DEPARTMENT OF CHEMISTRY

B. Sc. Chemistry

Goals :

The Department has formulated three broad educational goals for the undergraduate degree programs:

Chemistry knowledge: To provide students with the basic foundation in Chemistry and allied subjects, the interplay of theory and experiment, and to motivate scientific enthusiasm and curiosity and the joy of learning.

Problem solving skills: To provide students with the tools needed to analyse problems with the skills required to succeed in graduate school, the chemical industry or professional school.

Employment and technical skills: To provide the students with technical skills necessary for successful careers in chemistry and related or alternative careers for which a chemistry foundation can be very useful. These include to a breadth of experimental techniques using modern instrumentation and communication skills (oral and written).

Programme Outcomes :

Knowledge outcome:

After completing B.Sc. Chemistry Programme students will be able to:

PO1: Transfer and apply the acquired fundamental knowledge of chemistry, including basic concepts and principles of 1) organic chemistry, Inorganic chemistry, Physical and Analytical Chemistry; (2) analytic techniques and experimental methods for chemistry to study different branches of chemistry;

PO2: Demonstrate the ability to explain the importance of the Periodic Table of the Elements and represent key aspects of it and its role in organizing chemical information.

Skills Outcomes

Professional Skills

After completing B.Sc. Chemistry Programme students will be able to:

PO3: apply and demonstrate knowledge of essential facts, concepts, laws, principles and theories related to chemistry;

PO4: demonstrate the learned laboratory skills, enabling them to perform qualitative and quantitative analysis of given samples and able to make conclusions on it;

PO5: set procedure and synthesize simple compounds of commercial importance;

PO6: engage in oral and written scientific communication, and will prove that they can think critically and work independently.

PO6: Communicate effectively using graphical techniques, reports and presentations within a scientific environment.

PO7: to recognize problems in chemical science and make strategies to solve it

PO8: Respond effectively to unfamiliar problems in scientific contexts

PO9: Plan, execute of design experiment, make documentation of it, interpret data at entry level of chemical industry and report the results;

PO10: Integrate and apply these skills to study different branches of chemistry.

Generic Competencies

PO11: The student will acquire knowledge effectively by self-study and work independently, present information in a clear, concise and logical manner and apply appropriate analytical and approximation methods

PO12: The student will learn professionalism, including the ability to work in groups and in society, and apply basic ethical principles.

Program Specific Outcomes

After completing B. Sc. Chemistry, students will be able to

PSO1: Understand the nature and basic concepts of Physical, Organic and Inorganic chemistry;

PSO2: Analyze Organic and inorganic compounds qualitatively and quantitatively;

PSO3: Understand the applications of physical, organic, inorganic and analytical chemistry in pharmaceutical, agriculture and chemical industries;

PSO4: Able to perform experimental procedures as per laboratory manual in the area of physical, Inorganic and organic chemistry;

PSO5: interpretation and synthesis of chemical information and data obtained from chemical and instrumental analysis.

Course Outcomes :

F.Y.B.Sc. Chemistry (CBCS-2019 Pattern)

CH- 101 Paper-I, Physical Chemistry Sem I

At the end of course student will be able to -

CO1: Apply thermodynamics principles to physical and chemical process and able to calculate the enthalpy bond energy, bond dissociation energy and resonance energy. Students are able to understand variation of enthalpy with temperature-Kirchoffs equation and third law of thermodynamics and its applications

CO2: Understand relation between free energy and equilibrium and factors affecting on equilibrium constant exergonic and endergonic reaction, gas equilibrium, equilibrium constant and molecular interpretation of equilibrium constant and van't Haff equation and its applications.

CO3: Understand the concept of ionization process occurred in acids, bases and pH scale. Related concepts such as common ion effect, hydrolysis constant ionic product, solubility product. Degree of hydrolysis and pH for different salts and buffer solutions.

CH- 102 Paper-II Organic chemistry Sem I

By the end of this course students will able to

CO1: Understand the effect of inductive effect, electromeric effect, resonanace effect and hyperconjugation on reactivity of reactivity and must able to differentiate these effects based on structures. Differentiate between hemolysis and heterolysis, all reaction intermediates like carbocation, carbanions and free radicles. Understand the factors affecting the strength and pKa values of acids and bases. Understand the concept of aromaticity based on Huckel rule

CO2: understand and classify the isomerisms in different organic compounds. Draw and interconvert different structural formulaes like wedge formula, Newmann projection formula, Saw horse and fischer presentation formula. In geometrical isomerism, draw and understand different confirmations of ethane, butane and cyclohexane. Differentiate between Cis and trans isomers of alkene and E and Z nomenclatures. Understand the origin of optical activity and chirality in organic compounds. Differentiate between enantiomers, distereomers, epimers and meso compounds, threo and erythro compounds. Assign the R/S configuration based on priority and CIP rule up to two asymmetric carbon atoms

CO3: Explain the physical properties, chemical Preparation and reactions of Functional groups like alkanes, alkenes and alkynes.

CH- 103 Paper-III, Practical Chemistry Sem I

At the end of course student will able **to**

CO1: Understand and follow safety in chemical laboratory while working in chemical laboratory.

CO2: Set up the apparatus properly for the given experiments. Perform all the activities in the laboratory with neatness and cleanness;

CO3: maintain records of quantitative and qualitative analysis;

CO4: acquire laboratory skills for the purpose of collecting, interpreting, analysing, and reporting (in written form) chemical data;

CO5: explain mole concept and its application in the preparation of normal and molar solutions, and use of mole concept in quantitative calculations for inorganic analysis;

CO6: perform quantitative analysis using chemical methods of quantitative analysis;

CO7: illustrate physical chemistry principle with the help of experiments;

CO8: Describe and demonstrate data using graphical representations and communicate the report.

CH-201 Paper I: Inorganic Chemistry Sem II

At the end of course students will able to

CO1: Understand Various theories and principles applied to revel atomic structure, Origin of quantum mechanics and its need to understand structure of

hydrogen atom, Schrodinger equation for hydrogen atom, Radial and angular part of hydrogenic wave functions, Significance of quantum numbers, Shapes of orbitals

CO2: Explain rules for filling electrons in various orbitals- Aufbau's principle, Pauli exclusion principle, Hund's rule of maximum multiplicity, Discuss electronic configuration of an atom and anomalous electronic configurations., Discuss concept of exchange energy and relative energies of atomic orbitals, Design Skeleton of long form of periodic table. Describe Block, group, modern periodic law and periodicity. Classification of elements as main group, transition and inner transition elements, Write name, symbol, electronic configuration, trends and properties.

CO3: Understand Attainment of stable electronic configurations., Define various types of chemical bonds- Ionic, covalent, coordinate and metallic bond,

CO4: Explain characteristics of ionic bond, types of ions, energy consideration in ionic bonding, lattice and solvation energy and their importance in the context of stability and solubility of ionic compounds

CO5: Summarize Born-Lande equation and Born-Haber cycle,

CO6: Define Fajan's rule, bond moment, dipole moment and percent ionic character.

CO7: Describe VB approach, Hybridization with example of linear, trigonal, square planer, tetrahedral, TBP, and octahedral.

CO8: Discuss assumption and need of VSEPR theory.

CO9: Application of non-bonded lone pairs in shape of molecule

CO10: Basic understanding of geometry and effect of lone pairs with examples such as ClF3, Cl2O, BrF5, XeO3 and XeOF4.

CH- 202 Paper II: Analytical Chemistry Sem II

At the end of course students will able to

CO1:Understand and remember Analytical Chemistry –branch of chemistry. Perspectives of analytical Chemistry, analytical problems

CO2: Make Calculations of mole, molar concentrations and various units of concentrations which will be helpful for preparation of solution. Relation between molecular formula and empirical formula, Make Stoichiometric calculation, Define term mole, millimole, molar concentration, molar equilibrium concentration and Percent Concentration. SI units, distinction between mass and weigh. Units such as parts per million, parts per billion, parts per thousand, solution-dilatant volume ratio, function density and specific gravity of solutions.

CO3: Separation of binary mixtures and analysis, Elemental analysis -Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test, Purification techniques for organic compounds,

CO4: Basics of chromatography and types of chromatography, Theoretical background for Paper and Thin Layer Chromatography,

CO5: pH meter and electrodes for pH measurement, Measurement of pH, Working of pH meter, Applications of pH meter.

Paper-III, Practical Chemistry

At the end of course student will able **to**

CO1: Inorganic Estimations using volumetric analysis,

CO2: Synthesis of Inorganic compounds, Analysis of commercial products, Purification of organic compounds, Preparations and mechanism of reactions involved.

S.Y.B.Sc. Chemistry

CH 301: -Paper-I Physical and Analytical Chemistry Sem III

After completion of course student will able to

CO1: Define / Explain concept of kinetics, terms used, rate laws, molecularity, order, Explain factors affecting rate of reaction, Explain / discuss / derive integrated rate laws, characteristics, expression for half-life and examples of zero order, first order, and second order reactions, Determination of order of reaction by integrated rate equation method, graphical method, half-life method and differential method, Explain / discuss the term energy of activation with the help of energy diagram, Explanation for temperature coefficient and effect of temperature on rate constant k, Derivation of Arrhenius equation and evaluation of energy of activation graphically, Derivations of collision theory and transition state theory of bimolecular reaction and comparison, Solve / discuss the problem based applying theory and equations

CO2: Define / explain adsorption, classification of given processes into physical and chemical adsorption, Discuss factors influencing adsorption, its characteristics, differentiates types as physisorption and Chemisorption, Classification of Adsorption Isotherms, to derive isotherms, Explanation of adsorption results in the light of Langmuir adsorption isotherm, Freundlich's adsorption Isotherm and BET theory, Apply adsorption process to real life problem, Solve / discuss problems using theory.

CO3: Define, explain and compare meaning of accuracy and precision, Apply the methods of expressing the errors in analysis from results, Explain / discuss different terms related to errors in quantitative analysis, Apply statistical methods to express his / her analytical results in laboratory, Solve problems applying equations

CO4: Explain / define different terms in volumetric analysis such as units of concentration, indicator, equivalence point, end point, standard solutions, primary and secondary standards, complexing agent, precipitating agent, oxidizing agent, reducing agent, redox indicators, acid base indicators, metallochome indicators, etc, Perform calculations involved in volumetric analysis, Explain why indicator show colour change and pH range of colour change, To prepare standard solution and b. perform standardization of solutions, To construct acid – base titration curves and performs choice of indicator for particular titration, Explain / discuss acid-base titrations,

complexometric titration / precipitation titration / redox titration, Apply volumetric methods of analysis to real problem in analytical chemistry / industry.

CH_302: Paper-II, Inorganic and Organic Chemistry, Sem.-III

After completion of course student will able to

CO1: define terms related to: optical isomerism, conformations of cyclohexane, elimination reaction, substitution reaction, addition reaction and

Nernst distribution law, partition coefficient, qualitative and quantitative analysis, error, accuracy, precision, significant figure, interfering radicals, common ion effect, solubility product;

CO2: explain the terms and facts related to Chemical kinetics, first order and second order chemical reaction, law of photochemistry, theory of extraction, organic and inorganic qualitative analysis;

CO3: recognize order and molecularity of chemical reaction, apply distribution law for extraction process, apply procedure for removal of interfering ions;

CO4: derive rate equation for first and second order chemical reaction, Nernst distribution law, Lambert's Beers Law, efficiency of extraction;

CO5: describe order of chemical reaction, process of extraction, accuracy of analysis, precision in analysis, methods to minimize errors in analysis;

CO6: distinguish between first and second order chemical reaction, accuracy and precision in analysis, photochemical and thermal reactions;

CO7: calculate order of and molecularity of chemical reaction, absolute and relative error in analysis, standard deviation in analysis;

CO8: solve numerical problems related to Physical and analytical chemistry.

rearrangement reaction, metallurgy and corrosion. Write formulas of organic and inorganic compounds. Write elementary reactions in organic and inorganic chemistry related to syllabus;.

CO2: explain the terms and facts related to: optical activity and isomerism, conformations of cyclohexane, corrosion and metallurgy. Will explain process of: metallurgy of Al, Fe, corrosion. Explain how to avoid the corrosion;

CO3: recognize functional groups and their reactions, addition reaction, nucleophilic substitution, elimination reaction. Will wire and explain mechanism of reactions such as SN1, SN2, E1, E2, Markovinkoves, rule, Satzeff's rule;

CO4: apply reaction mechanism to predict the products of reaction in SN1, SN2, E1, E2, rearrangement reaction. Apply rules of absolute configuration and will predict the configuration at chiral C atom;

CO5: determine absolute configuration at chiral C atom, determine suitable process for purification of particular ore, predict the products of specific organic reactions related to syllabus, predict the stability of different conformations of cyclohexane;

CO6: reasoning for appropriate facts related to optical activity, metallurgy, corrosion, reaction mechanism;

CO7: draw diagrams of various metallurgical processes;

CO8: predict products of various chemical reactions.

CH-222: Paper-II, Organic and Inorganic Chemistry, Sem. III

After completion of course student will able to

CO1: Define terms related to molecular orbital theory (AO, MO, sigma bond, pi bond, bond order, magnetic property of molecules, etc). Explain and apply LCAO principle for the formation of MO's from AO's. Explain formation of different types of MO's from AO's., istinguish between atomic and molecular orbitals, bonding, anti-bonding and nonbonding molecular orbitalsistinguish between atomic and molecular orbitals, bonding, anti-bonding and non bonding molecular orbitals, Draw and explain MO energy level diagrams for homo and hetero diatomic molecules. Explain bond order and magnetic property of molecule, Explain formation and stability of molecule on the basis of bond order, Apply MOT to explain bonding in diatomic molecules other than explained in syllabus,

CO-2: Define different terms related to the coordination chemistry (double salt, coordination compounds, coordinate bond, ligand, central metal ion, complex ion, coordination number, magnetic moment, crystal field stabilization energy, types of ligand, chelate effect, etc.), Explain Werner's theory of coordination compounds. Differentiate between primary and secondary valency. Correlate coordination number and structure of complex ion, Apply IUPAC nomenclature to coordination compound.,

CO-3: Identify and draw the structures aromatic hydrocarbons from their names or from structure name can be assigned.; Give the mechanism of reactions involved, Explain /Discuss important reactions of aromatic hydrocarbon, To correlate reagent and reactions.

CO-4: Identify and draw the structures alkyl / aryl halides from their names or from structure name can be assigned, Explain / discuss synthesis of alkyl / aryl halides, Write / discuss the mechanism of Nucleophilic Substitution (SN1 , SN2 and SNi) reactions, Explain /Discuss important reactions of alkyl / aryl halides, To correlate reagent and reactions, Give synthesis of expected alkyl / aryl halides.

CO-5: Identify and draw the structures alcohols / phenols from their names or from structure name can be assigned, Able to differentiate between alcohols and phenols, Able to differentiate between alcohols and phenols, Explain / discuss synthesis of alcohols / phenols, Write / discuss the mechanism of various reactions involved, Explain /Discuss important reactions of alcohols / phenols, To correlate reagent and reactions of alcohols / phenols, Give synthesis of expected alcohols / phenols.

CH-303 Paper-III, Practical Chemistry Sem III

After completion of practical course student should be able to

CO1: verify theoretical principles experimentally

CO2: interpret the experimental data and improve analytical skills

CO3: correlate the theory and experiments and understand their importance and Acquire the simple and complex practical skill

CO4: Understand systematic methods of identification of substance by chemical methods. Separation of organic compound and their identification by chemical methods.

CO5: Write balanced equation for all the reactions, they carry in the laboratory.

CO6: Perform organic synthesis and follow the progress of the reaction by using TLC technique.

CO7: Set up the apparatus properly for the given experiments. Perform all the activities in the laboratory with neatness and cleanness

CO8: Perform the complete qualitative chemical analysis of the given inorganic mixture and find out acidic and basic radicals.

CO9: Systematic working skill in laboratory will be imparted in student.

CH-401 Physical and Analytical Chemistry, Sem.-IV

At the end of course students will able to

CO1: Define the terms in phase equilibria such as- system, phase in system, components in system, degree of freedom, one / two component system, phase rule, etc, Explain meaning and Types of equilibrium such as true or static, metastable and unstable equilibrium, Discuss meaning of phase, component and degree of freedom, Derive of phase rule, Explain of one component system with respect to: Description of the curve, Phase rule relationship and typical features for i) Water system ii) Carbon dioxide system iii) Sulphur system,

CO2: Define various terms, laws, differentiate ideal and no-ideal solutions, Discuss / explain thermodynamic aspects of Ideal solutions-Gibbs free energy change, Volume change, Enthalpy change and entropy change of mixing of Ideal solution, Differentiate between ideal and non-ideal solutions and can apply Raoult's law, Interpretation of i) vapour pressure–composition diagram ii) temperature- composition diagram, Explain distillation of liquid solutions from temperature – composition diagram., Explain / discuss azeotropes, Lever rule, Henrys law and its application, Discuss / explain solubility of partially miscible liquids-systems with upper critical. Solution temperature, lower critical solution temperature and having both UCST and LCST, Explain / discuss concept of distribution of solute amongst pair of immiscible solvents. Derive distribution law and its thermodynamic proof, Apply solvent extraction to separate the components of from mixture interest, Solve problem by applying theory.

CO3:. Explain / define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc, Discuss / explain Kohlrausch's law and its Applications, Conductivity Cell, Conductivity Meter, Whetstone Bridge, Explain / discuss conductometric titrations, Apply conductometric methods of analysis to real problem in analytical laboratory, Solve problems based on theory / equations, Correlate different terms with each other and derive equations for their correlations.

CO4: Explain / define different terms in Colorimetry such as radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, molar absorptivity, Discuss / explain / derive Beer's law of absorptivity, Explain construction and working of colorimeter, Apply colorimetric methods of analysis to real problem in analytical laboratory, Solve problems based on theory / equations, Correlate different terms with each other and derive equations for their correlation,

CO5: Explain / define different terms in column chromatography such as stationary phase, mobile phase, elution, adsorption, ion exchange resin, adsorbate, etc. Explain properties of adsorbents, ion exchange resins, etc., Discuss / explain separation of ionic substances using resins, Discuss / explain separation of substances using silica gel / alumina, Apply column chromatographic process for real analysis in analytical laboratory.

CH-402 Inorganic and Organic Chemistry Sem IV

At the end of course students will able to

CO1: Isomerism in coordination complexes, Explain different types of isomerism in coordination complexes.

CO2: Apply principles of VBT to explain bonding in coordination compound of different geometries, Correlate no of unpaired electrons and orbitals used for bonding, Identify / explain / discuss inner and outer orbital complexes, Explain / discuss limitation of VBT,

CO3: Explain principle of CFT, Apply crystal field theory to different type of complexes (Td, Oh, Sq. Pl complexes), Explain: i) strong field and weak field ligand approach in Oh complexes ii) Magnetic properties of coordination compounds on the basis of weak and strong ligand field ligand concept. iii) Origin of colour of coordination complex, Calculate field stabilization energy and magnetic moment for various complexes, To identify Td and Sq. Pl complexes on the basis of magnetic properties / unpaired electrons, Explain spectrochemical series, tetragonal distortion / Jahn-Teller effect in Cu(II) Oh complexes only.

CO4: Identify and draw the structures aldehydes and ketones from their names or from structure name can be assigned, Explain / discuss synthesis of aldehydes and ketones, Write / discuss the mechanism reactions aldehydes and ketones, Explain /Discuss important reactions of aldehydes and ketones, To correlate reagent and reactions of aldehydes and ketones, Give synthesis of expected aldehydes and ketones, Perform inter conversion of functional groups.

CO5: Identify and draw the structures carboxylic acids and their derivatives from their names or from structure name can be assigned, Explain / discuss synthesis of carboxylic acids and their derivatives, Write / discuss the mechanism reactions carboxylic acids and their derivatives, Explain /Discuss important reactions of carboxylic acids and their derivatives, Correlate reagent and reactions of carboxylic acids and their derivatives, Give synthesis of expected carboxylic acids and their derivatives, Perform inter conversion of functional groups.

CO6: Identify and draw the structures amines from their names or from structure name can be assigned, Explain / discuss synthesis of carboxylic amines, Write / discuss the mechanism reactions carboxylic amines, Explain /Discuss important reactions of carboxylic amines, To correlate reagent and reactions of carboxylic amines, Give synthesis diazonium salt from amines and reactions of diazonium salt, Perform inter conversion of functional groups.

CO7: Draw the structures of different conformations of cyclohexane, Define terms such as axial hydrogen, equatorial hydrogen, confirmation, substituted cyclohexane, etc, Explain / discuss stability with respect to potential energy of different conformations of cyclohexane, Draw structures of different conformations of methyl / t-butyl monosubstituted cyclohexane (axial, equatorial) and 1, 2 dimethyl cyclohexane, Identify cis- and trans-isomers of 1, 2 dimethyl substituted cyclohexane and able to compare their stability.

CH-403 Paper –III Practical Chemistry-IV Sem-IV

At the end of course students will able to

CO1: Verify theoretical principles experimentally

CO2: Interpret the experimental data on the basis of theoretical principles, Understand / verify theoretical principles by experiment or explain practical output with the help of theory,

CO3: Understand systematic methods of identification of substance by chemical methods,

CO4: Write balanced equation for all the chemical reactions performed in the laboratory.

CO5: Perform organic and inorganic synthesis and able to follow the progress of the chemical reaction.

CO6: Set up the apparatus properly for the designed experiments.

CO7: Perform the quantitative chemical analysis of substances and able to explain principles behind it.

T.Y.B. Sc. Chemistry (2013 Pattern)

CH-331 Physical chemistry, Sem.-I

At the end of course students will able to

CO1: define / recall various terms related to electrolytic conductance, molecular spectroscopy, chemical kinetics and phase diagram.

CO2: write correct equation such as Ohms law, equivalent conductance, molar conductance, rate constant of first, second, third order reactions, Kohlarch law, Debye equation, transport number, molar polarization, force constant, energy of rotational, vibrational excitations, etc.

CO3: derive equations for half-life of third order reaction, rate constant of third order reaction, transport number, dipole moment, molar polarization, reduced mass of diatomic molecule, etc.

CO4: explain / describe various terms in electrolytic conductance, molecular spectroscopy, chemical kinetics and phase diagram. To derive relations between / among various terms / quantities in electrolytic conductance, molecular spectroscopy, chemical kinetics and phase diagram

CO5: differentiate between / among the terms / quantities with suitable example such as molecularity and order of reaction, conductance and resistance, equivalent and molar conductance, rotational and vibrational spectra, etc.

CO6: apply his knowledge to explain / interpret spectra of simple diatomic molecules

CO7: describe facts and observations in electrolytic conductance, molecular spectroscopy, chemical kinetics and phase diagram.

CO8: solve numerical related to electrolytic conductance, molecular spectroscopy, chemical kinetics and phase diagram.

CH-341 Physical chemistry, Sem.-II,

At the end of course students will able to

CO1: define / recall various terms related to electrochemistry, nuclear chemistry and application of radioactivity, crystallography and basics of quantum chemistry.

CO2: write / remember the correct equation such as Nernest equation, representation of cell and cell reactions, Bragg equation, half of radioactive materials, etc.

CO3: derive equations for potentials of various types of cells and electrodes, Bragg equation, half of radioactive materials, kinetics of decay of radioactive materials, particle in 1D box, quantum tunneling, etc.

CO4: explain / describe various terms related to electrochemistry, nuclear chemistry and application of radioactivity, crystallography and basics of quantum chemistry.

CO5: derive relations between / among various terms / quantities related to electrochemistry, nuclear chemistry and application of radioactivity, crystallography and basics of quantum chemistry.

CO6: apply his knowledge to explain experimental observation and should able to correlate theory and particle or observed facts.

CO7: describe facts and observations related to electrochemistry, nuclear chemistry and application of radioactivity, crystallography and basics of quantum chemistry.

CO8: solve numerical in in electrolytic conductance, molecular spectroscopy, chemical kinetics and phase diagram.

CH-332 Paper –II Inorganic Chemistry Sem-III

At the end of course students will able to

CO1: Define terms related to molecular orbital theory, coordination chemistry

CO2: Explain mononuclear and hetero nuclear molecules, LCAO principle, primary and secondary valancy, bond order and magnetic properties of molecules

CO3: Distinguish between atomic and molecular orbitals, bonding and antibonding molecular orbitals, different theories of coordination chemistry

CO4: Draw MO energy level diagrams for homo and hetero nuclear diatomic molecules, crystal field splitting energy level dig. for octahedral and tetrahedral complexes

CO5: Apply IUPAC nomenclature rules and writ name of coordinate complexes, predict structure of complexes by using hybridization

CO6: Describe valance bond theory and crystal field theory to different type of complexes
CO7: Calculate effective atomic number and crystal field stabilization energy for various complexes
CO8: solve numerical problems related to syllabus

CH-342 Paper –II Inorganic Chemistry Sem-IV

At the end of course students will able to

CO1: define lanthanides, actinides, semiconductors, superconductor, close packed structure, lanthanide contraction, super heavy elements, catalyst, catalysis
CO2: describe lanthanide contraction, types of holes in close pack structure
CO3: distinguish between lanthanides and actinides, homogeneous and heterogeneous catalysis, n-type and p-type semiconductor, nuclear fusion and fission
CO4: explain applications of lanthanides and actinides, superconductivity, acetic acid synthesis, properties of heterogeneous catalyst, separation of lanthanides
CO5: explain n(E), and N(E) curves for semiconductors, band structures for sodium metal, hemoglobin, vit. B12
CO6: predict product of nuclear reactions, geometry of ionic solid from radius ratio effect
CO7: derive names of super heavy elements and symbols form IUPAC rules
CO8: solve numerical problems related to syllabus.

CH -333 Paper III: Organic chemistry Sem. III

By the end of this course students will able to

CO1: define the terms related to Organic Reactions such as Aliphatic Nucleophilic, Aromatic electrophilic and Nucleophilic Substitution Reactions
CO2: list Different factors responsible for reactivity of organic compounds in Addition reactions to Unsaturated compounds
CO3: recall the information about acidity and Basicity
CO4: explain the Elimination reactions
CO5: solve the chemical Reactions for Aliphatic Nucleophilic, Aromatic electrophilic and Nucleophilic Substitution Reaction
CO6: classify the organic reactions like substitution, Addition and elimination Reactions.
CO7: categorize different nucleophiles Electrophiles and Bases.
CO8: judge what type of reagent need for the organic Conversion.

CH-343 Paper III: Organic chemistry Sem. IV

By the end of this course students will able to

CO1: define the terms related to Organic Reactions such as Carbanion, Retrosynthetic analysis Rearrangement Reactions and Spectroscopic methods of structure determination.

CO2: list Different factors responsible for reactivity of organic compounds in Oxidation, Reduction, Rearrangement Reactions
CO3: recall the information about Reactivity stability of carbanion
CO4: explain the Rearrangement reactions
CO5: solve the chemical Reactions for Carbanion Retrosynthetic analysis and rearrangement reactions
CO6: calculation of Wavelengths of Organic compounds.
CO7: identification of different functional groups in organic compounds.
CO8: judge the structure of organic compounds

CH-334 Paper- IV Course- Analytical Chemistry, (Semester -I)

At the end of course students will able to

CO1: remember /write/ explain terms/ recall the terms such as gravimetric analysis, common ion effect, solubility product, formation of complex ion, TGA, DTA DSC, spectrophotometry, terms related to absorption measurement, polarography, FES, AAS.
CO2: explain principles of electro-gravimetric analysis, Thermogravimetric analysis, differential thermal analysis, beers law and lamberts law, Polarography, AAS, FES.
CO3: describe various components used in UV-Visible Spectrophotometry, AAS, FES, Polarography, TGA and DTA
CO4: describe equations or reaction of solubility product, law of mass action, Lambert –Beers Law equation, Ilkvoic equation, equation for no. atoms in excited state, Nernst equation.
CO5: describe Instrumentation of UV-Visible Spectrophotometry, AAS, FES, Polarography, TGA and DTA
CO6: solve numerical problems related to solubility product, common ion effect, Thermal methods of analysis, polarography, spectrophotometry, AAS and FES
CO7: apply Electro-gravimetric analysis for separation of metal ion, TGA, DTA, spectrophotometry, polarography AAS and FES.
CO8: select particular chemical or instrumental method for analysis of sample

CH-344 Analytical Chemistry, (Semester -II)

At the end of course students will able to

CO1: remember /write/ explain terms/ recall the terms such as Distribution coefficient, Distribution ratio, Solvent extraction, chromatography, types of chromatography, Electrophoresis, types of electrophoresis, Nephelometry and Turbidimetry.
CO2: define the terms migration velocity, moving boundary method, zone electrophoresis, disc electrophoresis, Rf value, retention time, supercritical fluid chromatography, normalization, secondary peak, salting out, masking agent, counter-current extraction, synergistic extraction.
CO3: discuss various components used in GC, HPLC, Turbidimetry and Nephelometry.

CO4: derive relationship between distribution coefficient and distribution ratio, equation of turbidance, equation of multiple extraction.
CO5: describe Instrumentation of HPLC, GC, Turbidimetry, Nephelometry, electrophoresis.
CO6: solve numerical problems related to distribution ratio, % extracted, Rf values, no. of plates and theoretical plate, turbidance.
CO7: apply HPLC, paper chromatography, solvent extraction, GC, electrophoresis, Turbidimetry and Nephelometry technique for analysis.
CO8: select particular techniques for separation of sample

CH 335 Paper –V of Industrial Chemistry (Paper-V) Sem III,

By the end of this course student will able to-

CO1: define all the terms related to modern approach to chemical industry, agrochemicals, food and starch.
CO2: list basic chemicals, petrochemicals and eco-friendly fuels, cement and glass industry.
CO3: recall information about basic chemicals used in industry, agrochemicals, fuels and their types, nutritive aspects of food.
CO4: explain processes of manufacture of chemicals related to industry, properties of fuels, nutritive aspects of food and quality of soil.
CO5: calculate/determine calorific values of fuels.
CO6: classify fuels, chemical reactions, plant nutrients, herbicides, pesticides, insecticides and fungicides, glass and cement.
CO7: analyze applications and synthesis of different types of industrial chemicals and agrochemicals
CO8: select which principles are appropriate for industrial set up and to improve the yield of product.

CH 345 Industrial Chemistry (Paper V) Sem. IV,

By the end of this course students will able to

CO1: define the terms related to polymer chemistry, sugar and fermentation industry, soaps, detergents and cosmetics, dyes and paints, pharmaceutical industry, and terms related with pollution prevention and management.
CO2: list types of polymers, soaps, detergents, cosmetics, dyes, paints and pharmaceuticals.
CO3: recall information about soaps, detergents, fermentation process, dyes paints, drugs and pollution.
CO4: explain properties of drugs, polymers, soaps, detergents, dyes, paints and sugars.
CO5: determine quality of manufactured products in sugar and fermentation industry.
CO6: classify commercial polymers, soaps, detergents, cosmetics, dyes, paints, pigments and drugs.
CO7: analyze different types of manufacturing process of sugar industry, fermentation process and pollution prevention and waste management.

CO8: select what types of cosmetic products, drugs are important for human health.

CH 336E Chemistry (Paper-VI) Agriculture Semester: - III

By the end of this course students will able to

CO1: define all the terms related to soil chemistry, quality of irrigation water and plant nutrients.

CO2: list of fertilizers, manures, herbicides, pesticides, insecticides and fungicides.

CO3: recall information about soil, nutrient, quality of water, fertilizers and plant protecting chemicals.

CO4: explain properties of soil, impurities in water, effect of environmental condition on nutrient uptake, roll of fertilizers and effect of different types of plant protecting chemicals.

CO5: determine quality of irrigation water in terms of ppm meq/lit, epm, TSS, SAR, ESP and RSC.

CO6: classify soils, quality of water, plant nutrients, herbicides, pesticides, insecticides and fungicides

CO7: analyze different types of impurities present in irrigation and drinking water.

CO8: select appropriate fertilizer which would be more suitable for cultivation of different verities of crop with improve yield.

CH 346E Dairy Chemistry (Paper-VI) Semester: - IV

By the end of this course, the student will able to

CO1: define market milks, special milks, milk protein, carbohydrates, vitamins, died milk, butter, cheese, enzymes and adulterants in milk.

CO2: list out market milks, special milks, milk constituents, nutrients in milk, preservatives and adulterants in milk, milk products and dried milk products.

CO3: discuss about common dairy products, market milks, special milks, milk protein, carbohydrates and vitamins, adulterants in milk, cream, butter, cheese and dried milk.

CO4: explain properties of market milks, common dairy products, special milks, milk protein, carbohydrates and vitamins, cream, butter, cheese and dried milk products.

CO5: classify nutrient in milk, major milk constituents, common dairy processes, preservatives and adulterants in milk, milk products and dried milk powders, common dairy processes.

CO6: classify nutrients in milk, major milk constituents, common dairy processes, chemical composition of milk, milk proteins, special milks, pasteurization of milk process, preservatives and adulterants in milk and dried milk powders.

CO7: analyze different types of adulterations in milk, milk products and dried milk powders.

CO8: choose good quality milk and allied milk products available in the market, which would be suitable for human consumption.

CH-347 Practical Paper-I, Physical Chemistry Practical

CO1: Maintaining records of chemical and instrumental analysis.
CO2: Laboratory skills for the purpose of collecting, interpreting, analysing, practical data.
CO3: Laboratory skills for the purpose handling different analytical instruments.
CO4: Interpretation of results of experiment and their correlation with theory.
CO5: Study of reaction kinetics practically.
CO6: Study of conduct metric, potentiometric, colorimeter and pH metric principles.
CO7: Application of conduct metric, potentiometric, colorimetric and pH metric measurement in quantitative analysis.
CO8: Viscosity measurement and its application.
CO9: Refractometric measurement and its application.

CH-348 Practical Paper-II, Inorganic Chemistry Practical

CO1: Maintaining records of quantitative and qualitative analysis.
CO2: Laboratory skills for the purpose of collecting, interpreting, analysing, and reporting (in written form) chemical data.
CO3: Laboratory skills for the purpose handling different equipment's and analytical instruments.
CO4: Identify methods and instruments that can be used qualitative and quantitative analysis.
CO5: Mole concept and its application in the preparation of normal and molar solutions, and use of mole concept in quantitative calculations for inorganic analysis.
CO6: Choice of proper quantitative methods for analysis of samples containing inorganic substances.
CO7: Synthesis and purify coordination compounds.
CO8: Statistical treatment to quantitative data
CO9: Quantitative analysis using instrumental methods of quantitative analysis.

CH-349 Practical Paper-III, Organic Chemistry Practical

CO1: Maintaining records of quantitative and qualitative analysis.
CO2: Laboratory skills for the purpose handling different equipment's and analytical instruments.
CO3: Study of organic reactions their applications.
CO4: Separation of mixture of organic compound and their identification by chemical methods.
CO5: Perform organic synthesis and follow the progress of the reaction by using TLC technique.

CO6: Write balanced equation for all the reaction performed in laboratory and write it mechanism.
CO7: Choice of proper quantitative methods for analysis of samples containing organic substances.
CO8: Synthesis and purify organic compounds.
CO9: understanding of reaction mechanism involved.
CO10: physical constant determination.

DEPARTMENT OF CHEMISTRY

M. Sc. Chemistry

Goals :

The Department has formulated three broad educational goals for the Post-graduate degree programs:
Chemistry knowledge: To provide students with the advanced knowledge in Analytical Chemistry and allied subjects, the interplay of theory and experiment, and to motivate scientific enthusiasm and curiosity and the joy of learning.
Problem solving skills: To provide students with the tools needed to analyze problems with the skills required to succeed in graduate school, the chemical industry or professional school.
Employment and technical skills: To provide the students with technical skills necessary for successful careers in chemistry and related or alternative careers for which a advanced chemistry foundation can be very useful. These include to a breadth of experimental techniques using modern instrumentation and communication skills (oral and written).

Programme Outcomes :

Course Outcomes :

Credit and Semester Pattern 2013

M. Sc. Part-I (Organic Chemistry) 2013-2014

CHP-110: Basic Fundamentals of Physical Chemistry

At the end of course student should able to
CO1: describe discovery of atom with different models and also physical properties of matter and its study and rate of reaction.
CO2: relate classical mechanics and quantum mechanics and differentiation between orders of reactions.
CO3: illustrate the difference between molecular thermodynamics and classical thermodynamics.

CO4: solve the derivations regarding quantum mechanics, thermodynamics, chemical kinetics and molecular thermodynamics.
CO5: interpret and discuss about the numerical based on theory.
CO6: recall the concepts of quantum mechanics, thermodynamics, chemical kinetics and molecular thermodynamics.
CO7: derive the statistical and kinetics equations.
CO8: present the quantum mechanical based problems.

CHI -130 Molecular Symmetry and chemistry of p-block elements

At the end of course student should able to -
CO1: recall symmetry, group multiplication table, periodic table, periodic properties/ trends
CO2: list symmetry elements, types of planes, allotropes and their uses.
CO3: describe symmetry operations, hydrides, solutions in liq. Ammonia, organometallic compounds, and intercalation compounds.
CO4: discuss character table, SALC, molecular sieves, crown ethers, oxoanions of nitrogen, inter-halogen.
CO5: explain point group, boron hydrides, oxy-acids and oxoanions of halogen, structure and bonding.
CO6: classify molecules into point groups and planes, hydrides, carboranes.
CO7: derive the character table and SALC equation for different point groups.
CO8: draw structures of different compounds of s & p block elements.

CHO-150 Basic Organic Chemistry

By the end of this course students will able to
CO1: define the terms related to Organic Reactions such as Aliphatic Nucleophilic, Aromatic electrophilic and Nucleophilic Substitution Reactions
CO2: list Different factors responsible for reactivity of organic compounds in Addition reactions to unsaturated compounds
CO3: recall the information about acidity Basicity and Aromaticity
CO4: explain the Elimination reactions
CO5: solve the chemical Reactions for Aliphatic Nucleophilic, Aromatic electrophilic and Nucleophilic Substitution Reaction
CO6: classify the organic reactions like substitution, Addition and elimination Reactions.
CO7: categorize different nucleophiles Electrophiles and Bases.
CO8: judge what type of reagent need for the organic Conversion

CHA-190 Safety in Chemical Laboratory and Good laboratory practices

By the end of this course students will able to
CO1: list importance of safety and health in Laboratory.
CO2: establish Effective chemical safety and security management.
CO3: categorize different Personnel protective and other safety equipment's
CO4: classify the different Assessing routes of exposer for toxic chemicals, assessing hazards and risk in the laboratory, Managing Chemicals
CO5: illustrate scientific procedures and data for determining the safety of chemicals and chemical products.

CO6: define efficient handling of hazardous chemicals.
CO7: determine Protection guidelines to work in safe and healthy environment.
CO8: learn all safety measurement to handle laboratory equipment.

CHP-210 Fundamental of Physical chemistry-II

By the end of this course students will able to
CO1: Recognize spectroscopy in microwave, IR, Raman, electronic spectroscopy of molecules and nuclear chemistry.
CO2: Discuss the different interactions between matter and electromagnetic radiation as well as with gamma radiation.
CO3: Illustrate the difference between rotational, vibrational, raman, electronic spectra and radiolysis of water.
CO4: Derivations regarding diatomic molecules shows rotation and vibrations and also derive the half-life equations.
CO5: determine and discuss about the numerical based on theory.
CO6: recall the Concepts of molecular spectroscopy and nuclear chemistry.
CO7: describe nuclear fission, four factor formula, detection and measurement of radioactivity, electronic spectroscopy of molecules, nuclear waste management, and classification of reactors.
CO8: interpret the electron spin resonance, Mossbauer spectroscopy and applications of NMR spectroscopy as well as radiolysis of water, reactions involved in preparation of radioisotopes, reprocessing of spent fuels, neutron activation analysis, radiometric titrations.

CHI-230 Coordination and Bioinorganic chemistry

At the end of course student should able to -
CO1: Identify complex ions showing same R.S. terms, degeneracy of ground state terms of metal ions.
CO2: define ferromagnetic and antiferromagnetic substances, curie and Neel temperature, photosynthesis, metalloeznymes.
CO3: match the given pairs.
CO4: describe spin multiplicities of different configurations, selection rules, micro states, electronic transitions in the complexes, point groups, Fe-S proteins, model compounds and spontaneous self-assembly, metals in medicine, structures of proteins, Na/K pumps, blood coagulation.
CO5: explain concept of hole equivalency with examples, electornic spectrum of complexes, quenching of orbital magnetic moment by crystal field, role of metals in biological system, nitrogen fixation, detoxification of mercury, structure of RNA, cis-platin, dioxygen transport, amino acids, siderophore, calmoduline zinc finger proteins.
CO6: calculate degeneracy for terms/states, frequencies of absorption spectrum, 10Dq, Racah and nepholauxetic parameter for a complex, magnetic moments of complexes, spin orbital coupling constant.
CO7: classify magnetism, metalloproteins, DNA, RNA.
CO8: draw a diagram of correlation, Tanabe-Sugano and Orgel, and structures of proteins, DNA, RNA, cyanocobalamine, flavin, Fe-S cluster, chlorophyll, metal containing medicines,

corrin and porphyrin ring, Metalloproteins.

CHO-250: Organic chemistry

By the end of this course students will able to
CO1: define the terms related to Organic Reactions such as Oxidation, Reduction, Rearrangement Reactions and Spectroscopic methods of structure determination.
CO2: list Different factors responsible for reactivity of organic compounds in Oxidation, Reduction and Rearrangement Reactions.
CO3: Recall the information about reactivity of organometallic compounds CO4: explain the Rearrangement reactions
CO5: solve the chemical Reactions for Oxidation, Reduction, Rearrangement Reactions
CO6: calculate Wavelengths of Organic compounds.
CO7: identify different functional groups in organic compounds. CO8: judge the structure of organic compounds

CHA-290: General Chemistry

By the end of this course students will able to
CO1: define the basic principle of different method used for analysis.
CO2: discus the Principle, Instrumentation of Mass Spectrometry, HPLC, GC. CO3: explain the Application of Mass Spectrometry, HPLC, GC.
CO4: solve the numerical problems related to Mass Spectrometry, HPLC, GC, Chemistry Practical.
CO5: determine data sheet in analytical chemistry with error measurement in analysis.
CO6: predict Gaussian curve and standard deviation of each term.
CO7: present the all separation techniques including sample preparation and sampling and sample handling and ion exchange chromatography.
CO8: recall and solve the numerical based on data analysis.

CHP-107: Practical Course-I -Physical Chemistry

By the end of this course students will able to
CO1: create the preparation of solution and calibration of the instrument according to respective practical.
CO2: determine the concentration of sample by conductometry, potentiometry, pH metry colorimetry and spectrophotometrically.
CO3: illustrate the experiment of non-insrumental methods like chemical kinetics, viscosity, partial molar volume and steam distillation.
CO4: perform experiment on statistcal methods as well as XRD interpretation.
CO5: paraphrase the different examples of same technique.
CO6: recognize instrumental methods and non-instrumental methods of analysis.
CO7: justify the Preparation of Solutions.
CO8: identify the needs of every experiment including instrumental and non- instrumental.

CHI-147: Inorganic Chemistry Practical

By the end of this course students will able to
CO1: Learn the principles in qualitative and quantitative determination of ore and alloy

analysis.
CO2: Analyze the ore and alloy analysis.
CO3: Synthesize co-ordination complexes, studied composition, structure, properties, and reactions and checked their Purity with respect to metal.
CO5: Explain the principles, the method involved and reactions in the solvent extraction, ion exchange chromatography
CO6: interpret UV-visible spectra.
CO7: calculate percentage composition of metal and minerals in alloy. CO8: perform photochemistry and kinetics experiments.

CHO-247: Organic Chemistry Practicals

By the end of this course students will able to
CO1: recognize the handling of laboratory glassware's, hazardous chemicals, and safety in laboratory.
CO2: summarize the purification technique, separation and identification technique i.e. Recrystallization, distillation fractional distillation, chromatography and solvent extraction are used for all types of organic compound.
CO3: demonstrate the assembling of different glass apparatus such as soxhlet apparatus. Distillation unit, column of chromatography Rota evaporator.
CO4: analyze the preparation process such as nitration, oxidation and reduction, esterification, and chalcone formation
CO5: evaluate the preparation of organic molecule, this is the combination of the unit operation to handle the synthesis task, when a flow sheet superstructure has been established
CO6: judge the reaction mechanism and synthesis process.
CO7: defend the Separation of ternary mixture of organic compound and their identification by chemical methods
CO8: apply Chem win software used for drawing and analysis of known and unknown molecule

M. Sc. Part-II (Organic Chemistry) 2014-2015

CHO-350: Organic Reaction Mechanism

CO1: Understanding of reactive intermediates in organic reactions from synthetic point of view.
CO2: Economic use of organic strategies in synthesis
CO3: Applying knowledge of organic reaction mechanism for synthesis of important organic molecules
CO4: Understanding of behavior of organic intermediates in reactions under different reaction condition and making use in different named reactions
CO5: Significant importance of free radical reactions in polymerization reactions is important.
CO6: Extending the organic chemistry reaction mechanism to biological system is important for understanding role of vitamins, minerals. It is useful for drug discovery.

CHO-351: Spectroscopic methods in Structure determination.

CO1: Application of 1H-NMR spectroscopy for structure elucidation of organic molecules
CO2: Understanding the nature of carbons in organic compounds
CO3: Combination Advanced organic spectroscopic NMR techniques for structure elucidation of complicated organic molecules
CO4: Preliminary information for structure elucidation of molecules in Chemistry.
CO5: Applying All spectroscopic together is important for final structure elucidation of compounds.

CHO-352: Organic Stereochemistry

CO1: Understanding conformations of cyclic system in natural products.
CO2: Logical methods or tricks use for knowing stereochemistry's of cyclic systems.
CO3: Recognition of different cyclic systems in naturally occurring molecules.
CO4: Preliminary information for structure elucidation of molecules in Chemistry.
CO5: Understanding the interrelation of different optical isomers and applying separation ideas.
CO6: differentiation of isomers of olefin

CHO-353: Photochemistry, Pericyclic reactions and Heterocyclic Chemistry

CO1: To understand the mechanism of reactions which are carried out by light, heat or reagents this involves concerted or stepwise mechanism
CO2: To understand the synthesis and different types of reactions of heterocyclic compounds.

CHO-450: Chemistry of Natural Products

CO1: To understand the synthesis of compounds which are used as a drug or having medicinal values
CO2: To understand the concept of biogenesis of terpenoids, alkaloids and the compounds obtained from shikimate pathways

CHO-451: Advanced Synthetic Organic Chemistry.

CO1: To understand the preparation of catalyst and their application in organic synthesis
CO2: To understand the role of Organometallic compounds in organic synthesis.

CHO-452: Carbohydrates, Chiron Approach, Chiral drugs and medicinal Chemistry.

CO1: To understand the chemistry of asymmetric compounds (carbohydrates and amino acids).To understand the applications of chiral auxillary in assymetric synthesis (biologically active compounds).
CO2: To understand thorough analysis of recent trends in medicinal chemistry and evaluation of their significance for advancing productivity in drug discovery is presented

CHO -453:-Assymmetric synthesis.

CO1: To understand the advance stereochemistry and retrosynthetic approach

CHO-347:- Single stage preparations
CO1: To develop practical skill

CHO-447:- Double stage preparations
CO1: To develop practical skill

CHO-448 Project/Industrial training/Green Chemistry Practical
CO1: To understand the importance of green chemistry and chemical processes those are more sustainable by reducing the amount of compounds used and reducing and/or eliminating the amount of toxic substances.
CO2: To develop the research and industrial skill.

Choice Based Credit System Pattern 2019

M.Sc. Part-I (Chemistry) 2019-20

Semester-I

CCTP-1: CHP-110, Physical Chemistry-I, (Fundamentals of Physical Chemistry) (4 Credits)

SECTION - I (2 Credits, 24 L, 6T)

CO1. To get the knowledge of Thermodynamics, Change of State, Quantum Chemistry, Chemical Bonding.

SECTION – II (2 Credits, 24 L, 6 T) Chemical Kinetics and Reaction Dynamics

CO1. To get the knowledge of Rate Laws, Kinetics of Complex Reactions, Molecular Reaction Dynamics, Enzyme Catalysis, Molecular Thermodynamics

Semester-II

CCTP-4: CHP-210, Physical Chemistry-II, (Molecular Spectroscopy and Nuclear Chemistry) (4 Credits)

SECTION - I (2 Credits, 24 L, 6T) Molecular Spectroscopy

CO1. To get the knowledge of Microwave Spectroscopy, Infra-red Spectroscopy, Raman Spectroscopy, Electronic Spectroscopy of molecules, Mossbauer Spectroscopy

SECTION – II (2 Credits, 24 L, 6T) Nuclear and Radiation Chemistry

CO1. To get the knowledge of Radioactivity, Elements of Radiation, Nuclear Fission, Applications of Radioactivity,

Semester-I

CCTP-2: CHI-130, Inorganic Chemistry-I, (Molecular Symmetry and Chemistry of Main Group Elements) (4 credits)

SECTION-I (2Credits, 24 L, 6 T) Molecular Symmetry and its Applications

CO1. To get the knowledge of Molecular Symmetry and Symmetry Groups, Representations of Groups, Symmetry Adapted Linear Combinations, Application of Group theory to Infrared Spectroscopy

CO2. Student should visualize/ imagine molecules in 3 dimensions.

CO3. To understand the concept of symmetry and able to pass various symmetry elements through the molecule.

CO4. Understand the concept and point group and apply it to molecules.

CO5. To understand product of symmetry operations.

CO6. To apply the concept of point group for determining optical activity and dipole moment.

CO7. Student should understand the importance of Orthogonality Theorem.

CO8. They should able to learn the rules for constructing character table.

CO9. Using reduction formulae should be able to find out the possible type of hybridization.

CO10. Student should know the concept of SALC.

CO11. Student able to find out character for reducible representation.

CO12. To know about projection operator.

CO13. Apply projection operator to find out the normalized wave function for atomic orbital.

CO14. Student should correlate the application of symmetry to spectroscopy.

CO15. Students able to find out the possible modes of vibration.
CO16. From the previous knowledge of symmetry student must able to find out which mode are IR active.

Section-II (2 Credits, 24 L, 6 T) Chemistry of Main Group Elements

CO1. To get the knowledge of Hydrogen and its compounds, Alkali and Alkaline Earth Metals, Boron, Carbon, Nitrogen, Oxygen, Halogen, and Noble gases Group, Organometallic Compounds

CO2. Student should understand the detail chemistry of S and P block elements w.r.t. their compounds, their reactions and applications.
CO3. To learn the advance chemistry of boranes, fullerene, zeolites, polymers etc.
CO4. Organometallic chemistry of some important elements from the main groups and their applications

Semester-II

CCTP-5: CHI-230, Inorganic Chemistry, (Coordination and Bioinorganic Chemistry) (4 Credits)

SECTION-I (2 Credits, 24 L, 6T) Coordination Chemistry

CO1. To get the knowledge of Concept and Scope of Ligand Fields, Ligand Field Theory of Coordination Complexes, Electronic spectra of Transition Metal Complexes, Magnetic Properties of Coordination Complexes
CO2. Student should able to find out the no of microstates and meaningful term symbols, construction of microstate table for various configuration
CO3. Hund's rules for arranging the terms according to energy.
CO4. Student should understand interelectronic repulsion.
CO5. Student should know the concept of weak and strong ligand field.
CO6. Student able to find out splitting of the free ion terms in weak ligand field and strong ligand field.
CO7. To draw correlations diagram for various configurations in Td an Oh ligand field.
CO8. Student should know basic instrumentation and selection rules and relaxation in rules.
CO9. Student should know basic d-d transition, d-p mixing, charge transfer spectra.
CO10. Interpretation of electronic spectra for spin allowed oh and td complexes using Orgel diagram.
CO11. Understand the concept of spectro chemical series and Nephelauxetic series.
CO12. Should able to solve numerical based on crystal field parameters.
CO13. Understand the various terms involved in magnetochemistry.
CO14. Various phenomenons of magnetism and their temperature dependence.
CO15. Various experimental methods to find out magnetic moment.
CO16. Understand the various Quenching of orbital angular momentum

Section-II: (2Credits, 24 L, 6 T) Bioinorganic Chemistry

CO1. To get the knowledge of Overview of Bioinorganic Chemistry, Concepts of Inorganic Chemistry in Bioinorganic Chemistry, Functions and Transport of Alkali and Alkaline Earth Metal Ions, Biochemistry of Elements.

CO2. Importance of bioinorganic chemistry.
CO3. Role of metals in Metalloprotein and metalloenzymes.
CO4. Similarities in coordination theory for metal complexes and metal ions complexed with biological ligands.
CO5. Importance and transport of metal ions.
CO6. Passive transport metal ions by ionophores and gramicidin.
CO7. Mechanism for active transport of $Na^+$and K^+
CO8. Nerve impulse generation in rod cell of retina.
CO9. Importance and function of Ca, Fe and Mg in metalloprotein
CO10.Catalytic role of Mn in photosynthesis.

Semester-I
CCTP-3:CHO-150, Organic Chemistry-I, (4 Credits)
SECTION-I (2 Credits, 24 L, 6T) Basic Organic Chemistry
CO1. To get the knowledge of Structure and Reactivity, Heterocyclic Chemistry, Stereochemistry,

SECTION-II (2 Credits, 24 L, 6T)
CO1. To get the knowledge of Structure, Stability and Reactions of Reactive Intermediates, Rearrangements, Ylides, Oxidation and Reduction Reactions,
CO2. To understand some fundamental aspects of organic chemistry, to learn the concept aromaticity, to understand the various types of aromaticity
CO3. To study heterocyclic compound containing one and two hetero atoms with their structure, synthesis and reactions.
CO4. To know stereochemistry of organic compounds; able to do interconversion of Fischer to Newmann, Newmann to Sawhorse and vice versa, Able to assign R and S to given molecules; understand stereoselective and stereospecific reactions; acquire knowledge on topicity.
CO5. To study structure, formation, stability and related name reaction of intermediates like Carbocation, Carbanion, Free Radical, Carbenes and nitrenes; Recognize neighboring group participation
CO6. To study rearrangement reaction with specific mechanism and migratory aptitude of different groups.
CO7. To study Ylides and their reaction.
CO8. To understands the basis of redox reaction; acquire knowledge about the reagents which causes selective oxidation / reduction in various compounds; learn the basic mechanism of oxidation / reduction in organic compounds.

Semester-II
CCTP-6: CHO – 250, Organic Chemistry-II, (4 Credits)
SECTION-I (2 Credits, 24 L, 6T) Photochemistry and Pericyclic Reactions
CO1. To get the knowledge of Photochemistry, Pericyclic Reactions
SECTION-II (2 Credits, 24 L, 6T) Spectroscopic Methods in Structure Determination of Organic Compounds
CO1. To get the knowledge of UV and IR Spectroscopy, H1-NMR, C13-NMR, Mass spectrometry (MS), Problems

CO2. MOT and will be able to extend this in predicting reaction mechanism and stereochemistry of electrocyclic reactions.
CO3. The concepts in free radical reactions, mechanism and the stereo chemical outcomes.
CO4. The basic principle of spectroscopic methods and their applications in structure elucidation of organic compounds using given spectroscopic data or spectra.

Semester-I
CBOP-1: CHG – 190, General Chemistry-I, (4 Credits)
SECTION-I: Theory Course (2 Credits, 24 L, 6T)
(Any one option is to be selected by candidate)
Elective Option-A : Introduction to Solid State of Matter
CO1. To get the knowledge of Bonding in Solids and Electronic Properties, Defects and Non-Stoichiometry, Superconductivity, Synthesis of Solids

At the end of course student will understand
1. Bonding in solids – band theory
2. Electronic conductivity
3. Semiconductors, photoconductivity
4. Non-stoichiometry, defects and types of defects in solids
5. Ionic conductivity and their applications
6. Superconductivity and theory of superconductivity
7. Method of synthesis of solids

Elective Option-B: Chemical Mathematics
CO1. To get the knowledge of Functions, Differential Equations, Vectors Matrices, and Determinants

Elective Option-C: Introduction to Chemical Biology-I
CO1. To get the knowledge of Overview of Biochemical Concepts, Chemistry of Biomembranes, Carbohydrates, Lipids, Amino Acids and Proteins
CO2. The goal of this course is to introduce students to fundamental concepts in Chemical Biology and methods of chemistry used to solve problems in molecular and cell biology. After completion of this course, successful students will:
CO3. Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
CO4. Students will be able to function as a member of an interdisciplinary problem solving team.
CO5. To impart the students thorough idea in the chemistry of carbohydrates, amino acids, proteins and nucleic acids etc.
CO6. Be able to describe the chemical basis for replication, transcription, translation and how each of these central processes can be expanded to include new chemical matter.
CO7. Develop skills to critically read the literature and effectively communicate research in a peer setting.

SECTION-II: Practical Course (2 Credits,48 L 12T)
(Any one option to be selected by candidate)
Elective Option-A: Inorganic Material Analysis, Synthesis and Applications

CO1. To get the knowledge of Analysis of ores, alloys, Synthesis of solid state materials / nano-materials, Applications of Solid State Materials

Elective Option - B: Chemical Biology-I Practical
CO1. To get the knowledge of Preparations, Qualitative and Quantitative analysis, Chromatography, Isolations

Semester-II
CBOP-2: CHG – 290, General Chemistry -II, (4 Credits)
SECTION-I: Theory Course (2 Credits, 24 L, 6T)
(Any one option is to be selected by candidate)
Elective Option-A: Material Characterization Technique
CO1. To get the knowledge of XRD, TEM, SEM, XRF
CO2. Different characterization technique of solids.
CO3. Principle of XRD, instrumentation of powder XRD, Brags law, applications of XRD for crystal structure determination, numerical problems.
CO4. Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM.
CO5. Principle of TEM, instrumentation of TEM and interpretation of TEM images.
CO6. Basics of X-rays, Principle of XRF, types of XRF, instrumentation, qualitative and quantitative analysis, numerical.

Elective Option - B: Organometallic and Inorganic Reaction Mechanism
CO1. To get the knowledge of Organometallic Chemistry, Organometallic Reactions and Catalysis, Coordination Compounds: Reactions and Mechanism
CO2. Valence electron count, back bonding in organometallics, spectral characterization of organometallic compounds.
CO3. Catalytic reaction involving organometallic compounds and mechanism of these reactions
CO4. Types of reaction involving organometallic compounds
CO5. Types of reactions in coordination compounds, inert and labile complexes, substitution reactions in coordination complexes and their mechanism, stereochemistry of reaction, kinetics of reactions.

Elective Option– C: Introduction to Chemical Biology-II
After completion of this course, successful students will:
CO1. Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
CO2. Students will be able to function as a member of an interdisciplinary problem solving team.
CO3. To impart the students thorough idea in the chemistry of carbohydrates, amino acids, proteins and nucleic acids etc.
CO4. Be able to describe the chemical basis for replication, transcription, translation and how each of these central processes can be expanded to include new chemical matter.
CO5. Develop skills to critically read the literature and effectively communicate research in a peer setting.
CO6. Describe the importance of chemical biology research and interdisciplinary work.

SECTION-II: Practical Course (2 Credits, 48 L, 12T)

(Any one option to be selected by candidate)

Elective Option-A: Electrochemical Methods of Analysis

Time allotted: One practical Session of 4 hours per week for one semester

CO1. To get the knowledge of Conductometry, Polarography, Potentiomerty, pH metry, Table Work

Elective Option-B: Chemical Biology-II Practical

CO1. To get the knowledge of Purification and separation of biomolecules by chromatography, electrophoresis, dialysis

Semester-I

CCPP-1: CHP-107: Practical Course – I: Semester -I

Basic Practical Chemistry (Compulsory) (4 Credits, 96 L, 24T)

Time allotted: Two practical sessions of 4 hours per week for one semester (one practical session for Section-I and one practical session for Section-II per week is compulsory)

Sec-I: Physical Chemistry Practical (11 Experiments)

CO1. To get the knowledge of Chemical Kinetics, Non-Instrumental, Colorimetry and spectrophotometry, Radioactivity

Sec-II: Organic Chemistry (11 Experiments)

Introduction to Laboratory Safety

CO1. To get the knowledge of Purification Techniques, Introduction to Green Chemistry, Green Chemistry Experiments,

Semester-II

CCPP-2: CHP-227: Practical Course-II: Semester -II

Basic Practical Chemistry (Compulsory) (4 Credits, 96 L, 24T)

Time allotted: Two practical sessions of 4 hours per week for one semester (one practical session for **Section-I and one practical session for Section-II per week is compulsory)**

Section-I: Inorganic Chemistry (11 Experiments)

CO1. To get the knowledge of Synthesis of coordination complexes, Inorganic Conductometry, Inorganic characterization techniques, Inorganic Kinetics Experiment, Ion – Exchange Chromatography, Solvent Extraction and colorimetric,

Section -II: Organic Chemistry

CO1. To get the knowledge of a) Relevant chemical analysis. b) Column chromatography. c) Elemental analysis. d) Spectroscopic interpretation. e) How to draw schemes and mechanism using Chem Draw / ISIS Draw etc.

CO2. Students are trained to different purification techniques in organic chemistry like recrystallization, distillation, steam distillation and extraction.

CO3. Students are made aware of safety techniques and handling of chemicals.

CO4. Students are made aware of carrying out different types of reactions and their workup methods.

CO5. This practical course is designed to make student aware of green chemistry and role of green chemistry in pollution reduction.

M.Sc. Part-II (Chemistry)

M.Sc. (II) Organic Chemistry- 2020-2021

Semester-III

CCTP-7, CHO-350: Organic Reaction Mechanism and Biogenesis [48L+12T]

Section I: Organic Reaction Mechanism, [24 L + 6 T]

CO1. To get the knowledge of Methods for determining Reaction Mechanisms, Free Radicals, Linear Free Energy Relationships, Hammet plots, Hammet equation, Taft equation, solvent effects.

Section II: Biogenesis: The Bbuilding Blocks and Cconstruction Mmechanism, [24 L + 6 T]

CO1. To get the knowledge of Terpenoids, Alkaloids, The Shikimate pathway, case study: Alkaloids isolated from the Roots of Piper nigrum,

CCTP-8, CHO-351: Structure Determination of Organic Compounds by Spectroscopic Methods [48L +12L]

Section-I: NMR Spectroscopy [24 L + 6 T]

CO1. To get the knowledge of NMR in Stereochemistry Determination, 13C NMR spectroscopy, 15N, 19F and 31P NMR spectroscopy, 2D NMR

Section-II: Mass Spectrometry [24 L + 6 T]

CO1. To get the knowledge of Mass Spectrometry, Applications of Mass Spectrometry: Problems solving

CCTP-9, CHO-352: Stereochemistry and Asymmetric Synthesis of Organic Compounds [48L + 12T]

Section I- Stereochemistry [24L + 6T]

Conformations of polysubstituted cyclohexane, six membered rings with SP2 carbon, heterocycles with N and O, anomeric effect, stereochemical principles involved in reactions of six membered rings and other than six membered rings, concept of I- Strain, Stereochemistry of fused and bridged ring systems: Nomenclature, synthesis; stereochemical aspects of Perhydrophenanthrene, Perhydroanthracene, hydrindane, Steroids; Bridged system (bi, tri and polycyclo system) including heteroatoms, Bredt's Rule. Conformations of following compounds with justification of each: cis and trans -1,3- and l,4-di-t-butyl-cyclohexanes; Cis-4-di-t-butyl- cis-2,5-dihydroxycyclohexane; Twistane; bicyclo- [2.2.2]octane; Trans-anti-trans- Perhydro-anthracene and the lactone; cyclohexane-l,4-dione; 1,2,2,6,6-penta-methyl-4- hydroxy-4-phenylpiperidine; ψ-tropine; 2-hydroxy-2-phenyl quinolizidine; 4-t-butyl-4- methyl-l,3-dioxane; cis- and trans-2,5-di-t-butyl-l,3-dithianes;cis-2,5-di-t-butyl-l,3,2- dioxaphosphorinan-2-one, Determination of configuration, Cram's rule, Cram's cycle model, Cram's dipolar model, Felkin-Anh Model; Resolution and analysis of stereomers - formation of racemization and methods of resolution. Stereochemistry of a polymer chain – Types and examples of Tacticity, Decalols, Decalones, Octahydronaphthalenes, decahydroquinolines

Section II- Asymmetric Synthesis [24L + 6T]

Introduction of Asymmetric Synthesis, Chirol pool and Chiral auxillaries. Asymmetric Organocatalysis, Asymmetric Aldol Reaction, Enantioselective, diastereoselective and double diastereoselective Aldol reactions. Transition Metal-Catalyzed Homogeneous Asymmetric Hydrogenation, Hydroxylation and Epoxidation, Asymmetric Phase-Transfer and Ion Pair Catalysis

CBOP-3, CHO-353(A): Protection - De-protection, Chiron approach and

Carbohydrate Chemistry OR CHO-353(B): Designing Organic Syntheses and Heterocyclic
Chemistry [48L + 12T]
CBOP-3, CHO-353(A): Protection - De-protection, Chiron approach and Carbohydrate
Section I: Protection - De-protection, Chiron approach [24L + 6T]
CO1. To get the knowledge of Protection and de-protection of functional group in organic synthesis, Diol - , Amines, Carboxyl group, Ketone and aldehydes, Chiron approach,

Section - II: Carbohydrate Chemistry [24 L + 6T]
CO1. To get the knowledge of Basics of Carbohydrates, Synthesis of Glycosides

CBOP-3, CHO-353(B): Designing Organic Syntheses and Heterocyclic Chemistry[**48 L + 12 T]**
Section I: Designing Organic Syntheses [24 L + 6 T]
CO1. To get the knowledge of Concepts of Retrosynthesis and Application of Retrosynthetic Approach
Section II: Advanced Heterocyclic Chemistry [24 L + 6 T]
CO1. To get the knowledge of Systematic nomenclature (Hantzsch-Widman System) for monocyclic, fused and bridged heterocycles. General chemical behaviour of heterocyclic compounds and their applications. Synthesis, reactions and structural effects of heterocyclic rings.

CCPP-3, CHO-354: Practical-I Solvent Free Organic Synthesis [96L +24T] Note:
CO1. To get the knowledge of Syntheses, Students should acquire pre-experiment (Reading MSDS, purification of reactants and reagents, mechanism, stoichiometry etc) and post-experiment skills (work-up, isolation and purification of products, physical constants characterization using any spectroscopic methods etc.)

Semester IV

CCTP- 10, CHO-450: Chemistry of Natural Products [48L +12T]
Section I: [24 L + 6 T]
CO1. To get the knowledge of Understanding and planning of total synthesis while maintaining the stereochemistry. A case study: Longifolene
CO2. To get the knowledge of Total Synthesis of Hirsutellone B, Ribisins A and B, Subincanadine
Section II : [24 L + 6 T]
CO1. To get the knowledge of Total Synthesis of Vannusals, Pinnaic acid

CCTP- 11, CHO-451: Organometallic Reagents in Organic Synthesis [48 L + 12T]
CO1. To get the knowledge of Transition metal complexes in organic synthesis**,** C=C formation reactions**,** Multi-component reactions**,** Ring formation reactions**,** Click chemistry, Click reactions in synthesis of bioconjugates, Metathesis, Use of Boron and Silicon reagents in organic synthesis, Other important reactions

CBOP-4, CHO-452(A): Concepts and Applications of Medicinal Chemistry [48L + 12T]

OR
CHO-452(B): Applied Organic Chemistry [48L + 12T]

CBOP-4, CHO-452(A): Concepts and Applications of Medicinal Chemistry [48L + 12T]
Section-I: [24 L + 6 T]
CO1. To get the knowledge of Introduction to Peptides and proteins, Proteins as biological catalyst Nucleic acids, Metabolism, Chemistry of cofactors/coenzymes, Chemistry of TPP, PLP, Folic Acid and other vitamins,
CO2. To get the knowledge of Principle of drug design, Chemistry of diseases and Drug development, Proton pump inhibitors and Problem solving, Peptides, sequencing and applications in therapeutics, Solution phase and solid phase peptide synthesis and Modern techniques for biomolecules and disease diagnosis,
CO3. To get the knowledge of Introduction to medicinal Chemistry. History, drug targets, Drug discovery, design and development, Case Study: Design of Oxamniquine. Pharmacokinetics and Pharmacodynamics of drug: Drug absorption, distribution, metabolism, elimination and toxicity, drug metabolism, biotransformation, Drug receptor interactions, Hansch Equation and significance of terms involved in it.
Section II: [24 L + 6 T]
CO1. To get the knowledge of Structure and activity Relationship: QSAR, Applications of SAR and QSAR in drug design, physio-chemical parameters lipophilicity, partition coefficient, electronic ionization constant, Case Study: Statins,
CO2. To get the knowledge of Introduction, Developments, SAR, Mode of action, limitations and adverse effect of Anti-infective Agents, Beta lactam antibacterial agents (Penicillins, Cephalosporins), Tetracyclins, Macrolides, Chloramphenicol, Polyenes, Amphotrecin-B, Azoles, Amantadine,Acyclovir, Quinine, Quinolines, Quinolones, Refamycine, Sulphonamides

CBOP-4, CHO-452(B): Applied Organic Chemistry [48 L + 12T]
Section-I:[24 L + 6 T]
CO1. To get the knowledge of Covalent Organic Frameworks: Structures, Synthesis, and Applications.
CO2. To get the knowledge of Organic Electroluminescent Materials,
Section –II :[24 L + 6 T]
CO1. To get the knowledge of Supramolecular Organic Compounds , Single Molecule Switches, Molecular Machines

CBOP-5, CHO-453: Practical-III: Select ANY TWO Section I, II and III [96 L + 24 T]
Section-I: Ternary Mixture Separation [48 L + 12 T]
CO1. Understand and employ concept of type determination and separation
CO2. Meticulously record physical constants
CO3. Perform micro scale chemical elemental analysis
CO4. Perform qualitative estimation of functional groups
CO5. Recrystallize /distill the separated compounds
CO6. Extend these skills to organic synthesis
Section-II: Carbohydrates Synthesis and Isolation Natural Products

[48 L + 12 T]

Unit I: Carbohydrate Synthesis (Any 3)

CO1. To understand the meaning of dry condition in reaction.
CO2. How to prepare dry solvents.
CO3. Workup of reaction in minimum quantity of water.
CO4. To acquire skill in handling of carbohydrates reaction.

Unit II: Isolation of pigments from the natural products (Any 3)

Orange Marigold, Rose, Sunflower, Hibiscus, Any colored flowers/fruits available in the local area **(only one is allowed).**

CO1. Students should be able to collect reasonable quantities of color pigments to do the characterization (Physical Constant, Elemental analysis functional group test etc) and shouldalso form the appropriate derivative. They are encouraged to use these pigments for developing food grade natural colors from lesser known plant sources.

Unit III: Isolation of essential oils from the natural products (Any 3)

Ginger, Lemongrass, Garlic, Ajwain/ajowan/Trachyspermum ammi, Vekhand (achourus calamus) root, Any natural products available in the local area **(only one is allowed)**

CO1. Students should be able to collect a reasonable quantities of essential oils to do the characterization(Physical Constant, Density, Elemental analysis functional group test) Should form the appropriate derivative. They are encouraged to use these essential oils for the development of the products like soap, perfumes etc.

Unit IV: Isolation of medicinally important component from the natural products (Any3)

Nimbin from Neem leave, Amyrin from Apati/Apta bark, Eujenol from Tulsi leaves, D-Galacturonic Acid from Jeshtamadh, Piper from Betel leaf, Any medicinally important plants available in the local area (only one is allowed)At least one natural product should be isolated by using column chromatographic techniques (Use micro columns to avoid excess use of solvents)

CO1. Students should be able to collect a reasonable quantities natural products to do the characterization (Physical Constant, solubility, Elemental analysis functional group test etc) and should also form the appropriate derivative. They are encouraged to study novel medicinal plants from their local area.

Section-III: Project [48 L + 12 T]

CO1. To get the knowledge of **Project/ Industrial Training/Summer Training/ Internships**

CCPP-04, CHO-454: Practical-II: Convergent and Divergent Organic Syntheses [96L +24T]

CO1. To get the knowledge of convergent and divergent synthesis from the given four sets.
CO2. To get the knowledge of **pre-experiment** (Reading MSDS, purification of reactants and reagents, mechanism, stoichiometry etc) and **post-experiment skills** (work-up, isolation and purification of products, physical constants characterization using any spectroscopic methods etc.)