. INORGANIC CHEMISTRY PRACTICALS-II

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Perform quantitative inorganic analyses using classical and instrumental techniques, including electrogravimetry, spectrophotometry, flame photometry, polarography, and solvent extraction with accuracy and precision.

CO2: Synthesize, characterize, and evaluate coordination compounds using spectroscopic, magnetic, conductometric, and analytical methods, and interpret their structural and bonding properties.

CHO SCP: 3.3/4.3. ORGANIC CHEMISTRY PRACTICALS-II

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Perform the isolation, purification, and quantitative estimation of natural products and organic compounds using appropriate extraction, chromatographic, and analytical techniques.

CO2: Interpret UV, IR, NMR, and Mass spectra for the structural elucidation and identification of organic compounds and correlate spectroscopic data with molecular structure.

CHP SCP: 3.4/4.4. PHYSICAL CHEMISTRY PRACTICALS

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Perform experiments involving chemical kinetics, electrochemistry, phase equilibria, and corrosion studies to determine reaction orders, activation parameters, equilibrium constants, and corrosion inhibition efficiency using appropriate experimental methods.

CO2: Apply conductometric, potentiometric, pH-metric, and spectrophotometric techniques for quantitative chemical analysis, evaluate experimental data, and interpret physicochemical properties of chemical systems.

SOFT CORE PAPERS

CHA SCT: 3.1. ELECTROCHEMICAL METHODS OF CHEMICAL ANALYSIS

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the principles, instrumentation, and working of electroanalytical techniques including potentiometry, coulometry, electrogravimetry, voltammetry, and polarography, and evaluate their applications in qualitative and quantitative chemical analysis.

CO2: Apply electrochemical methods, sensors, and biosensors for the analysis of chemical, environmental, pharmaceutical, and biological samples, and interpret electroanalytical data for research and industrial applications.

CHI SCT: 3.2. FRONTIERS IN INORGANIC CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the synthesis, structure, properties, and characterization of advanced materials, including ceramics, silicates, molecular materials, nanomaterials, and nanocomposites, and correlate their structure with functional properties.

CO2: Evaluate the fabrication techniques and applications of functional and nanostructured materials in energy storage, electronics, catalysis, sensors, biomedical devices, and sustainable technologies.

CHO SCT: 3.3. CHEMISTRY OF NATURAL PRODUCTS-II

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the classification, isolation, biosynthesis, structural elucidation, and biological significance of alkaloids and correlate their chemical structures with pharmacological properties.

CO2: Analyze the chemistry, synthesis, structural features, and biological functions of steroids, including hormones and sterols, and evaluate their pharmaceutical and biomedical applications.

CHP SCT: 3.4. MATERIALS CHEMISTRY

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

CO1: Explain the synthesis, structure, properties, characterization, and theoretical concepts of nanomaterials, including metal nanoparticles, carbon nanostructures, quantum dots, graphene, and semiconductor nanomaterials.

CO2: Analyze the principles and applications of semiconductors, superconductors, and nanomaterials in modern technologies such as electronics, energy storage, catalysis, sensing, biomedical devices, and advanced functional materials.

FOURTH SEMESTER

CHI HCT: 4.1. BIOINORGANIC CHEMISTRY

Course Outcomes (COs)

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

CO1: Explain the structure, function, and biological significance of metal ions, metalloproteins, metalloenzymes, and metal-mediated biochemical processes in living systems.

CO2: Analyze the mechanisms of oxygen transport, electron transfer, ion transport, bioenergetics, and the role of metal-containing enzymes in biological reactions.

CO3: Evaluate the applications of inorganic chemistry in medicine, including metal-based therapeutics, radiopharmaceuticals, anticancer drugs, and strategies for the treatment of metal toxicity.

CHO HCT: 4.2. HETEROCYCLIC AND BIOORGANIC CHEMISTRY

Course Outcomes (COs)

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

CO1: Explain the nomenclature, structure, synthesis, reactivity, and synthetic applications of important heterocyclic compounds and relate their properties to pharmaceutical and biological applications.

CO2: Analyze the chemistry, stereochemistry, biosynthesis, structural elucidation, and biological significance of carbohydrates, amino acids, peptides, proteins, and nucleic acids.

CO3: Apply concepts of protecting group chemistry, peptide and oligonucleotide synthesis, and biomolecular structure–function relationships to solve problems in organic synthesis, medicinal chemistry, and chemical biology.

CHP HCT: 4.3. NUCLEAR, RADIATION AND PHOTOCHEMISTRY

Course Outcomes (COs)

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

CO1: Explain the principles of photochemistry, radiation chemistry, and nuclear chemistry, including electronic excitation, photochemical reactions, radioactive decay, nuclear reactions, and radiation detection techniques.

CO2: Analyze photochemical and radiochemical processes by applying concepts such as quantum yield, fluorescence, phosphorescence, photocatalysis, isotope tracer techniques, radiation dosimetry, and radiochemical separation methods to solve chemical and environmental problems.

CO3: Evaluate the applications of photochemical, radiochemical, and nuclear techniques in environmental remediation, medical diagnostics, industrial processes, isotope analysis, and nuclear power generation while recognizing the importance of radiation safety and protection.

SOFT CORE

CHA SCT: 4.1 CHEMICAL METHODS OF ANALYSIS

Course Outcomes (COs)

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

CO1: Explain the principles, instrumentation, operation, and applications of automated analytical techniques, flow analysis systems, and sample preparation methods used for the analysis of industrial, environmental, and clinical samples.

CO2: Apply appropriate analytical methods for the preparation, qualitative and quantitative analysis, and interpretation of real and clinical samples while evaluating method accuracy, reliability, and quality assurance in analytical measurements.

CHI SCT: 4.2. BIOINORGANIC PHOTOCHEMISTRY

Course Outcomes (COs)

CO1: Explain the fundamental concepts of light–matter interactions, electronic excited states, photophysical deactivation pathways, and photochemical reactions involving inorganic and coordination compounds.

CO2: Apply the principles of bioinorganic photochemistry to understand and analyze applications in biosensing, photodynamic therapy, antimicrobial treatments, nanomedicine, photoprotection, and photocatalytic environmental remediation.

CHO SCT: 4.3. Natural Products and Medicinal Chemistry

Course Outcomes (COs)

CO1: Explain the isolation, structural elucidation, synthesis, and biological importance of carotenoids and vitamins, including their role in human health and biochemical processes.

CO2: Analyze the principles of medicinal chemistry, drug action mechanisms, structure–activity relationships, synthesis, and therapeutic applications of important pharmaceutical agents.

CHP SCT: 4.4. QUANTUM CHEMISTRY AND BIOSENSORS

Course Outcomes (COs)

CO1: Apply quantum mechanical principles and molecular orbital theories to explain molecular structure, bonding, electronic configurations, and properties of chemical systems.

CO2: Explain the working principles, components, and applications of various biosensors for the detection and analysis of biological, environmental, and pharmaceutical analytes.