

## Course Outcomes

### SEMESTER - I

#### **Paper -I: CH 101 (INORGANIC CHEMISTRY)**

- CO1 Discuss the concept of symmetry element, symmetry operation and point groups
- CO2 Classify & recognize the symmetry elements and their operations as required to specify molecular symmetry & possible point groups from symmetry elements & be able to find point group of molecule by systematic procedure .
- CO3 Discuss the d-orbital splitting pattern in different geometries like octahedral, tetrahedral.
- CO4 Calculate magnetic moment & crystal field stabilization energy of metal complexes.
- CO5 Explain high spin and low spin complexes & formation of metal complexes in solution.
- CO6 Discuss HSAB rule chelation, macro cyclic, cryptate effect.
- CO7 Determine stability constant of particular complex through pH metry , polagraphic methods etc
- CO8 Discuss bonding modes of CO,NO, 18-electron rule , different bond lengths & frequencies of CO, NO.
- CO9 Explain different nitrogen complexes & how chemical fixation of dinitrogen takes place.

#### **Paper- II: CH 102 T (Organic Chemistry)**

- CO1 Identify the symmetry elements and symmetry operations in molecules
- CO2 Explain the criteria for chirality and discuss axial, planar and helical chirality
- CO3 Discuss the methods of determination of relative and absolute configuration
- CO4 Discuss Racemization and Resolution techniques
- CO5 Determine the configuration in E and Z isomers
- CO6 Explain the mechanism of electrophilic addition to carbon carbon double bond and elimination reactions
- CO7 Discuss the various methods of determination of reaction mechanism
- CO8 Discuss the conformations in saturated and unsaturated acyclic compounds and the factors affecting the stability and reactivity of conformations
- CO9 Explain the general methods in structure determination of terpenoids and alkaloids
- CO10 Explain the nomenclature, synthesis and reactivity of heterocyclic compounds

### **PAPER – III: CH 103 ( PHYSICAL CHEMISTRY)**

- CO1: Write down the concept of entropy. Describe 3<sup>rd</sup> law of thermodynamics and evaluation of absolute entropy from heat capacity data.
- CO2 Write down Gibb's equations for non equilibrium system and conditions for material and phase equilibrium . Derive Clausius- Clapeyron equation and equation for equilibrium constant of ideal gas reactions.
- CO3 Give the concept of partial molar properties and chemical potential. Derive Gibb's Duhem equation.
- CO4 Explain chemical cell and concentration cell( with and without transfer). Derive the expression of liquid junction potential.
- CO5 Write down the applications of EMF measurement. Define electrode polarization , decomposition potential and concentration over potential.
- CO6 Write down Debye – Huckel theory of electrolytic solution and Bjerrume theory of ion association. Derive Debye – Huckel – Onsagar equation.
- CO7 Write down the concept of black body radiation. Describe operators, commutation of operators eigen function, eigen value and well behaved function.
- CO8 Write down the postulates of quantum mechanics. Derive the expression of wave function and energy of particles moving in one and three dimensional box.
- CO9 Write down collision theory and transition state theory of reaction rate. Describe Lindemann's theory of unimolecular reaction.
- CO10 Write down linear free energy relationship – Hammett and Taft equation. Describe primary and secondary steric effect, reactivity – selectivity principle and Hammond postulate.

### **PAPER-IV: CH 104 (ANALYTICAL TECHNIQUES AND SPECTROSCOPY- I)**

- CO1 Discuss the techniques of chromatography and quantification of HPLC and GC methods
- CO2 Explain the principle of <sup>1</sup>H NMR spectroscopy, instrumentation, chemical shifts, factors affecting them, signal integration, Spin-spin coupling, Coupling constants and factors affecting them and applications of <sup>1</sup>H NMR spectroscopy.
- CO3 Explain the principles of Rotational spectroscopy and calculate bond lengths and atomic mass from rotational spectra of diatomic molecules, Isotope effect on rotational spectra

- CO4 Explain the principles of Vibrational spectroscopy, an harmonic nature of vibrations , Stereo chemical effects on the absorption pattern and Isotope effect on vibrational spectra
- CO5 Discuss the Classical and Quantum theories of Raman effect.
- CO6 Explain the principles of Ultraviolet/Visible Spectroscopy, Woodward-Fieser rules and their applications

## SEMESTER - II

### **PAPER-I: CH 201 INORGANIC CHEMISTRY**

- CO1 Explain different types of substitution reaction like SN1,SN2 etc ,and difference between acid hydrolysis & base hydrolysis
- CO2 Discuss how ligand substitution reaction takes place in octahedral and square- planar, trans effect and trans influence and how trans effect is applicable in synthesis of different metal complexes.
- CO3 Explain about different types of electron transfer reaction (one electron transfer reaction and direct electron transfer reaction ) and factors affecting them.
- CO4 Discuss terms, state & microstate & Orgel diagram and calculate microstate & terms of different configurations.
- CO5 Explain j-j coupling ,L-S coupling scheme, hole- formalism, Hund's rules & Racah parameters.
- CO6 Discuss classification of clusters and different structural patterns of metal clusters .
- CO7 Explain how low nuclearity clusters differ from high nuclearity clusters and capping rules in metal clusters
- CO8 Explain how metal ions take part in biological system and their concentration effect and physiological effect on biological system.
- CO9 Discuss primary ,secondary and tertiary structure and oxygenation equilibria of hemoglobin,myoglobin
- CO10 Discuss photosynthesis and photosystem1 &photosystem2 ,vitamin B6 model system and their reaction.

### **PAPER-II: CH 202 T (ORGANIC CHEMISTRY)**

- CO1 Discuss nucleophilic aromatic substitution reaction and benzyne mechanisms.
- CO2 Explain Neighbouring group participation in aliphatic Electrophilic substitution.
- CO3 Discuss Ambident nucleophiles , non-classical carbocation & SET mechanism.

- CO4 Explain pericyclic reactions like Electrocyclic reactions, Cycloaddition reactions and Sigmatropic reactions.
- CO5 Discuss Aromatic Transition States (ATS)/Perturbation Molecular Orbitals (PMO) approach- Concept of Huckel –Möbius aromatic and antiaromatic transition states and Solve problems based on ATS approach
- CO6 Explain the Frontier Molecular Orbital (HOMO-LUMO) approach, WoodwardHofmann selection rules for all the pericyclic reactions and solve problems based on FMO approach.
- CO7 Discuss the Photochemistry of  $\pi\text{-}\pi^*$  transitions with particular reference to cis- trans isomerisation and Di-Pi methane rearrangement
- CO8 Discuss the Photochemistry of ( $n\text{-}\pi^*$ ) transitions with particular reference to Norrish type I , Norrish II type reactions , Paterno Bucchi reactions & photochemistry of nitrites.
- CO9 Explain the generation, detection, structure, stability and reactions of carbocations, carbanions, carbenes, nitrenes and free radicals

### **PAPER- III: CH 203 (PHYSICAL CHEMISTRY)**

- CO1 Write down the thermodynamic properties of ideal, non ideal and ideally dilute solution. Give the concept of fugacity and fugacity coefficient.
- CO2 Define lowering of vapour pressure, elevation of B.P. and depression of F.P. derive the relation between molality and elevation of B.P. or depression of F.P.
- CO3 Give the concept of distribution and probability and derive Boltzmann distribution law.
- CO4 Describe quantum yield and the method of it's determination. Derive quantum yield of fluorescence and phosphorescence.
- CO5 Describe types of photochemical reactions and photo sensitization reaction.
- CO6 Explain E- type delayed fluorescence and principle of flash photolysis.
- CO7 Describe Schrodinger's wave equation for hydrogen atom and separate it in to three component equations.
- CO8 Describe variation principle and variation method. Write down the application of variation principle to H atom He, H<sub>2</sub><sup>+</sup> and H<sub>2</sub> molecule.
- CO9 Explain the band theory of metal, insulator and semiconductor. Define p-n junction.
- CO10 Classify super conductors and write down the BCS theory of superconductivity.

## **PAPER-IV ANALYTICAL TECHNIQUES AND SPECTROSCOPY**

- CO1 Explain the instrumentation, types of currents and applications of DC polarography in qualitative and quantitative analysis.
- CO2 Give a brief account of (i) A.C.polarography (ii) Square-wave polarography (iii) Pulse polarography (iv) Differential pulse polarography and discuss their advantages over conventional d.c.polarography.
- CO3 Discuss the principle, instrumentation, types and applications of amperometric titrations and Cyclic Voltammetry.
- CO4 Give a brief account of the different types of thermo analytical methods.
- CO5 Discuss the principles and applications of thermogravimetry, differential thermal analysis and Differential scanning calorimetry.
- CO6 Discuss the principles, chemical shifts, coupling constants, and application of  $^1\text{H}$ ,  $^{19}\text{F}$ ,  $^{31}\text{P}$  and solid state NMR spectroscopy .
- CO7 Discuss the Principles and instrumentation of different types of mass spectrometer
- CO8 Outline Salient features of fragmentation pattern of organic compounds
- CO9 Discuss the Principle and Instrumentation of Photoelectron Spectroscopy, Interpretation of Vibrational spectral data for ionized ( $\text{M}^+$ ) species.
- CO10 Discuss principle, instrumentation of Electron Spin Resonance spectroscopy and its applications.

## SEMESTER - III

### **PAPER-1: CH (OC) 301T: SYNTHETIC REAGENTS, ADVANCED NMR, CONFORMATIONAL ANALYSIS AND ORD**

- CO1 Discuss the protection of various functional groups like alcohols, 1,2-diols, amines, carbonyls, carboxylic acids to get the desired result.
- CO2 Explain methods of preparation and applications of organometallic reagents like organo lithium, organo copper, organosilicon, organoborane reagents in organic synthesis.
- CO3 Discuss the reagents used in reactions like Carbonyl methylenation, carbene insertion and C-H activation.
- CO4 Discuss different types of reagents used for oxidation and reduction reactions.
- CO5 Discuss types of CMR spectra and methods of recording spectra.
- CO6 Explain the factors affecting chemical shift and CMR and applications of CMR
- CO7 Discuss the Conformational analysis of cyclic molecules.
- CO8 Discuss optical rotatory dispersion and how it is used for the determination of structure of chiral molecules.
- CO9 Write down the factors governing the reactivity of axial and equatorial substituents in cyclohexanes.

### **PAPER- II: CH (OC) 302T: MODERN ORGANIC SYNTHESIS**

- CO1. Explain Prostereoisomerism, prochiral nomenclature, conditions of stereo selectivity and analytical methods with brief introduction of stereo selective reactions.
- CO2. Discuss the types of asymmetric synthesis controlled by chiral auxiliary, chiral catalyst, chiral substrate and chiral reagent with examples.
- CO3. Discuss the terminology, criteria for selecting target, synthesis involving chemo and regio selectivity, reversal of polarity and cyclisation involved in retro synthesis analysis.
- CO4. Explain order of events, one bond and two bond C-C and C-X disconnection and control in carbonyl condensation with examples.
- CO5. Define strategic bond and discuss guidelines for disconnection with greatest simplification using symmetry and corresponding to known reliable reactions, Retro synthesis of Retronecene, Longifoline.
- CO6. Discuss new synthetic reactions involving c-c coupling reaction, c=c formation reaction, multi component reactions.

- CO7. Discuss Ring formation reactions, ring opening & closing, metathesis, 1,3 dipolar cycloaddition reaction .
- CO8 . Explain the new techniques and concepts used in synthesis of peptides ,oligosaccharides and oligodeoxynucleotides
- CO9. Apply Baldwin rules for cyclisation of various compounds
- CO10. Discuss Chiron approach in organic synthesis & determine the absolute configuration by Mosher's method.

### **PAPER-III: CH (OC) 303T (CB1): BIOORGANIC CHEMISTRY**

- CO1 Determine configuration and ring size of sugars and conformational analysis of monosaccharide.
- CO2 Explain structure, synthesis, ring size determination, and conformational structure of different types of carbohydrates.
- CO3 Discuss structure and synthesis of nucleosides and nucleotides.
- CO4 Explain primary, secondary and tertiary structure of DNA and RNA and their different types.
- CO5 Discuss Replication, transcription, translation, genetic code and DNA fingerprinting.
- CO6 Discuss the classification and properties of lipids, Chemical synthesis and biosynthesis of phospholipids and glycolipids.
- CO7 Explain the Classification, nomenclature and bonding of peptides and biological importance and classification of different structure of proteins.
- CO8 Discuss classification, mechanism of action and factors affecting enzyme catalysis, Enzyme inhibition and immobilized enzymes.
- CO9 Explain Classification, structure, and biological functions of different type of Coenzymes.
- CO10 Discuss the Classification, structure, synthesis and biological importance of different vitamins.

#### **PAPER-IV: CH (OC) 304T (CB3): GREEN CHEMISTRY AND ORGANIC MATERIALS**

- CO1 Design a green synthesis using principles of prevention of waste/by-products/toxic products, atom economy.
- CO2 Discuss the designing of safer chemicals, selection of appropriate auxiliaries, use of catalytic reagents, prevention of chemical accidents and development of analytical techniques.
- CO3 Explain Microwave assisted reactions in organic solvents and solvent free reactions, ultra sound assisted organic synthesis.
- CO4 Discuss Organic synthesis in aqueous phase and ionic liquids.
- CO5 Explain Phase transfer catalyst and biocatalyst in organic synthesis.
- CO6 Introduction to organic nano materials, approach & nanomanipulation.
- CO7 Discuss the applications of carbon nano: nano car & molecular machines.
- CO8 Discuss the Synthetic modifications of natural products as Opto electronic molecules by supramolecular chemistry, lock & key model of various structures such as cryptands.
- CO9 Explain Enantioselective molecular recognition of cyclodextrins, crown ethers and chiral receptors.

#### **SEMESTER - IV**

#### **PAPER - I: CH (OC) 401T: DRUG DESIGN AND DRUG DISCOVERY**

- CO1 Explain the stages involved in drug discovery
- CO2 Discuss the various Lead modification strategies and also how these can be used in drug development process with examples
- CO3 Discuss the Structure-Activity Relationship studies in sulfa drugs, benzodiazepines, and taxol analogs
- CO4 Identify the various physicochemical properties of drug molecules and the relationship between these and biological activity
- CO5 Explain the various tools used in QSAR studies and how these are applied in the design of drugs using examples
- CO6 Outline the principles of Computer aided drug design



- CO7 Discuss the Combinatorial approach in the process of drug discovery and plan and design combinatorial synthesis

### **PAPER-II: CH (OC) 402T: DRUG SYNTHESIS AND MECHANISM OF ACTION**

- CO1 Explain the basic concepts of mechanism of drug action
- CO2 Outline the discovery and mechanism of action of the drugs acting on metabolic processes or antifolates
- CO3 Describe the structure of bacterial cell wall and discuss the synthesis and mechanism of action of penicillins and cephalosporins on the bacterial cell wall
- CO4 Discuss the synthesis and mode of action of drugs acting on specific enzymes
- CO5 Discuss the classification and mechanism of action of drugs acting on genetic material
- CO6 Give an overview of the nervous system, describe the structure of neuron and nerve transmission
- CO7 Discuss about the classification, synthesis and mode of action of drugs acting on the various receptors
- CO8 Give an overview of chiral drugs, explain the role of chirality on biological activity and discuss the synthesis and pharmacological activity of some important chiral drugs

### **PAPER-III: CH (OC)-403T (CB1): ADVANCED HETEROCYCLIC CHEMISTRY**

- CO1 Discuss the different types of strains, interactions and conformational aspects of nonaromatic heterocycles.
- CO2 Outline the synthesis, reactivity and importance of ring systems like Azirines, Aziridines, Oxiranes, Thiiranes, Diazirenes, Diaziridines, Oxaziridines, Azetidines, Oxetanes and thietanes
- CO3 Explain the criteria for aromaticity and Huckel's  $4n+2$  electron rule for benzene and non benzenoid aromatic compounds.
- CO4 Outline the synthesis, reactivity, aromatic character and importance of five and six membered heterocyclics with two hetero atoms
- CO5 Discuss the synthesis, reactivity, aromatic character and importance of heterocyclics with more than two hetero atoms.

- CO6 Discuss the synthesis and importance of purines and pteridines.
- CO7 Outline the synthesis of Caffeine, theobromine and theophylline.
- CO8 Discuss the synthesis, structure, stability, rearrangements and reactivity of Azepines, Oxepines and Thiopines, Diazepines, benzo fused heterocycles .
- CO9 Outline the synthesis of selenophenes, Tellerophenes, Phospholes and Boroles.

#### **PAPER-IV: CH (OC) 404(CB3) T: ADVANCED NATURAL PRODUCTS**

- CO1 Determine the biosynthetic mechanism, discuss biosynthetic precursors and feeding experiments of secondary metabolites.
- CO2 Explain Acetate -malonate pathway, Shikimic acid pathway and Mevalonic acid pathway of secondary metabolites with examples.
- CO3 Determine structure and stereochemistry of Morphine, Reserpine, Abietic acid, Cholesterol and Rotenone.
- CO4 Determine Structure of natural products through Spectroscopic techniques.
- CO5 Study of solved problems of Geraniol, Menthol, Apparicine, Stricticine, Buxaquamarine,  $\alpha$ -Picoline and  $\beta$ -Methyl furan.
- CO6 Discuss the total stereo selective synthesis including Nicalou's synthesis of Dynemycin A, and Taxol, Corey's Synthesis of Prostaglandins and Pacoriflorin.
- CO7 Discuss Sharpless synthesis of L-Hexoses, Danishefsky synthesis of Indolizomycin.
- CO8 Discuss Takasago synthesis of Menthol, Hoffmann-LaRoche synthesis of Biotin.