

Course Outcome

Semester-I

C1T: Organic Chemistry – I

Students will gain knowledge on:

- different types of bond of carbon and other elements in organic molecules/compounds along with hybrid orbitals
- stability/reactivity of molecules due to electronic displacement
- the difference between valence bond and molecular orbital concepts
- aromaticity
- physical properties of compounds influenced by hybridization
- classification of organic reactions
- electrophile and nucleophile
- reactive intermediates
- deriving plausible reaction mechanism
- stereochemistry including representation of molecules, symmetry and chirality, configuration of chiral molecules and their optical activity

C1P:

Students will gain knowledge on:

- how to maintain lab safety by properly handling lab equipments, chemical reagents etc.
- how to maintain a practical notebook
- how to perform common laboratory techniques like aqueous extraction, reflux, filtration, distillation, purification, crystallization, melting point, boiling point, chromatography
- how to separate binary solid mixtures of organic molecules based upon solubility
- how to identify a pure solid or liquid compound based upon solubility and some specific chemical reactions.

C2T: Physical Chemistry – I

Students will gain knowledge on:

- How temperature, Pressure and volume of gas varies with each other.
- The no. density of molecule in a said region.
- How pressure changes with the density and velocity of gaseous molecule.
- The average velocity, most probable velocity and root mean square velocity and their relationship.
- The kinetic theory and Kinetic energy of gas.
- How gaseous molecule collide with each other and combining pattern of atoms or molecules.
- Intermolecular forces like Debye , Keesom and London interactions.
- Properties of thermodynamic variables.
- The application of mathematical tools to calculate thermodynamic and kinetic properties.
- The relationship between microscopic properties of molecules with macroscopic thermodynamic observables.
- The deviation of rate equations from mechanistic data.
- The use of simple models for preventive understanding of physical phenomena associated to chemical thermodynamics and kinetics.
- The limitations and uses of models for the solution of applied problems involving chemical thermodynamic and kinetics.

C2P :

Students will gain knowledge on:

- The topic how to determine the pH of unknown solution by colour matching method.
- How to calculate heat of neutralization of a strong acid by a strong base.
- The topic study of kinetics of acid-catalyzed hydrolysis of methyl acetate.
- Determination of kinetics of decomposition of H_2O_2 .

GE-1T:

Students will gain knowledge on:

- Electronic configuration of atoms
- Position of elements in the periodic table, electronegativity, general characteristics of s, p, d and f-elements
- Different concepts on acidic/basic properties of compounds
- Balancing of chemical reactions by oxidation number
- Structure of organic molecules, stability/reactivity of molecules due to electron displacements
- Electrophiles and nucleophiles, reactive intermediates, idea on reaction mechanism
- Three-dimensional chemistry emphasizing on isomerism, symmetry, chirality and nomenclature of a particular configuration
- Nucleophilic substitution and elimination reaction
- Preparation, reactions and their corresponding mechanisms of alkanes, alkenes and alkynes

GE-1P :

Students will gain knowledge on:

- The estimation of sodium carbonate and sodium bicarbonate in a mixture.
- Titration of oxalic acid by KMnO_4 .
- how to perform systematic qualitative analysis of some single solid organic compounds based on detection of special elements, solubility, special chemical reactions of some functional groups melting point determination.

DSC-1AT (CC-1):

Student will gain knowledge on:

- The Study of new approach to atomic structure.
- The various types bonding and their chemical properties.
- Statement of Born- Lande equation for lattice energy calculation.
- Shape of some inorganic molecules and ions on the basis of VESPER theory.
- The idea of physical effect, electronic dipolemoment, inductive effect , electromaric effect, resonance and hyperconjugation.

- Concept of chirality and CIP rules.
- Fundamental chemistry in aliphatic hydrocarbon.

DSC-1AP:

Student will gain knowledge on:

- Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
- The estimation of oxalic acid by titration it with KMnO_4 .
- Detection of extra element in organic chemistry.
- Identify and separate the sugar present in the given mixture by paper chromatography.

Semester-II

C3T: (Inorganic chemistry)

Students will gain knowledge on:

- Describe the structure of atoms in form of protons, neutrons and electrons.
- Define Sommerfeld theory wave mechanism.
- The fundamental radial and angular wave functions of hydrogen atom.
- How to calculate the exchange energy and ground state term symbols of atoms or ions.
- Periodicity of elements in the periodic table.

C3P:

Students will gain knowledge on:

1. How to do acid and base titration.
2. Estimation of free alkali present in different soaps and detergents.
3. Estimate the Fe(II) and Fe(III) In mixture of $\text{K}_2\text{Cr}_2\text{O}_7$.
4. Calculate amount of Fe(II) using oxidation reduction titrimetric method in KMnO_4 solution.

C4T: Organic Chemistry – II

Students will gain knowledge on:

- Kinetics and thermodynamics of chemical reactions
- Acidic/basic properties of organic molecules
- Tautomeric equilibrium
- Chirality arising due to the presence of chiral axis/plane and nomenclature of it
- Conformational analysis of acyclic molecule.

C4P:

Students will gain knowledge on:

- how to calculate the amount of chemicals required for a reaction, yield and percent yield of product(s)
- how to set up a chemical reaction
- how to predict the outcome and mechanism of some very simple reactions based on understanding of relative reactivity of functional groups

GE-2T:

Students will gain knowledge on:

- How temperature, Pressure and volume of gas varies with each other.
- The no. density of molecule in a said region.
- How pressure changes with the density and velocity of gaseous molecule.
- The average velocity, most probable velocity and root mean square velocity and their relationship.
- Brief discussion about surface tension and viscosity.
- Different types of solid like Crystalline solid and amorphous solid.
- Packing efficiency and different types of metal defect.
- Rate of reaction, rate constant, different order reaction etc.

- ionic bonding including lattice energy, Born-Landé equation, Born-Haber cycle, Fajan rule, percentage of ionic character
- VB approach of covalent bonding, shapes of inorganic molecules on the basis of VSEPR theory and hybridization
- Concept of resonance and MO theory, MO of heteronuclear diatomic molecules like CO, NO etc.
- Study of p-block elements focusing on group trends, inert pair effect

GE-2P:

Students will gain knowledge on:

- How to determine the surface tension of a liquid using stalagmometer.
- How to determine the viscosity of a liquid using an Ostwald's viscometer.
- Determination of surface tension of liquid using stalagmometer
- Determination of relative and absolute viscosity of liquid using Ostwald viscometer
- Acid hydrolysis of methyl acetate with hydrochloric acid
- Qualitative semimicro analysis of mixtures containing three acid and/or basic radicals

DSC-1BT (CC-2):

Student will gain knowledge on:

- Concept of standard state and standard enthalpy of formation, internal energy and calculation of bond energy.
- Free energy change in chemical reaction and Le Chatelier's principle.
- The idea of degree of ionization, buffer solution solubility and solubility product.
- Electrophilic and nucleophilic substitution reaction.
- Iodoform test, Aldol condensation, Cannizzaro reaction, Wittig reaction, Benzoin condensation.

DSC-1BP:

Student will gain knowledge on:

- Determination of heat capacity of calorimeter for different volumes.
- Study of the solubility of benzoic acid in water .
- Measurement of PH of different solution like aerated drinks, fruit juices, shampoos and soaps.
- Preparation of buffer.
- Determination of melting boiling points.

Semester-III

C5T: Physical Chemistry – II

Students will gain knowledge on:

- How viscosity of liquids changes with temperature.
- How dilution influence the conductance.
- Relation between E, H, G, S & T and chemical potential.
- How to determine the chemical potential of an ideal gas in an ideal gas mixture.
- About different types of operator, commutator and uncertainty relationship.
- Comparison with free particle Eigen functions and Eigen values.

C5P:

- The topic how to determine the viscosity of unknown liquids with respect to water.
- How to determine partition coefficient for the distribution of I₂ between water and CCl₄.
- Conductometric titration of an acid against strong base.
- The topic study of saponification reaction conductometrically.

C6T: (inorganic chemistry)

Students will gain knowledge on:

1. Understand how the concept of valency can account for its applications with predict the formation of complex .
2. How to the different of salvation energy and lattice energy .
3. calculate the formal chage, diupole momemt ,hybridization,and polarizability.
4. How to draw the appropriate structure of the compound and MO diagram.
5. Knowing the different bonding character of the compound.
- 6.concept of radio activity , nuclear quantum number,and magic number.

C6P:

Students will gain knowledge on:

1. How to estimate the Cu(II)from the complex .
2. Estimate the available chlorine in bleaching powder.
3. Identifying the Cu in brass and Fe in cement.
4. Find out the absolute amount of Cr and Mn in steel.

C7T: Organic Chemistry – III

Students will gain knowledge on:

- addition reactions to alkenes and alkynes
- electrophilic and nucleophilic aromatic substitution reactions
- fundamental reactions of carbonyl compounds and their green approach
- preparations and uses of organometallic reagents in organic synthesis

C7P:

Students will gain knowledge on:

- how to perform systematic qualitative analysis of some single solid organic compounds based on detection of special elements, solubility, special chemical reactions of some functional groups melting point determination and literature survey

SEC-1T: Pharmaceutical Chemistry

Students will gain knowledge on:

- history behind drug discovery
- drug design and development
- name and synthesis of some essential drugs required very much in our everyday life for curing from different diseases
- fermentation process involved in the synthesis of drugs, vitamins

SEC-1P: Pharmaceutical Chemistry

Students will gain knowledge on:

- preparation and analysis of analgesic-aspirin
- preparation of antacid –magnesium bisilicate

GE-3T :

Students will gain knowledge on:

- Preparation, electrophilic substitution and oxidation of benzene
- Preparation of organometallic compounds and their use in organic synthesis
- Preparation of alcohols, phenols and ethers and some of their important reactions
- Fundamentals of carbonyl compounds

GE-3P :

Students will gain knowledge on:

- Determination of heat capacity of calorimeter for different volumes
- Preparation of buffer solution and find the pH of an unknown buffer solution by color matching method
- Identification of a pure solid/liquid organic compound on the basis of stability and some specific reaction of some functional groups

DSC-1CT (CC-3):

Student will gain knowledge on:

- The thermodynamics of ideal solution, ideal solution and Raoult's law.
- Derivation of Clausius-Clapeyron equation, phase diagram of one and two component system.
- Concept of conductivity, Kohlrausch law of independent migration of ions.
- Reversible and irreversible cells, concept of EMF of a cell.
- Comparative study of nucleophilicity of acyl derivatives.
- Determination of configuration of monosaccharides, absolute configuration of glucose and fructose.

DSC-1CP:

Student will gain knowledge on:

- Construction of the phase diagram of binary system using cooling curves.
- Determination of cell constant.
- Potentiometric titration of strong acid vs strong base.
- Separation of amino acids by paper chromatography.
- Differentiation between reducing

SEC-1T: Basic Analytical Chemistry

Student will gain knowledge on:

- Concept of sampling.
- Importance of accuracy, precision and sources of error in analytical measurements.
- Composition of soil, pH of soil and analysis of soil by complexometric titration.
- Concept of pure water, contaminating water and water purification methods.
- Idea about nutritional value of foods, food processing and its preservations.
- Basic principles of chromatography and its different types.
- Analysis of cosmetics and function of the ingredients.

SEC-1P:

Student will gain knowledge on:

- Estimation of calcium and magnesium ion as calcium carbonate by complexometric titration.
- Determination of pH, acidity and alkalinity of a water sample.
- Paper chromatographic separation of mixture of metal ion(Fe^{3+} and Al^{3+})
- Spectrophotometric determination of ion in vitamin tablets.

Semester-IV

C-8T: Physical Chemistry – III

Students will gain knowledge on:

- Different types of colligative properties.
- The Derivation procedure using chemical potential to derive relations between the four colligative properties.
- How liquid and vapour equilibrium exist for two component system.
- About Ideal solution at fixed temperature and pressure.
- Postulates and qualitative description Debye-Huckel limiting law.
- Different types of Faraday's laws of electrolysis.
- How to calculate free energy, enthalpy ,entropy, equilibrium constant and pH values using hydrogen or quinone-hydroquinone electrodes applying EMF measurement.

- About different types of operator, commutator and uncertainty relationship.
- Comparison with free particle Eigen functions and Eigen values.
- Brief discussion about quantization of square of total angular momentum and Z-component.
- The topic Qualitative treatment of hydrogen atom and hydrogen like atom.
- Derive LCAO-MO treatment of H_2^+ ion.
- Comparison between LCAO-MO and VBT treatments of H_2 and their limitations.

CC-8P(Practical) :

Students will gain knowledge on:

- Solubility of sparingly soluble salt in water, in electrolyte with common ions and in neutral electrolyte.
- Potentiometric titration of Mohr's salt solution against standard $K_2Cr_2O_7$ solution.
- How to determine K_{sp} for AgCl by potentiometric titration of $AgNO_3$ solution against standard KCl solution.
- Effect of ionic strength on the rate of Persulphate-Iodide reaction.
- pH- metric titration of acid against strong base.

C-9T: (Inorganic chemistry)

Students will gain knowledge on:

- The idea of electrolytic reduction , hydrometallurgy and methods of purification of metals.
- Study of oxides and oxo-acids of nitrogen, phosphorus, sulphur and chlorine
- Accurance and uses, rationalization of inertness of noble gas.
- Comparison of inorganic polymers and organic polymers.
- Warner's theory of coordination complex, isomerism in coordination compounds.

C-9P:

Students will gain knowledge on:

- The study of complexometric titration for Zn^{2+} .
- Separation of Ca^{2+} and Mg^{2+} from its mixture.
- The preparation of potassium diaquadioxaletocromate(III).
- The preparation of tetraamincarbonetocobult(III) ion

C10T: Organic Chemistry – IV

Students will gain knowledge on:

- preparation, reactions and uses of nitrogen containing organic compounds
- some outstanding name reactions where rearrangement occur
- the logic of organic synthesis through the idea of retrosynthetic analysis
- spectroscopic methods like UV, IR, NMR, for the determination of structure of organic compounds

C10P:

Students will gain knowledge on:

- Quantitative estimation of organic compounds e.g. glycine by Sorensen method, glucose and sucrose by Fehling solution, vitamin-C, aromatic amine by bromination method, acetic acid in commercial sugar etc.

SEC-2T: Chemistry of Cosmetics and Perfumes

Students will gain knowledge on:

- preparation, uses and side effects of cosmetics like hair dye, shampoo, lipsticks, suntan lotions, talcum powder, creams
- importance of essential oils like jasmine, geraniol, rose oil, eucalyptus in cosmetic industries

SEC-2P: Chemistry of Cosmetics and Perfumes

Students will gain knowledge on:

- preparation of shampoo, nail polish and its remover, talcum powder

GE-4T:

Students will gain knowledge on:

- Clear concept about ideal and non-ideal solution.
- Solution distillation process and Nernst distribution Law.
- How two component systems involving eutectics in a phase.
- How dilution influence the conductance
- Relation between E, H, G, S & T and chemical potential.
- Brief discussion on different types of separation technique like TLC, HPLC etc.

GE-4P:

Students will gain knowledge on:

- Study of the equilibrium of one of the following reaction by the distribution method
- Determine the dissociation constant of a weak acid.
- The conductometric titration of a weak acid by strong base.
- Potentiometric titration of a weak acid by a strong base.

DSC-1DT (CC-4):

Student will gain knowledge on:

- The idea of electronic configuration, valency, colour, magnetic and catalytic properties, of transition element.
- The study of valence bond theory and inner and outer in complexes.
- Concept of crystal field theory and CFSE energy calculation in octahedral and tetrahedral complexes.
- Postulates of kinetic theory of gases and derivation of kinetic gas equation.
- Idea of surface tension, viscosity of a liquid.
- Law of crystallography.

DSC-1DP:

Student will gain knowledge on:

- Identifying acid and basic radical.
- Determination of concentration of Na^+ and K^+ using flame photometry.
- Calculate the total hardness of water by complexometric titration.
- Surface tension measurement.
- Viscosity measurement.

SEC-2T: Analytical Clinical Biochemistry

Student will gain knowledge on:

- Structures, properties and function of carbohydrates, proteins, enzymes, lipids and hormones.
- Analysis of blood and urine.

SEC-2P:

Student will gain knowledge on:

- Qualitative and quantitative estimation of carbohydrates.
- Determination of iodine number of oil.

Semester-V

C-11T (Inorganic chemistry):

Students will acquire knowledge on:

- Elementary ideas of Crystal Field Theory regarding splitting of d_n configurations in octahedral, square planar and tetrahedral fields, crystal field stabilization energy (CFSE) in weak and strong fields; pairing energy and spectrochemical series.
- Jahn- Teller distortion. Octahedral site stabilization energy (OSSE).
- MO concept, and elementary ideas of Metal ligand bonding –sigma and pi-bonding in octahedral complexes and their effects on the oxidation states of transitional metals.

- Elementary idea of orbital and spin magnetic moments, spin only moments of dn ions and their correlation with effective magnetic moments, including orbital contribution; quenching of magnetic moment: super exchange and antiferromagnetic interactions
- Concept of colour based on the ideas of d-d transitions, L-S coupling, qualitative Orgel diagrams for 3d1 to 3d9 ions only, Racah parameter, selection rules for electronic spectral transitions, spectrochemical series of ligands; charge transfer spectra.
- General comparison of 3d, 4d and 5d elements in term of electronic configuration, oxidation states, redox properties, coordination chemistry.
- Regarding lanthanoids, general comparison on electronic configuration leading to oxidation states, colour, spectral and magnetic properties with special reference to lanthanide contraction and its significance. Ion-exchange method for separation of lanthanides

C-11P:

Students will do experiments on:

- Paper chromatographic separation from mixture of some metal ions such as Ni (II) and Co (II) ; Fe (III) and Al (III)
- Gravimetric estimation of Ni(II), copper(I), Al(III) and chloride ions.
- Spectrophotometric measurement of 10Dq hence determination of λ_{max} of $[\text{Mn}(\text{acac})_3]$ and $[\text{Fe}(\text{acac})_3]$ complexes.

C12T: Organic Chemistry – V

Students will gain knowledge on:

- synthesis and reactivity of polynuclear aromatic hydrocarbons
- chemistry of heterocyclic compounds very commonly found in nature and used for the synthesis of drug molecules
- three-dimensional chemistry of cyclic molecules
- chemical reactions which take place in the presence of heat or sunlight and where reagents have almost no influence
- basics of biomolecules like carbohydrates, amino acids

C12P: Organic Chemistry – V

Students will gain knowledge on:

- Chromatographic Separations 1. TLC separation of a mixture containing 2/3 amino acids 2. TLC separation of a mixture of dyes (fluorescein and methylene blue) 3. Column chromatographic separation of leaf pigments from spinach leaves 4. Column chromatographic separation of mixture of dyes 5. Paper chromatographic separation of a mixture containing 2/3 amino acids 6. Paper chromatographic separation of a mixture containing 2/3 sugars
- Spectroscopic Analysis of Organic Compounds
- Assignment of labelled peaks in the ^1H NMR spectra of the known organic compounds explaining the relative δ -values and splitting pattern.
- Assignment of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (C-H, O-H, N-H, C-O, C-N, C-X, C=C, C=O, N=O, C \equiv C, C \equiv N stretching frequencies; characteristic bending vibrations are included).
- The students must record full spectral analysis of at least 15 (fifteen) compounds from the following list:

(i) 4'-Bromoacetanilide (ii) 2-Bromo-4'-methylacetophenone (iii) Vanillin (iv) 2'-Methoxyacetophenone (v) 4-Aminobenzoic acid (vi) Salicylamide (vii) 2'-Hydroxyacetophenone (viii) 1,3-Dinitrobenzene (ix) trans-Cinnamic acid (x) trans-4- Nitrocinnamaldehyde (xi) Diethyl fumarate (xii) 4-Nitrobenzaldehyde (xiii) 4'- Methylacetanilide (xiv) Mesityl oxide (xv) 2-Hydroxybenzaldehyde (xvi) 4-Nitroaniline (xvii) 2-Hydroxy-3-nitrobenzaldehyde (xviii) 2,3-Dimethylbenzoxirane (xix) Pent-1-yn-3-ol (xx) 3-Nitrobenzaldehyde (xxi) 3-Ethoxy-4-hydroxybenzaldehyde (xxii) 2-Methoxybenzaldehyde (xxiii) Methyl 4-hydroxybenzoate (xxiv) Methyl 3- hydroxybenzoate (xxv) 3-Aminobenzoic acid (xxvi) Ethyl 3-aminobenzoate (xxvii) Ethyl 4-aminobenzoate (xxviii) 3-nitroanisole (xxix) 5-Methyl-2-nitroanisole (xxx) 3'-Methylacetanilide

DSE-1T: Advanced Physical Chemistry

Students will gain knowledge on:

- Different types of solid like Crystalline solid and amorphous solid.
- Brief discussion on Hauy's law and Steno's law.
- Packing efficiency and different types of metal defect.

- How microstate relates with microstate.
- Brief discussion on Boltzmann Distribution law and Partition function.
- Absolute Entropy and Adiabatic demagnetization.
- Synthesis of nylon
- Preparation of urea-formaldehyde resin
- Determination of hydroxyl number of a polymer using colorimetric method

DSE-1P:

Students will gain knowledge on:

- Computer programming based on numerical methods for
 - (i) Roots of equations
 - (ii) Numerical differentiation
 - (iii) Numerical integration, probability distributions and mean values

DSE2T: Analytical Methods in Chemistry

The students will learn:

- Qualitative and quantitative aspects of analysis such as sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.
- Optical methods of analysis such as origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.
- UV-Visible Spectrometry with emphasis on
 - *basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument
 - *basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers
 - *determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

- Infrared Spectrometry involving
 - *basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques
 - * structural illustration through interpretation of data, Effect and importance of isotope substitution.
- Flame Atomic Absorption and Emission Spectrometry:
 - *basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs
 - * techniques of atomization and sample introduction
 - * method of background correction, sources of chemical interferences and their method of removal
 - *techniques for the quantitative estimation of trace level of metal ions from water samples.
- Theory of thermogravimetry (TG), basic principle of instrumentation and techniques for quantitative estimation of Ca and Mg from their mixture.
- Electroanalytical methods: Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.
- Separation techniques:
 - * Classification, principle and efficiency of the technique
 - * mechanism of extraction by solvation and chelation
 - * technique of extraction: batch, continuous and counter current extractions
 - * qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.
- Chromatography:
 - *classification, principle and efficiency of the technique
 - *mechanism of separation: adsorption, partition & ion exchange.
 - *development of chromatograms: frontal, elution and displacement methods
 - *qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.
- Stereoisomeric separation and analysis:
 - * measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents
 - *chiral chromatographic techniques using chiral columns (GC and HPLC). Role of computers in instrumental methods of analysis.

DSE-2P:

Students will gain general and some specific knowledge on the following:

- Chromatography methods of separation and identification of
 - * the monosaccharides present in the given mixture (glucose & fructose))
 - * Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values
 - * the active ingredients of plants, flowers and juices by TLC
- Solvent Extraction method for separation of a mixture of Ni²⁺ & Fe²⁺ by complexation with DMG and extracting the Ni²⁺-DMG complex in chloroform, and determine its concentration by spectrophotometry.
- Analysis of soil such as
 - * determination of pH of soil,
 - * exchange capacity of cation exchange resins and anion exchange resins
 - * estimation of calcium, magnesium, phosphate by Ion exchange

Spectrophotometric method of determination of pK_a values of indicator, chemical oxygen demand (COD) and Biological oxygen demand (BOD).

DSE-1AT: Polymer Chemistry

Students will gain knowledge on:

- Monomer, polymer, classification of polymers and polymer nomenclature, bonding in polymers
- Functionality, classification of polymerization process, degree of polymerization, polydispersity index
- Kinetics of polymerization
- Crystallization and factors affecting crystalline melting point
- Structure property relationship
- Determination of molecular weight by methods like end group analysis, viscometry, light scattering
- Glass transition temperature and factors affecting it
- Solubility and thermodynamics of polymer solution
- Preparation structure, properties and applications of some polymers like polyalkenes, bakelite, nylon, silicone, polypyrrole etc

DSE-1AP:

Students will gain knowledge on:

- Synthesis of nylon
- Preparation of urea-formaldehyde resin
- Determination of hydroxyl number of a polymer using colorimetric method
- Determination of molecular weight by end group analysis
- IR studies of polymers

SEC-3T: Pharmaceutical Chemistry

Students will gain knowledge on:

- history behind drug discovery
- drug design and development
- name and synthesis of some essential drugs required very much in our everyday life for curing from different diseases
- fermentation process involved in the synthesis of drugs, vitamins

SEC-3P: Pharmaceutical Chemistry

Students will gain knowledge on:

- preparation and analysis of analgesic-aspirin
- preparation of antacid –magnesium bisilicate

Semester-VI

C13T: INORGANIC CHEMISTRY-1

Student will gain knowledge on:

- **Bioinorganic Chemistry**

*Elements of life: essential and beneficial elements, major, trace and ultratrace elements.

*Basic chemical reactions in the biological systems and the role of metal ions (specially Na^+ , K^+ , Mg^{2+} , Ca^{2+} , Fe^{3+} , Fe^{2+} , Cu^{2+} , and Zn^{2+}).

*Metal ion transport across biological membrane Na^+ / K^+ -ion pump. Dioxygen molecule in life.

*Dioxygen management proteins: Haemoglobin, Myoglobin, Hemocyanine and Hemerythrin.

*Electron transfer proteins: Cytochromes and Ferredoxins. Hydrolytic enzymes: carbonate bicarbonate buffering system and carbonic anhydrase and carboxyanhydrase A.

*Biological nitrogen fixation, Photosynthesis: Photosystem-I and Photosystem-II.

*Toxic metal ions and their effects, chelation therapy

* Pt and Au complexes as drugs, metal dependent diseases

- **Organometallic Chemistry**

Definition and classification of organometallic compounds on the basis of bond type.

* Concept of hapticity of organic ligands. 18-electron and 16-electron rules (pictorial MO approach).

*Applications of 18-electron rule to metal carbonyls, nitrosyls, cyanides.

*General methods of preparation of mono and binuclear carbonyls of 3d series.

*Structures of mononuclear and binuclear carbonyls. π -acceptor behaviour of CO, synergic effect and use of IR data to explain extent of back bonding.

*Zeise's salt: Preparation, structure, evidences of synergic effect.

*Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation).

* Reactions of organometallic complexes: substitution, oxidative addition, reductive elimination and insertion reactions.

- **Catalysis by Organometallic Compounds**

Study of the following industrial processes

* Alkene hydrogenation (Wilkinson's Catalyst)

* Hydroformylation

* Wacker Process

* Synthetic gasoline (Fischer Tropsch reaction)

* Ziegler-Natta catalysis for olefin polymerization.

- **Reaction Kinetics and Mechanism**

Introduction to inorganic reaction mechanisms of

*Substitution reactions in square planar complexes, theories of Trans- effect and its application in complex synthesis,

* Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates,

*Mechanism of substitution in octahedral complexes.

C13P:

Students will gain general and some specific knowledge on the following:

- Qualitative semimicro analysis of mixtures containing four radicals with emphasis on the understanding of the chemistry of different reactions and to assign the most probable composition.

*Cation Radicals: Na⁺, K⁺, Ca²⁺, Sr²⁺, Ba²⁺, Al³⁺, Cr³⁺, Mn²⁺/Mn⁴⁺, Fe³⁺, Co²⁺/Co³⁺, Ni²⁺, Cu²⁺, Zn²⁺, Pb²⁺, Cd²⁺, Bi³⁺, Sn²⁺/Sn⁴⁺, As³⁺/As⁵⁺, Sb³⁺/5⁺, NH₄⁺, Mg²⁺.

*Anion Radicals: F⁻, Cl⁻, Br⁻, BrO₃⁻, I⁻, IO₃⁻, SCN⁻, S²⁻, SO₄²⁻, NO₃⁻, NO₂⁻, PO₄³⁻, AsO₄³⁻, BO₃³⁻, CrO₄²⁻ / Cr₂O₇²⁻, Fe(CN)₆⁴⁻, Fe(CN)₆³⁻.

*Insoluble Materials: Al₂O₃(ig), Fe₂O₃(ig), Cr₂O₃(ig), SnO₂, SrSO₄, BaSO₄, CaF₂, PbSO₄

C-14T: Physical Chemistry – V

Students will gain knowledge on:

- **Molecular Spectroscopy**

*Interaction of electromagnetic radiation with molecules and various types of spectra; BornOppenheimer approximation

*Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution

*Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies; Diatomic vibrating rotator, P, Q, R branches

*Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion

*Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules

*Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals

- **Photochemistry**

*Lambert-Beer's law: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients;

*Laws of photochemistry, Stark, Einstein law of photochemical equivalence quantum yield, actinometry, examples of low and high quantum yields

*Photochemical Processes: Potential energy curves (diatomic molecules), Frank-Condon principle and vibrational structure of electronic spectra; Bond dissociation and principle of determination of dissociation energy (ground state); Decay of excited states by radiative and non-radiative paths; Pre-dissociation; Fluorescence and phosphorescence, Jablonski diagram;

*Rate of Photochemical processes: Photochemical equilibrium and the differential rate of photochemical reactions, Photostationary state; HI decomposition, H₂-Br₂ reaction, dimerisation of anthracene; photosensitised reactions, quenching

* Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence

- **Surface phenomenon**

*Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; Work of cohesion and adhesion, spreading of liquid over other surface; Vapour pressure over curved surface; Temperature dependence of surface tension

*Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs adsorption isotherm and surface excess

*Heterogeneous catalysis (single reactant); Zero order and fractional order reactions;

*Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Determination of Avogadro number by Perrin's method; Stability of colloids and zeta potential; Micelle formation

C14P:

Students will gain knowledge on:

- Determination of surface tension of a liquid using Stalagmometer
- Determination of CMC from surface tension measurements
- Verification of Beer and Lambert's Law for KMnO₄ and K₂Cr₂O₇ solution

- Study of kinetics of $K_2S_2O_8 + KI$ reaction, spectrophotometrically
- Determination of pH of unknown buffer, spectrophotometrically
- Spectrophotometric determination of CMC

DSE-3T: Inorganic Materials of Industrial Importance

Students will gain general and some specific knowledge on the following:

- **Silicate Industries:**

*Glass: Concepts of classification, manufacture and processing, properties and uses of different types of glass such as soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

*Ceramics: General concepts on the types, manufacture, processing and applications of clays and ceramics with special emphasis on- High technology ceramics, superconducting and semiconducting oxides, fullerenes, carbon nanotubes and carbon fibre.

*Cements: Classification of cement, ingredients and their role, manufacture of cement and the setting process, quick setting cements.

- **Fertilizers:**

Classification and manufacture of the fertilizers such as urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

- **Surface Coatings:**

*Preliminary treatment of surface, classification of surface coatings.

*Formulation, composition and related properties several oils, paints and pigments, fillers, thinners, enamels, emulsifying agents.

*Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives,

*Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

- **Batteries:**

*Concept of primary and secondary batteries, battery components and their role and characteristics of Battery.

*Working principles of batteries such as Pb acid, Li-Battery, Solid state electrolyte battery, Fuel cells, Solar cell and polymer cell.

- **Alloys:**

*Classification of alloys according to composition and specific properties of elements.

*Manufacture, composition, properties, surface treatment of different types of steel.

- **Nanomaterials:**

*Chemistry of Nano Materials including Graphene. Syntheses, characterization and applications. Plasmonic materials, Semiconductor, Band gap, Types of Semiconductors, Colour Centres.

- **Catalysis:**

*General principles and properties of homogenous and heterogenous catalysts and their industrial applications, Deactivation or regeneration of catalysts.

*Phase transfer catalysts, application of zeolites as catalysts.

- **Chemical explosives:**

*Preparation and explosive properties of some explosive such as lead azide, PETN, cyclonite (RDX).

*Primary concepts on rocket propellants.

DSE3P:

Students will gain general and some specific knowledge on the following:

- Determination of free acidity in ammonium sulphate fertilizer.
- Estimation of Calcium in Calcium ammonium nitrate fertilizer.
- Estimation of phosphoric acid in superphosphate fertilizer.
- Electroless metallic coatings on ceramic and plastic material.
- Determination of composition of dolomite (by complexometric titration).
- Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
- Analysis of Cement.
- Preparation of pigment (zinc oxide).

DSE-4T: Polymer Chemistry

Students will gain knowledge on:

- Monomer, polymer, classification of polymers and polymer nomenclature, bonding in polymers
- Functionality, classification of polymerization process, degree of polymerization, polydispersity index
- Kinetics of polymerization
- Crystallization and factors affecting crystalline melting point

- Structure property relationship
- Determination of molecular weight by methods like end group analysis, viscometry, light scattering
- Glass transition temperature and factors affecting it
- Solubility and thermodynamics of polymer solution
- Preparation structure, properties and applications of some polymers like polyalkenes, bakelite, nylon, silicone, polypyrrole etc

DSE-4P:

Students will gain knowledge on:

- Synthesis of nylon
- Preparation of urea-formaldehyde resin
- Determination of hydroxyl number of a polymer using colorimetric method
- Determination of molecular weight by end group analysis
- IR studies of polymers

DSE-1BT: Green Chemistry

Students will gain knowledge on:

- Need and goals of green chemistry
- Principles of green chemistry
- Designing a green synthesis especially focusing on green solvent, catalyst, alternative energy source
- Green synthesis of compounds like catechol, adipic acid
- Significant name reactions with green approach
- Some real world cases
- Future trends in green chemistry - biomimetic reagents, combinatorial green chemistry

DSE-1BP:

Students will gain knowledge on:

- Preparation of propene from 1-propanol using sulphuric acid based on the principle of atom economy
- Mechanochemical solvent free synthesis of azomethines
- Photoreduction of benzophenone to bezopinacol in the presence of sunlight.

SEC-4T: Pesticide Chemistry

Students will gain knowledge on:

- Natural and synthetic pesticides
- Benefits and adverse effects of pesticides
- Structure activity relationship
- Changing concept of pesticides
- Synthesis and uses of some important pesticides like DDT, malathion, carbofuran, chloranil, alachlor etc.

SEC-4P:

Students will gain knowledge on:

- Preparation of simple organophosphates, phosphonates and thiophosphates
- Calculating acidity/alkalinity in a given sample of pesticide formulation as per BIS specifications

