MSc. CHEMISTRY

PROGRAMME AND COURSE OUTCOMES

MSc. Chemistry

Programme Outcomes

PO1	Develop a better understanding of the current chemical principles, methods and theories with the ability to critically analyse at an advanced level.
PO2	Acquire solid knowledge of classical and modern experimental techniques and interpretation of results; thereby acquire the ability to plan and carry out independent projects.
PO3	Develop the qualities of time management and organization, planning and executing experiments.
PO4	Have a good level of awareness of the problems associated with health, safety and environment.
PO5	Understand how chemistry relates to the real world and be able to communicate their understanding of chemical principles to a lay audience and as well apply the knowledge when situation warrants.
PO6	Learn to search scientific literature and databases, extract and retrieve the required information and apply it in an appropriate manner.
PO7	Demonstrate proficiency in undertaking individual and/or team-based laboratory investigations using appropriate apparatus and safe laboratory practices.
PO8	Develop analytical solutions to a diversity of chemical problems identified from application contexts; critically analyse and interpret qualitative & quantitative chemical information's.
PO9	Set the scene to make use of the wide range of career options open to chemistry graduates.

Course Outcomes

Semester 1

COURSE TYPE	CORE
COURSE NAME	INORGANIC CHEMISTRY I
COURSE CODE	CH 211
HOURS	90 H (5 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Employ crystal field theory in analysing the splitting of d orbitals in octahedral, tetragonal, square planar, tetrahedral, trigonal bipyramidal and square pyramidal fields, calculate Crystal Field Stabilization Energy and Interpret Octahedral Site Stabilization Energy.
CO2	Apply Jahn-Teller theorem and demonstrate evidence for JT effect, static and dynamic JT effect.
CO3	Illustrate MOT for octahedral and tetrahedral complexes with and without pi bonds and construct MO diagrams.
CO4	Critically evaluate data from a variety of analytical chemistry techniques and apply knowledge of the statistical analysis of data.
CO5	Interpret complexometric titrations, redox titrations, gravimetric titrimetry and titrations in non-aqueous solvents.
CO6	Apply TG, DTA and DSC in the study of metal complexes.
CO7	Explain the functioning of the frontier materials in inorganic chemistry like Solid Electrolytes, Solid oxide fuel cells, Rechargeable battery materials, Molecular materials and fullerides.
CO8	Explain the preparation, properties and structure of isopoly acids of Mo, W and V and heteropoly acids of Mo and W.
CO9	Explain preparation and properties of xenon fluorides, and noble gas compounds, aluminosilicates, zeolites and silicones and identify the importance of shape selectivity.
CO10	Identify the chemical processes occurring naturally in earth's atmospheric, aquatic and soil environments and evaluates the impacts of human perturbations to these processes.

COURSE TYPE	CORE
COURSE NAME	ORGANIC CHEMISTRY I
COURSE CODE	CH 212
HOURS	90 H (5 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Write down the IUPAC name of polycyclic, spirocyclic and heterocyclic compounds and draw the structures from the IUPAC name of these compounds.
CO2	Determine R and S, P and M, E and Z configuration of compounds with chiral centres, biphenyls, allenes, spiranes and draw the configurations in dash and wedge formula, or zig –zag configurations.
CO3	Detect prochirality in a compound and explain relevance of prochirality.
CO4	Explain chiral centre, chiral axis and chiral plane with examples, stability of conformations, stereoselective and stereospecific reactions.
CO5	Calculate Cotton effect of a compound from its structure and configuration.
CO6	Explain different methods for generation of free radical and different types of free radical reactions- Predict the products in a free radical reaction.
CO7	Describe different types mechanism of substitution, elimination, hydrolysis and addition reactions.
CO8	Differentiate the rate, mechanism and stereochemistry influenced by solvent, substrate structure, intermediate stability.
CO9	Predict the products or reactants or reagents in selected types of reactions.
CO10	Design the mechanism of selected reactions.

COURSE TYPE	CORE
COURSE NAME	PHYSICAL CHEMISTRY I
COURSE CODE	CH 213
HOURS	90 H (5 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Outline the development of quantum mechanics and its tools and apply them in determining the wave functions and energies of moving particles.

CO2	Recognize the nature of adsorption and propose theories and choose theoretical and instrumental methods of measurements of surface property.
CO3	Understand theory and mechanism of catalytic action.
CO4	Correlate thermodynamic properties and apply them in systems.
CO5	Understand theories, mechanism and, kinetics of reactions and solve numerical problems.
CO6	Identify point groups and construct character table and predict hybridisation and spectral properties of molecules.

COURSE TYPE	CORE
COURSE NAME	INORGANIC CHEMISTRY PRACTICALS I
COURSE CODE	CH 214
HOURS	125 H (3 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
CO2	Estimate volumetrically the concentration of Zn, Mg and Ni using EDTA and the volumetric estimation of Fe.
CO3	Estimate volumetrically the hardness of water and concentration of Ca in water samples using EDTA.
CO4	Estimate colorimetrically the concentration of Chromium – (using Diphenyl carbazide), Iron (using thioglycollic acid), Iron (using thiocyanate), Manganese (using potassium periodate), Nickel (using dimethyl glyoxime).
CO5	Carry out the preparation of the metal complexes Potassium trioxalatochromate(III), Tetraammoniumcopper (II) sulphate, Hexamminecobalt (III) chloride.
CO6	Record the UV spectra, IR spectra, magnetic susceptibility, TG, DTA and XRD of the complexes prepared.

COURSE TYPE	CORE
COURSE NAME	ORGANIC CHEMISTRY PRACTICALS I
COURSE CODE	CH 215
HOURS	125 H (3 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
CO2	Determine the correct method for separation of a binary mixture and make the separated compounds in pure form.
CO3	Develop thin layer chromatogram of a compound and determine its purity.
CO4	Separate two compounds by column chromatography.
CO5	Utilize the synthetic procedures and reagents to convert a compound into another. Differentiate the products by spectroscopic methods.
CO6	Use green chemical principles in the synthesis.
CO7	Solve GC MS and LC MS of a compound to ascertain purity and identity, apply the basic principles

COURSE TYPE	CORE
COURSE NAME	PHYSICAL CHEMISTRY PRACTICALS I
COURSE CODE	CH 216
HOURS	125 H (3 HOURS/WEEK)
COURSE OUTCOME	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
CO2	Construct the Freundlich and Langmuir isotherms for adsorption of acetic/oxalic acid on active charcoal/alumina and determine the concentration of acetic/ oxalic acid
CO3	Determine the rate constant, Arrhenius parameters, rate constant and concentration using kinetics
C04	Construct the phase diagram and determine the composition of an unknown mixture
CO5	Construct the ternary phase diagram of acetic acid chloroform-water system and out the procedure in an unfamiliar situation to find out the composition of given homogeneous mixture.
CO6	Construct the tie-line in the ternary phase diagram of acetic acid chloroform-water system
CO7	Determine distribution coefficient using distribution law.

CO8	Determine the equilibrium constant employing the distribution law.
CO9	Determine the coordination number of Cu2+ in copper-ammonia complex.
CO10	Determine Kf of solid solvent, molar mass of non-volatile solute, mass of solvent and composition of given solution
CO11	Determine KT of salt hydrate, molar mass of solute, mass of salt hydrate and composition of given solution.
CO12	Determine surface tension and parachor of liquids.
C013	Ascertain the relationship between surface tension with concentration of a liquid and use this to find out the composition of given homogeneous mixture.
CO14	Determine the concentration of given strong acid/alkali.
CO15	Determine the heat of ionisation of acetic acid.
CO16	Determine the heat of displacement of Cu2+ by Zn.

Semester 2

COURSE TYPE	CORE
COURSE NAME	INORGANIC CHEMISTRY II
COURSE CODE	CH 221
HOURS	90 H (5 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Obtain the term symbols of dn system and determine the splitting of terms in weak and strong octahedral and tetrahedral fields.
CO2	Explain the correlation diagrams for dn and d10-n ions in octahedral and tetrahedral fields and interprets electronic spectra of complexes.
CO3	Applies magnetic measurements in the determination of structure of transition metal complexes.
CO4	Relates crystalline structure to X-ray diffraction data and the reciprocal lattice and explains the diffraction methods
CO5	Explains crystal defects.
CO6	Elaborates the structure of selected compounds of AX, AX2, AmX2, ABX3 and spinels.
CO7	Explains the electronic structure of solids using free electron theory and band theory.
CO8	Understands the differences in semiconductor and dielectric materials and their electrical and optical properties
CO9	Explain the structure and reactions of S–N, P–N, B–N, S–P compounds and boron hydrides.
CO10	Analyse the topological approach to boron hydride structure and estimates styx numbers and apply Wade's rules in borane and carboranes.
CO11	Identify the electronic configurations and term symbols of lanthanides and actinides.

CO12	Sketches the shapes of f orbital and shows their splitting in cubic ligand field.
CO13	Elaborates the importance of the beach sands of Kerala and their important components.

COURSE TYPE	CORE
COURSE NAME	ORGANIC CHEMISTRY II
COURSE CODE	CH 222
HOURS	90 H (5 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Discuss the fundamentals, operating principles and instrumentation of separation techniques.
CO2	Differentiate the principle and applications of phase transfer catalysis with examples.
CO3	Describe the various methods of determining reaction mechanisms and basic thermodynamic principles of organic reactions.
CO4	Explain the Hammet parameters of reaction and design an experiment to confirm the mechanism of a reaction.
CO5	Identify different types of rearrangement reactions, determine the product of the reaction applying migratory aptitude, and reproduce the evidences for the mechanism of the reaction.
CO6	Understand that the outcomes of pericyclic reactions may be understood in terms of frontier orbital interactions, correlation diagram, Mobius and Huckel approach.
CO7	Recall and define the various types of pericyclic reaction; define such terms as ‘conrotatory’, ‘suprafacial’.
CO8	Predict and rationalise the outcomes of pericyclic reactions including stereospecificity, regioselectivity, and stereoselectivity.
CO9	State the synthetic importance of the above cycloaddition and rearrangement reactions, and give disconnections of target compounds corresponding to these reactions.
CO10	Describe the fate of excited molecule based on Jabolonoski diagram, predict the course of an organic photochemical reaction and identify the product with the type of functional group.

CO11	Propose synthetic routes to a variety of molecules, starting from simple precursors with correct stereochemistry and reagents of selected reactions.

COURSE TYPE	CORE
COURSE NAME	PHYSICAL CHEMISTRY II
COURSE CODE	CH 223
HOURS	90 H (5 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Apply quantum mechanical principles in solving both real and imaginary spherical harmonics systems-multi electron systems and analyse spectral lines.
CO2	Describe and explain the physical and chemical principles that underlie molecular structure determination techniques like microwave, vibrational, Raman and electronic spectroscopy.
CO3	Predict likely spectral characteristics of given molecular species, and be able to rationalise those characteristics on the basis of structural and electronic arguments.
CO4	Acquire knowledge of basics of statistical mechanics and compare statistical methods.
CO5	Understand and apply of theories of heat capacity.
CO6	Understand theories of electrolytes and electrochemical reactions.
CO7	Ascertain the application of electrochemistry in industrial fields.
CO8	Understand the theories and applications behind various types of analytical techniques in electrochemistry.
CO9	Acquire skill in solving numerical problems.

COURSE TYPE	CORE
COURSE NAME	INORGANIC CHEMISTRY PRACTICALS I
COURSE CODE	CH 214
HOURS	125 H (3 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.

CO2	Estimate volumetrically the concentration of Zn, Mg and Ni using EDTA and the volumetric estimation of Fe.
CO3	Estimate volumetrically the hardness of water and concentration of Ca in water samples using EDTA.
CO4	Estimate colorimetrically the concentration of Chromium – (using Diphenyl carbazide), Iron (using thioglycollic acid), Iron (using thiocyanate), Manganese (using potassium periodate), Nickel (using dimethyl glyoxime).
CO5	Carry out the preparation of the metal complexes Potassium trioxalatochromate (III), Tetraammoniumcopper (II) sulphate, Hexamminecobalt (III) chloride.
CO6	Record the UV spectra, IR spectra, magnetic susceptibility, TG, DTA and XRD of the complexes prepared.

COURSE TYPE	CORE
COURSE NAME	ORGANIC CHEMISTRY PRACTICALS I
COURSE CODE	CH 215
HOURS	125 H (3 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
CO2	Determine the correct method for separation of a binary mixture and make the separated compounds in pure form.
CO3	Develop thin layer chromatogram of a compound and determine its purity.
CO4	Separate two compounds by column chromatography.
CO5	Utilize the synthetic procedures and reagents to convert a compound into another. Differentiate the products by spectroscopic methods.
CO6	Use green chemical principles in the synthesis.
CO7	Solve GC MS and LC MS of a compound to ascertain purity and identity, apply the basic principles

COURSE TYPE	CORE
COURSE NAME	PHYSICAL CHEMISTRY PRACTICALS I

COURSE CODE	CH 216
HOURS	125 H (3 HOURS/WEEK)
COURSE OUTCOMES	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
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CO3	Determine the rate constant, Arrhenius parameters, rate constant and concentration using kinetics
CO4	Construct the phase diagram and determine the composition of an unknown mixture
CO5	Construct the ternary phase diagram of acetic acid chloroform-water system and out the procedure in an unfamiliar situation to find out the composition of given homogeneous mixture.
CO6	Construct the tie-line in the ternary phase diagram of acetic acid chloroform-water system
CO7	Determine distribution coefficient using distribution law.
CO8	Determine the equilibrium constant employing the distribution law.
CO9	Determine the coordination number of Cu2+ in copper-ammonia complex.
CO10	Determine Kf of solid solvent, molar mass of non-volatile solute, mass of solvent and composition of given solution
CO11	Determine KT of salt hydrate, molar mass of solute, mass of salt hydrate and composition of given solution.
CO12	Determine surface tension and parachor of liquids.
CO13	Ascertain the relationship between surface tension with concentration of a liquid and use this to find out the composition of given homogeneous mixture.
CO14	Determine the concentration of given strong acid/alkali.
CO15	Determine the heat of ionisation of acetic acid.
CO16	Determine the heat of displacement of Cu2+ by Zn.

Semester 3

COURSE TYPE	CORE
COURSE NAME	INORGANIC CHEMISTRY III
COURSE CODE	CH 231
HOURS	90
COURSE OUTCOMES	
CO1	Demonstrate knowledge of advanced content in the areas of inorganic chemistry such as in organometallic compounds, bioinorganic compounds, spectroscopic methods in inorganic Chemistry and nuclear chemistry.
CO2	Examine the bonding in simple and polynuclear carbonyls with and without bridging and complexes with linear π donor ligands.
CO3	Explain the structure and bonding of ferrocene and dibenzenechromium with the help of MO theory.
CO4	Understand fundamental reaction types and mechanisms in organometallics and to employ them to understand selected catalytic processes in industry.
CO5	Contrasts the thermodynamic and kinetic stability of complexes, analyses the factors affecting stability of complexes and explains the methods of determining stability constants.
CO6	classifies ligand substitution reactions and explains its kinetics and various mechanisms.
CO7	Analyze the chemical and physical properties of metal ions responsible for their biochemical action as well as the techniques frequently used in bioinorganic chemistry such as oxygen transport, e-transfer, communication, catalysis, transport, storage etc.
CO8	Explain the principles of spectroscopic methods employed in inorganic chemistry and their applications in the study of metal complexes.
CO9	Demonstrate a knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions, counting techniques.
CO10	Evaluate the role of nuclear chemistry to find the most suitable measures, administrative methods and industrial solutions to ensure sustainable use of the world's nuclear resources.

COURSE TYPE	CORE
COURSE NAME	ORGANIC CHEMISTRY III
COURSE CODE	CH 232
HOURS	90
COURSE OUTCOMES	
CO1	Describe and explain the physical and chemical principles that underlie molecular structure determination techniques such as UV-visible, IR, mass and NMR spectroscopy.
CO2	apply knowledge of molecular structure determination using UV-visible, IR, mass and NMR spectroscopic techniques to identify and/or characterise chemical compounds from experimental data.
CO3	Calculate λmax of a compound, apply IR frequency table to determine the functional groups present in the molecule, interpret mass spectrum of compound from fragmentation.
CO4	Predict likely spectral characteristics of given molecular species; solve the structures of unknown molecules using appropriate spectroscopic techniques.
CO5	Devise a 2 D NMR of a compound based on learned principles and solve the structure of a compound based on NMR data.
CO6	Discuss organic transformations with organometallic compounds and predict the products of the reactions.
CO7	Propose the retro synthetic pathways to a variety of molecules
CO8	Propose mechanisms for chemical reactions, given starting materials, reagents, conditions, and/or products.
CO9	Compare the reactions and mechanism and determine the products of a selected set of reactions; identify protecting group strategies.
CO10	Devise combinatorial method to create a library of compounds.
CO11	Give examples of stereoselective, regioselective and chemoselective reductions and oxidations.

COURSE TYPE	CORE
COURSE NAME	PHYSICAL CHEMISTRY III
COURSE CODE	CH 233
HOURS	90
COURSE OUTCOMES	
CO1	Understand the theories of chemical bonding and their application with help of approximate methods predict the nature of orbitals and molecular spectra.
CO2	Compare MO and VBT
CO3	Understand the properties of gases and liquids and the nature of the intermolecular forces in them.
CO4	Describe the principle behind the determination of surface tension and coefficient of viscosity.
CO5	Describe and explain the physical and chemical principles that underlie molecular structure determination techniques like NMR, ESR, Mossbauer, NQR and PES spectroscopy.
CO6	Judge the degrees of freedom of systems and understand theories of irreversible thermodynamic systems.
CO7	Understand the quantum mechanical and non-quantum mechanical methods in computational chemistry, potential energy surface and basis functions.
CO8	Write the Z matrix of simple molecules.
CO9	Acquire skill in solving numerical problems.

COURSE TYPE	CORE
COURSE NAME	INORGANIC CHEMISTRY PRACTICALS – II
COURSE CODE	CH 234
HOURS	125
COURSE OUTCOMES	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
CO2	Estimate a simple mixture of ions (involving quantitative separation) by volumetric and gravimetric methods.
CO3	Perform COD, BOD, DO, TDS analysis.

CO4	Predict likely spectral characteristics of given metal compexes solve the structures of unknown metal compexes using appropriate spectroscopic techniques and magnetic measurements.
CO5	Analyse the XRD of simple substances.
CO6	Interpret TG and DTA curves

COURSE TYPE	CORE
COURSE NAME	ORGANIC CHEMISTRY PRACTICALS – II
COURSE CODE	CH 235
HOURS	125
COURSE OUTCOMES	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
CO2	Predict likely spectral characteristics of given molecular species; solve the structures of unknown molecules using appropriate spectroscopic techniques
CO3	Develop paper chromatogram of a compound and determine its purity.
CO4	Estimate quantitatively the Aniline, Phenol, glucose, Ascorbic acid and Aspirin in a sample Ap 7, 8 5.
CO5	Estimate colorimetricaly paracetamol, protein and ascorbic acid
CO6	Use green chemical principles in the synthesis

COURSE TYPE	CORE
COURSE NAME	PHYSICAL CHEMISTRY PRACTICALS – II
COURSE CODE	CH 235
HOURS	125
COURSE OUTCOMES	
CO1	Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
CO2	Determine the strength of strong/ weak acids by conductometric titrations.
CO3	Verify Onsager equation and Kohlraush's law conductometrically

CO4	Determine the activity and activity coefficient of electrolyte.
CO5	Determine the concentration of a solution potentiometrically or pH metrically.
CO6	Employ spectrophotometry in determining unknown concentration.
CO7	Determine the viscosity of liquid mixtures and use this in determining the concentration of a component in a mixture.
CO8	Determine the concentration of a liquid mixture using a refractometer.
CO9	Determine the unknown concentration of a given glucose solution.

Semester 4

COURSE TYPE	CORE
COURSE NAME	CHEMISTRY OF ADVANCED MATERIALS
COURSE CODE	CH 241
HOURS	90
COURSE OUTCOMES	
CO1	Understand dimensions, synthesis, physicochemical properties of nanomaterials and its applications.
CO2	Understand and apply characterization tools for analysing nano structures.
CO3	Outline and recognize the types of polymerization, kinetics and mechanisms.
CO4	Understand the stereochemical aspects and methods for the determination of molecular weights of polymers.
CO5	Discuss the synthesis and applications of selected classes of speciality polymers.
CO6	Distinguish the types and important applications of smart materials.

COURSE TYPE	CORE
COURSE NAME	INORGANIC CHEMISTRY-IV
COURSE CODE	CH 242
HOURS	90
COURSE OUTCOMES	
CO1	Explain the schemes for σ and π bonding with examples.
CO2	Explain MO and Ligand field theory with the support of group theory and construct the MO diagram of octahedral complexes. U, C 1 3. apply character tables to find out the Infrared and Raman active modes for C2v, C3v and D4h.
CO3	Assimilate the concepts of molecular recognition, self assembly, dynamic combinatorial chemistry and supramolecular chirality, and be aware of the most important work in the field.
CO4	Understand the nature of bonding in metal atom clusters and distinguish Low nuclearity and High nuclearity carbonyl clusters.

CO5	Perform the electron counting schemes in cluster compounds.
CO6	Differentiate the different types of cluster molecules and understand their utility in catalysis. An 1 8.
CO7	Understand and explain the role of metal ions in biological systems and give examples for the use of metals in medicine.
CO8	Differentiate the defects arising due to deficiency and excess presence of metal ions in the body.
CO9	Explain the acid base concept in non aqueous media and identify the reactions taking place in selected non aqueous solvents.

COURSE TYPE	CORE
COURSE NAME	(A) DISSERTATION
COURSE CODE	CH 243
COURSE OUTCOMES	
CO1	Demonstrate an advanced theoretical and technical knowledge of chemistry as a creative endeavour; analyse, interpret and critically evaluate scientific information.
CO2	Present information, articulate arguments and conclusions, in a variety of modes, to audiences in their field of research.
CO3	As part of a team or individually, design, conduct, analyse and interpret results of an experiment, and effectively communicate these in written reports and other formats.
CO4	Develop an understanding of the requirements to undertake independent research in a chemistry field.
CO5	Demonstrate an understanding of the relationship between scientific research and the progress of new knowledge in a global scenario

COURSE TYPE	CORE
COURSE NAME	(B) VISIT TO R & D CENTRE
COURSE CODE	CH 243
COURSE OUTCOMES	
CO1	Understand the relevance of independent supervised research in a chemistry field and the need of well developed judgement, adaptability and accountability as a practitioner or learner