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**Y.S. Palpara Mahavidyalaya**  
**Programme Specific Outcome**  
**CHEMISTRY (Honours)**

Upon successful completion of this course,

1. Students will be able to gather the fundamental scientific principles in the different fields of chemistry (Organic, Inorganic, Physical and analytical Chemistry).
2. Independently execute synthetic and analytical experiment safely and efficiently.
3. Students will be able to identify and describe the underlying principles behind the chemical techniques relevant to academia, industry and government in addition.
4. Students can gain the power to prepare logical, organized and concise write up and oral and poster presentations that effectively communicate chemical content to other people.
5. Through proper learning of full UG course in chemistry, a student can get various opportunities for their future work in interdisciplinary field like biochemistry, nano fields, polymer science and industrial chemistry.
6. To demonstrate the ability to present the results of a experiment, both in an oral presentation or written in a paper.
7. Apply for different technical course related to chemistry.
8. To improve their performance in chemistry competitions (like IIT-JAM, BHU, IISC e.t.c.)
9. Apply for job in different chemical company.

**Y.S. Palpara Mahavidyalaya**  
**Course outcome**  
**CHEMISTRY (Honours)**

**Semester-I**

**CC-1: ORGANIC CHEMISTRY-I**

**Theory (C1T)**

- a) **Basics of Organic Chemistry:** To know the bond length, bond polarity, bond angle and bond strength. To know the resonance energy and orbital picture.
- b) **General treatment of reaction mechanism:** To know the bond cleavage and bond formation. To know the reactive intermediate like carbocation and carbanion.

- c) **Stereo chemistry:** To know the 3D structure of molecules. Identify stereogenic centres, distinguish between different type of isomer including enantiomer, diastereomer R/S nomenclature of molecule. To know about conformational and configurational isomer.

#### **Practical (C1P)**

- a) To know the separation technique of binary solid mixture.  
b) To determine the boiling point of common organic molecule.  
c) To identify the solid and liquid pure organic molecules.

### **CC-2 :PHYSICAL CHEMISTRY-I**

#### **Theory (C2T)**

- a. **Kinetic Theory and Gaseous state:** To know the kinetic theory of gases, Maxwell's distribution of speed and energy as well as real gas and virial equation.  
b. **Chemical Thermodynamics:** To know the Zeroth, First law and Second law of Thermodynamics, Thermochemistry and Thermodynamic relations pertaining to Maxwell's relations; Gibbs- Helmholtz equation, Joule-Thomson experiment and its consequences.  
c. **Chemical kinetics:** To know the rate law, order and molecularity, role of temperature and theories of reaction rates as well as theories of Homogeneous catalysis, Enzyme catalysis and Michaelis-Menten equation.

#### **Practical (C2P)**

- a. To determination of pH of unknown buffer solution by color matching method.  
b. To determination of heat of neutralization of a strong acid by a strong base.  
c. To study of kinetics of acid-catalyzed hydrolysis of methyl acetate.  
d. To study of kinetics of decomposition of  $\text{H}_2\text{O}_2$ .  
e. To determination of heat of solution of oxalic acid from solubility measurement.

### **GE-1 : ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES, REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS**

#### **Theory (GE1T)**

- a) **Atomic Structure:** To Know about Bohr's theory, Sommerfeld's Theory, Quantum numbers, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations.  
b) **Chemical Periodicity:** To make student understand the modern periodic table which stand the backbone in understanding Chemistry and the periodic properties like Atomic and Ionic size, Ionization Energy, Electron Affinity, Electro negativity and Group trends and periodic trends in these properties for s- and p- block elements.  
c) **Acids and bases:** This portion of the curriculum is the one part of acid base reaction. Discuss main concept on Brönsted-Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases ( HSAB concept), applications of HSAB process.  
d) **Redox reactions:** To know about balancing of equations by oxidation number and ion-electron method oxidimetry and reductimetry.

- e) **Fundamentals of Organic Chemistry:** To know inductive effect, resonance and hyperconjugation; cleavage of bonds: homolytic and heterolytic; structure of organic molecules on the basis of VBT; nucleophiles electrophiles; reactive intermediates: carbocations, carbanions and free radicals.
- f) **Stereochemistry:** To know about Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity, elements of symmetry, interconversion of Fischer and Newman representations; enantiomerism and diastereomerism, meso compounds; threo and erythro, D and L, cis and trans nomenclature; CIP Rules: R/S (upto 2 chiral carbon atoms) and E/Z nomenclature.
- g) **Nucleophilic Substitution and Elimination Reactions:** To know about Nucleophilic substitutions reaction.
- h) **Aliphatic Hydrocarbons:** To know about Chemistry of alkanes, alkenes and alkynes ( Upto 5 carbon atom).

#### Practical (GE1P)

- a) Students can perform estimation of some inorganic compound.
- b) Students can detect special elements and functional groups in organic compound.

### Semester-II

#### CC-3: INORGANIC CHEMISTRY-I

##### Theory (C3T)

- a) **Extra nuclear Structure of atom:** To Know about Bohr's theory, Sommerfeld's Theory, Wave mechanics, Quantum numbers Ground state Term symbols of atoms.
- b) **Chemical periodicity:** To make student understand the modern periodic table which stand the backbone in understanding Chemistry and the periodic properties like Atomic and Ionic size, Ionization Energy ,Electron Affinity ,Electro negativity and Group trends and periodic trends in these properties for elements and Inert pair effect.
- c) **Acid-Base reactions:** This portion of the curriculum is the one part of acid base reaction. Discuss main concept on theory of Acid-Base like Arrhenius concept, theory of solvent system (in H<sub>2</sub>O, NH<sub>3</sub>, SO<sub>2</sub> and HF), BronstedLowry's concept, relative strength of acids, Pauling's rules. Lux- Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects. Thermodynamic acidity parameters, Drago-Wayland equation. Superacid, Gas phase acidity and proton affinity; HSAB principle. Acid-base equilibria in aqueous solution (Proton transfer equilibria in water), pH, buffer. Acid-base neutralisation curves; indicator, choice of indicators.
- d) **Redox Reactions and precipitation reactions:** To Know about Ion-electron method of balance of redox reaction, Elementary idea on standard redox potentials, Students also learn about Solubility product principle and common ion effect and their applications to the precipitation and separation of common metallic ions.

##### Practical (C3P)

- a) Students can perform different acid base titration.
- b) Students can perform different Oxidation-Reduction Titrimetric reaction like estimation of f Fe(II) and Fe(III), Estimation of Fe(III) and Mn(II), Estimation of Fe(III) and Cu(II) and Estimation of Fe(III) and Cr(III) in a mixture using K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>.

## CC-4: ORGANIC CHEMISTRY-II

### Theory (C4T)

- Stereochemistry II:** To know about Chirality arising out of stereo axis, Concept of pro stereoisomerism and Conformation.
- General treatment of reaction mechanism-:**To know acidity and basicity of organic molecule, HSAB principal, keto enol tautomerism and reaction kinetics.
- Substitution and elimination reaction:** To know the stereochemical features of organic reaction. To know the stereoselectivity, regio selectivity and different type of elimination reaction.

### Practical (C4P)

- Students can prepare some organic compound and study the crystallization process and melting point determination technique.

## GE-2 : STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTURE, p-BLOCK ELEMENTS

### Theory (GE2T)

- Kinetic theory of gases and Real gas:** To know the pressure and temperature, mean free path, collision number, To know the viscosity of gas and effect of temperature.
- Liquid:** To know the surface tension and viscosity of liquid and its application.
- Solid:** To know details about solid compounds.
- Chemical kinetics:** To know rate law, order, molecularity, collision theory, Lindemann theory of unimolecular reaction.
- Chemical Bonding and molecular structure:** To know about ionic bonding, covalent bonding, and concept of resonance and resonating structure.
- Comparative study of p-block element:** To know the property electronic configuration of p block elements.

### Practical (GE2P)

- To measure surface tension, viscosity and the study of kinetics.
- Qualitative analysis of radical mixture.

## Semester-III

## CC-5: Physical Chemistry-II

### Theory (C5T)

- Transport processes**  
To know the theories of Fick's law and Viscosity as well as theories of conductance and transport number.
- Applications of Thermodynamics – I**  
To know about partial molar properties and chemical potential, Chemical Equilibrium, Thermodynamics of mixing, Nernst distribution law and Raoult law.
- Foundation of Quantum Mechanics**  
To know about the development of Quantum Mechanics, Wave function, Concept of Operators,

Particle in a box and Simple Harmonic Oscillator.

### Practical (C5P)

- To study the viscosity of unknown liquid samples with respect to water.
- To determination of partition coefficient for the distribution of  $I_2$  between water and  $CCl_4$ .
- To determination the equilibrium constant of  $KI + I_2 = KI_3$  using partition coefficient between water and  $CCl_4$ .
- To determine the concentration of the supplied strong and weak monobasic acids and dibasic acids by conductometric titrations against a strong base.
- To study the saponification reaction conductometrically.
- To verify Ostwald's dilution law and determination of dissociation constant of a weak acid.

### CC-6 (Inorganic Chemistry-II)

#### Theory (C6T)

- Chemical Bonding-I** :Students can know about different properties of ionic bond like size effects, radius ratio rule, Born-Landé equation, Kapustinskii expression for lattice energy, Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids. Students also learn about the properties of Covalent bond like Polarizing power, ionic potential, Fajan's rules. Valence Bond Theory, hybridizations, Bent's rule, Dipole moments, VSEPR theory e.t.c.
- Chemical Bonding-II**: Students learnt about molecular orbital theory of some homonuclear molecules and some heteronuclear molecules. Qualitative idea of valence bond, Semiconductors and defects in solids can be known from this chapter. Students can also known about weak chemical forces like van der Waals forces, ion-dipole forces, dipole-dipole interactions and induced dipole interactions.
- Radioactivity**: Student learnt about Nuclear forces, Nuclear models (elementary idea), Nuclear Reactions, Radio chemical methods.

#### Practical (C6P)

- Students can perform some Iodo-/ Iodimetric Titrations like Estimation of Cu(II), Vitamin C 3, arsenite and antimony in tartar-emetic iodimetrically and available chlorine in bleaching powder.
- Students can perform estimation of Cu in brass, Cr and Mn in Steel and Fe in cement.

### CC-7 : Organic Chemistry-III

#### Theory (C7T)

- Chemistry of alkene and alkyne**: To know the markownikoff and anti markownikoff addition. To know the addition of siglet and triplet carbene. To know the different types of reaction involving alkyne.
- Electrophilic and Nucleophilic substitution**: To know the different types of electrophilic reaction (Nitration, sulfonation, Fridel craft). To know the addition and elimination mechanism and cine substitution.
- Carbonyl and related compound**: To know the nucleophilic addition to carbonyl compound. To know the reduction of carbonyl compound. To know alkylation of carbonyl compound.

#### Practical (C7P)

- a) Qualitative analysis of single solid organic compound: Student will detect special elements and functional groups present in organic molecule and also measure melting point and make derivative.

### **SEC-1: Pharmaceutical Chemistry**

#### **Theory (SEC1T)**

- a) **Pharmaceutical Chemistry:** To know design, development and basic retro synthetic approach, synthesis representative drugs.
- b) **Fermentation:** To know the fermentation process and production of different compounds.

#### **Practical (SEC1P)**

Preparation of Aspirin and magnesium (antacid).

### **GE3: Chemical Energetics, Equilibria, Organic Chemistry-II**

#### **Theory (GE3T)**

**a. Chemical Energetics**

To study first law of thermodynamics, thermochemistry, second law of thermodynamics, Carnot theorem, Carnot engine, refrigerator, concept of entropy and free energy.

**b. Chemical Equilibrium**

To study degree of advancement, Variation of free energy with degree of advancement, relation between  $K_p$ ,  $K_c$  and  $K_x$ , van't Hoff's reaction isotherm, isobar and isochore and Le Chatelier's principle.

**c. Ionic equilibrium**

To study degree of ionization, ionization constant and ionic product of water; pH scale, common ion effect; Salt hydrolysis and calculation of hydrolysis constant, Buffer solutions; Solubility and solubility product of sparingly soluble salts and applications of solubility product principle.

**d. Aromatic Hydrocarbons**

To study the preparation and electrophilic substitution, nitration, halogenation, sulphonation and Friedel-Craft's reactions of Benzene.

**e. Organometallic Compounds**

To study the preparation of Grignard reagents, concept of umpolung reaction and Reformatsky reaction.

**f. Aryl halides**

To study preparation of aryl halides from phenol, Sandmeyer reactions, nucleophilic aromatic substitution reactions and effect of nitro substituent.

**g. Alcohols, Phenols and Ethers**

To study preparation of 1°, 2° and 3° alcohols (up to 5 Carbons) and reduction of aldehydes, ketones, carboxylic acids and esters and Oppenauer oxidation, Pinacol-pinacolone rearrangement, Preparation and reactions of phenol, Reimer-Tiemann reaction, Houben-Hoesch condensation, Schotten-Baumann reaction, Fries rearrangement and Claisen rearrangement, Williamson's ether synthesis

**h. Carbonyl Compounds**

To study the preparation, properties and reactions of aldehydes and ketones, Cannizzaro reaction, Wittig reaction, benzoin condensation; Clemmensen reduction, Wolff-Kishner reduction and Meerwein-Ponndorff-Verley (MPV) reduction

**Practical (GE3P)**

- a. To study the determination of heat capacity of a calorimeter for different volumes
- b. To study the determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide
- c. To study the determination of enthalpy of ionization of acetic acid
- d. To study the determination of enthalpy of hydration of copper sulphate
- e. To study the measurement of pH of aerated drinks, fruit juices, shampoos and soaps
- f. To study the determination pH of an unknown buffer solution by colour matching method
- g. To study the solubility of benzoic acid in water
- h. Identification of various pure solid and liquid organic compounds

**Semester-IV****CC-8: Physical Chemistry-III****Theory (C8T)**

- a. **Application of Thermodynamics II**  
To know about colligative properties, phase rule and binary solutions.
- b. **Electrical properties of molecules**  
To know about ionic equilibrium, Debye-Huckel limiting law, Electromotive force, Concentration cells with and without transference and dipole moment and polarizability
- c. **Quantum mechanics**  
To know about angular momentum, qualitative treatment of hydrogen atom and hydrogen-like ions and LCAO and HF-SCF methods

**Practical (C8P)**

- a. To determine the solubility of sparingly soluble salt in water
- b. To perform potentiometric titration of Mohr's salt solution against standard  $K_2Cr_2O_7$  solution
- c. To determine the solubility product of  $AgCl$  by potentiometric titration of  $AgNO_3$  solution against standard  $KCl$  solution
- d. To study the effect of ionic strength on the rate of persulphate – Iodide reaction
- e. To study phenol-water phase diagram
- f. To study pH-metric titration of mono- and di-basic acids against a strong base

**CC-9: INORGANIC CHEMISTRY-III****Theory (C9T)**

- a) **General Principles of Metallurgy:** Students learnt about the Chief modes of occurrence of metals based on standard electrode potentials. Students will gather knowledge about the Methods of purification of metals.
- b) **Chemistry of s and p Block Elements:** Students will learn about the Chemistry of s and p block elements. They will gather knowledge about some compounds like Beryllium hydrides and halides, Boric acid and borates, boron nitrides, borohydrides, graphitic compounds, silanes, Oxides and oxoacids of nitrogen, phosphorus, sulphur and chlorine. Peroxo acids of sulphur, sulphur-nitrogen compounds, interhalogen compounds, polyhalide ions, pseudohalogens, fluorocarbons and basic properties of halogens.
- c) **Noble Gases:** Students learnt about Chemistry of noble gas compounds specially some Xenon Compounds like Xenon- fluoride compounds and Xenon-oxygen compounds.

- d) **Inorganic Polymers:** Students will learn about inorganic polymers like silicones, siloxanes, Borazines, silicates and phosphazenes.
- e) **Coordination Chemistry-I:** Students will learn basic idea of coordination compound, IUPAC nomenclature, Isomerism in square planar and octahedral complexes.

#### **Practical (C9P)**

- a) Students can perform some complexometric titration like Zn(II), Zn(II) in a Zn(II) and Cu(II) mixture, Ca(II) and Mg(II) in a mixture and Hardness of water.
- b) Students can also prepare some complexes.

### **CC-10: ORGANIC CHEMISTRY- IV**

#### **Theory (C10T)**

- a) **Nitrogen compound:** Preparation and separation of primary, secondary, tertiary amine. To know the mechanism of carbonyl synthesis. To know diazonium salts and their related compounds.
- b) **Rearrangement:** To know the different electron deficient nitrogen rearrangements. Aromatic rearrangements, migration from oxygen to carbon and green approach.
- c) **The logics of organic synthesis:** To know the disconnection process, FGI, FGA. To know the strategy of ring synthesis.
- d) **Organic spectroscopy:** To know the electronic transition, wave length. To know the force constant. To know the different types of protons present in organic molecules.

#### **Practical (C10P)**

Quantitative estimation: Students will perform quantitative estimation of some organic compounds.

### **SEC-2: CHEMISTRY OF COSMETICS & PERFUMES**

#### **Theory (SEC2T)**

- a) **Students will learn about** preparation and uses of Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams, antiperspirants and artificial flavours. Students also learn about Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmine, Civetone, Muscone.

#### **Practical (SEC2P)**

Students will prepare talcum powder, shampoo, enamels, hair remover, face cream, nail polish and nail polish remover.

### **GE-4 :Solutions, Phase Equilibria, Conductance, Electrochemistry & Analytical and Environmental Chemistry-I**

#### **Theory (GE4T)**

#### **Section A: Physical Chemistry-III**

##### **a. Solutions**

To study ideal solutions and Raoult's law, deviations from Raoult's law, non-ideal solutions;

Vapour pressure composition and temperature-composition curves of ideal and non-ideal solutions; Distillation of solutions; Lever rule; Azeotropes, Critical solution temperature; Nernst distribution law and its applications, solvent extraction

**b. Phase Equilibria**

To study phases, components and degrees of freedom of a system, thermodynamic derivation of Gibbs Phase Rule, Derivation of Clausius – Clapeyron, Phase diagrams of one and two component systems, congruent and incongruent melting points

**c. Conductance**

To study conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law, Ostwald's dilution law; Application of conductance measurement, Transport Number and principles of Hittorf's and Moving-boundary method

**d. Electromotive force**

To study Faraday's laws of electrolysis, Chemical cells, reversible and irreversible cells, measurement of electromotive force of a cell, Nernst equation; Standard reduction potential, calculation of  $G$ ,  $H$  and  $S$  from EMF data, Concentration cells with and without transference, liquid junction potential; pH determination using hydrogen electrode and quinhydrone electrode and qualitative discussion of potentiometric titrations.

**Section B: Analytical and Environmental Chemistry**

**e. Chemical Analysis**

To study the fundamentals of gravimetric analysis, gravimetric estimation of chloride, sulphate, lead, barium, nickel, copper and zinc.

To study the fundamentals volumetric analysis, primary and secondary standards, principles of acid-base, oxidation – reduction and complexometric titrations

To study the fundamentals of acid-base, redox and metal ion indicators

To study the fundamentals of column chromatography and thin layer chromatography

**f. Environmental Chemistry**

To study the composition and structure of the atmosphere, ozone layer and its importance, origin and harmful effects of major air pollutants like  $\text{CO}$ ,  $\text{SO}_2$  and  $\text{NO}_x$ , green house effect, acid rain and photochemical smog

To study the environmental role of water, natural water sources, water treatment for industrial, domestic and laboratory uses, water pollutants, action of soaps and detergents,

To study thermal and radioactive pollution and their effects on animal and plant life

To study waste water treatment; chemical treatment and microbial treatment, water quality standards like DO, BOD, COD, TDS and hardness parameters; desalination of sea water, reverse osmosis.

To study the effect of waste matters and pollutants on soil, waste classification, treatment and disposal, soil pollution and control measures.

**Practical (GE4P)**

- To study of the equilibrium of a reaction by the Distribution method.
- To study construction of the phase diagram of a binary system using cooling curves.
- To study the determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
- To study the determination of dissociation constant of a weak acid by conductance measurement.
- To study the conductometric titration of a strong acid and a weak acid against a strong base.

- f. To study the potentiometric titrations of a weak acid against a strong base.
- g. To study the potentiometric titration of Mohr's salt by potassium dichromate.

### Semester-V

#### CC-11: Inorganic Chemistry – IV

##### Theory (C11T)

- i) **Chemistry Coordination -II:** Students will know about limitation VBT, detailed study of Crystal field theory, Spectrochemical series. Jahn- Teller distortion. Metalligand bonding (MO concept, elementary idea), Magnetism and Colour of complexes, d-d transitions; L-S coupling; qualitative Orgel diagrams, Selection rules, charge transfer spectra.
- ii) Chemistry of d- and f- block elements: Students will know about chemistry of d- and f- block elements, lanthanides, and actinides.

##### Practical (C11P)

- i) Students will perform estimation of Ni(II) using Dimethylglyoxime (DMG), estimation of copper as CuSCN, estimation of Al(III) by precipitating with oxine and estimation of chloride by Gravimetrically.
- ii) Students will measure  $10 Dq$  and  $\lambda_{\max}$  of  $[\text{Mn}(\text{acac})_3]$  and  $[\text{Fe}(\text{acac})_3]$  complexes by Spectrophotometrically.
- iii) Paper chromatographic separation in a mixture of Ni (II) /Co (II) and Fe (III) / Al (III).

#### CC-12: Organic Chemistry – V

##### Theory (C12T)

- a) **Carbocycles and heterocycles:** To know poly nuclear hydrocarbon and their derivatives. To know synthesis and reaction hetero cyclic compounds.
- b) **Cyclic stereochemistry:** To know the reaction involved in alicyclic compound.
- c) **Pericyclic reaction:** To know the mechanism , stereochemistry, regeoselectivity of electrocyclic reaction, cycloaddition, and sigmatropic reaction.
- d) **Carbohydrates:** To know the properties, rotation, interconversion of mono, di and poly saccharides.
- e) **BIO molecules:** To know the synthesis of amino acids.to know the peptide linkage and hydrolysis peptide bond. To know the structure and types of nucleic acid.

### **Practical (C12P)**

- a) Chromatographic separation: Students will perform TLC, column and paper chromatographic separation technique.
- b) Spectroscopic analysis of organic compounds: To know H1 NMR spectra and their chemical shift. To know the IR spectra and stretching frequencies.

### **DSE 1:Advanced Physical Chemistry**

#### **Theory (DSE1T)**

##### **a. Crystal Structure**

To know about Bravais Lattice and the Laws of Crystallography and Crystal planes

##### **b. Statistical Thermodynamics**

To know about Configuration, microstate, macrostate, Boltzmann distribution law pertaining to Thermodynamic probability, Relation between entropy and thermodynamic probability, Partition function and Gibb's paradox.

##### **c. Special selected topics**

To know about heat capacity of solids, Dulong Petit's law, Einstein's theory and Debye  $T^3$  law, Third law of thermodynamics, Planck's law, Nernst heat theorems, Adiabatic demagnetization and Polymers.

#### **Practical (DSE1P)**

To study Computer programs based on numerical methods for

- a) To determine the roots of equations e.g. volume of van der Waals gas and comparison with ideal gas as well as pH of a weak acid.
- b) To perform numerical differentiation e.g. change in pressure for small change in volume of a van der Waals gas and potentiometric titrations.
- c) To perform numerical integration e.g. entropy and enthalpy change from heat capacity data, probability distributions from kinetic theory of gases and mean values.
- d) To perform Matrix operations e.g. application of Gauss-Siedel method in colourimetry.
- e) To perform simple exercises using molecular visualization software.

### **DSE-2: Analytical Methods in Chemistry**

#### **Theory (DSE2T)**

- a) **Qualitative and quantitative aspects of analysis:** Students will learn about Sampling, evaluation of analytical data, errors, accuracy and precision, normal law of distribution, statistical test of data.
- b) **Optical methods of analysis:** Students will learn about basic principles of instrumentation of UV-Visible Spectrometry, Infrared Spectrometry and Flame Atomic Absorption and Emission Spectrometry. Students will also learn about basic principles of quantitative analysis by UV-Visible Spectrometry, Infrared Spectrometry and Flame Atomic Absorption and Emission Spectrometry.
- c) **Thermal methods of analysis:** Students will learn theory of thermogravimetry (TG), and basic principle of instrumentation.

- d) **Electroanalytical methods:** Students will know about basic principle of pH metric, potentiometric and conductometric titrations.
- e) **Separation techniques:** Students will learn Solvent extraction, Mechanism of extraction, Technique of extraction, Qualitative and quantitative aspects of solvent extraction, Chromatography, Development of chromatograms, Qualitative and quantitative aspects of chromatographic methods of analysis and Stereoisomeric separation and analysis

#### **Practical (DSE2P)**

- a) Students will perform Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography, Separate a mixture of Sudan yellow and Sudan Red by TLC technique and Chromatographic separation of the active ingredients of plants, flowers and juices by TLC
- b) Students will separate a mixture of  $\text{Ni}^{2+}$  &  $\text{Fe}^{2+}$  by complexation with DMG by Spectrophotometrically, analysis of soil and Determination of exchange capacity of cation exchange resins and anion exchange resins.
- c) Students will determine pKa values of indicator, chemical oxygen demand (COD), Biological oxygen demand (BOD) by using by Spectrophotometrically.

### **Semester- VI**

#### **CC-13: Inorganic Chemistry-V**

##### **Theory (C13T)**

- i) **Bioinorganic Chemistry:** Students will learn about Basic chemical reactions in the biological systems and the role of metal ions, Dioxygen management proteins, Electron transfer proteins, Hydrlytic enzymes, Biological nitrogen fixation, Photosynthesis, Toxic metal ions and their effects, chelation therapy, Pt and Au complexes as drugs and metal dependent diseases.
- ii) **Organometallic Chemistry:** Definition and classification of organometallic compounds on the basis of bond type are discussed here. Reactions of organometallic complexes: substitution, oxidative addition, reductive elimination and insertion reactions are also learn by the students.
- iii) **Catalysis by Organometallic Compounds:** students will learn Study of the following industrial processes like Alkene hydrogenation (Wilkinson's Catalyst), Hydroformylation, Wacker Process, Synthetic gasoline (Fischer Tropsch reaction), Ziegler-Natta catalysis for olefin polymerization.
- iv) **Reaction Kinetics and Mechanism:** Students will learn about the Substitution reactions in square planar complexes, 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 are also known to the students.

##### **Practical (C13P)**

Students will learn about the Qualitative semimicro analysis of Inorganic compounds.

#### **CC-14 :Physical Chemistry V**

##### **Theory (C14T)**

- a) **Molecular Spectroscopy**  
To know about Rotation, vibrational, Raman, NMR and ESR spectroscopy
- b) **Photochemistry**  
To know about Lambert-Beer law, Franck-Condon principle, Fluorescence, Phosphorescence and rates of various photochemical processes.
- c) **Surface tension**  
To know about surface tension, surface energy, adsorption processes, theories of heterogeneous catalysis and colloids.

#### **Practical (C14P)**

- a) To determine surface tension of the supplied liquid using a stalagmometer.
- b) To determine of CMC from surface tension measurements.
- c) To verify Lambert-Beer's law using  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$  solutions.
- d) To study the kinetics of  $\text{K}_2\text{S}_2\text{O}_8 + \text{KI}$  reaction spectrophotometrically.
- e) To determine the pH of an unknown buffer solution spectrophotometrically.
- f) To determine CMC spectrophotometrically.

#### **DSE 3: Inorganic Materials of Industrial Importance**

##### **Theory (DSE3T)**

- a) Silicate Industries: Students will learn about Silicate Industries, ceramic materials and cement.
- b) Fertilizers: Students will learn the Manufacture of some nitrogen based fertilizers.
- c) Surface Coatings: Students will learn about Surface Coatings.
- d) Batteries: Students will learn about Batteries.
- e) Alloys: Students will learn about Alloys.
- f) Chemistry of Nano Materials including Graphene: Students will learn Chemistry of Nano Materials including Graphene
- g) Catalysis: Students will learn about Catalysis.
- h) Chemical explosives: Students will learn about Chemical explosives

##### **Practical (DSE3P)**

The following practical are also learn by the student.

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

#### **DSE4: Polymer Chemistry**

##### **Theory (DSE4T)**

- a. **Introduction and history of polymeric materials**  
To study the classification of polymers, polymer nomenclature, molecular forces and chemical bonding in polymers and texture of polymers
- b. **Functionality and its importance**  
To study the criteria for synthetic polymer formation, classification of polymerization processes, Flory's principle, bi-functional and poly-functional systems

c. **Kinetics of Polymerization**

To study the mechanism and kinetics of step growth, radical, coordination and copolymerization processes

d. **Crystallization and crystallinity**

To study the process of determination of crystalline melting point and degree of crystallinity, morphology of crystalline polymers and the factors affecting crystalline melting point

e. **Nature and structure of polymers**

To study the relationship between structure and property of polymers

f. **Determination of molecular weight of polymers**

To study the determination of  $M_n$  and  $M_w$ , principle of determination molecular weights by viscometry, light scattering and osmotic pressure methods.

g. **Glass transition temperature ( $T_g$ ) and determination of  $T_g$**

To study free volume theory, WLF equation and the factors affecting glass transition temperature

h. **Polymer Solution**

To study the criteria for polymer solubility, solubility parameter, thermodynamics of polymer solutions, determination of entropy, enthalpy, and free energy change due to mixing of polymers solutions, Flory- Huggins theory, and Lower and Upper critical solution temperatures

i. **Properties of Polymers**

To study the preparation, structure, properties and applications of a few commonly used polymers

**Practical (DSE4P)**

- a. Free radical solution polymerization of styrene, Methyl Methacrylate (MMA), Methyl Acrylate (MA), Acrylic acid (AA)
- b. Determination of molecular weight by viscometry and end group analysis

Polymer analysis by IR and DSC studies