Course Outcomes (COs)

Programmed: M.Sc. Chemistry

	M.Sc. Semester I
Title of the Course and Course Code	**Inorganic Chemistry-l (MSCCHE CC-1)**
CO1	Recall basic concepts of VSPER Theory, bent rule and CFT to understand the structures of complexes. Explain and illustrate M.O. diagram for hetero-nuclear di- and triatomic molecules and M.O.T. for σ and π bonding.
CO2	Outline the concept of term symbols, spin orbit coupling, anomalous magnetic moments, magnetic properties of inner transition element.
CO3	Determination of formation constants by pH metry and spectrophotometer. Formulate and drive the expression for stepwise and overall formation constants, chelate effect and its thermodynamic origin.
CO4	Understand and acquire knowledge of reaction mechanism of transition metal complexes. Outline the concepts of evidences of theories of trans-effect and Marcus-Hush theory.
CO5	Discuss the chemistry of Isopoly and Heteropoly acids and salts.
Title of the Course and Course Code	**Physical Chemistry-I (MSCCHE CC-2)**
CO1	Outline and recall basic knowledge of polymer, kinetics and mechanism of polymerization, determination of molecular mass of polymer.
CO2	Explain the electrode potential in term of chemical potential, Debye Huckel theory. Qualitative treatment of Debye Huckel limiting law, Butler Volmer equation and Tafel plot.
CO3	Discuss mechanism and dynamics of consecutive, opposing reactions along with activated complex theory, photolysis and kinetics of enzyme catalysis.
CO4	Define and analyze chemical thermodynamics, chemical potential, Gibbs Duhem equation, fugacity and activity of gas mixture.
CO5	Explain and illustrate statistical thermodynamic properties, Translational, rotational and vibrational, electronic partition function and Sakure Tetrode

	equation.
Title of the Course and Course Code	**Organic Chemistry-l (MSCCHE CC-3)**
CO1	Recall the concept of aromaticity in benzenoid and non-benzenoid compounds and its application to identify various organic compounds. Predict and cite examples of aromaticity of annulenes, heterocyclic and non-heterocyclic compound.
CO2	Review various terms in stereochemistry and explain aspects of configurations in many chiral compounds and apply their understanding about the organic reactions of a number of compounds with respect to the chemoselectivity, regioselectivity and enantioselectivity.
CO3	Explain the reactions mechanism of different types of reactions and predict the products/intermediates. Study and understand the Hammett equation and linear free energy relationship, Hammond's postulate and Curtin-Hammett principle.
CO4	Discuss kinetics, reactions mechanism and stereochemistry of aliphatic and aromatic nucleophilic substitution reactions at an allylic, aliphatic trigonal and a vinylic carbon. Study the various name reactions such as the Von-Richter, Sommelet-Hauser, and Smiles rearrangements.
CO5	Define and explain aliphatic electrophilic substitution, aromatic electrophilic substitution and elimination reactions with mechanism. Compare between E1 and E2 reactions. Understand the evidences, reactivity and mechanism of various elimination and substitution reactions
Title of the Course and Course Code	**Practical (physical Chemistry) (MSCCHE CC-4)**
CO1	Perform the experiment, tabulate the observations and draw the graph of colorimetry experiments and determine heat of acid base solution.
CO2	Perform the experiment of chemical kinetics, i.e., hydrolysis of methyl acetate and saponification of ethyl acetate.
CO3	Determine the distribution coefficient acetic acid/benzoic acid between water and benzene.
CO4	Find out the specific and molar rotation of sugar and rate constant by inversion of sugar.
CO5	Illustrate and interpret dissociation constant and solubility product using potentiometrically.
M.Sc. Semester II	

Title of the Course and Course Code	**Advances in Chemistry (MSCCHE CC-5)**
CO1	To get the knowledge of Nuclear Chemistry such as Shell model, Liquid Drop Model, Nuclear Reactions and their types along with the Nuclear Reactions in Cross-section.
CO2	Basic concepts of nanomaterials in chemistry, its sources, examples, Bottom-up Method of synthesis in nano chemistry. Characterizations and applications of nanomaterials was also studied.
CO3	Basics of Solid-State Chemistry along with advanced theory and applications of Conductor, Semiconductor, and superconductor have to be studied.
CO4	Industrial Application of Chemistry with references to the cement, paper and pulp, and petroleum.
CO5	Study of waste management and their classification such as nuclear waste management, e-waste management, recycling of plastic with sorting, washing, shredding and extruding.
Title of the Course and Course Code	**Inorganic Chemistry-Il (MSCCHE CC-6)**
CO1	Learn orgel and Tanabe Sugano diagrams for transition metal complexes, Review the concept of John Teller effect, spectrochemical and Nephelauxetic series.
CO2	Outline the concept of symmetry to imagine molecules in three dimensions and identify the symmetry elements and symmetry operations and be able to pass through the molecule.
CO3	Classify the symmetry elements possessed by a molecule and assign it to a point group and generalize the importance of Orthogonality Theorem and learn the rules for constructing character tables.
CO4	Known the preparation, bonding, structure and important reaction of transition metal carbonyls & nitrosyl
CO5	Describe structure and bonding in higher boranes & carboranes. Understand the wade's rules, 18 electron rule and its application.
Title of the Course and Course Code	**Physical Chemistry-II (MSCCHE CC-7)**
CO1	Recall and define basic terminologies of quantum chemistry, particle in three-dimensional box, Hermitian operators and Theorems of operators.
CO2	Solve quantum mechanical problem for Harmonic oscillator using Hermit differential equation through recursion relation.
CO3	Formulate and solve quantum mechanical problems based on variation method. Perturbation method for He atom.
CO4	Explain Huckel molecular orbital theory of conjugated system, bond order and charge density calculation.
CO5	Review and relate the concepts involved in chemical bonding, LCAO-MO theory and its application for H2 molecule.

Title of the Course and Course Code	**Organic Chemistry-II (MSCCHE CC-8)**
CO1	Study the various name reaction with examples. Learn the mechanism of rearrangement reaction, use synthetic reagent of oxidation and reduction for solving the problems.
CO2	Define and explain principles of photochemistry of Carbonyl Compounds & Unsaturated system.
CO3	Explain pericyclic reactions and justify their mechanisms by using Woodward-Hoffmann correlation diagrams, FMO and PMO approach.
CO4	Describe, conformation of monosaccharides and important derivatives of monosaccharides, glycosides, deoxy sugar, amino sugar and study the structure determination and chemical synthesis of sucrose, and maltose.
CO5	Learn the types of proteins and propose chemical and enzymatic hydrolysis of proteins, amino acid sequencing.
Title of the Course and Course Code	**Practical (Organic Chemistry) (MSCCHE CC-9)**
CO1	Separation and identification organic compounds from binary mixtures by chemical tests. Detection of special elements and functional groups.
CO2	Determination of melting points of unknown organic compounds and preparation of their derivatives.
CO3	Synthesize organic compounds in two steps reaction i.e., prepare *p*-bromoaniline and *p*-nitroaniline from acetanilide.
CO4	Preparation of anthranilic acid from phthalic anhydride in two steps.
CO5	Synthesize organic compounds in two steps reaction i.e., p-bromoacetanilide and p-nitroacetanilide from aniline.
M.Sc. Semester III	
Title of the Course and Course Code	**Application of Spectroscopy (MSCCHE CC-10)**
CO1	Define and describe basic principles of rotational spectroscopy and explain various types of rotators and demonstrate their applications.
CO2	Study of vibrational spectra, Raman effect and photoelectron spectroscopy and describe basic principles of photoelectric effect ionization process, PES and XPS.
CO3	Learn nuclear magnetic resonance and ESR spectroscopy. Explain chemical shift value, spin lattice relaxation & spin-spin interaction and factors affecting its value.

CO4	Define and describe Mass spectrometry. Determine structures from fragmentation data and discuss factors controlling fragmentation.
CO5	Solve problems based on - UV, IR, NMR, CMR and mass spectral data. Propose structures of compounds using spectroscopic data. Distinguish compounds using spectroscopic methods.
Title of the Course and Course Code	**Bio-Inorganic Chemistry (MSCCHE CC-11)**
CO1	Recall the role of metals ions in biological processes, Concept of Na+/K+ pump. Definition and examples of essential and trace metals. Study the Toxic effect of heavy metals and their detoxification.
CO2	Understand the bioenergetics and ATP Cycle, DNA polymerization, Overview of photosystem I and photosystem II in cleavage of water. Details understanding of glucose storage process. Review the role of chlorophylls.
CO3	Basic idea about Heme proteins and oxygen uptake, haemoglobin, myoglobin, hemocyanics and hemerythrin.
CO4	Discussion on electron Transfer in Biological system, cytochromes and ion-sulphur proteins. Interpretation of biological nitrogen fixation with spectroscopic and other evidences.
CO5	Explain role of metal in medicines, biochemical bases of essential metal deficient diseases anticancer activity and various mechanism using metal complexes and polyethylene amines as chelating drugs.
Title of the Course and Course Code	**Environmental Chemistry and Green Chemistry (MSCCHE CC-12)**
CO1	Learn about composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere, biogeochemical cycles of C, N, P, S and O.
CO2	Study the chemicals compositions of water bodies lakes, streams, rivers, and wet lands. Describe analytical methods for measuring BOD, DO, COD, F, Oils, Metals.
CO3	Explain chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect. Define various analytical methods for measuring air pollutants.
CO4	Describe twelve principles of Green Chemistry, atom economy in chemical synthesis and important technique employed in practice of Green chemistry.
CO5	Outline the replacement of CFC and hydrocarbon blowing agents with environmental friendly blowing agent CO2 in the production of polystyrene.
Title of the Course and Course Code	**Bio-organic Chemistry (MSCCHE CC-13)**
CO1	Introduction to chemical and biological catalysis, hypothesis of Fischer's lock and key and Koshtand's induced fit model. Mechanism of enzyme catalysis Michaelis Menten and Line weave-Burk plots.
CO2	Review on Transition-state theory for acid base and covalent catalysis. Illustration on some typical enzyme mechanisms for chymotrypsin, lysozyme and carboxypeptidase A.

CO3	Demonstration of Enzyme catalyzed reactions and the coupling of ATP cleavage to endergonic processes, Transfer of sulphate, addition and elimination reaction.
CO4	Define and explain Co-Enzyme Chemistry, apoenzymes, Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD, NADI, FMN, FAD, Lipole acid and vitamin B 12.
CO5	Study and understand biotechnological use of enzymes in daily life applications, drug design, Clinical uses, enzyme therapy and DNA technology.
Title of the Course and Course Code	**Practical (Inorganic Chemistry) (MSCCHE CC-14)**
CO1	To analyze ions (Mg^{2+}, Ca^{2+}, and Al^{3+}) quantitatively using EDTA.
CO2	To apply green methods for the preparation of the following complexes and their characterization via IR, electronic spectra and T.G.A. (a) Pot trioxalato ferrate (III) (b) Pot trioxalato chromate (III) (c) Chromus Acetate (d) Hg [Co $(SCN)_4$] (e) Hexa ammine Ni (II) chloride.
CO3	To quantitatively analyze the inorganic mixture containing six radicals including interfering radical.
	M.Sc. Semester IV
Title of the Course and Course Code	**Inorganic Chemistry Special (MSCCHE EC- la)**
CO1	Study alkyls and aryls transition metals & their types, routes of synthesis, stability and decomposition pathways and organocopper in organic synthesis.
CO2	To get the knowledge of transition metal π-complexes with unsaturated organic molecules alkenes, alkynes, allyl, diene, dienyl, arene, trienyl complexes, their structural features and important nucleophilic and electrophilic reactions.
CO3	Study the basics of homogeneous catalysis by taking examples such as Zeigler Natta polymerization of olefins, catalytic reactions involving CO, oxo palladation reactions.
CO4	Basics of supramolecular chemistry (non-covalent interactions, self-assembly in supramolecular chemistry, reactivity, catalysis design, synthesis, transport processes and carrier design) and Photo chemistry of metal complexes were studied.
CO5	Study basics of molecular rearrangement via D and A process, reactions of inversions, isomerization, geometrical and optical isomers, optical racemization of octahedral complexes and Fluxional organometallic compounds.
Title of the Course and Course Code	**Physical Chemistry Special (MSCCHE EC- lb)**

CO1	State and describe Hartree Fock theory, Born Oppenheimer approximation. Salter Condon rule, Koopman theory, Semi Empirical Theories and HMO Theory.
CO2	Discuss the kinetics of catalytic reaction, reaction intermediate and oscillatory reactions.
CO3	Outline the basic facts, concepts, kinetics of condensed phase reaction and apply different methods to study fast reaction.
CO4	Explain the kinetics of electrode reaction with theoretical expression and factor affecting on its kinetics.
CO5	Review scope, economic impact on corrosion and electrochemical theories. Illustrate the thermodynamics of solid including heat capacity and specific heat.
Title of the Course and Course Code	**Organic Chemistry Special (MSCCHE EC- lc)**
CO1	Explain the types of terpenoids, isoprene rule and special isoprene rule. Study structure, stereochemistry and synthesis of Citral, Terpineol, Camphor, Santonin and abietic acid.
CO2	Discuss synthesis and structure determination of papaverine, Nicotine, Atropine, Quinine and Morphine.
CO3	Study classification, theories of drug activity, assay of drugs and SAR factors affecting bio activity.
CO4	Acquire knowledge about the various types of drugs such as antineoplastic agents, cardiovascular drugs and anti-tubercular drugs.
CO5	Known the preparation and properties of benzofused five membered heterocyclic compounds, Five, Six, Seven and large membered heterocycles with two or more heteroatoms.
Title of the Course and Course Code	**Practical Inorganic Chemistry (Special) (MSCCHE EC (P) -2a)**
CO1	Perform experiments of metal ions in alloys and minerals, analyze and interpret the experimental results.
CO2	Carry out qualitative analysis of inorganic mixture containing six radicals including various samples using different instrumentation techniques.
CO3	Spectrophotometric determination of Fe, Ni, M", C., V, I.i, F, NO^{3-} and $P0_4^{----}$
Title of the Course and Course Code	**Practical Physical Chemistry (Special) (MSCCHE EC (P) -2b)**
CO1	Apply the laboratory skills and concepts to carry out the Conductometric titration using acid base mixture.
CO2	Perform Potentiometric experiments to determine EMF, pH and carry out acid base titration.

CO3	Carry out the experiment to determine partition coefficients of acetic acid and iodine in different medium.
Title of the Course and Course Code	**Practical Organic Chemistry (Special) (MSCCHE EC (P) -2c)**
CO1	Learn the chemical methods to separate and identify organic compounds from mixtures of up to three unknown compounds.
CO2	Perform the multi-step experiments for the preparation of different organic compounds.
CO3	Estimation of biomolecule e.g., carbohydrates, protein, amino acids, and blood cholesterol by UV-visible Spectrophotometric method
CO4	Quantitative estimation of ascorbic acid and aspirin using Spectroscopic technique.
CO5	Practical skill will be developed on handling various organic reactions and compounds.