M.Sc. CHEMISTRY

PROGRAMME OUTCOME

PO1- Provide advanced level of learning in various field in chemistry especially in Inorganic, Organic and physical Chemistry

PO2- Enable the students use modern lab equipments and advanced learning techniques

PO3- Familiarise students with online learning resources like INFIBNET, e-PG Pathsala,

NP-TEL and MOOC

PO4- Equip students in the research methodology of Chemistry for pursuing research after PG course

PO5- Strengthen their communication skill and help them to interact and connect with people, ideas and technology

PROGRAMME SPECIFIC OUTCOME

PSO-1: Acquire in-depth knowledge in branches of chemistry -Inorganic Chemistry, Physical Chemistry, Organic Chemistry and Theoretical Chemistry

PSO-2: Develop problem solving skills in the areas of quantum mechanics, thermodynamics, spectroscopy and electrochemistry

PSO-3: Develop skills in designing computational chemistry experiments

PSO-4: Interpret and analyse spectral data for structure elucidation of compounds

PSO-5: Understand the principles, synthesis and characterization of nanomaterials and supramolecular compounds

PSO-6: Provide fundamental ideas of the research methodology in Chemistry

PSO-7: Able to interact with Scientists, present papers in Seminar/conferences by doing project work in reputed National institutions like NIT, IIT, BARC and University departments

SEMESTER I

Course Code - CH 50 01 01

Course Title – ORGANOMETALLICS AND NUCLEAR CHEMISTRY

CO-1	Understand the methods of synthesis and structure-bonding aspects of organometallic compounds
CO-2	Understand the types of reactions of organometallic compounds
CO-3	Apply the reactions of organometallic compounds in selected catalytic reactions
CO-4	Attain thorough knowledge about the significance of metals in biological processes
CO-5	Understand the role of metals in photosynthesis, oxygen transport ,blood clotting and therapeutic applications
CO -6	Understand the basic principles of nuclear chemistry , counting techniques and synthesis of transuranic elements
CO-7	Analyse the importance and applications of radioisotopes in various fields

Course Code - CH 50 01 02

Course Title – STRUCTURAL AND MOLECULAR ORGANIC CHEMISTRY

CO-1	Understand the fundamental aspects of the types of organic reactions ,mechanism and aromaticity
CO-2	Describe linear free energy relationships involved in organic reactions on the basis of Hammet equation and Taft equation
CO-3	Identify the mechanism of ester formation and hydrolysis
CO-4	Apply HSAB principle to classify organic compounds and reactions
CO-5	Acquire knowledge on the photoreactions of carbonyl compounds, photochemistry of conjugated dienes and vision
CO -6	Understand the basic principles of stereochemistry , types of chirality and topicity
CO-7	Identify geometrical isomers on the basis of E-Z notation

Course Code - CH 50 01 03

Course Title – QUANTUM CHEMISTRY AND GROUP THEORY

CO-1	Understand the basics of quantum mechanics and group theory
CO-2	Identify the symmetry elements and point group of molecules
CO-3	Create character tables for point groups
CO-4	Determine irreducible representation of molecules using Great Orthogonality Theorem
CO-5	Understand elementary concepts of quantum mechanics and postulates of quantum mechanics
CO -6	Apply the postulates of quantum mechanics for calculation of wave functions
CO-7	Solve Schrodinger equation for particle in one dimensional box, three dimensional box ,Harmonic oscillator ,hydrogen like atoms
CO-8	Familiarize with Hermite ,Legendre and Laguerre polynomials

Course Code - CH 50 01 04

Course Title – THERMODYNAMICS, KINETIC THEORY AND STATISTSICAL THERMODYNAMICS

CO-1	Remember the mathematical foundations of thermodynamics including conversion formulas, reciprocity characteristics and Euler's theorem
CO-2	Understand the fundamental laws and equations of classical and statistical thermodynamics
CO-3	Understand the properties of gases based on the kinetic theory
CO-4	Create knowledge about the macroscopic and microscopic approach in science through thermodynamic calculations
CO-5	Apply principles and laws of equilibrium thermodynamics to multicomponent systems
CO -6	Analyse the concept of heat capacity of gases based on the classical and quantum theories
CO-7	Evaluate the deviation in the behaviour of real gases from ideal gases using the principles and techniques of thermodynamics

SEMESTER II

Course Code - CH 50 02 01

Course Title — COORDINATION CHEMISTRY

CO-1	Remember the sufficient breadth and depth of coordination compounds in day to day life
CO-2	Understand the classification of complexes based on the co-ordination numbers and possible geometries
CO-3	Understand the fundamental theories for the formation of coordination compounds with special focus on crystal field theory, molecular orbital theory and ligand field theory
CO-4	Analyse the electronic spectra of complexes based on Orgel diagrams and Tanabe-Sugano diagrams
CO-5	Apply the basic concepts of geometrical and optical isomerism in octahedral complexes for the determination of their absolute configuration
CO -6	Analyse the general characteristics of coordination complexes of lanthanides and actinides
CO-7	Evaluate the electron transfer reactions with special reference to inner sphere and outer sphere mechanisms

Course Code - CH 50 02 02

Course Title — ORGANIC REACTION MECAHNISMS

CO-1	Recall the fundamentals of organic reaction mechanisms
CO-2	Identify the types of reaction intermediates in organic chemistry
CO-3	Explain the role of carbanions ,carbocations,carbenes ,carbenoids ,nitrenes and arynes in named organic reactions
CO-4	Understand the reactions and mechanism of carbonyl compounds
CO-5	Classify concerted organic reactions
CO -6	Apply Woodward Hoffmann rule for determining the feasibility of pericyclic reactions

Course Code - CH 50 02 03

Course Title — CHEMICAL BONDING AND COMPUTATIONAL CHEMISTRY

CO-1	Understand and apply the principles of group theory in spectroscopic techniques
CO-2	Develop a mathematical background relating to variation and perturbation methods
CO-3	Interpret molecular structure and chemical bonding of diatomic and polyatomic molecules
CO-4	Apply Hartree-Fock for sketching Slater type and Gaussian type orbitals
CO-5	Understand the importance of computational chemistry, Ab initio method and DFT methods
CO -6	Acquaint the software GAMESS/Firefly used in computational chemistry calculations
CO-7	Determine Z-matrix of polyatomic molecules Ab initio , semi-empirical and DFT methods

Course Code - CH 50 02 04

Course Title – MOLECULAR SPECTROSCOPY

CO-1	Understand the basic principles and theory of spectroscopic techniques
CO-2	Distinguish molecules on the basis of principle moments of inertia
CO-3	Explain the rotational spectra of polyatomic molecules
CO-4	Understand the concepts of normal modes of vibration overtones ,hot bands and Fermi resonance in vibrational spectra
CO-5	Acquire knowledge on the instrumentation of FTIR technique
CO -6	Apply Franck –Condon principle and Birge-Sponer method for calculating dissociation energy and heat of dissociation
CO-7	Determine the term symbols of diatomic molecules
CO-8	Understand the theory of NMR, chemical shift, relaxation methods ,FTNMR and solid state NMR
CO-9	Apply the principles of Mossbauer spectroscopy in the structure elucidation of metal complexes

SEMESTER III

Course Code - CH 50 03 01

Course Title – STRUCTURAL INORGANIC CHEMISTRY

CO-1	Illustrate the classification of crystal structures, defects in crystals and properties such as electrical conductivity, optical properties, magnetic properties and chemical reactivity
CO-2	Analysis of properties of crystals based on various theories such as free electron theory, molecular orbital theory and zone theory
CO-3	Study various phase transitions, kinetics of phase transitions and thermal decomposition reactions
CO-4	Define superconductivity, types of superconducting materials and theories relating to it
CO-5	Examine inorganic chains, rings, cages and clusters of different elements and study their structures.
CO -6	Acquire knowledge about organometallic polymers, preparation and applications
CO-7	Understand magnetic nanoparticles and familiarize various synthetic methodologies and applications of nanoparticles

Course Code - CH 50 03 02

Course Title — ORGANIC SYNTHESES

CO-1	Examine Organic synthetic protocols via oxidation and reduction reactions
CO-2	Understand various organic reactions through modern synthetic methods, study their mechanisms and applications
CO-3	Analyse chemical reagents as tools for the synthesis of organic compounds
CO-4	Construct carbocyclic and heterocyclic ring systems mostly using named reactions
CO-5	Learn the principles of protecting group chemistry and retrosynthetic approach towards organic synthesis

Course Code - CH 50 03 03

Course Title — CHEMICAL KINETICS, SURFACE CHEMISTRY AND CRYSTALLOGRAPHY

CO-1	Understand the concept of quantum yield, chemical actinometry and photosensitization
CO-2	Highlight the principle of utilization of solar energy, solar cell and different types of solar cell
CO-3	Provide the importance of photochemistry in environment, green house effect and lasers in photochemical kinetics.
CO-4	Understand the instrumentation of Fluorescence Spectroscopy
CO-5	Compare the various diffraction techniques in spectroscopy
CO -6	Understand the principle and instrumentation of AAS,AES and FES
CO-7	Differentiate electrochemical cell and electrolytic cell
CO-8	Understand the theory and working of Fuel cell
CO-9	Analyze the concept of over voltage and its types
CO-10	Detailed study on electroanalytical techniques
CO-11	Recognize the thermodynamic aspects of metabolism ,respiration, glycolysis, biological redox reactions

Course Code - CH 50 03 04

Course Title – SPECTROSCOPIC METHODS IN CHEMISTRY

CO-1	Understand the basic principles and theory of organic spectroscopy
CO-2	Apply Woodward –Fieser and Fieser-Kuhn rules for calculating maximum wavelength of absorption, Octant rule for identifying the type of Cotton effect
CO-3	Identify the characteristic regions of IR spectrum
CO-4	Understand the concepts of two dimensional NMR, Nuclear Overhauser effect , DEPT,INEPT and MRI
CO-5	Distinguish homotopic ,enantiotopic and diastereotopic protons by NMR
CO -6	Understand the various types of ionization techniques employed in Mass spectrometry and the principles of HRMS,MS-MS,LC-MS ,GC-MS
CO-7	Apply Mc Lafferty rearrangement for structure elucidation of organic compounds
CO-8	Interpret a given NMR, IR,UV-Visible and Mass spectra
CO-9	Apply the principles of spectroscopic techniques for elucidating the structure of organic compounds
CO-10	Analyse reactions on the basis of their respective spectrums (NMR/IR/Mass/UV-Visible)

SEMESTER IV

Course Code - CH 80 04 01

Course Title – ADVANCED INORGANIC CHEMISTRY

CO-1	Analyse the principles of group theory
CO-2	Apply the group theoretical principles in finding the hybridization and SALC of complexes
CO-3	Determine the structure of coordination compounds using spectroscopic techniques
CO-4	Understand the basic principles involved in the synthesis, characterization and applications of nanomaterials and metal organic frameworks
CO-5	Identify the types and synthetic strategies of inorganic supramolecules
CO-6	Develop a basic understanding on inorganic photochemistry

Course Code - CH 80 04 02

Course Title — ADVANCED ORGANIC CHEMISTRY

CO-1	Understand the basic principles of green chemistry
CO-2	Understand the concepts of molecular recognition in biological systems
CO-3	Understand the importance of stereoselective transformations in organic synthesis
CO-4	Apply the principles of green chemistry in organic synthesis
CO-5	Explain the biosynthesis and biomimetic synthesis of cholesterol, morphine ,alkaloids and carbohydrates
CO -6	Acquire knowledge about the structure and synthesis of natural products and biomolecules
CO-7	Understand the importance and applications of conducting polymers and dendrimers
CO-8	Develop research aptitude by studying the research methodology
CO-9	Create understanding on various drug designing techniques and mode of action of antibiotics ,drugs for cancer ,diabetes

Course Code - CH 80 04 03

Course Title — ADVANCED PHYSICAL CHEMISTRY

CO-1	Understand the concept of quantum yield, chemical actinometry and photosensitization
CO-2	Highlight the principle of utilization of solar energy, solar cell and different types of solar cell
CO-3	Provide the importance of photochemistry in environment, green house effect and lasers in photochemical kinetics
CO-4	Understand the instrumentation of Fluorescence Spectroscopy
CO-5	Compare the various diffraction techniques in spectroscopy
CO -6	Understand the principle and instrumentation of AAS,AES and FES
CO-7	Differentiate electrochemical cell and electrolytic cell
CO-8	Understand the theory and working of Fuel cell
CO-9	Analyze the concept of over voltage and its types
CO-10	Detailed study on electro analytical techniques
CO-11	Familiarise the thermodynamic aspects of metabolism ,respiration, glycolysis, biological redox reactions

Course Code - CH 50 02 05

Course Title — INORGANIC CHEMISTRY PRACTICAL-1

CO-1	Understand the fundamental principles involved in the separation of metallic cations in solution
CO-2	Understand the synthesis of coordination complexes
CO-3	Analyse the coordination complexes using IR,NMR and electronic spectra
CO-4	Apply Beer-Lambert's law for colorimetric estimation of Iron, Nickel ,ammonium and phosphate ions

Course Code - CH 50 02 06

Course Title – ORGANIC CHEMISTRY PRACTICAL-1

CO-1	Purity assessment of the organic compounds can be carried out using TLC
CO-2	Develop the basic skills in techniques like solvent extraction , Soxhlet extraction, and distillation
CO-3	Hands on experience in softwares like ChemDraw, Symyx Draw and Chemsketch.
CO-4	Help to interpret a given NMR & IR data.
CO-5	Improves the qualitative skill of separating organic mixtures

Course Code - CH 50 02 07

Course Title — PHYSICAL CHEMISTRY PRACTICAL-1

CO-1	Provide hand on experience in Freundlich and Langmuir adsorption isotherm using Charcoal –Oxalic acid system
CO-2	Helps to construct the phase diagram of simple eutectics
CO-3	Helps to determine the surface tension of given liquid by drop weight and drop number
CO-4	Apply the distribution law to find the distribution coefficient of Iodine between an organic solvent and water
CO-5	Experience the application of computational chemistry to optimize the geometry of a molecule
CO -6	Apply Koopmans theorem to compute the Ionisation energy of a molecule
CO-7	Construct an Z-matrices of furan, thiophene, pyrrole and benzene using software's like Chemsketch

Course Code - CH 01 04 05

Course Title —INORGANIC CHEMISTRY PRACTICAL 2

CO-1	Enable students for the estimation of binary mixture of metal ions using gravimetry and volumetry
CO-2	Acquire training in the analysis of alloys and ores
CO-3	Apply Paper chromatography to separate a mixture of three cations
CO-4	Predict kinetics of cis-trans isomerisation of complexes using UV-Visible spectrophotometer

Course Code - CH 01 04 06

Course Title — ORGANIC CHEMISTRY PRACTICAL 2

CO-1	Apply the methods of green chemistry in organic synthesis
CO-2	Acquire hands on experience on microwave –assisted and two-step organic synthesis
CO-3	Estimate Organic compounds using UV-Visible spectrophotometer
CO-4	Predict the ^{1}H , ^{13} CNMR ,IR and UV-Visible spectrum of organic compounds

Course Code - CH 01 04 06

Course Title — PHYSICAL CHEMISTRY PRACTICAL 2

CO-1	Provide hands on experience in Viscometer, Polarimeter , Conductometer & Potentiometer
CO-2	Helps to verify Kendall's equation.
CO-3	Apply Onsagar equation in the titration between weak acid & strong base
CO-4	Determine single electrode potential using potentiometer.
CO-5	Report a data on the complex formation between potassium iodide and mercuric iodide system
CO -6	Determine the rate constant of the hydrolysis of ester by sodium hydroxide
CO-7	Apply Polarimetric measurements to compare the relative strength of given acids.
CO-8	Analyze the difficulties in titration of a mixture of acids against a strong base.

COURSE OUTCOME OF COMPLEMENTARY COURSES IN CHEMISTRY

Semester I

CH1CMT01 - BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

CO1: Provide an insight into fundamental concepts and principles in Chemistry.

CO2: Study the basics of atomic structure, chemical bonding, periodic properties, solution chemistry, acids and bases.

CO3: Understand the elementary principles of analytical and chromatographic techniques.

Semester II

CH2CMT02 – BASIC ORGANIC CHEMISTRY

CO1: Understand fundamental information about the type of reagents, reaction intermediates and mechanism of organic reactions.

CO2: Analyse the stereochemistry of different organic compounds by using an idea about different types of isomerism.

CO3: Explain the importance of the different natural and synthetic polymers in day-to-day life..

Semester III

CH3CMT03 – PHYSICAL CHEMISTRY – I

CO1: Understand basic ideas about the type, structure and lattice parameters of solids.

CO2: Illustrate various theories of solids and their magnetic properties

CO3: Analyse the point group of both the molecules and crystal systems using symmetry elements.

CO4: Understand basic ideas about the properties of liquids, liquid crystals, solutions and colloids.

CO5: Apply kinetic molecular model of gases to determine the molecular velocities of gases.

CO6: Familiarize phase rule to determine the behaviour of one component, two component and simple eutectic systems.

Semester IV

CH4CMT05 – PHYSICAL CHEMISTRY – II

CO1: Understand the basic principles and theories of different spectroscopic techniques.

CO2: Acquire knowledge about the synthesis and properties of Nanomaterials.

CO3: Apply rate law to determine the rate and half life period of first and second order reactions.

CO4: Classify catalysis and define the laws of photochemistry.

CO5: Understand fundamental laws of electrolysis and applications of conductance measurement.

CO6: Analyse different types of electrodes and cells.

CH2CMP01 – VOLUMETRIC ANALYSIS

CO1: Estimate the concentration of an unknown solution by volumetric analysis

CH4CMP02 – PHYSICAL CHEMISTRY PRACTICALS

CO1: Acquire awareness about the chemical properties of salt hydrates, conductivity measurements and emf measurements