आज दिनांक 09.02..2012 को विश्वविद्यालय परिसर में निम्न विषय की पाठ्यक्रम समिति की एक आवश्यक बैठक हुई, जिसमें निम्न प्राध्यापकगण उपस्थित हुए :–

Date :- 09.02.2012 Subject :- Chemistry Committee Place :- Committee Hall

1. Dr. K. A. Gupta
2. Dr. C. P. Singh
3. Dr. S. K. Pandey
4. Dr. S. K. Agarwal

# B.Sc. - FIRST YEAR

# CHEMISTRY

**There shall be three written papers and a practical examination as follows:**

| | | Max. Marks |
|---|---|---|
| Paper – I | Inorganic Chemistry | 50 |
| Paper – II | Organic Chemistry | 50 |
| Paper – III | Physical Chemistry | 50 |
| | **TOTAL** | **150** |
| | PRACTICAL | 50 |
| | **GRAND TOTAL** | **200** |

Candidate will be required to pass in Theory and Practical Separately.

## B.Sc. – I Chemistry (Paper-I)

**Inorganic Chemistry :**

### Unit – I

**I. Atomic Structure:**

Idea of de-Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of $\Psi$ and $\Psi^2$, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d, orbitals, Aufbau and Pauli exclusion principles, Hund's multiplicity rule, Electronic configurations of the elements, effective nuclear charge.

**II. Periodic Properties:**

Atomic and ionic radii, ionization energy, electron affinity and electronegativity-definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

### Unit – II

**III. Chemical Bonding:**

(A) Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shall electron pair repulsion (VSEPR) theory to $NH_3$, $H_3O^+$, $SF_4$, $ClF_3$, $ICl^-_2$ and $H_2O$, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electro-negativity difference.

(B) Ionic Solids – Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, salvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule, Metallic bond-free electron, valence bond and band theories.

(C) Weak Interactions – Hydrogen bonding, Vander Waals forces.

### Unit – III

**IV. s-Block Elements:**

Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

**V. Chemistry of Noble Gasses:**

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

### Unit – IV

**VI. p-Block Elements:**

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of group 13-16, hydrides of boron-diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides.

## B.Sc. – I Chemistry (Paper-II)

**Organic Chemistry :**

### Unit – I

**I. Structure and Bonding:**

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonances, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

**II. Mechanism of Organic Reactions:**

Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations.

Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species.

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

**III. Alkanes and Cycloalkanes:**

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atom in alkanes, Isomerism in alkanes, sources methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Cycloalkanes – Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strain less rings. The case of cyclopropane ring, banana bonds.

### Unit – II

**IV. Stereochemistry of Organic Compounds:**

Concept of isomerism, Types of isomerism;

Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, disasteromers, threo and erythro diastereomers, meso compounds, resolution of enantionmer, inversion, retention and recemization.

Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometric isomerism – determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse

formulae, Fischer and flying wedge formulae, Difference between configuration and conformation.

## Unit – III

**V. Alkenes, Cycloalkenes, Dienes and Alkynes:**

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halids, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes – mechanism involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes, Industrial applications of ethylene and propene.

Methods of formation, conformation and chemical reactions of cycloalkenes;

Nomenclature and classification of dienes : isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, chemical reaction – 1, 2 and 1, 4 additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes, Methods of formation,

Chemical reactions of alkynes, acidity of alkynes, Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

## Unit – IV

**VI. Arenes and Aromaticity:**

Nomenclature of benzene derivatives, The aryl group, Aromatic nucleus and side chain, Structure of benzene; molecular formula and kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity: The Huckle rule, aromatic ions.

Aromatic electrophilic substitution – general pattern of the mechanism, role of $\sigma$ and $\pi$ complexes, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction;

Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene;

**VII. Alkyl and Aryl Halides:**

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, $S_N2$ and $S_N1$ reactions with energy profile diagrams;

Polyhalogen compounds : Chloroform, carbon tetrachloride;

Methods of formation of aryl halides, nuclear and side chain reactions;

The addition-elimination and the elimination-addition mechanisms of nucleophilc aromatic substitution reactions;

Relative reactivities of alkyl halides vs allyl, vingl and aryl halides, Synthesis and uses of DDT and BHC.

## B.Sc. – I Chemistry (Paper-III)

**Physical Chemistry :**

### Unit – I

**I. Mathematical Concepts and Computers:**

***(A) Mathematical Concepts:***

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like $K_x$, $e^x$, $X^n$, sin x, log x; maxima and minima, partial differentiation and reciprocity relations, Integration of some useful/relevant functions; permutations and combinations, Factorials, Probability.

***(B) Computers:***

General introduction to computers, different components of a computer, hardware and software, input-output devices; binary numbers and arithmetic's; introduction to computer languages, programming, operating systems.

### Unit – II

**II. Gaseous States:**

Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state;

*Critical Phenomena* : PV isotherms of real gases, continuity of states, the isotherms of vander Waals equation, relationship between critical constants and vander Waals constants, the law of corresponding states, reduced equation of state.

*Molecular velocities* : Root mean square, average and most probable velocities, Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter, Liquification of gases (based on Joule – Thomson effect).

**III. Liquid State:**

Intermolecular forces, structure of liquids (a qualitative description).

Structural differences between solids, liquids and gases;

Liquid crystals: Difference between liquid crystal, solid and liquid, Classification, structure of nematic and cholestric phases, Thermography and seven segment cells.

### Unit – III

**IV. Solid States:**

Definition of space lattice, unit cell;

Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices (iii) Law of symmetry, Symmetry elements in crystals.

X-ray diffraction by crystals, Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

**V. Colloidal States:**

Definition of colloids, classification of colloids;

Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.

Liquids in liquids (emulsions) : types of emulsions, preparation, Emulsifier,

Liquids in solids (gels) : classification, preparation and properties, inhibition, general application of colloids, colloidal electrolytes.

## Unit – IV

**VI. Chemical Kinetics and Catalysis:**

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light catalyst, concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life, Determination of the order of reaction – differential method, method of integration, method of half life period and isolation method.

Radioactive decay as a first order phenomenon;

Experimental methods of chemical kinetics: conductometric, potentiometric, optical methods, polarimetry and spectrophotometer.

Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis), Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis, characteristics of catalysed reactions, classification of catalysis homogeneous and heterogeneous catalysis, enzyme catalysis, miscellanceous examples.

**B.Sc. – I (PRACTICAL)** 180 hrs (6 Hrs/week)

**Inorganic Chemistry :**

Semi micro Analysis – cation analysis, separation and identification of ions from Grops I, II, III, IV, V and VI, Anion analysis.

**Organic Chemistry :**

Laboratory techniques;

***Calibration of Thermometer*:**

80-82$^0$ (Naphthalene), 113.5-114$^0$ (Acetanilide)

132.5-133$^0$ (Urea), 100$^0$ (Distilled Water)

***Determination of melting point*:**

Naphthalene 80-82$^0$, Benzoic acid 121.5-122$^0$

Urea 132.5-133$^0$, Succinic acid 184.5-185$^0$

Cinnamic acid 132.5-133$^0$, Sallicylic acid 157.5-158$^0$

Acetanilide 113.5-114$^0$, m-Dinitrobenzene 90$^0$

p-Dichlorobenzene 52$^0$, Aspirin 135$^0$

***Determination of boiling point*:**

Ethanol 78$^0$, Cyclohexane 81.4$^0$, Toluene 110.6$^0$, Benzene 80$^0$

***Mixed melting point determination*:**

Urea-Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)

***Distillation*:**

Simple distillation of ethanol-water mixture using water condenser,

Distillation of nitrobenzene and aniline using air condenser

***Crystallization*:**

Concept of induction of crystallization,

Phthalic acid from hot water (using fluted filter paper and steamless funnel)

Acetanilide from boiling water

Naphthalene from ethanol

Benzoic acid from water

***Decolorisation and crystallization using charcoal*:**

Decolorsation of brown sugar (sucrose) with animal charcoal using gravity filtration.

Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixes with 0.3 g of Congo Red using 1g decolorizing carbon) from ethanol.

***Sublimation (Siple and Vacuum)*:**

Camphor, Naphtalene, Phthalic acid and succinic acid.

***Qualitative Analysis*:**

Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.

**Physical Chemistry :**

***Chemical Kinetics:***

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at rooms temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To compare the strengths of HCl and $H_2SO_4$ by studying the kinetics of hydrolysis of ethyl acetate.
4. To study kinetically the reaction rate of decomposition of iodide by $H_2O_4$.

***Distribution Law:***

1. To study the distribution of iodine between water and $CCl_4$.
2. To study the distribution of benzoic acid between benzene and water.

***Colloids:***

1. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi- and trivalent anions.

***Viscosity, Surface Tension:***

1. To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.
2. To determine the viscosity of amyl alcohol in water at different concentration and calculate the excess viscosity of these solutions.
3. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

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# B.Sc. - SECOND YEAR

# CHEMISTRY

**There shall be three written papers and a practical examination as follows :**

| | | Max. Marks |
|---|---|---|
| Paper – I | Inorganic Chemistry | 50 |
| Paper – II | Organic Chemistry | 50 |
| Paper – III | Physical Chemistry | 50 |
| | **TOTAL** | **150** |
| | PRACTICAL | 50 |
| | **GRAND TOTAL** | **200** |

Candidate will be required to pass in Theory and Practical Separately.

## B.Sc. – II Chemistry (Paper-I)

**Inorganic Chemistry :**

### Unit – I

**I. Chemistry of Elements of First Transition Series**

Characteristic properties of d-block elements.

Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry.

**II. Chemistry of Elements of Second and Third Transition Series**

General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

### Unit – II

**III. Coordination Compounds**

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

### Unit – III

**IV. Chemistry of Lanthanide Elements**

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses.

**V. Chemistry of Actinides**

Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.

### Unit – IV

**VI. Oxidation and Reduction**

Electrode potential, electrochemical series and its applications, Principles involved in the extraction of the elements.

**VII. Acids and Bases**

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concept of acids and bases.

**VIII. Non-aqueous Solvents**

Physical properties of a solvent, types of solvents and their general characteristics, Reactions in non-aqueous solvents with reference to liquid $NH_3$ and Liquid $SO_2$.

## B.Sc. – II Chemistry (Paper-II)

**Organic Chemistry :**

### Unit – I

**I. Electromagnetic Spectrum Absorption Spectra**

Ultraviolet (UV) absorption spectroscopy – absorption laws (Beer-Lambert law); molar absroptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. U.V. spectra of conjugated enes and enones.

Infrared (I.R.) absorption spectroscopy – molecular vibrations, Hooke's law, selection rules, intensity and position of I.R. bands, measurement of I.R. spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of I.R. spectra of simple organic compounds.

### Unit – II

**II. Alcohols**

Classification and nomenclature,

Monohydric alcohols – nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols.

Dihydric alcohols - – nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and $HIO_4$] and pinacol-pinacolone rearrangement.

Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol.

**III. Phenols :**

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman syntheis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

### Unit – III

**IV. Ethers and Epoxides**

Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method.

Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

**V. Aldehydes and Ketones:**

Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid

chlorides, synthesis of aldehydes and ketones uses 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties.

Mechanism of nucleophillic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction.

Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones An introduction to α, β unsaturated aldehydes and Ketones.

**Unit – IV**

**VI. Carboxylic Acids:**

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, Preparation of carboxylic acids, Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction, Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids, Mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids, Hydroxy acids: malic, trartaric and citric acids.

Methods of formation and chemical reactions of unsaturated monocarboxylic acids.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

**VII. Carboxylic Acid Derivatives**

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anyhydrides.

Relative stability of acyl derivatives, Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reaction. Mechanisms of esterificaton and hydrolysis (acidic and basic)

**VIII. Organic Compounds of Nitrogen:**

Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nuclephilc substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid.

Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrities), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substituton in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

## B.Sc. – II Chemistry (Paper-III)

**Physical Chemistry :**

### Unit – I

### (Thermodynamics & Chemical Equilibrium)

**I. Thermodynamics – I**

***Definitions of thermodynamic terms :***

System, surroundings etc. Types of systems, intensive and extensive properties, State and path functions and their differentials, Thermodynamic processes, concept of heat and work.

***First Law of Thermodynamics :***

Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure and their relationship, Joule's law – Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isotheral and adiabatic conditions for reversible process.

***Thermochemistry :***

Standard state, standard enthalpy of formation – Hess's Law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy, Kirchhoff's equation

### Unit – II

**II. Chemical Equilibrium**

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, Le Chatelier's principle

Reaction isotherm and reaction isochore – Clapeyron-clausius equation and its applications.

**III. Thermodynamics – II**

***Second Law of Thermodynamics :***

Need for the law, different statements of the law, Cornot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature.

***Concept of entropy:***

Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, clausius inequality, entropy as a criteria of spontaneity and equilibrium, Equilibrium change in ideal gases and mixing of gases.

***Gibbs and Helmholtz functions:***

Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.

***Third Law of Thermodynamics:***

Nernst heat theorem, statement and concept of residual entropy.
Nernst distribution law – thermodynamic derivation, applications.

**Unit – III**

**(Electrochemistry – I & Solutions)**

**IV. Electrochemistry – I:**

***Electrical transport:-*** Conduction in metals and in electrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation of molar equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only), Transport number, definition and determination by Hittorf's method and moving boundary method.

Applications of conductivity measurements: determination of degree of dissociation, determination of $K_a$ of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

**V. Solutions:**

Liquid – Liquid mixtures- Ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes – HCl-$H_2O$ and ethanol – water systems.

Partially miscible liquids- Phenol – water, trimethylamine – water, nicotine-water systems, Immiscible liquids, steam distillation.

**Unit – IV**

**(Electrochemistry – II & Phase Equilibrium)**

**VI. Electrochemistry – II:**

Types of reversible electrodes – gas-metal ion, metal-ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, strandard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells–reversible and irreversible cells, conventional representation of electrochemical cells;

EMF of a cell and its measurements, Computation of cell EMF, Calculation of thermodynamic quantities of cell reactions (OG, OH and K)

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and $pK_a$, determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods;

Buffers – Mechanism of buffer action, Henderson-Hazel equation, application of buffer solution, Hydrolysis of salts

## VII. Phase Equilibrium:

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system-water, '$CO_2$' and 'S' systems

Phase equilibria of two component system – solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead.

Solid solutions – compound formation with congruent melting point (Mg-Zn) and incongruent melting point, ($FeCl_3$-$H_2O$) and ($CuSO_4$-$H_2O$) system

**B.Sc. – II (Practical)** 180 hrs. (6 hrs/week)

**Inorganic Chemistry :**

Calibration of fractional weights, pipettes and burettes, Preparation of standards solutions, Dilution – 0.1 M to 0.001 M solutions.

***Quantitative Analysis:***

*Volumetric Analysis* :

(a) Determination of acetic acid in commercial vinegar using NaOH.

(b) Determination of alkali content – antacid tablet using HCl.

(c) Estimation of calcium content in chalk as calcium oxalate by permanganometry.

(d) Estimation of hardness of water by EDTA.

(e) Estimation of ferrous and ferric by dichromate method.

(f) Estimation of copper using thiosulphate.

*Gravimetric Analysis* :

Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime).

**Organic Chemistry :**

***Laboratory Techniques***

**A.** Thin Layer Chromatography

Determination of R*f* values and identification of organic compounds:

(a) Separation of green leaf pigments (spinach leaves may be used).

(b) Preparation of separation of 2, 4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40:60)

(c) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

**B.** Paper Chromatography: Ascending and Circular

Determination of R*f* values and identification of organic compounds:

(a) Separation of a mixture of phenylalanine and glycine, Alanine and aspartic acid, Leucine and glutamic acid, Spray reagent – ninhydrin.

(b) Separation of a mixture of D, L – alanine, glycine, and L-Leucine using n-butanol:acetic acid:water (4:1:5), Spray reagent – ninhydrin.

(c) Separation of monosaccharide – a mixture of D-galactose and D-fructose using n-butanol:acetone:water (4:5:1), spray reagent – aniline hydrogen phthalate.

***Qualitative Analysis:***

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

**Physical Chemistry :**

***Transition Temperature***

1. Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $MnCl_2.4H_2O/SrBr_2.2H_2O$).

***Phase Equilibrium***

2. To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.
3. To construct the phase diagram of two component (e.g. diphenylamine – benzophenone) system by cooling curve method.

***Thermochemistry***

1. To determine the solubility of benzoic acid at different temperatures and to determine OH of the dissolution process.
2. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the entrhalpy of ionization of the weak acid/weak base.
3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.

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# B.Sc. - THIRD YEAR

# CHEMISTRY

**There shall be three written papers and a practical examination as follows:**

| | | Max. Marks |
|---|---|---|
| Paper – I | Inorganic Chemistry | 75 |
| Paper – II | Organic Chemistry | 75 |
| Paper – III | Physical Chemistry | 75 |
| | **TOTAL** | **225** |
| | PRACTICAL | 75 |
| | **GRAND TOTAL** | **300** |

Candidate will be required to pass in Theory and Practical Separately.

## B.Sc. – III Chemistry (Paper-I)

**Inorganic Chemistry :**

### Unit – I

**I. Metal-ligand bonding in Transition Metal Complexes**

Limitations of valance bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, factors affecting the crystal-field parameters.

**II. Thermodynamic and Kinetic Aspects of Metal Complexes**

A brief outline of thermodynamics stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes.

### Unit – II

**III. Magnetic Properties of Transition Metal Complexes**

Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of $\mu_s$ and $\mu_{eff}$ values, orbital contribution to magnetic moments, application of magnetic moment data for 3d- metal complexes.

**IV. Electronic spectra of Transition Metal Complexes**

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for $d^1$ and $d^9$ states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

### Unit – III

**V. Organometallic Chemistry**

Definition, nomenclature and classification of organometallic compounds,

Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Snl.

Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear carbonyls.

**VI. Silicones and Phosphazenes**

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

### Unit – IV

**VII. Hard and Soft Acids and Bases (HSAB)**

Classification of acids and bases as hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness, Symbiosis, theoretical basis of hardness and softness, electro negativity and hardness and softness.

**VIII. Bioinorganic Chemistry**

Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin, Biological role of alkali and alkaline earth metal ions with special reference to $Ca^{2+}$.

## B.Sc. – III Chemistry (Paper-II)

**Organic Chemistry :**

### Unit – I

**I. Spectroscopy**

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance ($^1$H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of $^1$H NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structures elucidation of simple organic compounds using UV, IR and $^1$H NMR spectroscopic, techniques.

### Unit – II

**II. Organometallic Compounds**

Organomagnesium compounds : the Grignard reagents, formation, structure and chemical reactions.

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

**III. Organosulphur Compounds**

Nomenclature, structural formation, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and Sulphaguanidine.

**IV. Hetrocyclic Compounds**

Introduction : Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives, Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six membered heterocycles, Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis, Mechanism of electrophilc substitution reactions of indole, quinoline and isoquinoline.

### Unit – III

**V. Carbohydrates**

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides, Erythro and threo diastereomers, Conversion of glucose intro mannose, Formation of glcosides, ethers and esters, Determination of ring size of monosaccharides, Cyclic structure of D(+)-glucose, Mechanism of mutarotation.

Structures of ribose and deoxyribose,

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

**VI. Amino Acids, Peptides, Proteins and Nucleic Acids:**

Classification, structure and stereochemistry of amino acids, Acid-base behaviour isoelectric point and electrophoresis, Preparation and reactions of α-amino acids, Structure and nomenclature of peptides and proteins, Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, classical peptide synthesis, solid-phase peptide synthesis, Structures of peptides and proteins, Levels of protein structure, Protein denaturation/ renaturation;

Nucleic acids : Introduction, constituents of nucleic acids, Ribonucleosides and ribonucleotides, The double helical structure of DNA.

## Unit – IV

**VII. Fats, Oils and Detergents**

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils, Saponification value, iodine value, acid value, Soaps, synthetic detergents, alkyl and aryl sulphonates.

**VIII. Synthetic Polymers**

Addition or chain-growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers,

Condensation or step growth-polymerization, Polyesters, plyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes, Natural and synthetic rubbers, Elementary idea of organic conducting polymers.

**IX. Synthetic Dyes**

Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.

**X. Organic Synthesis via Enolates**

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate.

Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines.

## B.Sc. – III Chemistry (Paper-III)

**Physical Chemistry :**

### Unit – I

### (Introductory Quantum Mechanics, Spectroscopy, Physical Properties and Molecular Structure)

**I. Introductory Quantum Mechanics:**

Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (without derivation) their solution of overall solution and its defects, Compton effect, de-Broglie's hypothesis, the Heisenberg's uncertainty principle, Hamiltonian Operator.

**II. Spectroscopy:**

Introduction : electromagnetic radiation, regions of the spectrum, basic features of different spectrophotometers, statement of the born-oppenheimer approximation, degrees of freedom.

**III. Physical Properties and Molecular Structure:**

Optical activity, polarization – (Clausius – Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetic, Magnetic susceptibility, its measurements and its importance.

### Unit – II

**IV. Elementary Quantum Mechanics:**

Schrödinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

Molecular orbital theory, basic ideas – criteria for forming M.O. from A.O., construction of M.O's by LCAO – $H_2^+$ ion, calculation of energy levels from wave functions, physical picture of bonding and anti-bonding wave functions, concept of $\sigma$, $\sigma^*$, $\pi$, $\pi^*$ orbitals and their characteristics, Hybrid orbitals – sp, $sp^3$, $sp^2$, calculation of coefficients of A.O's used in sp and $sp^2$ hybrid orbitals and interpretation of geometry.

Introduction to valence bond model of $H_2$, comparison of M.O. and V.B. models.

### Unit – III

**V. Rotational Spectrum:**

***Diatomic Molecules:*** Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

***Vibrational Spectrum :***

***Infrared Spectrum:*** Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

***Raman Spectrum :*** Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

***Electronic Spectrum :*** Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.

Qualitative description of $\sigma$, $\pi$ and $\eta$ M.O. their energy levels and the respective transition.

## Unit – IV

## (Photochemistry, Solutions, Dilute Solutions and Colligative Properties)

**VI. Photochemistry :**

Interaction of radiation with matter, difference between thermal and photochemical processes, Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non- radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions – energy transfer processes (simple examples), Kinetics of Photo chemical reaction.

**Solutions, Dilute Solutions and Colligative Properties:**

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, Elevation of boiling point and depression of freezing, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.

**B.Sc. – III (PRACTICAL)** 180 hrs. (12 hrs./week)

**Inorganic Chemistry :**

***Synthesis and Analysis:***

(a) Preparation of sodium trioxalator ferrate (III), $Na_3[Fe(C_2O_4)_3]$ and determination of its composition by permagonometry.
(b) Preparation of Ni-DMG complex, $[Ni(DMG)_2]$
(c) Preparation of copper tetraammine complex. $[(Cu(NH_3)_4]SO_4$.
(d) Preparation of *cis*-and *trans*-bisoxalato diaqua chromate (III) ion.

**Instrumentation:**

***Colorimetry***

(a) Job's method (b) Mole-ratio method
Adulteration – Food stuffs.
Effluent analysis, water analysis

***Solvent Extraction***

Separation and estimation of Mg(II) and Fe(II)

***Ion Exchange Method***

Separation and estimation of Mg(II) and Zn(II)

**Organic Chemistry :**

***Laboratory Techniques:***

***Steam Distillation***

Naphtalene from its suspension in water
Clove oil from cloves
Separation of *o*-and *p*-nitrophenols

***Column Chromatography***

Separation of fluorescein and methylene blue
Separation of leaf pigments from spinach leaves
Resolution of racemic mixture of (±) mandelic acid

***Qualitative Analysis***

Analysis of an organic mixture containing two solid components using water, $NaHCO_3$,
NaOH for separation and preparation of suitable derivatives

***Synthesis of Organic Compounds***

(a) Acetylation of salicylic acid, aniline, glucose and hydroquinone, Benzoylation of aniline and phenol
(b) Aliphatic electrophlic substitution
Preparation of iodoform from ethanol and acetone
(c) Aromatic electrophilic substitution
Nitration
Preparation of m-dinitrobenzene

Preparation of p-nitroacetanilide

Halogenation

Preparation of p-bromoacetanilide Preparation of 2, 4, 6-tribromophenol

(d) Diazotization/coupling
Preparation of methyl orange and methyl red

(e) Oxidation
Preparation of benzoic acid from toluence

(f) Reduction
Preparation of aniline from nitrobenzene
Preparation of m-nitroaniline from m-dinitrobenzene

***Stereochemical Study of Organic Compounds via Models***

R and S configuration of optical isomers E, Z configuration of geometrical isomers
Coformational analysis of cyclohexanes and substituted cyclohexanes

**Physical Chemistry :**

***Electrochemistry:***

1. To determine the strength of the given acid conductometrically using standard alkali solution.
2. to determine the solubility and solubility of a sparingly soluble electrolyte conducometrically.
3. to study the saponification of ethyl acetate condutometrically.
4. To determine the ionization constant of a weak acid condutometrically.
5. To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of $Fe^{++}/Fe^{+++}$ system on the hydrogen scale.

***Refractrometry, Polarimetry:***

1. To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.
2. To determine the specific rotation of a given optically active compound.
3. To determine stoichiometry and stability constant of complexes.

***Molecular Weight Determination:***

1. Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.
2. Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy.

***Colorimetry:***

1. To verify Beer – Lambert Law for $KMnO_4/K_2Cr_2O_7$ and determining the concentration of the given solution of the substance from absorption measurement.

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# M.SC. I

## Paper – I ( Physical Chemistry – I )[ Cy- 501]

1. **Atomic Structure and Bonding:**

Atomic orbital, electronic configuration of atoms( L-S coupling) and periodic properties of elements, ionic radii, ionization potential, electron affinity, electronegativity, concept of hybridization, homo and hetero nuclear diatomic molecules

2. **Quantum Chemistry:**

Wave particle duality, Schrodinger wave equation, postulates of quantum mechanics, eigen values and eigen function, discussion of solution, Schrodinger wave equation to some model system viz. particle in a box, the harmonic oscillator, the rigid rotor, application of variation method and perturbation theory to the hydrogen atom.

3. **Thermodynamics:**

Brief resume of concept of laws of thermodynamics, entropy and entropy changes, free energy and work function, Gibbs's Helmholtz equation, Maxwell's thermodynamic relations, partial molar quantities, chemical potential, Gibbs's duhem equation, concept of fugacity and its determination

4. **Electrochemistry:**

Electrochemical cells, cell reactions, reference electrodes, indicator electrodes, glass electrode, ion selective electrodes, measurement of EMF, concentration cells with & without liquid junction potential, use of EMF in determination of activity & pH, Potentiometric titrations, Polarography, Ilkovic equation, half wave potential and its significance. Amperometric titrations, Electrokinetic phenomenon, electrode- electrolyte interface, electrical double layer, structure of double layer (Helmholtz , Goy –Chapman , Stern and Graham Devanathan model) Over potential, exchange current density. Derivation of Butler-Volmer equation, Tafel plot.

5. **Conductimetry:**

Conductance, equivalent & molar conductance, measurement of conductance, Ostwald dilution law, Deby-Huckel limiting law, relaxation& electrophorectic effects, Onsager equation , ionic

& hydrogen chlorine) fluoremetry, chemical laser & practical laser, application c laser in chemistry, a brief discussion of photo electron spectroscopy.

**4. Gaseous State:**

Kinetic gas equation , deviation from ideal behavior, real gases, Vander wall's equation, virial equation of state, distirbution of molecular speed.

**5. Liquid & Solid State:**

Physical properties of liquids ( surface tension ,viscosity & refractive index) structure of liquid, lattice and unit cell, identification of lattice planes, X ray elecrtron, neutron diffraction.

**6. Gas Liquid Chromatography and High Performance Liquid Chromatograph**

Basic principles of GLC, HPLC and their applications

***References:***


1. *Physical chemistry,P.W.Atkins,ELBS*
2. *Introduction to quantum chemistry, A.K. Chadda, Tata Mc graw HIll*
3. *Advance physical chemistry, Puri, Sharma & Pathania*
4. *Advance physical chemistry, K.L. Kapoor, Mac millan India.*
5. *Chemical kinectics ,K.J.Laidlar, Mc graw Hill*
6. *Modernelectro chemistry ,Bockris & Reddy, Planum.*
7. *Basic concepts of analytical Chemistry: S. M. Khopkar, Wiley Eastern Ltd.*


## Paper –III( Inorganic Chemistry- I)[CY- 503]

**1. Chemistry Of Non-Transition Elements :**

General discussion on the properties of non-transition elements; preparation, properties and structure of boric acid, borates, boron nitrides, borohydrides (diborane), carboranes, oxides and oxyacids of nitrogen, phosphorous, sulphur and chlorine; interhalogen compounds, polyhalide ions, pseudohalogens, fluorocarbons and basic of noble gases, preparation, structure and bonding of noble gas compounds

**2. Chemistry of Transition Elements:**

General characteristics, variable oxidation states, complex formation,colour, magnetic and catalytic properties. Comparative study of 4d and 5d transition elements with 3d analogues with respect to their ionic radii, oxidation states and magnetic properties.

3. **General Chemistry Of " f " Block Elements**:

Lanthanides and actinides; separation, oxidation states, magnetic and spectral properties, lanthanide contraction.

4. **Coordination Chemistry**:

Double salts and Coordination compounds, Werner's theory of Coordination compounds, IUPAC nomenclature, Effective atomic number (EAN), Isomerism in coordination compounds, Valence bond theory and its limitations, crystal field theory. Crystal field splitting of d- orbitals in octahedral, tetrahedral and square planar complexes, Calculation of stabilization energies (CFSE) for $d^1$ to $d^9$ in weak and strong fields, octahedral complexes, spectrochemical series. Electronic spectra of 3d transition metal complexes, types of electronic transitions, selection rules for electronic transitions spectroscopic ground states for $d^1$ to $d^{10}$ systems. Magnetism; Dia-, Para-, Ferro-, and ant ferromagnetism, quenching of orbital angular moment, spin orbital coupling, inorganic reactions mechanism; substitution reactions, trans effect and electron transfer reactions

5. **Nuclear chemistry**:

Nuclear reactions; Mass defect and Binding energy, Nuclear fission and fusion. Nuclear reactions; Radioisotopes and their applications.

***References:***


1. *Inorganic Chemistry: Cotton & Wilkinson*
2. *Advanced inorganic chemistry: J. D. Lee*
3. *Selected topics in Inorganic Chemistry: W.U. Malik, G. D. Tuli and R. D. Madan*
4. *Advanced Inorganic Chemistry vol I & II: Gurdeep Raj*
5. *Advanced Inorganic Chgemistry: Cotton & Wilkinson, Wiley*


## Paper-IV( Inorganic Chemistry- II)[CY- 504]

1. **Bio- inorganic chemistry**:

Essential and trace elements in biological processes, Metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with reference to $Ca^{2+}$.

2. **Non-aqueous solvents**:

Reactions in liquid $NH_3$, HF, $SO_2$ and $H_2SO_4$. Failure of solvent system concepts, coordination model of non-aqueous solvents. Some highly acidic media, fluorosulphuric acid and super acids.

**3. Pollution and its control:**

Air pollution, types of air pollutants; control of air and water pollution, radioactive pollution. Depletion of $O_3$ layer, effects of oxides of nitrogen, fluorochlorocarbons and their effect on $O_3$ layer, Greenhouse effect, Acid rain.

**4. Solid state chemistry**:

Classification of solids, seven crystal systems, elements of symmetry in crystals, space lattice and unit cell, classification of solids on the basis of bond types; ionic solid, metallic solids, covalent solids, and molecular solids. The close packing of spheres, hcp, ccp, and bccp. Coordinatio0n number, radius ratio rules, calculation of some limiting radius ratio values. Structures of NaCl, ZnS, CsCl, $CaF_2$, $CdI_2$, and rutile. Imperfection in crystals, stoichiometric and nonstoichiometric defects, impurity defects, semiconductors. Elementary study of liquid crystals

**5. Acids and bases**:

Bronsted and Lewis theories of acids and bases. Hard and soft acids and bases, HSAB principle, relative strengths of acids and bases and the effect of substituents and solvents on their strength

***References:***


1. *Inorganic Chemistry:* ***Cotton & Wilkinson***
2. *Advanced inorganic chemistry:* ***J. D. Lee***
3. *Selected topics in Inorganic Chemistry:* ***W.U. Malik, G. D. Tuli and R. D. Madan***
4. *Advanced Inorganic Chemistry vol I & II:* ***Gurdeep Raj***
5. *Advanced Inorganic Chgemistry:* ***Cotton & Wilkinson, Wiley***
6. *Environmental Chemistry and Pollution control: S. S. Dara*
7. *Environmental Chemistry: C. baird, W. H. Freeman & Co.Newyark*
8. *Chemical pollution: A Global Overview: UNEP*
9. *Environmental Chemistry: A. K. Day, New Age International Ltd.*
10. *Environmental Chemistry: B. K. Sharma& H. Kaur, Goel Publishing House*
11. *Pollution Science: Pepper, Gebra& Brusseam, Academic Press*


## Paper-V( Organic Chemistry- I)[ CY- 505]

**1. Nature of bonding in organic molecules:**

Delocalized bonding, aromaticity, Huckel rule, Homoaromatic and anti aromatic systems, steric hinderance, hydrogen bonding, Charge transfer complexes

2. **Substitution and elimination reactions:**
$S_{N2}$, $S_{N1}$ and $S_{Ni}$ Change, Solvent effect, Competition between $S_{N1}$ and $S_{N2}$ mechanism, elimination reactions, $E_1$, $E_2$ and $E_1CB$ mechanism, Hofmann elimination, cyclic elimination, Competition between elimination and substitution reactions, aromatic nucleophilic substitution, rearrangements involving nucleophilic aromatic substitution, Bombarger rearrangement, Bucherer reaction, Smiles rearrangement and Sommlett Hauser rearrangement

3. **Reactive intermediates:**
Classical and non classical carbocation, Carbanions, radicals, radical anions, radical cations, carbenes, arynes and nitrenes, general methods of generetion, detection and reactivity of these intermediates, singlet oxygen, its generation and reaction with organic compounds.

4. **Named reactions:**
Claisen condensation, Hoffmann- bromide degradation, Beckmann's rearrangement, Pinacole- Pinacolone rearrangement, Cannizaro and crossed Cannizaro reaction, Favorskii rearrangement, Arndt- Eistert synthesis, Baeyer-Villiger reaction, Perkin , stobbe, Dieckmann condensation, Schmidt, Lossen, Curtius, Fries Rearrangement, Reimer-Tiemann reaction, Reformatsky and Grignard reaction, Diels – alder reaction, Claisen rearrangement, Friedal Crafts reaction, Wittig reaction, and Robinson annulation, routine functional group transformations and interconversion of simple functionalities, hydroboration. Oppenaur oxidation, Clemmenson, wolff- Kishner, Meerwein-Pondorf- Varley and Birch reductions

5. **Stereochemistry:**
Conformational analysis of acyclic systems and cycloalkanes(6-8 membered), Optical isomerism, Chirality, Chiral synthesis, Geometrical isomerism in acyclic, cyclic, condensed and bridged systems, methods of interconversion E to Z and Vice- versa.

***References:***


1. *Reactions and reagents in organic Synthesis: O. P. Agarwal, Goel Publishing House*
2. *Stereochemistry of carbon compounds: Eliel, TMH Publishing Co. Ltd.*
3. *Synthetic Organic Chemistry: O. P. Agarwal, Goel Publishing*
4. *Mechanism in Organic Chemistry: Peter Syke*
5. *Advanced Organic Chemistry: March, Wiley*
6. *Synthetic reactions: House*

## Paper-VI( Organic Chemistry- II)[ CY-506]

1. **Alkaloids:**
General methods of isolation, structure of coniine. Nicotine, piperine and papaverine

2. **Carbohydrates:**

Introduction, Classification and chemistry of monosaccharides, disaccharides, polysaccharides etc.

3. **Heterocyclic compounds:**
Introduction, nomenclature, Synthesis, reactions and structure of 5 and 6 membered heterocyclics having one heteroatom e.g. Pyrrole, Furan, Thiophene, Pyridine,quinoline , isoquinoline, indoles and acridines

4. **Purines:**
Structure and sunthesis of Uric acid, adenine guanine, caffeine, threobromine, theophylline and xanthine

5. **Terpenoids:**
Isolation , general method of structure determination with particular emphasis on (a). Acyclic monoterpenoids: Myrcene, Ocimene and Citral (b).Monocyclic monoterpenoids: α-Terpeneol, Carvone (c). Bicyclic monoterpenoids: α- Pinene and Camphor

6. **Dyes:**
Introduction, Colour and constitution, nomenclature, classification, nitrodyes, nitrosodyes, azodyes, diarylmethanedyes, triarylmethane dyes, xanthen dyes, acridine dyes, quinoline dyes, azine dyes, vat dyes, anthraquinonoid dyes, Phthalocyanines, fluoroscent brightening agents

***References:***


1. *Organic Chemistry: R.T. Morrison and R.N. Boyd P. H. Ltd.*
2. *Topics in Organic Chemistry:Fieser & Fieser, Reinhold*
3. *Organic Chemistry Vol I& II: I. L. Finar, Elbs with Longmann Pub.*

## Paper IV( Chemistry of natural Products)[ CY-604]

1. **Proteins**: Amino acids, Classification of amino acids, Synthesis of amino acids. properties of amino acids, Classification of Proteins, peptide linkage, primary structure of Proteins, Synthesis of peptides, Oxytocin, Insulins, Vasopressin, Spatial arrangement of Protein molecules, Nucleoproteins, Nucleic acids, structure of nucleosides& nucleotides, Structure of DNA

2. **Alkaloids:** Definition, general methods for determining structure , classification of alkaloids, Pyrrolidine group- Hygrine,Cuscohygrine Pyridine & Piperidine group- Ricinine, Pyrrolidine-Pyridine group- Atropine, Quinoline group- Quinine, Isoquinoline group-Berberine, Indole group- Reserpine

3. **Terpenoids:** Introduction , General methods for determining structure, diterpenoids- Phytol, Sesqueterpenoids-Farnesol, zingiberine, cadinene, Triterpenoid- Squalene polyterpenoids: Rubber

4. **Vitamins:** Introduction, Classification and Chemistry of Vitamin A, $B_1$, $B_2$, $B_6$, Folic acid, Vitamin C, D, E and K

5. Steroids: Introduction, classification and Chemistry of Cholesterol, Oesterone, Testosterone, Androgens& Progesterone

6. Antibiotics: Introduction, Structure of Major Antibiotics eg Penicillin,Cephalosporins, Tetracyclines, Chloramphenicol, Streptomycin and Quinolone antibiotics (Ciprofloxacin and Norfloxacin )

7. Lipids: Fats, Oils and Waxes, Fattyacids,Characterizationand their Physico-Chemical properties, Introduction to Phosolipids- Lecithins, Cephalins, Sphingomyleins& glycolipids

# Paper-V Medicinal Chemistry-I(CY-605)

1. **Basic Principles of medicinal Chemistry:** Introduction, Characteristic of drugs, therapeutic index, Mechanism of chemotherapeutic action, metabolic antagonism with examples
2. **Principles of Drug Design:** Introduction, relationship between Molecular structure & biological activity,, physiological properties of Drugs,viz acid base properties, relative acid strength(pKa), Degree of ionization, water solubility, of drug, Hydrogen bond, Stereochemistry, & Drug action, , Optical isomerism,& biological activity, geometrical isomerism & biological activity, Bicisosterism and isosteric modifications in drug design,( classical & non classical isosteric modifications,, general introduction of QSAR.

   Synthetic procedures for selected drugs, mode of action, Structure Activity Relationship( SAR) including Physicochemical and steric aspects etc.

3. **CNS stimulants:** Nikethiamide, Ethamivan, Benigride, Doxiprarn,Biphenyl ethylamine derivatives,eg. Amphetamine, Fenfluramine hydrochloride, Chlorophentermine hydrochloride, Phenmetrazinehydrochloride, Caffeine, Theophylline,
4. **Antihelmintics:** Phenolic compounds viz 4.-N Hexyl Resorcinol, Bithional, Piperazine derivatives, Heterazan, Antepar, Thiabenidazole viz Mintezole
5. **AntiSpasmodic& antiulcer:** Dicycloamine, Piperidolate(Dactil), Propantheline, Mepiperphenidol, $H_2$ Receptor antagonist eg Cimetidine & Ranitidine
6. **Adrenergic Harmones& Drugs:** Adrenoreceptor agonist and SAR of Adrenomimetics, Main clinical use of adrenoreceptor- Bronchodialatorsviz Salbutamol,Isoprenatine, Ephedrine, Adrenaline
7. **AntiHistaminics:** $H_1$ receptor antagonists, Mepyramine, Thiopylamine, Zolamine, Carbinoxamine, Doxylamine, Propylamine derivatives vizPheniramine maleate. Chloropheniramine maleate, unsaturated derivatives eg. Triprolidine7 Pyrobutamine
8. **Autocoids:** Ephedrine, Epinephrine, Isoprenaline, Methoxamine hydrochloride, Metaraminol, Oxymetazoline, phenylpropylamine hydrochloride,
9. **Nonsteroidal AntiInflammatory Drugs:** Hetero aryl acetic acid analogues viz Indomethacin,Tolwetin, Aryl acetic acid analogues eg Ibuprofen, Naphthalene acetic acid analogues viz Naproxen, Anthranilic acis analogues eg. Mefenamic acid& Flufenamic acid, Pyrazoles eg. Phenyl butazones& Oxyphenbutazones, Salicylic acid analogues eg. Aspirin,p- amino phenolAnalogues eg. Paracetamol
10. **Diuretic agent:** Thiazide, Chlorothiazide, Benzthiazide, Cyclothiazide, Hydro chlorthiazide, Methylclothiazide, TrichlorMethiazide, Bendroflumothiazide

## Paper VI( Medicinal Chemistry-II) [ CY- 606]

Synthetic procedures for selected drugs, mode of action, Structure Activity Relationship( SAR) including Physicochemical and steric aspects etc.

1. **General Anaesthetics and Local Anaesthetics**: General Anaesthetics: Ether, Ethyl Chloride, Cyclopropane, Vinyl Ether, Fluoroxene, Halothene, Nitrous Oxide, Chloroform, Thiopental Sodium, Thiomylal Sodium, Hydroxy dione Sodium Succinate, Fentanyl Citrate, Tribromo Ethanol, Paraldehyde, Ketamine Hydrochloride Local Anaesthetics: Aminoethyl Benzoate, Butamben, Orthocaine, Procaine Hydrochloride, Tetracaine Hydrochloride,, Butacaine Sulphate, Cyclomethylcaine Sulphate, Lignocaine Hydrochloride, Prilocaine Hydrochloride, Mepivacaine Hydrochloride, Bupivacaine Hydrochloride, Pyrrocaine hydrochloride, D-Eucaine, Benzamin Hydrochloride, Euphthalamine, Dibucaine Hydrochloride, Isomethaquin Hydrochloride
2. **Opoid Analgesics**: Morphine Sulphate, Codeine, Dihydro Codeine Phpsphate, Levorphenol Tartarate, Dextro methorphine hydrobromide, Metazocine, Cycloazocine, Pentazocine, Fentanyl Citrate, Pethidine Hydrochloride, Methadone Hydrochloride, Tramadol Hydrochloride, Naloxone Hydrochloride,
3. **Antitussives:** Benzonatate, Levopropoxyphene Napsylate
4. **Anticonvulsants:** Phenobarbital, Phenytoin, Ethotoin, Methytoin, Trimethadione, Paramethadione, Phensuximide, Mesusuxinimide, Ethosuximide, Pyrimidone, Phrnacemide, Carbamazepine
5. **Antiperkinsonism drugs:** Biperiden Hydrochloride, Cycrimine Hydrochloride, Trihexyl Phenidyl Hydrochlodide, Procyclidine Hydrochloride, Benzotropine Napsylate, Ethopropazine Hydrochloride, L-Dopa
6. **Cardiovascular drugs:** Hydralzine Hydrochloride, Methyl Dopa, Captopril, Diazoxide, Quinidine Sulfate, Diisopyramide, Lorcainide, Procainamide, Propanol, BretyliumTosylate
7. **Antineoplastic agents:** Mechlorethamine Hydrochloride, Mephalan, Chlorambucil, Busulfan, Triethyenemelamine,Carmustine, Lomustine, Methotrexate, Mercaptopurine, Cytrabine, Vinblastineand Vincristine(only activity), Pipobroman, Testolactone
8. **Thyroid and antithyroid drugs:** Thyroxin, ThioImidazoles, Methylthiouracil& Propyl thiouracil
9. **Insulin and oral Hypoglycemic agents:**Insulin, Chlorpropamide, Tol butamide, Phenformin, Metformin
10. **Diagnostic agents:** Iopanoic Acid, Indigotin disulphonate Sodium, Evan blue, Fluorescein Sodium

## M.Sc.II

| Paper | | Subject | Subject code | Lecture Hrs(per week) |
|---|---|---|---|---|
| I | : | Applied Organic Chemistry | CY- 601 | 03 |
| II | : | Advanced Organic Chemistry | CY- 602 | 03 |
| III | : | Organic Spectroscopy | CY- 603 | 03 |
| IV | : | Chemistry of Natural Products | CY- 604 | 03 |
| V | : | Medicinal Chemistry – I | CY-605 | 03 |
| VI | : | Medicinal Chemistry –II | CY- 606 | 03 |
| VII | : | Practcals | CY- 607P | 18 |

## Paper-I( Applied Organic Chemistry)[CY- 601]

### 1. Heterocyclic Chemistry:

Polyheterocyclic ring systems viz

(i) Azoles, Oxazoles, isoxazoles,Pyrazoles, Imidazole and Thiazole
(ii) Pyrimidines and Pteridines
(iii) Condesed ring systems: Acridine, Quinazoline, Phenothiazine
(iv) Purines: Uric acid, Adenine, Guanine, Caffeine etc.

### 2. Organic Reagents:

Preparation, properties and uses of following reagents:
Diisopropylamide, Diazomethane, Lithium Aluminium hydride, Ozone, Osmium tetroxide, Potassiumpermanganate, Leadtetracatate, Raney nickel, Sodiumborohydride, N- bromosuccinimide, Dicyclohexylcarbodiimide, Lithium tritert-butyloxyaluminium hydride

### 3. Polymers:

Illustration of principles with reference to polymeric materials, Polymer structure and physical properties,Thermoplastic and thermosetting resins, fibres, rubbers (natural and synthetic), Engineering polymers, liquid crystalline polymers, conducting polymers, structure relationship with respect to electrical and optical properties.

### 4. Organometallics

Principles, preparation, properties and applications of following in organic Synthesis with mechanistic details;
Li, Mg, Hg,Cd and Zn compounds

### 5. Pyrones

Anthocyanines, Flavones, Isoflavones, Flavanones, Depsides, Coumarins, Quinones

### 6. Polyaromatic hydrocarbons:

Introduction, Isolated systems or polyphenyl compounds( diphenyl, diphenic acid, Diphenylmethane, triphenylmethane,triphenylcarbinol, triphenylmethyl chloride and hexaphenylethane), condensed ring systems(Naphthalene, Anthracene,

Phenanthrene), carcinogenic hydrocarbons.

***References:***


1. *Reactions and reagents in organic Synthesis: O. P. Agarwal, Goel Publishing House*
2. *Stereochemistry of carbon compounds: Eliel, TMH Publishing Co. Ltd.*
3. *Synthetic Organic Chemistry: O. P. Agarwal, Goel Publishing*
4. *Mechanism in Organic Chemistry: Peter Syke*
5. *Advanced Organic Chemistry: March, Wiley*
6. *Synthetic reactions: House*
7. *Organic Chemistry: R.T. Morrison and R.N. Boyd P. H. Ltd.*
8. *Topics in Organic Chemistry:Fieser & Fieser, Reinhold*
9. *Organic Chemistry Vol I& II: I. L. Finar, Elbs with Longmann Pub.*
10. *Polymerscience:V.R.Gowariker, N.V. Vishwanathan& J. sreedhar, New Age Internation pvt Ltd.*
11. *Text book of Polymer Science: Billimayer F.W., John wiley & sons*
12. *Plastic materials: BrydsMJ.A., Butterworth- Heinmann*


## Paper-II( Advance Organic Chemistry )[ CY- 602]

1. **Photo chemistry:**

   Interaction of electromagnetic radiation with matter, Types of excitations, fate of excited molecules, quantum yield, transfer of excitation energy. tochemistry of alkenes, carbonyl compounds, aromatic compounds and miscellaneous reactions

2. **Pericyclic reactions:**

   Selection rules, Mechanism and stereo chemistry of electro cyclic, cycloaddition and sigmatropic shifts.

3. **Stereochemistry:**

   Conformational analysis, Stereochemistry of biphenyls, allenes and spiranes, Stereoselective and stereospecific reactions, Neighbouring group participation taking example of carboxylic, phenyl, halogen, hydroxy, alkoxy, acetoxy group etc.

4. **Rections involving carbanions:**

   Benzil- Benzilic acid rearrangement, Favorskii rearrangement, Hoffmann rearrangement, Curtius rearrangement, Schmidt rearrangement, Michael addition, Mannich reaction, aromatic nucleophilic substitution, Knoevenagel reaction.

5. **Oxidation:**

Different oxidative processes, Hydrocarbons, alkenes, aromatic rings, saturated C-H groups( activated and unactivated), alcohols, diols, aldehydes, ketones, ketals and carboxylic acids, amines, hydrazines and sulphides

***References:***


1. *Reactions and reagents in organic Synthesis: O. P. Agarwal, Goel Publishing House*
2. *Stereochemistry of carbon compounds: Eliel, TMH Publishing Co. Ltd.*
3. *Synthetic Organic Chemistry: O. P. Agarwal, Goel Publishing*
4. *Mechanism in Organic Chemistry: Peter Syke*
5. *Advanced Organic Chemistry: March, Wiley*
6. *Synthetic reactions: House*
7. *Organic Chemistry: R.T. Morrison and R.N. Boyd P. H. Ltd.*
8. *Topics in Organic Chemistry:Fieser & Fieser, Reinhold*
9. *Organic Chemistry Vol I& II: I. L. Finar, Elbs with Longmann Pub.*
10. *Photochemistry: Gurdeep Raj, Goel Publication*
11. *Photochemistry of heterocycles: N. J. Turro*
12. *Fundamentals of PhotoChemistry: K.K.Rohtagi- Mukherjee, Wiley Eastern Ltd.*


## Paper- III( Organic Spectroscopy )[ CY- 603]

### 1. Optical Rotatory Dispersion(ORD) and Circular Dichroism(CD):

Definition, deduction of absolute configuration, octant rule for ketones

### 2. Ultraviolet and Visible Spectroscopy:

Various electronic transitions(185-800 nm), Beer- Lambert law, effect of solvant on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser- Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds, Steric effect in biphenyls

### 3. Infrared spectroscopy:

Instrumentation and sample handling, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds( ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds), effect of hydrogen bonding and solvant effect

on vibrational frequencies, overtones, combination bands and fermi resonance, FT IR, IR of gaseous, solids and polymeric materials

**4. Nuclear Magnetic Resonance Spectroscopy**

General Introduction and definition, Chemical shift, spin- spin interaction, shielding mechanism. Mechanism of measurement, Chemical shift values and correlation for protons bonded to carbon( aliphatic, olefinic, aldehydic and aromatic) and other nuclei( alcohols , phenols, enols, carboxylic acids, amines, amidesand mercapto), chemical exchange, effect, of deuteration, complex spin-spin interaction between two, three, four and five nuclei(first order spectra), virtual coupling, stereochemistry, hindered rotation, Karplus curve- variation of coupling constant with dihedral angle, Simplification of complex spectra, nuclear magnetic double resonance, contact shift reagents, solvant effects, fourier transform technique

**5. Carbon –13 spectroscopy:**

General considerations, chemical shift( aliphatic, olefinic, alkyne,aromatic, heteroaromatic and carbonyl carbon), coupling constants

**6. Mass spectroscopy:**

Introduction, ion production- EI, CI, and FAB, factors affecting fragmentation, ion analysis, ion abundance, Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement, Nitrogen rule, High resolution mass spectroscopy, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination

***References:***


1. *Spectroscopy: B. K. Sharma, Goel Publishing House*
2. *Molecular Spectroscopy: Sindhu, TMH Pub Co. Ltd.*
3. *Instrumental methods of chemical analysis*
4. *Organic spectroscopy: Kemp, Macmillan publication*
5. *Spectroscopy of organic compounds: P. S. Kalsi, New Age International Ltd.*
6. *Spectroscopic Identification of organic compounds: Silverstein, Bassler& Morrill, J. Wiley*
7. *Spectroscopic methods in organic Chemistry: William & Flemming, TMH Co. Ltd.*
8. *Organic Spectroscopy: Dyer*

mobility, conductometric titrations , high frequency conductometric titrations.

**6. Phase Equilibrium:**

Thermodynamic criterion of phase equilibria, chemical potential vs. temperature curves for different phases of a pure substance. Nernest distribution law. Gibb's phase rule, application of phase rule to three component system, Etirenfest classification of phase transition

***References:***


1. *Physical chemistry, P.W.Atkins,ELBS*
2. *Introduction to quantum chemistry, A.K. Chadda, Tata Mc Graw Hill*
3. *Advance physical chemistry, Puri, Sharma & Pathania*
4. *Advance physical chemistry, K.L. Kapoor ,Mac Millan ,India.*
5. *Chemical kinetics, K.J.Laidlar, Mc Graw Hill*
6. *Modernelectro chemistry,Bockris &Reddy, Planum.*


## Paper-II( Physical Chemistry- II)[ CY502]

**1. Chemical kinetics:**

Collision and activated complex theory, comparison of results with Eyring and Arrhenius equation, kinetics of III order reaction, kinetics of parallel, opposing, consecutive and chain reactions, kinetics of unimolecular reaction, Lindman theory, Hinshelwood theory, RRKM theory, primary & secondary salt effect , kinetics of fast reactions( flow, relaxation, flash photolysis & NMR method) kinetics of homogeneous catalytic reaction, kinetics of enzyme catalysed reactions.

**2. Surface chemistry:**

Adsorption of gases at solid surface, physical and chemical adsorption,freundlich, langmuir , temkin isotherm, BET equation and its derivation , use of Adsorption in determination of surface area, heat of adsorption , Gibbs Adsorption isotherm and its derivation, surface composition, Augur electron spectro scopy, Adsorption & catalysis (Langmuir-hinshelwood & Eley-Rideal mechanism

**3. Photochemistry:**

Characteristic of electronic transition , fate of electronically excited state, fluorescence & phosphorescence, jablonski diagram , laws of photochemistry, quantum yield & its determination, photosensitization. & quenching, photochemical rate law, kinetics of photochemical reaction (hydrogen –bromine

## M.Sc. I

| Paper | | Subject | Subject code | Lecture Hrs. ( per week) |
|---|---|---|---|---|
| I | : | Physical Chemistry-I | CY- 501 | 03 |
| II | : | Physical Chemistry-II | CY- 502 | 03 |
| III | : | Inorganic Chemistry-I | CY- 503 | 03 |
| IV | : | Inorganic Chemistry-II | CY- 504 | 03 |
| V | : | Organic Chemistry-I | CY- 505 | 03 |
| VI | : | Organic Chemistry-II | CY- 506 | 03 |
| VII | : | Practicals | CY- 507P | 18 |

# Course Outcomes (Chemistry)

B.Sc. (Chemistry) CO1 Study of atomic structure, periodic properties of elements, structure and chemical bonding, Study of s and p block elements.

B.Sc. (Chemistry) CO2 Structure and bonding of organic molecules, Mechanism of organic reactions, type studies of aromatic and aliphatic compounds.

B.Sc. (Chemistry) CO3 Mathematical concepts and fundamentals of computer, physical properties of matters (Gas, liquids, solids, and colloids), Chemical kinetics and catalysis.

B.Sc. (Chemistry) CO4 Study of d and f block elements, complex compounds, Acids, bases and non aq. Solvents.

B.Sc. (Chemistry) CO5 UV and IR spectroscopy, Types studies of alcohols, phenols, esters, carboxylic acids and nitrogen containing compounds.

B.Sc. (Chemistry) CO6 Thermodynamics, thermo chemistry, chemical equilibrium, Electro chemistry and phase equilibrium.

B.Sc. (Chemistry) CO7 Metal Ligand bonding in complexes, Stability of complexes, reaction mechanism, electronic spectra of complex, bioinorganic chemistry, Hard and Soft Acids and Bases and organ metallic chemistry.

B.Sc. (Chemistry) CO8 Nuclear magnetic resonance (NMR) spectroscopy, Organo metallic Compounds, Organosulphur Compounds, Heterocyclic Compounds. Carbohydrates, Amino Acids, Peptides, Proteins and Nucleic Acids, Fats, Oils and Detergents, Synthetic Polymers, Synthetic Dyes, Organic Synthesis via Enolates.

B.Sc. (Chemistry) CO9 Introductory Quantum Mechanics, Spectroscopy, Physical Properties and Molecular Structure, Elementary Quantum Mechanics, Rotational Spectrum, Vibrational Spectrum Raman Spectrum, Electronic Spectrum, Photochemistry, Solutions, Dilute Solutions and Colligative Properties.

M.Sc. (Chemistry) CO1 Study of Stereochemistry and Bonding in Main Group Compounds, Metal Ligand Equlilbria in Solution, Reaction Mechanism of Transition Metal Complexes, Metal Ligand Bonding, Electronic Spectra and Magnetic Properties of Transition Metal Complexe, Metal π – Complexes, Metal Clusters, Isopoly and Heteropoly Acids and Salts.

M.Sc. (Chemistry) CO2 Nature of Bonding in Organic Molecules, Stereochemistry, Reaction Mechanism Structure and Reactivity, Aliphatic Nucleophilic Substitution, Aliphatic Electrophilic Substitution, Aromatic Electrophilic Substitution, Aromatic Nucleophilic Substitution, Free Radical Reactions, Addition to Carbon Carbon Multiple Bonds, Addition to Carbon Hetero Multiple Bonds, Elimination Reactions, Pericyclic Reactions.

M.Sc. (Chemistry) CO3 Study of Quantum Chemistry, Thermodynamics, Chemical Dynamics, Surface Chemistry, Electrochemistry.

M.Sc. (Chemistry) CO4 Symmetry and Group Theory in Chemistry, Unifying Principles, Microwave Spectroscopy, Vibrational Spectroscopy, Electronic Spectroscopy, Magnetic Resonance Spectroscopy, Photoacoustic Spectroscopy, X ray Diffraction, Electron Diffraction, Neutron Diffraction.(B)Biology for Chemist Cell structure and Functions, Carbohydrate, Lipids, Amino acids, Peptides and Proteins, Nucleic Acids, or (B) Mathematics for Chemists Vectors and Matrix Algebra, Differential Calculus, Elementary Differential Equations, Permutation and probability.

M.Sc. (Chemistry) CO5 **(a)** Vibrational Spectroscopy, Electron Spin Resonance Spectroscopy, Nuclear Magnetic Resonance of Paramagnetic Substances in Solution and Mossbauer Spectroscopy of inorganic molecules. Ultraviolet and Visible Spectroscopy, Infrared Spectroscopy, Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD), Nuclear Magnetic Resonance Spectroscopy, Carbon 13 NMR Spectroscopy and Mass Spectrometry of organic molecules. **(b)** Photochemical Reactions, Determiantion of Reaction Mechanism, Photochemistry of Alkenes, Photochemistry of Carbonyl Compounds, Photochemistry of Aromatic Compounds, Miscellaneous Photochemical Reactions. **(c)** Solid State Reactions, Crystal Defects and Non Stoichiometry, Electronic Properties and Band Theory, Organic Solids

M.Sc. (Chemistry) CO6 **(a)** Metal ions in Biological Systems, Na+/K+ Pump, Bioenergetics and ATP Cycle, Transport and Storage of Dioxygen, Electron Transfer in Biology, Nitrogenase. (b) Introduction, Enzymes, Mechanism of Enzyme Action, Kinds of Reaction Catalysed by Enzymes, Co Enzyme Chemistry, Enzme Models, Biotechnological Applications of Enzymes. **(c)** Biological Cell and its Constituents, Bioencergetics, Statistical Mechanics in Biopolymers, Biopolymer Interactions, Thermodynamics of Biopolymer Solutions, Cell Membrane and Transport of Ion, Biopolymers and their Molecular Weights, Diffraction Methods. **(d)** Study of environment, Environment, Hydrosphere, Industrial Pollution .

M.Sc. (Chemistry) CO7 **(a)** Organometallic Reagents, oxidation, reduction Rearrangements, Metallocenes, Nonbenzeoid Aromatics and Polycylic Aromatic Compounds. **(b)** Disconnection Appoach, Protecting Gropus, Protecting Gropus, Two Group C C Disconnections, Ring Synthesis, Synthesis of Some Complex Molecules.

CO**8** Heterocyclic Chemistgry and Chemistry of Natural Products

## Programme Outcomes (Chemistry)

B.Sc. (Chemistry) PO1 Basic knowledge of inorganic, organic and physical chemistry.

B.Sc. (Chemistry) PO2 Basic knowledge of metal, non metal, aliphatic and aromatic compounds. B.Sc. (Chemistry) PO3 Basic knowledge of structure and bonding of transition metal complexes and organo metallic compounds.

B.Sc. (Chemistry) PO4 Qualitative and quantitative analysis of organic and inorganic compounds M.Sc. (Chemistry) PO1 Advance knowledge of organic chemistry, inorganic chemistry, physical chemistry, photo chemistry, Environmental chemistry, Spectroscopy and instrumentation.

M.Sc. (Chemistry) PO2 Advance knowledge of bioinorganic, bioorganic, biophysical and heterocyclic chemistry. Analytic ability to analyze various given samples by different methods. General methods of organic synthesis and preparation of transition metal complexes.

## Programme special outcomes (Chemistry)

B.Sc. (Chemistry) PSO1 Academic value for higher studies and industries, environmental pollution control board, and various completive exams.

B.Sc. (Chemistry) PSO2 Skill development, practical and theoretical knowledge of chemistry for higher studies and various industries and departments such as pharmaceuticals and food adulteration departments etc.

M.Sc. (Chemistry) PSO1 Advance knowledge of chemistry for various R & D industries of pharmaceuticals, petroleum, Paint, Metallurgy, environmental pollution control board, forensic lab and various other industries such as polymer and plastic.

M.Sc. (Chemistry) PSO2 Education sector, Research and analysis.

## Course Outcomes (Industrial Chemistry)

B.Sc. (Industrial Chemistry) CO1 General chemistry I & II Nomenclature of compounds, basic metallurgical operation

B.Sc. (Industrial Chemistry) CO2 Operations and energy balance in chemical industry B.Sc. (Industrial Chemistry) CO3 Material balance, utility in chemical industry

B.Sc. (Industrial Chemistry) CO4 Unit process in organic chemicals manufacture I (Synthetic applications in synthetic organic chemistry)

B.Sc. (Industrial Chemistry) CO5 Unit process in organic chemicals manufacture II (Synthetic applications in synthetic organic chemistry)

B.Sc. (Industrial Chemistry) CO6 Unit process in inorganic manufacture I.

B.Sc. (Industrial Chemistry) CO7 Chemical process economics and industrial chemical

analysis: Study of industrial management and spectroscopic techniques for chemical analysis

B.Sc. (Industrial Chemistry) CO8 Heavy inorganic chemicals and heavy organic chemicals Synthesis and applications of heavy inorganic and organic chemicals.

B.Sc. (Industrial Chemistry) CO9 Applications of catalysts, Industrial solvents, analytical reagents, Common solutions, Essential oils, Biochemical reagents, fine chemicals, coloring agents, Chromatographic materials and HPLC solvents

## Programme Outcomes (Industrial Chemistry)

B.Sc. (Industrial Chemistry) PO1 Basic knowledge of various Industrial operations, Metallurgical process Chromatographic separation, and identification of organic compounds.

B.Sc. (Industrial Chemistry) PO2 Synthetic applications of various organic chemicals in chemical industry.

B.Sc. (Industrial Chemistry) PO3 Basic knowledge of industrial management and chemical process for various chemical industry.

B.Sc. (Industrial Chemistry) PO4 Knowledge of Spectroscopic techniques, heavy organic and inorganic chemicals and synthesis.

B.Sc. (Industrial Chemistry) PO5 Knowledge of various environmental pollutions due to industry and prevention methods.

## Programme special outcomes (Industrial Chemistry)

B.Sc. (Industrial Chemistry) PSO1 Specific knowledge about chemical industries and skill developments for various posts in chemical and pharmaceutical industries. After completing this courses students can work as Researcher; Technician, Teacher, Analytical Chemist, Lab Chemist, Production Chemist, Chemical Engineering Associate, Biomedical Chemist, Demographer, Technical Writer.