Learning outcomes

B.Sc. in Chemistry (Hons)

Program specific outcome:

PSO1: Students will have a basic knowledge of fundamentals and application of current chemical and scientific theories.

PSO2: Students will be able to record and analyze the results of experiments.

PSO3: Students will be skilled in problem solving, critical thinking and analytical.

PSO4: Students will understand the central role of chemistry in our society.

PSO5: Students will become aware of the ethical behaviour in issues facing chemist.

PSO6: Every branch of science and technology is related to chemistry.

PSO7: Students will help in understanding the causes of environmental pollution.

PSO8: Students will become familiar with the different branches of chemistry like analytical, organic, inorganic, physical, environmental, polymers and biochemistry.

Semester I

CH-101

Section A: INORGANIC CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to

CO1: Understand the basic idea of atomic structure and wave character and electronic configuration of the elements.

CO2: Understand the details of periodicity, periodic table, chemical bonding, valence bond theory, molecular orbital theory and VSEPRT.

CO3: Understand the theory of quantitative and qualitative analysis, acid, base, pH, common ion effect, Gravimetric analysis.

Section B: ORGANIC CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to understand:

CO1: The basics of structure and chemical bonding in organic molecules, organic reactions and their mechanisms.

CO2: The nomenclature and properties of cycloalkanes, chemical reactions and mechanisms of alkenes, dienes and alkynes.

Section C: PHYSICAL CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Understand the basic idea of Gaseous state-1, kinetic molecular model of a gas and gaseous state-II, deviations from ideal gas behaviour.

CO2: Understand concept of liquid state, nature of liquid state, intermolecular forces, surface tension and coefficient of viscosity.

CO3: Learn in detail solid state, nature of the solid state, laws of constancy of interfacial angles, law of rational indices, Miller indices.

CH-101P:

INORGANIC CHEMISTRY PRACTICAL (25 Marks; 45 Hours)

(i) Semimicro analysis:

Identification of two acid and two basic radicals by semi-micro qualitative analysis technique (including interfering radicals)

(ii) Qualitative analysis:

Volumetric estimation (one metal), Iodometry, dichromatometry.

Semester II

CH-202

Section A: INORGANIC CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Learn in detail acids and bases, Arrhenius concept, Bronsted-Lowry theory, electronic theory, Lux-flood theory, solvent system theory, Lewis theory of acid and bases.

CO2: Understand the concept of oxidation and reduction, electronic concept of oxidation number, oxidation-reduction potentials.

CO3: Understand the details of non-aqueous solvents, classification of solvents, qualities of ionizing solvents, and reactions in liquid ammonia, liquid hydrogen fluoride and liquid sulphur dioxide.

CO4: Learn in details chemistry of s-block elements, comparative studies, diagonal relationships, salient features of hydrides, salvation and complexation tendencies including their function in biosystems.

Section B: ORGANIC CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to understand:

CO1: Stereochemistry of organic compounds with examples, concept of isomerism, D and L and R and S nomenclature of asymmetric molecules, E-Z system for geometrical isomers, conformational isomerism, difference between configuration and conformation.

CO2: Structure of benzene-Kekule structure, Aromaticity-the Huckel rule, mechanism of aromatic reactions.

CO3: Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 with energy profile diagram, nomenclature, methods of formation chemical reactions of alcohols.

Section C: PHYSICAL CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Learn in detail of solution, types of solution, Raoult's law and Henry's law, ideal and non-ideal solution, vapour pressure of liquid and liquid mixture.

CO2: Understand the details of dilute solution, colligative properties and applications in calculating molar masses of normal, dissociated and associated solutes in solution.

CO3: Understand the details of colloids and surface chemistry, preparation and purification of colloidal solution, Tyndal effect, Brownian motion, Physisorption and Chemisorption.

CO4: Understand the details of thermodynamics, intensive and extensive variable: state and path function; isolated and closed system; zeroth law of thermodynamics and other thermodynamic parameters.

CH-202P: ORGANIC CHEMISTRY PRACTICAL (25 Marks; 45 Hours)

After completion of the course, the students are able to understand:

CO1: Determination of melting and boiling points of organic compounds.

CO2: Mixed melting point determination: Urea-Cinnamic acid mixture using of various compositions (1:4, 1:1, 4:1)

CO3: Distillation: Simple distillation of ethanol-water mixture using water condenser, Distillation of nitrobenzene and aniline using air condenser.

CO4: Crystallization: Concept of induction of crystallisation, Benzoic acid from water, decolourisation and crystallisation using charcoal.

Semester III

CH-303

Section A: INORGANIC CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Learn in detail of metallurgy, mineral and ores, general principles of metallurgy, extraction of Li, K, Be, Sn, Sb, Bi, Cr and Mn.

CO2: Understand in details of chemistry of p-block elements, comparative studies, diagonal relationships, salient features of hydrides, oxides, oxyacids and halides, basic properties of halogens, interhalogens and polyhalogens.

CO3: Understand in details of general properties of d-block elements, definition, position in the periodic table, occurrence and abundance, variable oxidation state.

CO4: Understand in detail of coordination chemistry, Werner's theory and its experimental verification, types of ligands, nomenclature (IUPAC) and isomerism in coordination compounds.

Section B: ORGANIC CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Understand acidic character of phenols, resonance stabilization of phenoxide ion, reactions and mechanisms of phenols.

CO2: Learn in details methods of formation, physical properties, chemical reactions of ethers, Synthesis of epoxides, acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium regents with epoxides.

CO3: Learn in details of aldehydes and ketones- synthesis, reactions and mechanisms.

CO4: Learn preparation, chemical reactions and the reaction mechanisms of nitroalkanes and nitroarenes, structure, nomenclature, physical properties, preparation of amines.

Section C: PHYSICAL CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Learn the basics of thermochemistry and its application.

CO2: Learn second law of thermodynamics and related processes.

CO3: Understand the details of chemical equilibrium, criteria of thermodynamic equilibrium, equilibrium constants and their quantitative dependence on temperature, pressure and concentration.

CO4: Understand the details of chemical kinetics, order and molecularity of a reaction, rate law, concept of energy of activation and Arrhenius equation.

CH303P: PHYSICAL CHEMISTRY PRACTICAL (25 Marks; 45 Hours)

After completion of the course, the students are able to understand:

CO1: Surface tension measurements by drop number and drop weight method

CO2: Viscosity measurement, measurement of pH of different solutions and preparation of buffer solutions

Semester IV

CH-404

Section A: INORGANIC CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Learn in details of chemistry of lanthanides, position in the periodic table, electronic structure, oxidation states, ionic radii and lanthanide contraction, complex formation, uses of lanthanides and their compounds.

CO2: Learn in details of chemistry of actinides, position in the periodic table, identification and nuclear synthesis of trans-uranium elements, separation of Np, Pu and Am from U, similarities between the later actinides and later lanthanides.

CO3: Understands the details of chemistry of noble gases, position in the periodic table, chemical properties, bonding and stereochemistry of xenon compounds, uses of noble compounds.

CO4: Understand the details of hard and soft acids and bases, Pearson's concept, acid-base strength and hardness and softness.

Section B: ORGANIC CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to understand:

CO1: The structure, reactions and preparation of carboxylic acids and its derivatives.

CO2: Formation, structure and chemical reactions of organometallic compounds.

CO3: Formation of polymers, Types of Polymers with examples.

Section C: PHYSICAL CHEMISTRY (25 Marks; 30 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Understand the basic idea of catalysis, types of catalyst, specificity and selectivity, enzyme catalysis, acid-base catalysis, theory of catalysis-adsorption and intermediate compound formation.

CO2: Learn in details of ionic equilibria-I, electrolytes and non-electrolytes, strong, moderate and weak electrolytes, calculation of pH of weak acids and bases, common ion effect, buffer solutions, derivation of Henderson equation and its application.

CO3: Understand the details of ionic equilibria-II, solubility and solubility product of sparingly soluble salts-application of solubility product principle. Qualitative treatment of acid-base titration curves.

CO4: Understand the details of phase equilibria-I, phases, components and degree of freedom, Gibbs phase Rule for non-reactive and reactive system.

CH-404P: ANALYTICAL CHEMISTRY PRACTICAL (25 marks; 45 Hours)

After completion of the course, the students will be able to:

CO1: Determine Hardness of water using EDTA.

CO2: Estimate nickel using DMG.

CO3: Estimate calcium content in chalk as calcium oxalate by permanganometry.

CO4: Estimate reducing sugar by titration with standard Fehling solution/Benedict's solution.

CO5: Determine the equivalent weight of the given acid sample by direct titration method with alkali.

CO6: Determine the saponification value of the given fat or oil sample.

CO7: Estimate protein in the given sample by Folin Lowry method/Biuret method.

CO8: Estimate a reducing by colorimetric method.

CO9: Determine the concentration of a given sample by using Lambert-Beer's law.

CO10: Determine the amount of iodine from a given sample (salt) by titration method.

Semester V

CH-505: INORGANIC CHEMISTRY (67 Marks; 90 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Understand the basic idea of nuclear chemistry and radioactivity, nature of radiations, separation of isotopes, binding energy, group displacement law, artificial radioactivity and thermonuclear reactions.

CO2: Learn in details of chemistry of compounds of non-transition elements, comparison of s- and p-block elements.

CO3: Learn in details of chemistry of second and third transition element series, general characteristics, and comparative treatment with their 3d-analogues, vertical group and horizontal group relationship of 3d, 4d and 5d elements, role of transition elements in biology.

C04: Learn in details of alloy and intermetallic compounds, types of alloys and rules for the formation of alloys.

CO5: Learn the basic idea of UV-visible spectroscopy, fundamental laws of photochemistry, molar absorbity, energy levels of electron transition of $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$, presentation of electronic spectra, carbobyls and α, β-unsaturated carbonyl compounds and inorganic compounds.

CO6: Understand the details of infrared spectroscopy, unit of frequency, wavelength and wavenumber, molecular vibrations, factors influencing vibrational frequencies, application to characterisation of groups like C=N, C=O, C=C, COOR, N-H and $CONH_2$.

CO7: Undersatand the thermodynamic and kinetic aspects of metal complexes, factors affecting the stability and substitution reactions of squar planar complexes.

CO8: Acquire the knowledge of environmental chemistry, fundamental concept of atmosphere, reactions in atmosphere, photochemical smog, oxidation of organic compounds, radionuclides in environment. Know water pollution, nature of pollutants, treatment of water, toxic chemicals in environment, solid waste pollution, treatment and disposal.

CH-506: ORGANIC CHEMISTRY (67 Marks; 90 Hours)

Course outcome:

After completion of the course, the students are able to understand:

CO1: Nomenclature, Classification, and structures of carbohydrates

CO2: Classification, structure, stereochemistry of amino acids, acid-base behaviour and reactions of amino acids, Classification of proteins, peptide structure, protein denaturation and renaturation.

CO3: Introduction, structure and types of nucleic acids.

CO4: Basic concepts of fats, oils and detergents.

CO5: Definition, classification, types of Pericyclic reactions.

CO6: Classification, chemistry and synthesis of dyes,

CO7: Nomenclature, stereochemistry, structure and synthesis of steroids.

CO8: Isolation, classification of terpenes, chemical composition, Isoprene rule, synthesis and structure of terpenoids.

CO9: Definition, extraction, structure and synthesis of alkaloids.

CO10: Nomenclature, classification and chemical nature of enzymes, vitamins and elements in enzyme action.

CH-507: PHYSICAL CHEMISTRY (66 Marks; 90 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Learn the basic idea of mathematics for Chemists, uncertainty in measurement, types of uncertainties, combining uncertainties, statistical treatment of uncertainties, graphical and numerical data reduction and method of least squares (regression).

CO2: Learn in details of atomic structure, Bohr treatment of atomic structure and spectra of hydrogen like atoms, Black body radiation, Plank's theory, dual nature of matter, de Broglie's relationship, quantum chemistry, Heisenberg's uncertainty principle and postulates of quantum mechanics.

CO3: Learn in details of photochemistry, Grotthus-Drapers and Lambert Beer's Laws, Stark-Einstein's laws of photochemical equivalence, definitions of Photosynthesis, Phosphorescence, Fluorescence, Chemiluminescence and photosensitisation with examples.

CO4: Learn in details of Energetics, Gibbs-Helmholtz equation, Maxwell relations and thermodynamic equation of state, systems of variable compositions, Gibbs-Duhen equation and Nernst heat theorem.

CO5: Learn in details of specific heat of solids, the law of Dulong and Petit, atomic and molar heat capacities, Kopp's law and quantum theory of specific heats.

CO6: Understands purpose of statistical thermodynamics, probability of distributionand concept of ensemble.

CO7: Learn in details of interaction of molecules with electromagnetic radiations, wave length, wave number and frequency with their units and elementary idea of different spectroscopic techniques.

CO8: Understand classification and structures of natural and synthetic dyes.

CO9: Understand in details of conductance, metallic and electrolytic conductors, measurement of conductance, Kohlausch's law and its application.

CH-508P INORGANIC AND PHYSICAL CHEMISTRY PRACTICAL

100 Marks (Inorganic: 67 marks; Physical : 33 marks); 135 Hours

After completion of the course, the student should be able to understand

Inorganic Laboratory:

CO1: Preparation of inorganic complexes.

CO2: Estimation of two constituents from a binary mixture (one volumetrically and one gravimetrically).

CO3: Semimicro analysis of elements.

Physical Laboratory:

CO4: Study of equilibrium of reactions by distribution method.

CO5: Potentiometric /pH- metric titrations-(i) Strong acid with strong base (ii) weak acid with strong base (iii) dibasic acid with strong base and Mohr's salt with potassium dichromate.

CO6: Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.

CO7: Phase equilibria, construction of phase diagram.

Semester VI

CH-608: INORGANIC CHEMISTRY (66 Marks; 90 Hours)

Course outcome:

After completion of the course, the students are able to:

CO1: Learn in details of bonding in coordination compounds, theory of coordination bond, effective atomic number rule, valence bond theory and its limitation, crystal field theory.

CO2: Learn in detail of magnetic properties of transition metal complexes, types of magnetic behaviour, spin only formula, L-S coupling and application.

CO3: Understand basic idea of inorganic polymers, silicates and their classification and structures, phosphazenes as inorganic polymer, structure and bonding.

CO4: Learn in details of thermo analytical methods, thermo gravimitric (TGA), Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC).

CO5: Understand the details of organometallic chemistry, definition, nomenclature and classification of organometallic compounds.

CO6: Understand the details of bioinorganic chemistry, essential and nonessential trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin, biological roles of alkali and alkaline earth metal ions.

CO7: Understand the details of inorganic rings and cages and non-stoichiometric compounds.

CH-609: ORGANIC CHEMISTRY (66 Marks; 90 Hours)

Course outcome:

After completion of the course, the students are able to understand:

CO1: Nomenclature, structures, preparation and chemical reactions of organosulphur compounds-thiols, thioesters and sulphonis acids.

CO2: Elimination reactions and its mechanism, elimination Vs substitution reactions.

CO3: Use of active methylene groups in Organic synthesis via enolates-ethyl acetoacetate and diethyl malonate.

CO4: Structure, chemical reactions and mechanisms of heterocyclic compounds, molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Preparation, reactions and mechanisms of indole, quinoline and isoquinoline.

CO5: Synthesis of structure of sulphadrugs, analgesics, antimalarials and antibiotics.

CO6: Principles and applications of chromatography, mass spectroscopy, nuclear magnetic resonance spectroscopy, electron paramagnetic Resonance Spectroscopy and Green chemistry.

CH-610: PHYSICAL CHEMISTRY (67 Marks; 90 Hours)

Course outcome:

After completion of the course, the students are able to understand:

CO1: Basic idea of computer applications in chemistry, Algorithm-Flow chart application of computer in chemistry.

CO2: Quantum Chemistry-Schrodinger wave equation and its importance, probability distribution of electrons-radial probability distribution curves.

CO3: Details of spectroscopy-Rotational and Vibrational spectra of diatomic molecules. Raman spectroscopy: Raman Effect, Raman scattering-Stokes lines and Anti-Stokes lines and Raman shift.

CO4: Basic idea of symmetry and point groups, symmetry operations-products of symmetry operation of various point groups with examples.

CO5: Electrochemistry -chemical cells, reversible and irreversible cells with examples, concentration cells with and without transference, Theory of strong electrolytes-Debye-Huckel-Onsager theory.

CO6: Statistical thermodynamics-basic postulates of Maxwell-Boltzmann distribution law, partition function and its physical significance.

CO7: Surface active agents, amphiphiles, classification of surfactants and micelles.

CO8: Chemical kinetics-collision theory and transition state theory of reaction rate, Lindermann mechanism and kinetics of complex reactions.

CO9: Phase equilibria of two component system: solid-liquid equilibria, simple eutectic-Bi, Cd, Pb-Ag system, desilverisation of lead. Solid solutions: compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O).

CH-611P ORGANIC AND PHYSICAL CHEMISTRY PRACTICAL

100 Marks (Organic: 67 marks; Physical: 33 marks); 135 Hours

After completion of the course, the student should be able to understand

Organic Laboratory:

A. Qualitative analysis: Identification of organic compounds, Detection of extra elements (N, S and halogens) and functional groups, preparation of solid derivative.

B. Organic prepation:

(a) Acetylation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of aniline and phenol.
(b) Aliphatic electrophilic substitution; preparation of iodoform from ethanol and acetone.
(c) Electrophilic aromatic substitution:
Nitration: Preparation of m-dinitrobenzene, p-nitroacetanilide.
Halogenation: Preparation of p-bromoacetanilide, 2, 4, 6-tribromophenol.
(d) Diazotisation/coupling: Preparation of methyl orange and methyl red.
(e) Oxidation: Preparation of benzene from toluene.
(f) Reduction: Preparation of aniline from nitrobenzene.

Physical Laboratory

1. To study changes in conductance in the following systems
    (a) strong acid-strong base
    (b) weak acid-strong base and
    (c) mixture of strong acid and weak acid-strong base.
2. Study the kinetics of the following reactions
    (a) Acid hydrolysis of methyl acetate with hydrochloric acid, volumetrically or conductometrically.
    (b) Saponification of ethyl acetate.
3. Verification of Lambert-Beer's Law
4. Determination of pK (indicator) for phenolphthalein or methyl red.
5. Study the formation of a complex between ferric and thiocyanate (or salicylate) ions.