# SACRED HEART COLLEGE (AUTONOMOUS)

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**Name of the Programme: M Sc. Chemistry**

| S No | Title of the Paper | Course Code | Course Objectives | Course Outcomes | Relevance |
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| 1 | INORGANIC CHEMISTRY – I | CH717 | • To impart the knowledge about the structure of materials and their significance.<br>• To understand the theories of coordination complexes and their importance.<br>• To study the basic chemistry of rare earth elements and nano materials | • Gain knowledge about the structure and bonding of Inorganic compounds like polyacids, Inorganic Polymers, polysulphur – nitrogen and their significance<br>• Correlate the structure, bonding, stability and applications of metallocarboranes and Metal Clusters<br>• Relate and asses the applications of organometallic compounds in the field of synthetic chemistry and catalysis<br>• Analyse the solid materials with defects that can be used in field of electronic industries foe designing energy materials.<br>• Understand the Solid-state Transformation, its thermodynamic, kinetics and nucleation in solid state materials<br>• Design and synthesis the energy | National developmental needs |

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| | | | | producing nano materials and energy storage nanomaterials to meet the energy crisis in the future | |
| 2 | PHYSICAL CHEMISTRY – I | CH718 | • To study the basic concepts of various theories in chemical kinetics<br>• To illustrate the mechanism of acid, base and enzyme catalyzed reaction and their applications.<br>• To apply and analyse the kinetics of complex reactions and fast reactions by various methods.<br>• To learn and apply the symmetry elements and symmetry operations in molecules<br>• To understand the concepts of selection rules in for transitions and find out the vibrational modes of the molecules.<br>• To construct the character table for simple molecules. | • Understand the various theories of kinetics and compare their applications to reactions.<br>• Compare and contrast the different catalytic reaction and analyse their applications.<br>• Hypothesize mechanistic pathways for reactions based on the kinetic parameters.<br>• Learn and sketch the different symmetry elements and evaluate the implications of symmetry operations in molecules.<br>• Assess the vibrational modes of molecules and thereby formulate the selection rules for transitions<br>• Develop the character table and analyse the symmetry operations of molecules | National developmental needs |
| 3 | ORGANIC CHEMISTRY – II | CH818 | • To understand the addition, elimination, reduction and oxidation reaction mechanisms<br>• To learn the concept of bonding, structure and | • Define the concept of chirality and categorize the structure of organic molecules through stereo isomerism and various molecular 3D-models and stereochemical rules<br>• Annotate and integrate the | National developmental needs |

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| | | | reactivity of organic molecules | conformations and reactivity, chirality concepts involved in cyclic, acyclic, bicyclic systems<br>• Relate the product formation from various oxidation reactions and various oxidizing reagents with detailed mechanism<br>• Write and justify the product of reduction reactions and various reducing reagents with detailed mechanism.<br>• Illustrate the various selective naming reactions with mechanistic route and predict the product formation<br>• Justify the synthetic organic chemistry problems and predict the product with specific stereochemistry in oxidation, reduction and selective naming reactions | |
| 4 | INORGANIC CHEMISTRY – II | CH819 | • To study the concept of coordination Chemistry, stability of the complexes and stereochemistry of complexes.<br>• To study about structure and bonding in coordination complexes.<br>• To learn the use of Inorganic Compounds in Biological systems<br>• To study the electron transfer processes and substitution reactions in Coordination complexes | • Deduce the reaction mechanism and stability of the coordination compounds<br>• Understand the theories of coordination compounds and relate their importance.<br>• Know the basic chemistry of various elements and their functions in biological systems<br>• Comprehend and integrating the role of coordination compound in living system<br>• Analyze the basic application of electronic spectroscopy of complexes and apprise the stability of coordination compounds<br>• Design and synthesis coordination | National developmental needs |

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| | | | | compounds of biological and medicinal importance | |
| 5 | PHYSICAL CHEMISTRY – II | CH820 | • To study and apply the fundamentals and principles of quantum mechanics in chemistry<br>• To illustrate the physical significance of the wave functions and Schrodinger equation<br>• To learn and analyze the principles and significance of partial molar property and fugacity.<br>• To learn the fundamentals and applications of statistical thermodynamics.<br>• To understand and assess the concepts of equilibrium and non – equilibrium thermodynamics in various phenomenon.<br>• To apply non – equilibrium thermodynamics to chemical and biological systems. | • Understand and explain the principles of quantum mechanics and apply it to chemical systems.<br>• Describe the physical significance of the wave functions and apply the Schrödinger equation for some simple systems<br>• Understand the concepts and significance of thermodynamics and evaluate their applicability to chemical systems.<br>• Assess the different statistical approaches to chemical system and evaluate the thermodynamic quantities in terms of partition function.<br>• Recognize the principles that govern equilibrium and non-equilibrium thermodynamics and analyze the impact on non-equilibrium thermodynamics in electrokinetic and thermoelectric phenomenon<br>• Integrate the concepts and its implications of non – equilibrium thermodynamics to chemical and biological systems | National developmental needs |
| 6 | ELECTIVE-II HETEROCYCLIC CHEMISTRY | CH821B | • To learn the nature and reactions of heterocyclic compounds<br>• To understand the | • Acquire basic knowledge on classifications of Heterocyclic Compounds, nomenclature of Heterocyclic Compounds, structural | National developmental needs |

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| | | | classification and significance of heterocyclic compounds | characteristics, physical properties, synthesis of Heterocyclic Compounds and chemical reactions.<br>• Analyze and discuss the Information and data related to Heterocyclic Compounds.<br>• Detecting and leading the reactivity and stability of hetero aromatic compounds.<br>• Demonstrate the proficiency in designing reaction schemes to achieve six and seven membered ring heterocycles.<br>• Apply these hetero aromatic compounds in the synthesis of important industrial and pharmaceutical compounds.<br>• Understand the chemistry of large heterocyclic structures and plan to synthesize them | |
| 7 | ELECTIVE – III BIO - ORGANIC CHEMISTRY | CH821C | • To enable the student to understand and appreciate the importance of biomolecules.<br>• To understand the techniques involved in the extraction and methods of determination of structure of natural products.<br>• To describe the structure and function of nucleic acids<br>• To learn the synthetic procedure of alkaloids and terpenoids and their applications.<br>• To synthesis the steroids | • Understand and know the importance of the biomolecules<br>• Apply the extraction techniques and elucidate the structure of natural products.<br>• Describe the structure and function of DNA and RNA and justify the denaturation of nucleic acid<br>• Synthesis a common alkaloid and terpenoids and know their importance<br>• Design the synthetic route of steroids and interpret their functions in biological system<br>• Describe the general method of | National developmental needs |

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| | | | compounds and interpret their biological role.<br>• To Illustrate the method of synthesis of flavonoids | synthesis of anthocyanins and flavonoids. | |
| 8 | INORGANIC CHEMISTRY PRACTICALS – I | PCH814 | • To learn the basic principles of qualitative analysis of an inorganic mixture<br>• To understand and apply the principles of complexometric titrations. | • Understand the methodology of determining ions using complexometric titrations.<br>• Devise methods to prepare a complex from simple starting materials<br>• Employ a standard procedure to identify the common and rare ions<br>• Demonstrate the ability to identify and separate any ions from any mixtures by evolving the procedure<br>• Analyze the data obtained through various experiments and deduce conceptual explanations for theoretical concepts | National developmental needs |
| 9 | PHYSICAL CHEMISTRY PRACTICALS – I | PCH815 | • To learn various physical and electrochemical methods to perform chemical measurements | • Knowledge of measuring and determining the rate, order, rate constants of chemical reactions experimentally.<br>• Understand and use the concept of distribution coefficient to measure the equilibrium constant.<br>• Applying the concept of optical activity to measure the rate constant and to compare the strength of acids.<br>• Experimenting the relation between the amount of molecule adsorbed on the surface of a adsorbent and apply the | National developmental needs |

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| | | | | concepts of adsorption in the field of catalysis.<br>• Construct the phase diagram and apply it to metallurgical industry.<br>• Estimate the minimum energy required for the molecules to undergo chemical reactions.<br>• Evaluate the speed of chemical reactions in terms of temperature, concentration, and ionic strength.<br>• Apply chemical kinetics in solving problems related to dosage and stability of drugs, absorption, distribution, and elimination of drugs from the body.<br>• Linking between the theoretical concepts with the experimental data obtained in the chemical kinetics. | |
| 10 | ORGANIC CHEMISTRY – III | CH918 | • To learn photochemical reactions, pericyclic reactions and their importance.<br>• To learn the synthetic application of Organometallic compounds | • Identify the nature of rearrangement involved and intermediates generated in various organic molecules; Writing mechanism for the rearrangement involved in organic molecules.<br>• Interpret the role of reagents in multistep organic synthesis and correlate the next synthetic work up involved.<br>• Integrate the concept of organometallic compounds as homogeneous, heterogeneous catalysts and reagents in organic functional group conversions.<br>• Illustrate list of electronic transitions involved in various organic molecules | National developmental needs |

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| | | | | and correlate them with photochemical reactions and based on their photophysical processes.<br>• Invent corresponding mechanism based on thermal/photochemical condition and predicting the product with specific stereochemistry in various pericyclic reactions.<br>• Build the synthetic route theoretically for a given reactant and product with set of reagents. | |
| 11 | INORGANIC CHEMISTRY – III | CH919 | • To study about the basic theory of Inorganic spectroscopy.<br>• To illustrate the UV, IR and Raman spectral properties of some inorganic compounds and complexes.<br>• To study and illustrate the different types of magnetic behaviour in inorganic materials.<br>• To learn the basic concepts of superconductivity behaviour in the materials<br>• To apply the NMR, NQR, ESR and Mossbauer techniques in to simple inorganic systems.<br>• To learn the instrumentation of advance inorganic | • Students can recognize and interpret the spectroscopic techniques in terms of interaction of electromagnetic radiation with molecules<br>• Students can infer about the magnetic properties and superconductivity of materials and can able to calculate the magnetic susceptibility of the materials.<br>• Students can describe the principles and to interpret the instrumentation of various spectroscopic techniques.<br>• Students can illustrate the principle involved in ESR, NQR and Mossbauer Spectroscopy and distinguish chemical species using these spectroscopy<br>• Students can apply the principles of spectroscopy to predict the structure of compounds and analyse the various spectra of complexes<br>• Students can able to propose and | local, regional ,national and global developmental needs |

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| | | | spectroscopy techniques. | formulate the structure of a new compound based on the spectroscopic data | |
| 12 | ELECTIVE-III: INORGANIC PHOTOCHEMISTRY & MATERIALS SCIENCE | CH921A | • To provide the students with basic information on matter radiation interactions and their consequences excited state formation modes, photophysical and photochemical deactivation pathways, and application of theoretical knowledge.<br>• Students are equipped with the knowledge on composition, molecular and electronic structures of inorganic compounds.<br>• Students will know to identify and quantify the course of photophysical and photochemical processes. | • Understand the photochemical pathways in various chemical reactions<br>• Elucidate the photophysical kinetics of unimolecular reaction evaluating using Stern-Volmer equation.<br>• Understand weak and strong interaction in photochemical process and construct a mechanism for transformation of low energy reactants to high energy products.<br>• Elucidate the mechanism involved in various metal complex systems.<br>• Learn and apply the principles of the materials and constructing a reaction methodology using various precursor molecules.<br>• Elucidate the imperfections in the crystal lattice and describing the phase transformation in inorganic materials. | National and global developmental needs |
| 13 | ELECTIVE III : CHEMOINFORMATICS | CH921C | • To study the fundamentals principles of the various computational methods<br>• To interpret the various methods of representing molecules in a chemical database<br>• To learn to analyse the data available in various databases | • Describe the various methods of representing molecules in a chemical database and apply the various tools.<br>• Analyze the physicochemical data available in various databases<br>• Apply the data mining tools on datasets and interpret the results.<br>• Explain the fundamentals and apply the various computational methods in | National developmental needs |

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| | | | • To learn to apply the datamining tools on datasets and interpret the results | chemical calculations.<br>• Evaluate the chemical calculations using computer programs, construct the new molecule using molecular modelling tools<br>• Design the structure of the small molecules and integrate the docking process using the software | |
| 14 | PHYSICAL CHEMISTRY – III | CH1019 | • To study the importance and theory of ionic conductance.<br>• To learn the concepts of electrode - electrolytic interface and structure of the double layer.<br>• To learn the mechanism of electrode reactions and electron transfer process.<br>• To illustrate the importance and industrial applications of different types of fuel cells.<br>• To understand the concepts of various methods of energy calculation in many electron systems.<br>• To apply the VB, MO and HMO theory to simple many electrons system. | • Comprehend the concept of activity coefficient and ionic strength of electrolytes and to evaluate and relate the mean ionic activity coefficient of electrolytes.<br>• Describe the structure of the electrified interface, and define and describe mathematically the capacitance of various model of double layer<br>• Calculate and analyze the electron transport and kinetic overpotential for electrodes at which a one-step and multi-step electron reaction takes place.<br>• Know about the behavior of ions in solution phase under different conditions and its application towards different energy storage devices<br>• Describe many-electron atoms with the various approximation methods and evaluate the energy and construct wave function of many electron atoms with suitable methods<br>• Describe the chemical bonding quantum | National developmental needs |

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| | | | | mechanically with VB, MO and HMO theory and able to calculate the pi electron energy to simple systems. | |
| 15 | PHYSICAL CHEMISTRY PRACTICAL- II | PCH1015 | • To understand the principles that govern the basic electrochemical experiments<br>• To learn the physical methods used in determination of parameters such as pH, conductance and EMF etc. | • Learn and apply the principles of conductometry and potentiometry effectively for various titrations<br>• Explain the conductometric titration of strong acid, weak acid and mixture of acids with strong Base.<br>• Determine the equivalent conductance of strong electrolytes at infinite dilution and dissociation constant of weak electrolyte<br>• Calculate the pH of a buffer solution using emf measurements<br>• Prepare a salt bridge for potentiometric experiments.<br>• Verify the various laws like Ostwald's dilution law and Kohlrausch's law conductometrically and design working electrodes | local, regional ,national and global developmental needs |

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| 16 | SELF-STUDY PAPER (SSP) CHEMICAL SCIENCES FOR CSIR-UGC – NET/JRF/ GATE | CH1017SP1 | • To learn about the concept of all bonding and spectral characteristics of compounds<br>• To analyze the various theories of chemical reactions and apply to solve the related problems<br>• To understand the concept of stereochemical reactions and apply the rules to solve the problems | • Link the periodicity of elements with their chemical reactions, structure, bonding, spectral and magnetic properties and resulting applications<br>• Examine various theories with practical heating systems and thermodynamics of various modules and importance of adsorption in catalysis<br>• Sketch and build various stereo specific structure of various molecules, structure specific reactions with various reagents and their stereochemical outcomes | National developmental needs |