

# **Bachelor of Science – Chemistry**

## **Programme Specific Outcome (PSO)**

**PSO1** Students will be able to acquire core knowledge in the key areas of Chemistry, develop written & oral communication skills in communicating chemistry-related topics.

**PSO2** Design & conduct experiments, demonstrate their understanding of the scientific methods & processes.

**PSO3** Develop proficiency in acquiring data using a variety of instruments, analyse & interpret the data, learn applications of numerical techniques.

**PSO4** Realize & develop an understanding of the impact of Chemistry on society.

## **Course Outcome (CO)**

### **Semester I: CHC 101**

**CO1** To discuss Bohr's theory, Quantum theory for structure of an atom, the radial plots and probability distribution curves.

**CO2** To generalize the rules for electronic configuration of an atom.

**CO3** To explain and discuss the general characteristics of ionic compounds, covalent compounds, valence bond theory, VSEPR, and molecular orbital theory for covalent compounds.

**CO4** To understand the curved arrow notations, electronic displacement in organic reactions.

**CO5** To draw the structure, shape and reactivity of organic molecules.

**CO6** To learn the concept of isomerism, stereoisomerism, configuration, chirality and optical rotation.

**CO7** To understand various methods of preparation and reactions of alkanes, alkenes and alkynes.

**CO8** To estimate the metal ions by volumetric methods employing redox and acid-base titration concepts.

**CO9** To get hands on experience for the systematic qualitative analysis of the organic compounds.

**CO10** To learn the purification and separation techniques for organic compounds.

## **Semester I: CHG 103**

**CO1** To understand the various branches of science.

**CO2** To learn about the scientists who are inspirations to the youngster generation.

**CO3** To study organic chemistry and its application in daily life; carbon, nitrogen, water and oxygen cycles.

**CO4** To understand how chemistry and industry go hand in hand.

## **Semester II: CHC 102**

**CO1** To define the terms and state laws involved in thermodynamics, thermochemistry and chemical equilibrium.

**CO2** To derive the thermodynamic derivation of the law of chemical standard state, enthalpies of solution, chemical equilibrium and relationships between different equilibrium constants based on ideal gases.

**CO3** To solve numerical based on chemical energetics, chemical equilibrium and ionic equilibrium.

**CO4** To learn the preparation methods and reactions of aromatic hydrocarbons, alkyl and aryl halides, phenols, ethers and carbonyl compounds.

**CO5** To learn the various name reactions mentioned in the syllabus.

**CO6** To understand reactivity and relative strength of C-halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

**CO7** To understand Benzyne mechanism with respect to aromatic nucleophilic substitution.

**CO8** To understand Pinacol-pinacolone rearrangement with mechanism.

**CO9** To understand and develop the problem-solving skills and hands on experience with reference to concepts studied in theory pH metry, thermochemistry.

**CO10** To understand the mechanism of reactions involved in organic preparation experiments and develop hands on experience with reference to basic laboratory techniques required for organic preparations.

## **Semester II: CHG 104**

**CO1** To learn the importance of chemistry in daily life.

**CO2** To study various techniques to purify organic compounds.

**CO3** To learn various medicinal compounds derived from nature and their applications.

## **Semester III: CHC 103**

**CO1** To understand the difference between ideal and non-ideal solutions and draw the phase diagrams of various systems and to apply the phase rule equation.

**CO2** To study the conductance of strong and weak electrolytes.

**CO3** To study reversible and irreversible cells and measurement of EMF.

**CO4** To solve the numerical problems based on standard electrode potentials and conductance measurement of solutions.

**CO5** To learn the preparation/synthesis and reactions of carboxylic acids and their derivatives, amines, diazonium salts, amino acids and simple peptides.

**CO6** To study the laws, the terms involved and to distinguish between cis and trans isomers using UV –Visible Spectroscopy.

**CO7** To know Woodward-Fieser rules for calculation of  $\lambda_{\max}$  for conjugated dienes and  $\alpha$ ,  $\beta$  unsaturated carbonyl compounds.

**CO8** To know classification of carbohydrates and their general properties.

**CO9** To understand and develop the problem-solving skills and hands on experience with reference to concepts studied in theory. (phase equilibria, conductometry and potentiometry)

**CO10** To gain knowledge of analyzing organic compounds and perform estimations.

### **Semester III: CHS 101**

**CO1** To define renewable, non-renewable, alternative energy sources, fuel, calorific value and the characteristics of a good fuel.

**CO2** To understand composition and uses of coal gas, producer gas and water gas.

**CO3** To study coal gasification (Hydrogasification and Catalytic gasification), coal liquefaction, solvent refining, different types of petroleum products and their applications.

**CO4** To understand idea about food processing, food preservation, adulteration, the concept of pH and pH measurement with respect different types of soils.

**CO5** To study the use of different indicators for mapping various soil characteristics to improve soil fertility.

**CO6** To find out the sources responsible for contaminating water, study water sampling methods and methods employed for the purification of water.

**CO7** To understand the different methods employed for the determination of various physicochemical parameters of water.

**CO8** To understand the method of determination of soil pH.

### **Semester IV: CHC 104**

**CO1** To study the postulates of kinetic theory of gases and understand the deviations of real gases from ideal behavior, properties of liquids and the methods to measure them.

**CO2** To study the structures of cubic crystals and the laws explaining their structure.

**CO3** To understand rates of chemical reactions of zero, first and second orders.

**C04** To understand the complexing ability and stability of various oxidation states (Latimer diagrams) for Mn, Fe, and Cu.

**C05** To explain lanthanide contraction, separation of lanthanides (ion exchange method only).

**C06** To understand the factors affecting the magnitude of  $10Dq$  and the effect of strong field and weak field ligands on CFSE.

**C07** To study crystal field splitting in tetrahedral and octahedral complexes and to calculate CFSE.

**C08** To understand and develop the problem-solving skills and hands on experience with reference to concepts studied in theory.

**C09** To systematically analyse the cations and anions in a given mixture.

**C010** To quantitatively estimate several metal ions using the gravimetric and volumetric techniques.

## **Semester IV: CHS 107**

**C01** To explain the term cosmeticology.

**C02** To give examples of marketed products and describe the preparation formulation and packaging of various cosmetic products.

**C03** To define herb and other terms involved.

**C04** To describe the development of Ayurvedic and Herbal formulations and their evaluation by physical methods, chemical methods and microscopical techniques.

**C05** To describe the formulation and preparation of Herbal cosmetics for skin care and hair care products.

**C06** To understand the classification of perfumes, categorize the ingredients and the importance of essential oils in cosmetic industries.

**C07** To describe the general methods of obtaining volatile oils from plants. To describe the composition of volatile oils.

**C08** To understand the concept of cosmetics and develop preparation and skills of working and preparation of various cosmetic products.

## Semester V: CHC 105

**CO1** To study optical activity, polarization, dipole moment and methods of determination of dipole moments and structure of molecules.

**CO2** To classify different nuclides. Binding energy and nuclear forces. To study nuclear models, radioactivity.

**CO3** To study emf and its measurements. To study concentration cell, its measurements, applications.

**CO4** To study decomposition potential, overvoltage and factors affecting them.

**CO5** To define the principles, hypothesis, postulates of quantum mechanics in Quantum chemistry.

**CO6** To apply the basic mathematical concepts in quantum chemistry.

**CO7** To draw the wave functions, orbital diagrams and the graphs involved and to solve the numerical..

**CO8** To study electromagnetic spectrum, Rotational spectra of diatomic molecules, determination of bond lengths and qualitative description..

**CO9** To understand and develop the problem-solving skills and hands on experience with reference to concepts studied in theory (potentiometry, pH metry, Solubility, Chemical kinetics).

## Semester V: CHC 106

**CO1** To define the various periodic properties in the groups and the periods of the periodic table.

**CO2** To define Interhalogens, Oxyacids of Halogens, Polyhalides and Pseudo halogens and generalize their properties.

**CO3** To discuss the occurrence, general properties, hydrates and Clathrates of Noble gases.

**CO4** To introduce concept of defects in solids, define Schottky and Frenkel defects, Color center, extended defects and Non-stoichiometry.

**CO5** To generalize Werner's Co-ordination Theory, Ligand field Theory and Molecular Orbital Theory ( $\sigma$  as well as  $\pi$  bonding).

**CO6** To define the basic concepts of oxidation and reduction and the study of electrochemical series.

**CO7** To define and draw Frost, Latimer and Pourbaix diagrams for various types of reactions and to study the principles involved in extraction of elements.

**CO8** To introduce Nano chemistry and explain nano particles, their properties and applications.

**CO9** To study the roles of myoglobin and hemoglobin and to define and study metalloenzymes.

**CO10** To understand and to get hands on experience on the various steps involved in gravimetry for quantitative estimations of desired metal ions in the presence of other interfering ions in the mixture of salt solutions by precipitating method and preparation of some inorganic complexes.

## **Semester V: CHC 107**

**CO1** To understand the concept of aromaticity, mechanistic aspects of electrophilic and nucleophilic aromatic substitution.

**CO2** To understand the concept related to reactivity and orientation of activating and deactivating groups.

**CO3** To study methods for structure elucidation of Nicotine, Papaverine and Hygrine.

**CO4** To learn the synthesis of Nicotine from Succinimide, synthesis of Papaverine using Bischler-Napieralski reaction and synthesis of Hygrine from Pyrrole.

**CO5** To learn the concepts and interpretation of IR, NMR and Mass spectroscopic methods.

**CO6** To study heterocyclic compounds, bicyclic heterocycles with examples and classification with examples of oxygen, sulphur and nitrogen containing heterocycles (up to 6 membered).

**CO7** To understand structure, resonance, stability and reactivity of furan, pyrrole, thiophene, pyridine, indole, quinoline and isoquinoline and also learn about their industrial source and preparation methods.

**CO8** To study structure elucidation of Vitamin A, Vitamin C , Thyroxine and Adrenaline and also learn their synthesis from  $\beta$ -ionone, xylose, tyrosine and catechol respectively.

**CO9** To learn synthesis and understand chemistry of phenolphthalein, congo-red, crystal violet and methyl orange.

**CO10** To understand theoretical concepts required for experiments and develop hands on experience with reference to basic laboratory techniques required for organic preparations, estimations and identification and separation of organic binary mixtures.

## **Semester V: CHD 101**

**CO1** To define the terms involved in analytical chemistry, sampling techniques, data handling, chromatographic Techniques and electroanalytical methods.

**CO2** To explain scope and importance of analytical chemistry, different types of sampling and the types of solvent extractions.

**CO3** To classify different types of chromatographic techniques and errors with examples.

**CO4** To study the principles of volumetric analysis and gravimetric analysis and the instrumentation of electrogravimetry, coulometry and polarographic analysis.

**CO5** To solve numericals of evaluation of data and solvent extractions.

**CO6** To understand and develop the problem-solving skills and hands on experience with reference to concepts studied in theory (ion exchange chromatography, colorimetry, statistical data).

## **Semester V: CHD 102**

**CO1** To understand the need of Green Chemistry and to know the 12 principles of Green Chemistry.

**CO2** To know the Green chemistry institutes and organizations in the world and study green techniques in chemistry.

**CO3** To understand the mechanism of Phase Transfer Catalysis and to study the real-world cases in chemistry.

**CO4** To study the various risks and hazards involved in a chemical laboratory and use of personnel protective equipment to be used.

**CO5** To study the toxic hazards involved in a chemical laboratory and working of fire extinguishers.

**CO6** To study the different types of waste and their hazards associated in a chemical laboratory.

**CO7** To study the precautions to be taken while working with water-dependent, electrical, and heating devices and to study the handling of solid waste.

## **Semester VI: CHC 108**

**CO1** To study the molecular orbital theory diagrams and the graphs involved.

**CO2** To interpret the physical picture of bonding and antibonding wavefunction.

**CO3** To define terms involved in electrochemistry, pH, pOH, pKa, pKb. Buffer solution, buffer capacity. Measurement of pH using different electrodes by potentiometric methods.

**CO4** To derive and solve numerical on Henderson's equation.

**CO5** To study energy released in nuclear fission, fission products.

**CO6** To classify and describe the working of various nuclear reactors.

**CO7** To draw and interpret Jablonski diagrams.

**CO8** To study vibrational spectroscopy, IR, harmonic and anharmonic oscillator, Raman spectroscopy.

**CO9** To study stokes and antistock lines, Raman shift and selection rules involved.

**CO10** To understand and develop the problem-solving skills and hands on experience with reference to concepts studied in theory.

## **Semester VI: CHC 109**

**CO1** To define the terms Organometallic compounds, mononuclear, polynuclear metal carbonyls.

**CO2** To state the Effective atomic number rule, 18 electron rule for metal carbonyls and organometallic compounds.

**CO3** To study the different types of magnetic behavior.

**CO4** To discuss the measurement of magnetic susceptibility.

**CO5** To study the effect of crystal field splitting on magnetic and spectral properties of octahedral complexes.

**CO6** To study the substitution reaction mechanisms of octahedral complexes and the trans effect observed in square planar complexes.

**CO7** To explain the distinct types of reactions occurring in liquid ammonia and liquid Sulphur dioxide solvents.

**CO8** To introduce concept of Symmetry elements: Centre of symmetry, Rotation axis, Mirror plane, rotation – reflection axis and Identity. To apply concepts of symmetry and point groups to different molecules.

**CO9** To estimate the metal ions by volumetric methods employing redox, argentometric and complexometric titration concepts.

**CO10** To prepare complexes and estimate the metal ion by volumetric analysis.

## **Semester VI: CHC 110**

**CO1** To understand the reactions and mechanism of name reactions and rearrangements mentioned in the syllabus.

**CO2** To understand the generation of enolate ions and their use in synthetic organic chemistry.

- C03** To study Keto-enol tautomerism of ethylacetoacetate.
- C04** To study Jablonskii diagram and understand fluorescence, phosphorescence, intersystem crossing, and vibrational relaxation.
- C05** To learn and understand photochemical reactions.
- C06** To learn the synthesis and structure elucidation of terpenes.
- C07** To understand the reactions of glucose and determination of ring size of Glucose and sucrose.
- C08** To understand the open chain reactions of sucrose and inversion of cane sugar.
- C09** To know the evidence of presence of glucose and fructose unit in sucrose and to understand the stereospecific and stereoselective reactions.
- C010** To get hands on experience for the preparation of derivatives using the reactions learnt in theory and binary mixture separation followed by analysis of individual compound.

## **Semester VI: CHD 103**

- C01** To define the terms involved in chromatographic techniques and spectroscopic methods.
- C02** To explain working of chromatographic techniques and detectors, spectrophotometer, Atomic spectroscopy, DTA, DSC.
- C03** To describe the basic components of instruments.
- C04** To draw the schematic diagrams of different instruments.
- C05** To solve numerical on chromatographic techniques.
- C06** To discuss the applications of different chromatographic techniques and spectroscopic methods.