**J.T.S.S.P.M**

**Shri Shiv Chhatrapati College, Junnar.**

**Department of Chemistry**

**Program: B.Sc. (2019 Pattern)**

**Program Outcome**

After completing the Bachelor of Science degree, students are able to:

**POS Program Outcomes:**

PO1: Obtain knowledge with facts and figures related to various subjects in basic sciences such as Physics, Chemistry, Botany, Mathematics, Zoology etc.

PO2: Understand the fundamental concepts, principles, and scientific theories related to various scientific phenomena and their relevance in daily life.

PO3: Acquire expertise in handling scientific instruments, planning and performing laboratory experiments nothing losing the observations and drawing logical inferences from them.

PO4: Evaluate the given scientific data critically and systematically and drawing objective Conclusions.

PO5: Able to think creatively (divergently and convergent) to propose novel ideas in explaining facts or providing new solution to the problems.

PO6: Develop the scientific outlook not only with respect to science subjects but also in all aspects related to life.

PO7: Absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality.

PO8: Realize the knowledge of subjects in other faculties such as humanities, performing arts, social sciences etc. can greatly and effectively influence & inspire in evolving new scientific theories and inventions.

PO9: Apply their knowledge of science across a range of fields, with in depth knowledge in at least one area of study.

PO10: Employ highly developed conceptual, analytical, quantitative and technical skill and are adept with a range of technologies.

**Class:- First Year B.Sc. Chemistry**

**Semester: I**

**Subject: CH-101: Physical Chemistry**

**Course Outcome:**

1. Students will be able to apply thermodynamic principles to physical and chemical process

2. Calculations of enthalpy, Bond energy, Bond dissociation energy, resonance energy

3. Variation of enthalpy with temperature –Kirchoff’s equation

4. Third law of thermodynamic and its applications

5. Relation between Free energy and equilibrium and factors affecting on equilibrium constant.

6. Exergonic and endergonic reaction.

7. Gas equilibrium, equilibrium constant and molecular interpretation of equilibrium constant

8. Van’t Haff equation and its application

9. Concept to ionization process occurred in acids, bases and pH scale

10. Concepts such as Common-ion effect hydrolysis constant, ionic product, solubility product

11. Degree of hydrolysis and pH for different salts, buffer solutions

**Subject: CH-102: Organic Chemistry**

**Course Outcome:**

1. The students are expected to understand the fundamentals, principles, and recent developments in the subject area.

2. It is expected to inspire and boost interest of the students towards chemistry as the main subject.

3. To familiarize with current and recent developments in Chemistry.

4. To create foundation for research and development in Chemistry.

**Subject: CH-103: Chemistry Practical**

**Course Outcome:**

1. Importance of chemical safety and Lab safety while performing experiments in laboratory

2. Determination of thermo-chemical parameters and related concepts

3. Techniques of pH measurements

4. Preparation of buffer solutions

5. Elemental analysis of organic compounds (non instrumental)

6. Chromatographic Techniques for separation of constituents of mixtures

**Semester: II**

**Subject: CH-201: Inorganic Chemistry**

**Course Outcome:**

1. Students will be able to apply various theories and principles applied to revel atomic structure.

2. Origin of quantum mechanics and structure of hydrogen atom.

3. Schrodinger equation for hydrogen atom, Radial and angular part of hydrogenic wave functions.

4. Significance of quantum numbers Shapes of orbital’s.

5. Students will be able to explain rules for filling electrons in various orbital’s, Discuss electronic configuration, and stability of half-filled and completely filled orbital.

6. Discuss concept of exchange energy and relative energies of atomic orbitals

7. Design Skeleton of long form of periodic table, Describe Block, group, modern periodic law and periodicity, Classification of elements as main group, transition and inner transition elements

8. Write name, symbol, electronic configuration, trends and properties, periodicity in the properties.

9. Students will be able todefine various types of chemical bonds, characteristics of ionic bond, types of ions, energy consideration in ionic bonding, latticeand solvation energy and their importance

10. Summarize Born-Lande equation and Born-Haber cycle,Fajan’s rule, bond moment, dipole moment and percent ionic character.

11. Describe VB approach, Hybridization and geometry of molecules, assumption and need of VSEPR theory.

**Subject: CH-202: Organic Chemistry**

**Course Outcome:**

The student is expected to know -

1. Structure, nomenclature, preparation and reactions of organic compounds.

2. The characteristic reactions of each functional group which can be used to identify and distinguish that compound from other compounds.

3. Predict the conversion of one functional group into other functional group involving one or more number of steps.

4. Conversion of the given compound into other compound containing more or less number of carbon atoms.

5. Prediction of possible products when reactants are given. In case there is more than one possible product, identify the major and minor products.

6. Suggest the possible reagents to bring about the given conversion.

**Subject: CH-203: Chemistry Practical**

**Course Outcome:**

1. Inorganic Estimations using volumetric analysis

2. Synthesis of Inorganic compounds

3. Analysis of commercial products

4. Purification of organic compounds

5. Preparations and mechanism of reactions involved

**Class:- Second Year B.Sc. Chemistry**

**Semester: III**

**Subject: CH-301: Physical and Analytical Chemistry**

**Course Outcome:**

Student will able to-

1. Understand the concept of concept of kinetics, terms used, rate laws, types of order

2. Understand the mathematical equation of first order and second order reaction. Solve / discuss the problem based applying theory and equations

3. Understand concept ofadsorption and its classification, explanation of adsorption results in the light of Langmuir adsorption isotherm, Freundlich’s adsorption Isotherm and BET theory.

4. Extraction of solute from two immiscible solvent.

5. Elucidation of composition diagram.

6. Classify the common analytical techniques.

7. Understand errors and its interpretation.

8. Outline the basic principles in qualitative analysis.

9. Numerical based on related all topics.

**Subject: CH-302: Inorganic and Organic Chemistry**

**Course Outcome:**

1. Differentiate AO‘s and M.O‘s, BMO and ABMO, VBT and MOT

2. Draw of molecular orbital and calculate bond order and explain stability.

3. Know the various types of Ligands and meaning of the terms used in co-ordination chemistry.

4. Explain Werner’s theory of coordination compounds. Differentiate between primary and secondary valency. Correlate coordination number and structure of complex ion.

5. Apply IUPAC nomenclature to coordination compound.

6. Identify and draw the structures aromatic hydrocarbons, alkyl halides, alcohol, phenol and ether from their names or from structure name can be assigned.

7. Explain / discuss synthesis of aromatic hydrocarbons, alkyl halides, alcohol, phenol and ether

8. Give the mechanism of reactions involved.

9. Explain /Discuss important reactions of aromatic hydrocarbon, alkyl halides, alcohol, phenol and ether

10. To correlate reagent and reactions.

**Subject: CH-303: Chemistry Practical Semester III**

**Course Outcome:**

1. Verify theoretical principles experimentally.

2. Interpret the experimental data on the basis of theoretical principles.

3. Correlate theory to experiments. Understand/verify theoretical principles by experiment observations; explain practical output / data with the help of theory.

4. Understand systematic methods of identification of substance by chemical methods.

5. Write balanced equation for the chemical reactions performed in the laboratory.

6. Perform organic and inorganic synthesis and is able to follow the progress of the chemical reaction by suitable method (colour change, ppt. formation, TLC).

7. Set up the apparatus / prepare the solutions - properly for the designed experiments.

8. Perform the quantitative chemical analysis of substances explain principles behind it.

**Semester: IV**

**Subject: CH-401: Physical and Analytical Chemistry**

**Course Outcome:**

Student will able to-

1. Understand the terms in phase equilibria , one / two component system, phase rule, etc.

2. Meaning and Types of equilibrium, one/two component system with respect to: Description of the curve, Phase rule relationship and typical features.

3. Thermodynamic aspects of Ideal solutions, Differentiate between ideal and non-ideal solutions and can apply Raoult’s law.

4. Interpretation of i) Vapour pressure–composition diagram ii) temperature- composition diagram.

5. Discuss / explain solubility of partially miscible liquids, immiscible solvents.

6. Derive distribution law and its thermodynamic proof. Apply solvent extraction system

7.Different Concept of conductometry, Kohlrausch's law and its Applications, Conductivity Cell, Conductivity Meter, Whetstone Bridge.

8.Different terms in Colorimetric, discuss / explain / derive law of absorptivity.

9. Apply colorimetric methods of analysis to real problem in analytical laboratory.

10.Explain / define different terms in column chromatography, separation of ionic substances using resins, using silica gel / alumina.

11. Apply column chromatographic process for real analysis in analytical laboratory

12. Solve problems based on theory / equations.

13. Correlate different terms with each other and derive equations for their correlations.

**Subject: CH-403: Physical and Analytical Chemistry**

**Course Outcome:**

1. Verify theoretical principles experimentally.

2. Interpret the experimental data on the basis of theoretical principles.

3. Correlate the theory to the experiments. Understand / verify theoretical principles by experiment or explain practical output with the help of theory.

4. Understand systematic methods of identification of substance by chemical methods.

5. Write balanced equation for all the chemical reactions performed in the laboratory.

6. Perform organic and inorganic synthesis and able to follow the progress of the chemical reaction.

7. Set up the apparatus properly for the designed experiments.

8. Perform the quantitative chemical analysis of substances and able to explain principles behind it.

**Class:- Third Year B.Sc. Chemistry**

**Semester: V**

**DSEC-I:CH-501:Physical Chemistry-I**

**Course Outcome :**

1. Know historical of development of quantum mechanics in chemistry.
2. Understand and explain the differences between classical and quantum mechanics.
3. Understand the difference between thermal and photochemical processes.
4. Understanding of De Broglie hypothesis and the uncertainty principle
5. Understanding the operators: Position, momentum and energy
6. Photochemical reactions: photosynthesis, photolysis, photocatalysis, photosensitization
7. Physical interpretation of the ψ and ψ2 and sketching the wave function
8. Applications to conjugated systems, zero-point energy and quantum tunnelling,
9. Simple Harmonic oscillator model, Born-Oppenheimer approximation. Vibrational spectra of diatomic molecules selection rules, nature of spectral lines.
10. Explain the difference between Rayleigh, Stokes and anti-Stokes lines in a Raman spectrum.

**DSEC-I:CH-502:Analytical Chemistry-I**

**Course Outcome :**

1. Define basic terms in gravimetry, spectrophotometry, qualitative analysis and parameters in instrumental analysis. Such as: Gravimetry, precipitation, solubility product, ionic product, common ion effect, precipitating agent, washing of ppt., drying and ignition of ppt., linearity range, detection limit, precision, accuracy, Sensitivity, Selectivity, Robustness and Ruggedness, electromagnetic radiations, spectrophotometry, Beers law, absorbance, transmittance, molar absorptivity, monochromator, wavelength of maximum absorbance,metal ligand ration, qualitative analysis, group reagent, dry tests, wet test, confirmatory test, precipitation, thermogravimetry, thermogram, percent wt. loss, differential thermal analysis, etc.
2. Identify important parameters in analytical processes or estimations. Example: minimum analyte concentration in particular method, reagent concentration in particular analysis (gravimetry, spectrophotometry, thermogravimetry), reagent for particular analysis, reaction condition to convert analyte into measurable form, drying and ignition temperature for ppt in gravimetry, heating rate thermogravimetry, wavelength in spectrophotometry, group reagent, removal borate and phosphate in qualitative analysis, etc.Explain different principles involved in the gravimetry, spectrophotometry, parameters in instrumental analysis, qualitative analysis.
3. Perform quantitative calculations depending upon equations student has studied in the theory. Furthermore, student should able to solve problems on the basis of theory.
4. Discuss / Describe procedure for different types analyses included in the syllabus.
5. Select particular method of analysis if analyte sample is given to him.
6. Differentiate / distinguish / Compare among the different analytical terms, process and analytical methods.
7. Demonstrate theoretical principles with help of practical.
8. Design analytical procedure for given sample.
9. Apply whatever theoretical principles he has studied in theory during practical session in laboratory.

**DSEC-I: CH-503: Physical Chemistry Practical – I**

**Course Outcome :**

1. To determine the specific refractivity’s of the given liquids A and B and their mixture and hence determine the percentage composition their mixture C. Also to determine the molecular refractivity of the given liquids A, B, C and D.
2. To determine the molar refraction of homologues methyl, ethyl and propyl alcohol and show the constancy contribution to the molar refraction by -CH2 group. Determine the refractive index of a series of salt solutions and determine the concentration of a salt of unknown solution
3. To determine the indicator constant of methyl red indicator
4. To determine the order of reaction for the oxidation of alcohol by potassium dichromate and potassium permanganate in acidic medium calorimetrically.
5. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conduct metric method.
6. To determine the normality of citric acid in given fruit by titrating it against standard NaOH solution by conductometric method.
7. To determine the molecular weight of a high polymer by using solutions of different
8. concentrations. Determine the radius of glycerol molecule from viscosity measurement.
9. Analysis of Riboflavin from vitamin supplementary capsules / syrup / tablet sample by Photoflurometry
10. Analysis of the given vibration-rotation spectrum of HCl(g)

**DSEC-II: CH-504: Inorganic Chemistry – I**

**Course outcome:**

1. To understand MOT of Octahedral complexes with sigma bonding.
2. To understand about inert and labile complexes and stability of complexes in aqueous solutions.
3. To know trends in periodic properties of these elements w.r.t. size of atom and ions, reactivity, catalytic activity, oxidation state, complex formation ability, colour, magnetic properties, non-stoichiometry, density, melting point, boiling point.
4. The meaning of term f-block elements, Inner transition elements, lanthanides, actinides.
5. Explain the effect of temperature and impurity on conductivity of metals and Semiconductors.

**DSEC-II: CH-505: Industrial Chemistry – I**

**Course Outcome :**

1. 1.Importance of chemical industry, Meaning of the terms involved in it.
2. Comparison between batch and continuous process and Knowledge of various industrial aspects
3. Concept of basic chemicals and Their uses and manufacturing process.
4. They should also know the physico-chemical principals involved in manufacturing process
5. Importance of sugar industry and Manufacture of sugar with flow diagram.
6. Cane juice extraction by various methods and Clarification by processes like carbonation, Sulphitation, Phosphatation, etc.
7. Different types of soap products, Chemistry of soap. Raw materials required for soap manufacture and Meaning of the term’s Surfactants, Types of surfactants
8. Raw materials for detergents, Detergent builders, additives
9. Washing action of soap and detergents
10. Dyes: introduction, Dye intermediates, Structural features of a dye.

**DSEC-II: CH-506: Inorganic Chemistry Practical – I**

**Course Outcome:**

1. Estimate the metal by gravimetric method.
2. Preparation of inorganic complexes and spot tests for metal ions and ligands.
3. Prepare and determine percent purity of various inorganic complexes.
4. Understand inorganic qualitative analysis.

**DSEC-III: CH-507: Organic Chemistry – I**

**Course Outcome:**

1. Define and classify polynuclear and hetreonuclear aromatic hydrocarbons.
2. Write the structure, synthesis of polynuclear and hetreonuclear aromatic hydrocarbons.
3. Understand the reactions and mechanisms
4. Explain the reactivity of polynuclear and hetreonuclear aromatic hydrocarbons.
5. Describe the synthesis of chemical reactions of polynuclear and hetreonuclear aromatic Hydrocarbons.
6. Meaning of active methylene group, Reactivity of methylene group.
7. Synthetic applications ethyl acetoacetate and malonic ester 4. To predict product with panning or supply the reagent/s for these reactions
8. What is rearrangement reaction? Different types of intermediate in rearrangement reactions?
9. To write the mechanism of some named rearrangement reactions and their applications 4. Electrocyclic rearrangement with their mechanisms Chapter
10. 1,1 and 1,2 elimination, E1, E2 and E1cB mechanism with evidences of these reactions 4
11. Understand stereochemistry by using models and learn reactivity of geometrical isomers
12. Orientation and reactivity in E1 and E2 elimination, Hoffmann and Saytzeff’s Orientation, Effect of factors on the rate elimination reactions.

**DSEC-III: CH-508: Chemistry of Biomolecules**

**Course Outcome :**

1. **Introduction to molecular logic of life.** The student will understanding of Cell types, Difference between a bacterial cell, Plant cell and animal cell. Biological composition and organization of cell membrane, structure and function of various cell organelles of plant and animal cell. Concepts of biomolecules, Bonds that link monomeric units to form macromolecules
2. **Carbohydrates:** The student will understand the types of carbohydrates and their biochemical significance in living organisms, structure of carbohydrates and reactions of carbohydrates with Glucose as example. Properties of carbohydrates.
3. **Lipids:** The student needs to know the types of lipids with examples, structure of lipids, properties of lipids
4. **Amino acids and proteins:** The student will understand the structure and types of amino acids. Reactions of amino acids.Properties of amino acids.Peptide bond formation.Types of proteins.Structural features in proteins.Effect of pH on structure of amino acid, Determination of N and C terminus of peptide chain.
5. **Enzymes:** The student know the classes of enzymes with subclasses and examples. Enzyme specificity, Equations of enzyme kinetics Km and its significance, features of various types of enzyme inhibitions, industrial applications of enzymes.
6. **Hormones:** Basic concepts of Endocrinology. Types of Endocrine glands and their hormones.Biochemical nature of hormones.Mechanism of action of lipophilic and hydrophilic hormones.

**DSEC-III: CH-509: Organic Chemistry Practical-I**

**Course Outcome :**

1. Separation of Binary Mixtures and Qualitative Analysis The students will be able to
   1. Perform the quantitative chemical analysis of binary mixture, explain principles behind it.
   2. Separate, purify and analyse binary water insoluble mixture and water-soluble mixture.
   3. Understand the techniques involving drying and recrystallization by various method.
   4. Familiarize the test involving identification of special elements. Learn the confirmatory test for various functional groups.
2. Preparations The students will be able to
   1. Systematic working skill in laboratory will be imparted in student.
   2. Learn the basic principles of green and sustainable chemistry.
   3. Synthesis of various organic compounds through greener approach.
   4. Do and understand stoichiometric calculations and relate them to green process metrics.
   5. Learn alternative solvent media and energy sources for chemical processes.
   6. Learn the preparations of derivative various functional groups aspects of electrical experiments.
   7. Understand the techniques involving drying and recrystallization by various method
   8. Expertise the various techniques of preparation and analysis of organic substances
   9. Understand principle of TLC techniques and purification technique used in organic chemistry.

**SEC-I: CH-510: Skills Enhancing Course-I (Introduction to Medicinal chemistry)**

**Course Outcome:**

1. The basics of medicinal chemistry, biophysical properties, overview of basic concepts of traditional systems of medicine.
2. Over view of the overall process of drug discovery, and the role played by medicinal chemistry in this process.
3. Biological activity parameters and importance of stereochemistry of drugs and receptors.
4. Knowledge of mechanism of action of drugs belonging to the classes of infectious and non-infectious diseases.
5. Enhancement of practical skills in synthesis, purification and analysis.

**SEC-II: CH-511: Skills Enhancing Course-II (Environmental)**

**Course Outcome:**

1. Importance and conservation of environment.
2. Importance of biogeochemical cycles
3. Students should know Water resources, Hydrological Cycle and Organic and inorganic pollutants, Water quality parameters.
4. Students should learn the basic concepts about these representation methods.
5. Students should understand the significance of different representation methods for their specific applications.
6. Students should able to identify these representation methods with understanding.
7. Students should able to read these representation methods for basic examples.

**Class:- Third Year B.Sc. Chemistry**

**Semester: VI**

**DSEC-IV: CH-601: Physical Chemistry-II**

**Course Outcome:**

1. Electrochemical cells: Explanation of Daniell cell, Conventions to represent electrochemical cellsThermodynamic conditions of reversible cell, Explanations of reversible and irreversible electrochemical cell with suitable example, EMF of electrochemical cell and its measurement.
2. The Weston standard cell, The primary reference electrode: The standard hydrogen electrode (SHE) with reference to diagram, Construction, representation, working and limitation,
3. Secondary reference electrodes: (a) The calomel electrode, (b) The glass electrode (c) The silver-silver chloride electrode. Understanding of these electrodes with reference to diagram, representation, Construction, working
4. Distinguish between crystalline and amorphous solids / anisotropic and isotropic solids.
5. Explain the term crystallography and laws of crystallography.Weiss and Millers Indices, determination of Miller Indices. Bravais lattices, space groups, seven crystal systems and fourteen Bravais lattices; Cubic lattice and types of cubic lattice, Distance between the planes for 100, 110 and 111 for cubic lattice
6. Methods of Crystal structure analysis: The Laue method and Braggs method: Derivation of Bragg’s equation, Determination of crystal structure of NaCl by Bragg’s method, X ray analysis of NaCl crystal system and Calculation of d and λ for a crystal system.
7. Types and properties of radiations: alpha, beta and gamma. Detection and Measurement of Radioactivity: Cloud chamber, Ionization Chamber, Geiger-Muller Counter, Scintillation Counter, Film Badges
8. Types of radioactive decay: α- Decay, β-Decay and γ-Decay. The Group Displacement Law, Radioactive Disintegration Series
9. Kinetics of Radioactive Decay, Half-life, average life and units of radioactivity, Energy released in nuclear reaction: Einstein’s equation, Mass Defect, Nuclear Binding Energy,
10. Application of radioisotopes as a tracer: Chemical investigation- Esterification, Friedel -Craft reaction and structure determination w.r.t PCl5, Age determination use of tritium and C14 dating.

**DSEC-IV: CH-602 : Physical Chemistry-III**

**Course Outcome:**

1. Meaning of the terms-Solution, electrolytes, nonelectrolytes and colligative properties,
2. Lowering of vapour pressure of solvent in solution,
3. Elevation of B.P. of solvent in solution, Landsberger’s method, freezing point depression, Beckmann’s method Osmosis and Osmotic pressure, Berkeley and Hartley method,
4. Application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight,
5. Relation between Vant Hoff’s factor and degree of dissociation of electrolyte by colligative property
6. Factors affecting on solid state reactions,Rate laws for reactions in solid state, Applying rate laws for solid state reactions
7. Cohesive Energy of ionic crystals based on coulomb’s law and Born Haber Cycle, Correspondence between energy levels in the atom and energy bands in solid
8. Band structure in solids – Na ,Ca and diamond, Conductors and insulators – Its correlation with Extent of energy in energy bands, phenomena of photoconductivity
9. Semiconductors – Role of impurity in transformation of insulator into semiconductor
10. Temperature dependant conductivity semiconductors, Cohesive Energy in metals
11. History of polymers, Classification of polymers, Chemical bonding & Molecular forces in Polymer, Molecular weight of polymers, Practical significance of polymer molecular weights Molecular weight determination.

**DSEC-IV: CH-603 : Physical Chemistry Practical-II**

**Course Outcome:**

1. To determine the PKa value of given monobasic weak acid by potentiometric titration.
2. To determine the formal redox potential of Fe2+/ Fe3+ system potentiometrically.
3. To determine the amount of NaCl in the given solution by potentiometric titration against silver nitrate.
4. To determine the solubility product and solubility of AgClpotentiometrically using chemical cell.
5. Estimate the amount of Cl-, Br- and I- in given unknown halide mixture by titrating it against standard AgNO3 solution (mixture of any two ions).
6. To prepare standard 0.2 M Na2HPO4 and 0.1 M Citric acid solution, hence prepare four different buffer solutions using them. Determine the pH value of these and unknown solution.
7. To determine the composition of Zinc ferrocyanide complex potentiometrically
8. To determine the standard electrode potentials of Cu and Ag electrodes and to determine the EMF of a concentration cell.
9. To determine the degree of hydrolysis of aniline hydrochloride.
10. To determine the dissociation constant of oxalic acid by pH-metric titration with strong base.
11. Determination of Pka of given weak acid by pH metry titration with strong base
12. To determine the acid and base dissociation constant of an amino acid and hence the isoelectric point of an acid.
13. pH metric titration of strong acid against strong base by pH measurement and hence determine the concentration and strength of strong acid.
14. To determine plateau voltage of the given G M counter.
15. To determine the resolving time of GM counter.
16. To determine Emax of beta particle
17. To determine the molecular weight of solute by depression in freezing point method
18. To study the association of Benzoic acid in benzene by Beckmann Method
19. Determine the molecular weight of given electrolyte and non-electrolyte by Landsberger’s method and to study the abnormal molecular weight of electrolyte
20. Determination of SO42- and Cl- by turbidimetric method (turbidimetric titration or
21. calibration curve method)
22. To determine the molecular weight of a given polymer by turbidometry
23. Analysis of crystal structure from X-ray diffraction spectra of any two compounds (Calculation d, lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data)

**DSEC-V: CH-604 : Inorganic Chemistry–II**

**Course Outcome:**

1. To understand M-C bond and to define organometallic compounds
2. To understand the multiple bonding due to CO ligand.
3. To understand the uses of organometallic compounds in the homogenous catalysis. viii. Chemistry of ferrocene
4. Understand the essential properties of homogeneous catalysts-Give the catalytic reactions for Wilkinson’s Catalysis, hydroformylation reaction, Monsanto acetic acid synthesis, Heck reaction.
5. Understand the phenomenon of catalysis, its basic principles and terminologies.
6. Identify the biological role of inorganic ions & compounds.
7. Explain the functions of hemoglobin and myoglobin in O2 transport and storage.
8. Inorganic polymers and their use, synthesis, structural aspects of Inorganic polymers.
9. Understand Preparation of inorganic solids by various methods.
10. Ionic liquids, their preparations, and their significance w.r.t green chemistry.

**DSEC-V: CH-605: Inorganic Chemistry–III**

**Course Outcome:**

1. Student will learn the concept of acid base and their theories.
2. They will also come to know different properties of acids and bases.
3. Identify the C.N. of an ion in ionic solid.
4. Be able to solve simple problems based on Pauling’s univalent radii and crystal radii.
5. Different Zeolite Framework Types and their classification.
6. Various methods of nanoparticle synthesis.
7. To know the impact of toxic chemicals on enzyme.

**DSEC-V: CH-606: Inorganic Chemistry Practical-II**

**Course Outcome:**

1. Carry out quantitative analysis by volumetric method.
2. Prepare and determine percent purity of various inorganic complexes.
3. Understand and Perform Column chromatographic technique.
4. Purification of water using cation/anion exchange resin and analysis by qualitative analysis /conductometry.
5. Flame Photometry.
6. Nanomaterial synthesis. Synthesis of Silver nanoparticles. Synthesis of ZnO nanoparticles.

**DSEC-VI: CH-607: Organic Chemistry-II**

**Course Outcome:**

1. Students will learn the principle of mass spectroscopy, its instrumentation and nature of mass spectrum.
2. Students will understand the principle of UV spectroscopy and the nature of UV spectrum. They will learn types of electronic excitations.
3. Students will be able to calculate maximum wavelength for any conjugated system. And from the value of λ-max they will be able to find out the extent of conjugation in the compound.
4. Students will understand the principle of IR spectroscopy, types of vibrations and the nature of IR spectrum.
5. From the IR spectrum, they will be able to find out IR frequencies of different functional groups. And thus, they will be able to find functional groups present in the compound.
6. Students will understand the principle of NMR spectroscopy and will understand various terms used in NMR spectroscopy. They will learn measurement of chemical shift and coupling constants.
7. Students will be able to interpret the NMR data and they will be able to use it for determination of structure of organic compounds.
8. Students will be able to determine the structure of simple organic compounds on the basis of spectral data such as λ max values, IR frequencies, chemical shift (δ values).
9. Organic Spectroscopic Methods in Structure Determination. (Chapter 1-5) Students will learn the interaction of radiations with matter. They will understand different regions of electromagnetic radiations. They will know different wave parameters.

**DSEC-VI: CH-608: Organic Chemistry-III**

**Course Outcome:**

1. Understand the concept of designing organic synthesis.
2. To understand Principles and applications of asymmetric synthesis
3. Introduction, Different terms used – Disconnection, Synthons, Synthetic equivalence, FGI, TM. One group disconnection, Retrosynthesis and Synthesis of target molecules.
4. To understand Principles Organic Reaction Mechanism and Synthetic Applications.
5. Able to understand Structure and stereochemistry of natural product.

**1)Terpenoids:** Introduction, Isolation, Classification. Citral- structure determination using chemical and spectral methods, Synthesis of Citral by Barbier and Bouveault Synthesis.

**2)Alkaloids:** Introduction, extraction, Purification, Some examples of alkaloids and their natural resources. Ephedrine- structure determination using chemical methods.Synthesis of Ephedrine by Nagai.

**DSEC-VI: CH-609: Organic Chemistry Practical-II**

**Course Outcome:**

1. **Interpretations of IR and PMR Spectra The students will be able to** 
   1. Explain “fingerprint region” of an infrared spectrum can used in the identification of an unknown compound.
   2. Identify the functional group or groups present in a compound.
   3. Identify the broad regions of the infrared spectrum in which occur absorptions caused by N−H, C−H, and O−H, C≡C and C≡N, C=O, C=N, and C=C.
   4. Understand use NMR spectra to determine the structures of compounds.
   5. Interpret integration of NMR spectra
   6. Calculate coupling constants from 1 H NMR spectra.
   7. Interpret elemental analysis technique
2. **Organic Estimations The students will be able to** 
   1. Practical knowledge of handling chemicals.
   2. Achieve the practical skills required to estimations of glucose and glycine.
   3. Achieve the practical skills required to Saponification value of oil.
   4. Determine the molecular weight of given tribasic acids.
3. **Organic Extractions The students will be able to** 
   1. Apply the principles of extraction
   2. Understand the equipment for extraction.
   3. Gain practical hands-on experience of modern Extraction.
   4. Develop basic design of extractor
   5. Describe the extraction separation process.
4. **Column chromatography The students will be able to** 
   1. Defines the basic parameters in chromatography
   2. Explain the processes of a chromatography analysis
   3. Describes the types and materials of column.
   4. Explains the types of mobile phase and elution.
   5. Realize the selection of appropriate mobile phase, column and detector

**SEC-III: CH-610: Skill Enhancing Course-III (Chemistry of Soil and Agrochemicals)**

**Course Outcome:**

1. Understood various components of soil and soil properties and their impact on plant growth.
2. Understood the classification of the soil.
3. Explores the problems and potentials of soil and decide the most appropriate treatment for land use.
4. Understood the Reclamation and management of soil physical and chemical constraints.
5. Useful in making decisions on nutrient dose, choice of fertilizers and method of application etc. practiced in crop production.
6. Got experience on advanced analytical and instrumentation methods in the estimation of soil.
7. Understood various Nutrient management concepts and Nutrient use efficiencies of major and micronutrients and enhancement techniques.
8. Proper understanding of chemistry of pesticides will be inculcated among the students.
9. Imparts knowledge on different pesticides, their nature and, mode of action and their fate in soil so as to monitor their effect on the environment.

**SEC-IV: CH-611: Skill Enhancing Course-IV (Analytical Chemistry-II)**

**Course Outcome:**

1. Define basic terms in solvent extraction, basics of chromatography, HPLC, GC, and AAS and AES. Some important terms are: solvent extraction, aqueous and organic phase, distribution ratio and coefficient, solute remain unextracted, percent extraction, ion association complex, theoretical plate, HETP, retention time, selectivity, resolution, stationary phase, normal and reverse phase, ion exchange, column efficiency, carrier gas, split and spitless injection, packed column, tubular column, atomic absorption and emission spectroscopy, electronic excitation in atoms, nebulization, atomization, reduction of metal ions in flame, absorbance by atoms in flame, flame atomizers, furnace atomizers, interference in AES and FES, HCL, hydride generator, etc.
2. Identify important parameters in analytical processes or estimations. Example: minimum analyte concentration in particular method, reagent concentration for particular analysis, reagent for particular analysis, reaction condition to convert analyte into measurable form, wavelength selection in HPLC with spectrophotometric and fluorometric detector, solvent or carrier gas in HPLC and GC, choice method for the sample preparation in atomic spectroscopic methods, choice of filter and HCL in atomic spectroscopic methods, etc.
3. Explain different principles involved in the analyses using solvent extraction, basics of instrumental chromatography, HPLC, GC, and atomic spectroscopic techniques.
4. Perform quantitative calculations depending upon equations students has studied in the theory. Furthermore, student should able to solve problems on the basis of theory.
5. Discuss / Describe procedure for different types analyses included in the syllabus.
6. Select particular method of analysis if analyte sample is given to him.
7. Differentiate / distinguish / compare among the different analytical terms, process and analytical methods.
8. Demonstrate / explain theoretical principles with help of practical.
9. Design analytical procedure for given sample.
10. Apply whatever theoretical principles he has studied in theory during practical in laboratory.