

WAIKHOM MANI GIRLS' COLLEGE, THOUBAL

B.SC. (HONOURS) CHEMISTRY

Program Learning Outcomes of B.Sc. Chemistry (Honours)

The student graduated with Degree in B.Sc. Chemistry (Honours), should acquire

Program outcome (PO):

1. Knowledge and Understanding:

- ❖ The students acquired knowledge with comprehensive understanding of the fundamental concepts of chemistry.
- ❖ Understand the importance of the elements in the periodic table including their physical and chemical nature and role in the daily life.
- ❖ Acquired knowledge in depth of the subjects-concept, theories, principles and its applications.
- ❖ Knowledge about the emerging topics and current developments in Chemistry and its related fields
- ❖ Acquired knowledge about the importance of Chemistry in daily life.

2. Laboratory Skills and Techniques:

- ❖ The students gain good practical knowledge and laboratory skills by systematically training them.
- ❖ The students experience hands-on training of using basic chemical laboratory instruments through methodical instructions.
- ❖ Trained the students in basic knowledge about preparation of laboratory reagents, solutions and also protocols for their safe disposal.
- ❖ Students have ability to conduct experiments, analyses of data and interpretation of the results.
- ❖ Achieve the skills required to succeed in school, and the chemical industry like agro product, Rubber industries, Food processing industries, Fertilizer industries etc.

SEMESTER I

COURSE CODE: CH-101 SECTION A: INORGANIC CHEMISTRY

U-1: Atomic Structure

Course Outcome /Learning Outcomes: By the end of the course, students will be able to:

- ❖ Know the quantum mechanical model of an atom using Schrodinger equation.
- ❖ Understand the significance of wave function, quantum numbers, radial and angular distribution curves.
- ❖ Draw shapes of various atomic orbitals viz. s, p, and d.
- ❖ Understood Aufbau's principle, Paulis' exclusion principle, Hund's rule.
- ❖ Perform electronic configuration of different elements, effective nuclear charge.

U-2: Periodic classification of Elements

Learning Outcomes:

- ❖ Understood the ideas of Atomic and Ionic size Ionization Energy, Electron Affinity, Electro negativity, ionic radii.
- ❖ Understood periodicity in atomic radii, ionic radii, ionization enthalpy and electronegativity of elements.

U-3: Chemical Bonding**Learning Outcomes:**

- ❖ Acquainted the ideas of VBT and its limitation in covalent bond formations
- ❖ Understood how to predict the structure and geometries of molecules by using VSEPR theory.
- ❖ Can draw MO diagrams for homo- & hetero-nuclear diatomic molecules.
- ❖ The nature of bonding in electron deficient molecules.
- ❖ Know bond length, bond energy, percentage of ionic character, electronegativity of elements.

U-4: Theory of qualitative and quantitative analysis**Learning Outcomes:**

- ❖ Understood strength of acids and bases, PH, common ion effect, solubility product.
- ❖ Cleared the various fundamental concepts of pH, buffer solutions, solubility of sparingly soluble salts, acid-base indicators.
- ❖ Know the principles of oxidimetry, reductimetry, iodimetry and iodometry.
- ❖ To know gravimetric analysis, namely precipitation, co precipitation, post precipitation and errors associated with them.

SECTION B: ORGANIC CHEMISTRY**U-1: Structure and Bonding:****Learning Outcomes:**

- ❖ Understand various hybridizations, bond lengths, bond angles, length and energies.
- ❖ Understand localised and delocalised chemical bonds associated properties of the compounds.
- ❖ Familiarised about the inclusive compounds, clatherates.
- ❖ Familiarised resonance hyper conjugation, hydrogen bonding and its effects.

U-2: Mechanism of Organic reactions**Learning Outcomes:**

- ❖ To know types of bond breakages associated in organic chemical reactions
- ❖ the use of the different types of arrows associated in the organic reactions
- ❖ Understand type of reagents and reaction intermediates involved in various organic reactions.
- ❖ To know types of organic reactions and reaction intermediates associated in them
- ❖ Understood the different methods for determinations of reaction mechanisms.

U-3: Cycloalkanes**Learning Outcomes:**

- ❖ To know different cyclo-compounds and their naming

- ❖ The applications of the role Baeyer's strain theory for determination of the stability of cyclo-compounds
- ❖ Understood ring strains and strainless rings towards the stability of the cyclo compounds

U-4: Alkenes cycloalkanes, Dienes, Alkynes

Learning Outcomes:

- ❖ To know the mechanism of dehydration of alcohol, dehydrogenation of alkyl halides, regio selectivity in alcohol dehydration
- ❖ To know different reaction mechanisms involve in alkenes and alkynes and properties associated with them.
- ❖ Familiarised hydroboration, Epoxidation, ozonolysis, hydration, hydroxylation, and oxidation with KMnO_4 .
- ❖ Understood chemical reactions of 1,2 and 1,4 addition reactions and Diel's -Alder reaction

SECTION C: PHYSICAL CHEMISTRY

U-1 Gaseous state-I

Learning Outcomes:

- ❖ Kinetic molecular theory of gases, kinetic gas equation
- ❖ Collision frequency, collision diameter, mean free path
- ❖ Barometric distribution and its use in evaluating molecular velocities

U-2 Gaseous state-II

Learning Outcomes:

- ❖ Deviations from ideal gas behaviours, compressibility factor
- ❖ Van der Waal's equation of state, its deviation and applications
- ❖ Boyle temperature, continuity of states, critical state

U-3 Liquid state

Learning Outcomes:

- ❖ Nature of liquid state, intermolecular forces
- ❖ Qualitative treatment of the structure of the liquid state
- ❖ Physical properties of liquids
- ❖ Temperature variation of viscosity and surface tension of liquids

U-4 Solid state

Learning Outcomes:

- ❖ Nature of solid states, law of constancy of interfacial angles, law of rational indices
- ❖ Miller indices, idea of symmetry elements
- ❖ Symmetry elements and symmetry operations
- ❖ Seven crystal system and fourteen Bravais lattices
- ❖ X-ray diffraction, Bragg's law

CH-101P: INORGANIC CHEMISTRY PRACTICAL

Learning Outcomes:

- ❖ Facilitate the learner to define concentrations; Dilution of Solutions; Making different molar concentrations.
- ❖ To analyse the inorganic sample qualitatively. This will help students to work in some laboratory and find the chemical composition of an unknown inorganic compound or mixture.
- ❖ Perform volumetric Analysis of 1) Preparation of standard solution by weighing the given samples.
- ❖ Estimation of Fe (II) by dichromate using internal indicator, understand iodimetry titration

SEMESTER II

COURSE CODE: CH-202 SECTION A: INORGANIC CHEMISTRY

U-1: Acids and Bases

Learning Outcomes:

- ❖ Explain Arrhenius, Bronsted-Lowry theories of Acids and Bases
- ❖ Understand Lux-Flood theory, solvent system theory
- ❖ Identify various compounds as acids and bases, based on Lewis theory of acids and bases

U-2: Oxidation and Reduction

Learning Outcomes:

- ❖ Able to calculate oxidation numbers of ion/elements
- ❖ Explain electronic concept of Redox reactions with examples
- ❖ Understand reduction potentials, oxidation potentials, factors affecting redox potentials

U-3: Non-aqueous solvents

Learning Outcomes:

- ❖ Classify protic, aprotic, amphoteric solvents and their characteristics
- ❖ Qualities of ionising solvents
- ❖ Understand reactions in liquid ammonia, liquid hydrogen fluoride and liquid sulphur dioxide

U-4: Chemistry of S-block elements

Learning Outcomes:

- ❖ Know the comparative properties of S- block elements
- ❖ Diagonal relationship of S- block elements and its consequences
- ❖ Salient feature of hydrides of SO block elements, solvation.
- ❖ Understand complexing tendencies of s-block elements including their functions in bio system,

SECTION B: ORGANIC CHEMISTRY

U-1: Stereochemistry of Organic compounds

Learning Outcomes:

- ❖ Identify compounds having symmetry and non-symmetry elements
- ❖ Understand with examples, molecular chirality, enantiomers, stereogenic centre, chiral centre
- ❖ Optical activity of compounds and its related ideas
- ❖ Able to know stereochemistry of compounds in detail
- ❖ Different 3-D representation formulae of various compounds with
- ❖ Understand conformational and configurational analysis of compounds with their differences

U-2: Arenes and aromaticity

Learning Outcomes:

- ❖ Students are expected to apply their knowledge to problem-solve, deduce structures, and synthesize simple organic molecules using the studied reactions.
- ❖ Acquainted molecular formula and Kekule structure of benzene, stability, bond length resonance structure, Huckel's rule for aromaticity, aromatic ions, MO picture of benzene
- ❖ Acquired knowledge about different reaction mechanisms associated in benzene
- ❖ Know activation and deactivation substituents, orientation and ortho-/para ratio.

U-3: Alkyl halide and aryl halide

Learning Outcomes:

- ❖ Acquainted the reactions mechanisms of SN1 and SN2 with examples
- ❖ To know methods of formation of aryl halides, nuclear and side chain reactions
- ❖ To know the addition-elimination and elimination- addition mechanisms of nucleophilic aromatic substitution reactions

U-4: Alcohols

Learning Outcomes:

- ❖ Synthesis from carbonyl compounds, dihydric alcohols
- ❖ Method of formation of carbonyl compounds
- ❖ Chemical reactions of vicinal glycols, oxidative cleavage $[\text{Pb}(\text{OAc})_4]$ and HIO_4
- ❖ To know the nomenclature, chemical reactions, nitration reaction with KHSO_4 of trihydric alcohols.

SECTION C: PHYSICAL CHEMISTRY

U-1: Solutions

Learning Outcomes:

- ❖ To know miscible, immiscible liquids and their characteristics
- ❖ To Know the types of solutions with examples, Raoul's law, Henry's law with their applications
- ❖ To know Ideal and non-ideal solutions , characteristics , differences between them
- ❖ Vapour pressure of liquids, liquid mixture, separation of completely miscible binary liquid mixture by different methods
- ❖ Nerst's distribution law and its limitations

U-2: Dilute Solutions

Learning Outcomes:

- ❖ To know colligative properties and their applications and factors associated with the properties of solutions.
- ❖ To know Clapeyron Clausius equation
- ❖ Applications of in calculating molar masses of normal, dissociated and associated solutions

U-3: Colloids and Surface Chemistry

Learning Outcomes:

- ❖ To apply the concepts of colloids and gels, characteristics
- ❖ Classification, preparations, purifications, colloidal properties, Tyndall effect, Brownian motion.
- ❖ Adsorption, Types-Chemisorption, physisorption, Freundlich adsorption isotherm, Langmuir adsorption isotherm

U-4: Thermodynamics

Learning Outcomes:

- ❖ The application of mathematical tools to calculate thermodynamics.
- ❖ The relationship between microscopic properties of molecules with macroscopic thermodynamic observables
- ❖ The derivation of rate equations from mechanistic data
- ❖ The use of simple models for predictive understanding of physical phenomena associated to chemical thermodynamics and kinetics

CH-202P ORGANIC CHEMISTRY PRACTICAL

Learning Outcomes:

- ❖ Student can determine melting and boiling points of various organic compounds
- ❖ Establish the probable organic compounds from the M.P/B.P values
- ❖ Student can perform Crystallisation of benzoic acid from water
- ❖ Simple distillation of ethanol-water mixture using water condenser

SEMESTER III

COURSE CODE: CH-303 SECTION A: INORGANIC CHEMISTRY

U-1 Metallurgy

Learning Outcomes

- ❖ To know minerals and ores with examples.
- ❖ General principles of metallurgy.
- ❖ Extraction of Li,K,Be,Sn,Sb,Bi,Cr and Mn from the respective ores

U-2 Chemistry of p-block elements

Learning Outcomes

- ❖ Diagonal relationships and its consequences in the properties of elements
- ❖ Salient features of hydride, oxide, oxyacids and halides
- ❖ Basic properties of halogens, interhalogens and polyhalogens

U-3 Chemistry of p-block elements

Learning Outcomes:

- ❖ Position of d-block elements in the periodic table
- ❖ General characteristics of d- block elements
- ❖ Occurrence and abundance of d-block elements

U-4 Co-ordination Chemistry

Learning Outcomes:

- ❖ Warners's co-ordination theory, Nomenclature of Co-ordination compounds with respect to IUPAC system.
- ❖ Isomerism of Co-ordination compounds, Calculation of co-ordination number of Co-ordination compounds
- ❖ Stereochemistry of Co-ordination compounds and associated properties

SECTION B: ORGANIC CHEMISTRY

U-1: Phenols

Learning Outcomes

- ❖ Acidic characters of phenols, comparative acidic strength with alcohols
- ❖ Reactions of phenols towards electrophilic aromatic substitution reactions
- ❖ Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman Synthesis,
- ❖ Mechanisms of Hauben-Huesch reactions and Reimer-Tiemann reaction

U-2 Ethers and epoxide

Learning Outcomes

- ❖ Preparation, physical properties, chemical properties of ethers
- ❖ Synthesis of epoxide, acid based-catalysed ring opening of epoxides

- ❖ Orientation of epoxide ring opening
- ❖ Reactions of Grignard's reagents, organolithium reagents with epoxides

U-3 Aldehydes and ketones

Learning Outcomes

- ❖ Synthesis of aldehydes and ketones with reference to synthesis from acid Chlorides, 1,3-dithianes, nitril, carboxylic acids.
- ❖ Knowledge of various name reactions and their corresponding mechanisms

U-4 Organic compounds of Nitrogen

Learning Outcomes

- ❖ Acquired the knowledge of nitrogen containing organic compounds
- ❖ Acquired the knowledge of various reaction mechanisms of nitro organic compounds
- ❖ Stereochemistry of amines, preparation of alkyl and aryl amines
- ❖ Separations of primary, secondary, and tertiary amines

SECTION C: PHYSICAL CHEMISTRY

U-1 Thermochemistry

Learning Outcomes:

- ❖ Heat of reactions, standard states
- ❖ Enthalpy of formation of molecules
- ❖ Calculation of bond energy, bond dissociation energy
- ❖ Kirchoff's equations, and related problems

U-2 Thermodynamics-II

Learning Outcomes

- ❖ Carnot cycle and its efficiency
- ❖ Second law of thermodynamics, calculations of entropy
- ❖ Irreversible and reversible processes, Free energy, Function, Gibb's and Helmholtz equation

U-3 Chemical Equilibrium

Learning Outcomes

- ❖ Criteria of thermodynamic equilibrium
- ❖ Thermodynamic deviation of relation between Gibb's free energy of reaction
- ❖ Equilibrium constants and their quantitative dependence on temperature, pressure, concentration
- ❖ Thermodynamic deviation of relations between the various equilibrium constants, K_p , K_c ,
- ❖ Le-Chatelier's principle

U-4 Chemical Kinetics-I

Learning Outcomes

- ❖ Order and Molecularity of reactions
- ❖ Differential, integrated rate expressions up to second order reactions
- ❖ Half-life period with examples, effect of temperature on the rate of reactions
- ❖ Arrhenius equations and concept of energy of activation energy
- ❖ Experimental methods of the determination of rate laws

CH-303P PHYSICAL CHEMISTRY PRACTICAL

Learning Outcomes:

- ❖ Surface tension measurements
- ❖ Viscosity measurements using Ostwald's viscometer
- ❖ pH measurements using pH -meter

SEMESTER IV

COURSE CODE: CH-404 SECTION A: INORGANIC CHEMISTRY

U-1 Chemistry of lanthanides

Learning Outcomes

- ❖ General properties of lanthanides., position of lanthanides
- ❖ Consequences of lanthanide contractions
- ❖ Complex formation, uses of lanthanides and their compounds

U-2 Chemistry of Actinides

Learning Outcomes

- ❖ General properties of actinides, position of actinides in the periodic table
- ❖ Nuclear synthesis of trans-uranium elements
- ❖ Separation of Np,Pu,Am from U
- ❖ Similarity between later actinides and later lanthanides

U-3 Chemistry of Noble gases

Learning Outcomes

- ❖ Position of noble gases in the periodic table
- ❖ Principles of isolations, chemical properties
- ❖ Bonding and stereochemistry of xenon compounds
- ❖ Uses of noble gases

U-4 Hard and Soft acids and bases

Learning Outcomes

- ❖ Classifications of acids and bases as hard and soft
- ❖ Pearson's concept of hard and soft acids and bases
- ❖ acids and bases strengths and hardness and softness

SECTION B: ORGANIC CHEMISTRY

U-1 Carboxylic acids

Learning Outcomes

- ❖ To know the knowledge of the chemical behavior of carboxylic acid and their derivatives as esters, amides, halides and acid anhydride.
- ❖ Acidity of carboxylic acids, effect of substituents on acid strengths
- ❖ Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction
- ❖ Synthesis of acid chlorides, ester, amides

U-2 Carboxylic acids derivatives

Learning Outcomes:

- ❖ Able to write the order of reactivity of different carboxylic acid derivatives

- ❖ Inter conversion of acid derivatives by nucleophilic acyl substitution
- ❖ Preparation of carboxylic acid derivatives, chemical reactions.
- ❖ Mechanisms of esterification and hydrolysis

U-3 Organometallic compounds

Learning Outcomes

- ❖ Formation of Grignard's reagent, structure, and chemical reactions
- ❖ Formation, chemical reactions of organozinc compounds
- ❖ Formation, chemical reactions of organolithium compounds

U-4 Polymers

Learning Outcomes

- ❖ Natural and synthetic polymers
- ❖ Mechanisms of polymerisation reactions
- ❖ Condensation and addition polymers
- ❖ Thermosetting and thermoplastic polymers
- ❖ Synthetic rubbers, nylon-6, nylon-66, terylene

SECTION C: PHYSICAL CHEMISTRY

U-1 Catalysis

Learning Outcomes

- ❖ Types of catalyst, specificity, selectivity
- ❖ Mechanism of catalyst reactions at solid surfaces
- ❖ Effect of particle size and efficiency of the catalysts
- ❖ Michaelis-Menten mechanism, acid-base catalysis
- ❖ Theory of catalysis-adsorption and intermediate compound formation

U-2 Ionic equilibria-I

Learning Outcomes

- ❖ Electrolytes, non-electrolytes, strong and weak electrolytes
- ❖ Factors affecting degree of ionisation, ionic product of water
- ❖ Calculation of pH of dilute solutions of weak acids and bases
- ❖ Common ion effect, buffer solution, buffer range, buffer action, applications of buffer in analytical chemistry

U-3 Ionic equilibria-II

Learning Outcomes

- ❖ Solubility and solubility products of sparingly soluble salts
- ❖ Applications of solubility product principle
- ❖ Qualitative treatment of acids-base titration curves
- ❖ Theory of acids-base indicators, selection of indicators

U-4 Phase equilibria-III

Learning Outcomes

- ❖ Phases, components, and degree of freedom
- ❖ Gibb's phase rule for non-reactive and reactive system
- ❖ Application of Gibb's phase rule to one component system

CH-404P ANALYTICAL CHEMISTRY PRACTICAL

Learning Outcomes

- ❖ Determination of Hardness of water using EDTA
- ❖ Estimation of reducing sugar by titrating with standard Fehling's solution
- ❖ Determination of the equivalent weight of a given acid sample by direct titration method with alkali
- ❖ Determination of the saponification value of a given fat or oil sample

SEMESTER V

CH-505 INORGANIC CHEMISTRY

U-1 Nuclear Chemistry and Radioactivity

Learning Outcomes:

- ❖ Idea of discovery of radioactivity, nature of radiations
- ❖ Terms involved such as binding energy, mass defect, half-life period
- ❖ Group displacement law, artificial transmutation. Artificial radioactivity
- ❖ Nuclear binding energy and packing fraction
- ❖ Tracer techniques and their applications

U-2 Chemistry of compounds of non-transition elements

Learning Outcomes:

- ❖ Knowledge of comparative studies about S- and P- block elements
- ❖ How to prepare bleaching powder
- ❖ About Portland cement and borazole
- ❖ Knowledge regarding solid CO₂, carbonaceous fuel
- ❖ About oxides, oxyacids of phosphorus
- ❖ Knowledge about chemical reactivity of chalcogens

U-3 Chemistry of second and third transition element series

Learning Outcomes:

- ❖ General characteristic of 3d transition series with respect to oxidation states, magnetic properties, spectral properties
- ❖ Knowledge about the group relationship of 3d, 4d, and 5d elements
- ❖ Roles of transition elements in biology

U-4 Alloys and intermetallic compounds

Learning Outcomes:

- ❖ Idea of alloying, types of alloys
- ❖ Rules for formations of alloys
- ❖ Intermetallic compounds, characterises

U-5 UV-visible spectroscopy

Learning Outcomes:

- ❖ Learnt the fundamental laws of photochemistry
- ❖ Different types of Transitions, presentations of electronic spectra
- ❖ Applications to characterisation of conjugated dienes, carbonyls, etc.

U-6 Infra-red spectroscopy

Learning Outcomes:

- ❖ To know IR active and IR inactive compounds
- ❖ Acquainted with the term used in IR, frequency, wavelength, wavenumber, molecular vibrations
- ❖ Factors influencing vibrational frequencies
- ❖ Applications of IR in the characterisation of functional groups

U-7 Thermodynamics and kinetic aspect of metal complexes

Learning Outcomes:

- ❖ A brief outline of thermodynamic stability of metal complexes
- ❖ Facts affecting the stability
- ❖ Substitution reactions of square planar complexes

U-8 Environmental Chemistry

Learning Outcomes:

- ❖ Aware about environmental pollutions
- ❖ Factor responsible for water pollution, air pollution, photochemical smog
- ❖ To know toxic chemicals in environments, biochemical effects of Hg,Cd,Pb,pesticides
- ❖ Control and treatment of solid waste pollutants , treatment and disposals

CH-506 ORGANIC CHEMISTRY

U-1 Carbohydrates

Learning Outcomes:

- ❖ The fundamental properties and reactivity of biologically important molecules- carbohydrates
- ❖ Constitution of glucose and fructose, chain lengthening and Chain shortening of aldoses
- ❖ Formations of glycosides, ethers, Easters
- ❖ Determination of ring size of monosachacharides, cyclo structure of D(+) glucose

U-2 Amino acids, peptides and Proteins

Learning Outcomes:

- ❖ the fundamental properties and reactivity of biologically important molecules (e.g. amines and amino-acids)
- ❖ To know the classification, structure and stereochemistry of amino acids
- ❖ Acid-base behaviour, isoelectric point, electrophoresis nature of amino acids
- ❖ Classification of proteins, peptide structure determination, denaturation of protein

U-3 Nucleic acids

Learning Outcomes:

- ❖ Definition of nucleic acids, types of nucleic acids
- ❖ Constitution of nucleic acids, difference between RNA and DNA
- ❖ Double helical structure of DNA

U-4 Fats, Oils, detergents

Learning Outcomes:

- ❖ Natural oils, edible oils, industrial oils of vegetable origins
- ❖ Hydrogenation of unsaturated oils

- ❖ Saponification value, iodine value, acid value
- ❖ Soap versus detergents

U-5 Pericyclic reactions

Learning Outcomes:

- ❖ Definition, classification of pericyclic reactions
- ❖ Thermal, photochemical reactions
- ❖ Cyclo-addition reactions, FMO approach,
- ❖ Diels-Alder Reaction, photochemical [2+2] reaction

U-6 Synthetic dyes

Learning Outcomes:

- ❖ Colour and its constitution, Classification of dyes
- ❖ Synthesis of methylorange, Congo red, Malachite green, Crystal violet
- ❖ Synthesis of Phanolphthalein, Alizarin, Indigo

U-7 Steroids

Learning Outcomes:

- ❖ Acquainted occurrence, nomenclature, basic skeleton of steroids
- ❖ Diel's hydrocarbons and stereochemistry
- ❖ Isolation, structure determination, synthesis of cholesterol
- ❖ Isolation, structure determination, synthesis of estrone
- ❖ Biosynthesis of steroids

U-8 Terpenoids

Learning Outcomes:

- ❖ Occurrence, isolation, classification of terpenoids.
- ❖ To understand the structure determination, biosynthesis and synthesis of terpenoids

U-9 Alkaloids

Learning Outcomes:

- ❖ To learn about the structure, physiological action and occurrence of alkaloids.
- ❖ Extraction, general methods of determining structure, isolation, synthesis of nicotine, atropine, cocaine

U-10 Enzymes

Learning Outcomes:

- ❖ Chemical nature, characteristic of enzymes, nomenclature
- ❖ Vit. B-complex, elements in enzyme function

CH-507 PHYSICAL CHEMISTRY

U-1 Mathematics for chemists

Learning Outcomes:

- ❖ Uncertainties in measurements, types of uncertainties, combining uncertainties
- ❖ Statistical treatment of uncertainties, mean, standard deviation, relative error
- ❖ Data reduction and propagation errors
- ❖ Graphical and numerical data reduction, method of least square

U-2 Atomic structure

Learning Outcomes:

- ❖ Bohr treatment of atomic structure
- ❖ Spectra of hydrogen like atoms
- ❖ Limitations of Bohr model, black body radiation
- ❖ Planck's theory, Compton effect, dual nature of matter, de-Broglie relationship

U-3 Quantum chemistry-I**Learning Outcomes:**

- ❖ Planck's radiation law, photochemical effect
- ❖ Bohr's model of hydrogen atom, Heisenberg's uncertainty principle
- ❖ Quantum mechanical operators-momentum, position, energy
- ❖ Postulates of quantum mechanics.

U-4 photochemistry**Learning Outcomes:**

- ❖ Grotthus-Droppers, Lambert Beer's Laws, Stark-Einstein's laws of photochemical equivalence
- ❖ Photosynthesis, phosphorescence, Fluorescence
- ❖ Chemiluminescence and photosensitisation with examples

U-5 Energetics**Learning Outcomes:**

- ❖ Gibb's-Helmholtz equation, Maxwell relation, Systems of variable compositions
- ❖ Partial molar quantities, dependence of thermodynamic parameters on composition
- ❖ Gibb's-Duhem equation, chemical potential of ideal mixture
- ❖ Nernst heat theorem, third law, calculation of absolute entropy of molecule

U-6 Specific heats of solids**Learning Outcomes:**

- ❖ The law of Dulong and Petit, atomic and molar heat capacities
- ❖ Kopp's law, quantum theory of specific heat, Einstein equation of heat capacity of solids
- ❖ Debye's equation, Debye's T law

U-7 Statistical Thermodynamics**Learning Outcomes:**

- ❖ Purpose of statistical thermodynamics, probability of distribution
- ❖ Law of multiplication of probabilities, law of addition probabilities
- ❖ Sterling approximation, canonical ensemble
- ❖ Microcanonical ensemble and grandcanonical ensemble

U-8 Interaction of molecules with electromagnetic radiations**Learning Outcomes:**

- ❖ To understand the interaction of electromagnetic radiation with molecules.
- ❖ To understand basic principles of spectroscopy.

U-9 Macromolecules**Learning Outcomes:**

- ❖ Classification of polymers with examples and study of them

U-10 Conductance**Learning Outcomes**

- ❖ Metallic and electrolytic conductors and term involved with them
- ❖ Variation of conductance with dilution for strong and weak electrolytes
- ❖ Kohlrausch's law and its applications

COURSE CODE: 508P INORGANIC AND PHYSICAL CHEMISTRY PRACTICAL

After completion of the course, the learner shall be able to understand

- ❖ Preparations of Inorganic complexes:
- ❖ Estimation of two constituents from the binary mixture
- ❖ Semi microanalysis of five radicals
- ❖ Experiments of equilibrium reactions

SEMESTER VI

COURSE CODE: CH-608 INORGANIC CHEMISTRY

After completion of the course, the learner shall be able to understand

- ❖ To know bonding in co-ordination compounds
- ❖ Magnetic properties of transition metal complexes
- ❖ To know inorganic polymers and its importance
- ❖ To know the thermo analytical methods
- ❖ To know organometallic compounds, 18-electron rule
- ❖ Bioinorganic elements and their biological implications
- ❖ Inorganic rings and cages
- ❖ To know Non-stoichiometric compounds

COURSE CODE: CH-609 ORGANIC CHEMISTRY

After completion of the course, the learner shall be able to understand

- ❖ To know organosulphur compounds
- ❖ Acquired the knowledge of elimination reaction in organic reactions
- ❖ To understand the evidence, reactivity and mechanism of elimination and substitution reaction.
- ❖ To understand organic synthesis via organometallic compounds and enolate.
- ❖ To provide theoretical understanding of heterocyclic compounds which include various method for ring synthesis and application for the preparation of specific groups of heterocyclic system.
- ❖ Familiarised heterocyclic compounds and its importance
- ❖ General structural features of agents belonging to the therapeutic class, physiochemical properties, chemical reaction, synthetic pathways for selected drugs.
- ❖ The use of nuclear magnetic resonance spectroscopy, mass spectrometry and infrared spectroscopy for organic structure elucidation
- ❖ Green chemistry and its principles.
- ❖ Green synthesis and reactions.
- ❖ Green chemistry for sustainable solutions.

- ❖ Understanding principles of green chemistry.
- ❖ Understanding design of chemical reactions/chemical synthesis using green chemistry principles.
- ❖ Atom economy and design of chemical reactions using the principle.
- ❖ Understanding the use of green chemistry principle and processes in laboratory reactions.

COURSE CODE: CH-610 PHYSICAL CHEMISTRY

After completion of the course, the learner shall be able to understand

- ❖ Understand the needs of computer applications in the study of chemistry
- ❖ Schrodinger equation and application to free-particle and particle in a box, boundary conditions, wave functions and energies, degeneracy, hydrogen atom
- ❖ The uncertainty principle, wave function and its interpretation, conditions of normalization
- ❖ Rotational spectra of diatomic molecules
- ❖ Vibrational spectra of diatomic molecules
- ❖ Symmetry and point groups
- ❖ Understanding about chemical cells and their function
- ❖ Understanding about electrodes, EMF measurement.
- ❖ Theory of strong electrolytes, postulates of Maxwell-Boltzmann distribution law
- ❖ Knowledge about surface active agents,
- ❖ Collision theory and transition theory in chemical reactions
- ❖ Phase equilibria of two components system

COURSE CODE: CH-611 ORGANIC AND PHYSICAL CHEMISTRY PRACTICAL

After completion of the course, the learner shall be able to understand

- ❖ And able to perform qualitative analysis of a given organic compound systematically
- ❖ Able to perform organic preparation
- ❖ Able to perform conductometric titration independently