B.Sc (Pass Course)
Scheme of Examination

First Year Examination

Paper	Subject	Time	Total Marks	Internal assessment (marks)	Pass Percentage
	Inorganic	3hrs	40	10	40
II	Organic	3hrs	40	10	40
III	Physical	3hrs	40	10	40
Practical	Two sessions	3hrs each (Six hrs)	50	-	
		Total	170	30	

Second Year Examination

Paper	Subject	Time	Total Marks	Internal assessment (marks)	Pass Percentage
IV	Inorganic	3hrs	40	10	40
V	Organic	3hrs	40	10	40
VI	Physical	3hrs	40	10	40
Practical	Two sessions	3hrs each (Six hrs)	50	-	
		Total	170	30	

Third Year Examination

Paper	Subject	Time	Total Marks	Internal assessment (marks)	Pass Percentage
VII	Inorganic	3hrs	40	10	40
VIII	Organic	3hrs	40	10	40
IX	Physical	3hrs	40	10	40
Practical	Two sessions	3hrs each (Six hrs)	50	-	
		Total	170	30	

B.Sc (Hons Course)
Scheme of Examination

First Year Examination

Paper	Subject	Time	Total Marks	Internal assessment (marks)	Pass Percentage
I	Inorganic	3hrs	40	10	40
II	Organic	3hrs	40	10	40
III	Physical	3hrs	40	10	40
HS-I	Inorganic,Organic and Physical	3hrs	40	10	40
Practical	Two sessions	3hrs each (Six hrs)	50	-	
		Total	210	40	

Second Year Examination

Paper	Subject	Time	Total Marks	Internal assessment (marks)	Pass Percentage
IV	Inorganic	3hrs	40	10	40
V	Organic	3hrs	40	10	40
VI	Physical	3hrs	40	10	40
HS-II	Inorganic,Organic and Physical	3hrs	40	10	40
Practical	Two sessions	3hrs each (Six hrs)	50	-	
		Total	210	40	

Third Year Examination

Paper	Subject	Time	Total Marks	Internal assessment (marks)	Pass Percentage
VII	Inorganic	3hrs	40	10	40
VIII	Organic	3hrs	40	10	40
IX	Physical	3hrs	40	10	40
HS-III	Inorganic,Organic and Physical	3hrs	40	10	40
Practical	Two sessions	3hrs each (Six hrs)	50	-	
		Total	210	40	

Note for examiners and students for papers HS-I, HS-II & HS-III

1. Examiner will set ten questions in all, selecting three questions from each section of the syllabus, and one question consisting of four short questions will be set to cover the entire syllabus and that will be compulsory.

2. The candidates will be required to attempt five questions in all i.e. selecting at least one question from each section.

3. All questions will carry equal marks.

4. Pass percentage is 40 percent but to get Hon's Degree the aggregate percentage should be 50 percent.

B.Sc (Pass/Hons Course combined) First Year
Paper-I (Inorganic Chemistry)

M.Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

2. The candidates will be required to attempt five questions in all i.e. selecting one questions from each section and the compulsory question.

3. All questions will carry equal marks.

SECTION-A (15 Hrs)

Atomic structure:
Idea of de -Broglie matter waves, Heisenberg's uncertainty principle. Atomic orbitals, Schrodinger wave equation. Significance of ψ and ψ^2, Quantum numbers, Radial and angular wave functions and probability distribution curves, Shapes of s. p & d orbitals. Aufbau and Pauli's exclusion principles, Hund's multiplicity rule, Electronic configurations of the elements, Effective nuclear charge and screening effect, Slater's rules.

SECTION-B (15 Hrs)

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 behavior).

s-Block Elements:
Comparative study, Diagonal relationship, Salient features of hydrides, Solvation and complexation tendencies including their function in biosystems.

p-Block Elements:
Comparative study, Diagonal relationship, Compounds like hydrides, oxides, oxyacids and halides, Hydrides of boron-diborane and higher boranes (B_4H_{10}, B_5H_9,B_5H_{11} and $B_{10}H_{14}$), Silicates (structural principle), Basic properties of halogens, interhalogens and polyhalides.

SECTION-C (15 Hrs)

Covalent Bond:
Valence bond theory and formation of hydrogen molecule, concept of resonating structure and resonance energy, resonating structures of H_2, N_2, CO, CO_2, CO_3^{-2}, N_2O, Hybridization of atomic orbitals: sp, sp^2, sp^3d, sp^3d^2,sp^3d^3, Valence shell electron pair repulsion theory, shapes of simple molecules and ions on the basis of hybridization and VSEPR theory, examples: NH_3, H_2O, SF_4, ClF_3, XeF_2, IF_5, XeF_4, IF, XeF_6, NO_3^{-1}, CO_3^{-2} SO_4^{-2}, ClO_3^{-1}, ClO_4^{-1}. Molecular orbital theory: Linear combination of atomic orbitals, Molecular orbital electronic configuration and molecular behaviour of diatomic molecules (Be_2, N_2, N_2^+, O_2, O_2^-, O_2^+, O_2^{-2}, CO, NO, CN, NO^+, CN).

SECTION-D (15 Hrs)

Ionic Solids:
Radius ratio effect and coordination number, calculations of radius ratios, Lattice energy and Born-Haber cycle. Solvation energy and solubility of ionic solids, polarizing power and polarisability of ions. Fajan's rules, Percentage of ionic character from dipole moment and electronegativity difference. Metallic bonding-Free electron, Valence bond and Band theories.

Chemistry of Noble Gases:
Noble gases: Late discovery of noble gas compounds, Preparation, properties and structure of important compounds of noble gases-fluorides, oxides and oxy-fluorides of xenon (valence bond structure only). Krypton difluoride, Clathrates of noble gases.

Books Recommended:

1. Concise Inorganic Chemistry 4th Edn. By J.D. Lee.
2. Inorganic chemistry By J.E. Huheey.
3. Advanced Inorganic Chemistry, By Cotton & Wilkinson.
4. Chemistry of Elements by Greenwood & Earusham
5TheoreticalInorganicChemistryByDay&Selbin

B.Sc (Pass/Hons Course combined) First Year
Paper-II (Organic Chemistry)

M.Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

2. The candidates will be required to attempt five questions in all i.e. selecting one questions from each section and the compulsory question.

3. All questions will carry equal marks.

SECTION-A (15Hrs)

Structure and Bonding:
Concept of Hybridization w.r.t alkanes, alkenes, and alkynes, bond lengths and bond angles, bond energy, localized and delocalized chemical bond. Vander Waals interactions, Hydrogen bonding, inductive effect, electromeric effect, reasonance or mesomeric effect and hyperconjugation.

Basic Concepts of organic reactions:
Nature of the fission of covalent bond, types of reagents and reaction intermediates electrophiles, nucleophiles, free radicals, carbocations, carboanions, carbenes, enamines, nitrenes and benzyne. Types of organic reactions and methods of determination of reaction mechanism (product analysis, intermediates and isotope effects).

Stereochemistry of organic compounds:
Concept of isomerism. Types of isomerism. Structural and Stereoisomerism
Optical isomerism-elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, distereomers, threo and erythro distereomers. Meso compounds, resolution of enantiomers, inversion, retention and racimization. Relative and absolute configuration, sequence rules, R&S system of nomenclature.
Geometric isomerism-determination of configuration of geometric isomerism 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.

SECTION-B (15Hrs)

Alkanes and cycloalkanes

IUPAC nomenclature of branched and unbranched alkanes, the alkyl groups. Classification of carbon atoms in alkanes. Isomerism in alkanes, 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 strainless rings.

Alkenes, Cycloalkenes

Nomenclature of alkenes, methods of formation, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stability's 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.

Dienes and Alkynes:

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

Nomenclature, structure and bonding of alkynes. Methods of formation, chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, polymerization.

SECTION-C (15Hrs)

Alkyl and Aryl Halides:

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanism of nucleophilic substitution, reactions of alkyl halides. SN^1 and SN^2 reactions with energy profile diagram.

Polyhalogen compounds: chloroform, carbontetrachloride.

Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanism of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyhalides vs. allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

SECTION-D (15 Hrs)

Arenes and Aromaticity

Nomenclature of benzne derivatives, the aryl group. Aromatic nuleus and side chain, Structure of benzene: molecular formula and kekule structure. Stability and carbon carbon bond length of benzene, resonance structure and MO picture.
Atomaticity: the Huckel rule, aromatic ions.
Aromatic electrophilic substitution-general pattern of the mechanism, role of σ and π- complexes. Mechanism of nitration, halogenation, sulphonation and Friedal-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 reaction of alkylbenzene, alkynylbenzene and biphenyl.

Polynuclear Hydrocarbons: Synthesis, reactions of Naphthalene, anthracene and phenanthrene including relative reactivity of various positions.

Books Recommended

1. Organic Chemistry By Singh and Mukherjee (Vol. I , II).
2. Organic Chemistry By Paula Yurkanis Bruice
3. Stereo Chemistry, By P.S. Kalsi
4. Organic Chemistry By I.L.Finar (Volume-I)
5. Organic Chemistry By I.L.Finar (Volume-II)

B.Sc First Year Class
PAPER-III (Physical Chemistry)

Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

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3. All questions will carry equal marks.

Section-A (15 Hrs)

Gaseous state:

Molecular velocities: Root mean square, average and most probable velocities. Complete derivation of Maxwell's distribution law of molecular velocities, collision number, mean free path and collision diameter. Postulates of kinetic theory of gases, deviations from ideal behavior, Vander Waal's equations of states.

Critical Phenomena: P - V isotherms of real gases, continuity of gases, the isotherms of Vander Waal's equation, relationship between critical constants and Vander Waal's constants, the law of corresponding states, reduced equation of state, liquification of gases.

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural difference between solids, liquids and gases.

Liquid Crystals: Difference between liquid crystals and solid crystals, classification, structure of nematic and cholestic phases, thermography and seven segments cell.

SECTION-B (15 Hrs)

Solid State:

Definition of space lattice, unit cells, Laws of crystallography: (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices. (iii) Kind of Symmetry elements and symmetry operations. X-

ray diffraction by crystals. Bragg's equation only, qualitative analysis) and determination of crystal structures of NaCl, KCl.

Colloidal state:

Classifications of colloids, solids in liquids (sols): properties of colloidal solutions: (kinetic, optical and electrical). Stability of colloids, protective action, Hardy-Schulze law and gold number.

Emulsions: Types of emulsions and their preparation.

Gels: Classification, preparation and properties, inhibition, general applications of colloids.

SECTION-C (15 Hrs).

Chemical Kinetics and Catalysis:

Chemical kinetics and its scope, rate of reaction, factors influencing the rate of reaction: concentration, temperature, pressure, solvent, light, catalyst. Classification of reactions on the basis of molecularity and order. Mathematical derivations of chemical reactions - zero order, first order, second order, third order and pseudo order, half-life and mean life. Experimental methods for the study of chemical kinetics: Conductometric, potentio-metric, optical methods, polarimetry and spectrophotometry.

Theories of Chemical Kinetics: Effect of temperature on the rate of reaction, Arrhenius equation, concept of activation energy and activated complex. Reaction Rates and Chemical equilibria: dissociation constant and principle of microscopic reversibility.

Catalysis: Characteristics of catalysed reactions, classification of catalysts, catalytic poisoning, miscellaneous examples.

Indicators: Concept and theory

SECTION-D (15Hrs)

Thermodynamics: Definition of thermodynamic terms,: system, surroundings etc., Types of systems, intensive and extensive properties, state and path functions and their differentials, thermodynamic processes, Concepts of heat and work.

First Law of thermodynamic: Statement, definition of integral energy and enthalpy. Heat capacity, Heat capacities at constant volume and pressure and their relationship, Joul's Law, Joule- Thomson coefficient and inversion temperature. Calculation of w,q, dU& dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes. Isothermal and adiabatic expansion of real gases for reversible and irreversible process.

Thermochemistry: Standard state, standard enthalphy of formation. Hess's Law of heat summation and application. Bond dissociaton energy and its calculation from thermochemical data, temperature dependence of enthalphy (Kirchoff's equation).

Books Recommended:

1. Physical Chemistry, By S.C. Khetarpal,G.S. Shamra and R.K. Kalia
2. A text book of Physical Chemistry, K.K. Sharma and L.K. Sharma
3. Thermodynamics, By R.C. Srivastava, S.K. Saha and A.K. Jain.
4. Fundamentals of Chemical Thermodynamics By M.L. Lakhanpal
5. Physical Chemistry By P.N. Kapil, S.K. Guglani
6. Chemical Kinetics By K.J, Laidler

B.Sc (Hons) Chemistry (First Year)
Paper: HS-I (Inorganic,Organic,Physical Chemistry)

M.Marks: 40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set ten questions in all, selecting three questions from each section of the syllabus, and one question consisting of four short questions will be set to cover the entire syllabus and that will be compulsory.

2. The candidates will be required to attempt five questions in all i.e. selecting at least one question from each section.

3. All questions will carry equal marks.

4. Pass percentage is 40 percent but to get Hon's Degree the aggregate percentage should be 50 percent.

Section A (20Hrs)

Coordination Chemistry:

Ligand field theory, MO Theory for octahedral complexes (complexes with no π bonding and complexes with π bonding). Evaluation of 10Dq (Δo, Δt), CFSE in weak and strong fields, pairing energies, Factors affecting the magnitude of 10Dq (Δo, Δt), Octahedral Vs tetrahedral coordination, Tetragonal distortions from octahedral geometry, Jahn- Teller theorem, Square planar coordination.

Oxidation and Reduction

Reduction potentials,(Redox half reactions, kinetic factors) ,Redox stability in water (reaction with water, disproportination), Oxidation by atmospheric oxygen, Diagrammatic presentation of potential data (Latimer , Frost and Porbaux diagrams).

Nuclear Chemistry:

Nuclear Models (Shell model, Liquid drop model, Collective model) Types of nuclear reactions, Reaction cross Section, Concept of compound nucleus, Nuclear fission.

Section B (Organic Chemistry) (20Hrs)

Delocalized Chemical Bonding

Conjugation, cross-conjugation, resonance, hyperconjugation, tautomerism. Aromaticity in benzenoid and non benzenoid compound. Huckels rule, energy level of π molecular orbitals, anuulenes, antiaromaticity, homoaromaticity, PMO approach.

Photochemistry

General introduction, its scope and importance, comparison between photochemical and thermochemical reactions, Jablonski diagram (singlet and triplets states, internal conversion, ISC, fluorescence and phosphorescence). Photochemistry of carbonyl compounds

Dyes

Synthesis of azo dyes, diazo-coupling, mechanism of diazo coupling. Important groups of azo dyes. Synthesis of some typical azo dyes: methyl orange, methyl red, congo red. Triphenyl methane dyes: malachite green, pararosaniline, rosaniline, crystal violet, methyl violet. phenolphthalein and fluorescein, Copper phthalocyanine. Mordant and Vat dyes, Structure and synthesis of alizarin and indigo, Chemistry of dyeing, colour and constitution-Modern views.

Polymers

Introduction, polymerization reactions (addition and condensation polymerization), Mechanism of addition polymerization reaction (free radical), methods of polymerization: solution, bulk, emulsion and suspension. Vinyl polymers (PVC and polystyrene), Urea-formaldehyde and phenol-formaldehyde resins, Natural and synthetic rubbers. New concepts of polymers (general introduction to biomaterials, polymer supports and conductive polymers)

Section-C Physical Chemistry (20Hrs)

Bio-Physical Chemistry

Chemical constituent of the living cells, cell as the smallest biological entity, cell membrane, its structure and functions, the plasma membrane,, cytoplasm and its organelles; the endoplasmic reticulum, the mitochondria the Golgi apparatus, ribosomes, lysosome, centriole and microtubules, the interface nucleus

Oscillatory chemical reactions:

Classification of oscillatory reactions: (i) Homogeneous oscillations, (ii) Heterogeneous or in homogeneous oscillations, (iii) Thermochemical oscillations, (iv) Electrochemical oscillations ,(v) Spatial periodicities, (VII) Bio-chemical Oscillations.

Interface Chemistry :

Adsorption, types of adsorption; physical adsorption, chemical adsorption, isotherms: the Freundlich Isotherm, Langumir adsorption isotherm and its limitations.

Catalysis:

Homogeneous, heterogeneous and enzyme catalysis, Michaelis Menten kinetics.

Books Recommended:

For Section-A

1. Inorganic Chemistry By J.E. Huheey
2. Advanced Inorganic Chemistry By Cotton & Wilkinson
3. Inorganic Chemistry By Shriver, Atkins and Longford
4. Coordination chemistry By Basolo and Johnson
5. Nuclear Chemistry By B.G. Harvey

For Section-B

1. Reaction Mechanism By Singh and Mukherjee
2. Natural Products Vol-I By O.P. Aggarwal
3. Organic Chemistry, I.L. Finar Vol-I
4. Organic Chemistry:- Morrison & Boyd
5. Text Book of Polymer Science By Gwarikar et-al
6. Txst Book of Polymer Science By Nayak and Lenka

For Section-C

1. Text Books of Bio physical Chemistry Chemistry By U.N. Dash
2. Outlines of Biochemistry By E.E. Conn and P.K. Stumph
3. Thermodynamics for student of Chemistry By J. Rajaram and J.C. Kuriacose
4. Surface Chemistry By Adison, L.I. Osipow
5. Chemical Kinetics by K.J. Laidler

B.Sc (Pass/Hons Course combined) First Year
Practical Examination M.Marks: 50

Practical examination shall be of six hours duration and shall be held in two Sessions:

Evening Session — Inorganic mixture analysis + Volumetric analysis

Morning session — Organic qualitative analysis + Physical chemistry experiment

The contents of the practical shall consist of the following:

1. Inorganic qualitative analysis: Four ions including interfering PO_4^{3-} ion and similar
2. Volumetric analysis: Iodimetry, Iodometry ($CuSO_4$, $K_2Cr_2O_7$, Hypo-solution tartaremetic and arsenate).
3. Organic qualitative analysis: Detection of extra elements (N,S, and halogens) and functional groups (phenolic, carboxylic, carbonyl, ester, carbohydrates, amines, nitro and amides) in simple organic compounds. Determination of melting point.
4. Physical practical:

(a) Colloids: to prepare arsenious sulphide sol and compare the precipitating power of mono, bi and trivalent ions.

(b) Determination of surface tension and viscosity of pure liquids (benzene, carbon tetra chloride, alcohol).

Distribution of marks:

1.	Inorganic mixture analysis	12
2.	Volumetric analysis	08
3.	Organic qualitative analysis	07
4.	Physical chemistry practical	08
5.	Note Book	05
6.	Viva voce	05
7.	Internal assessment	05
	Total	50

Books Recommended

1 Vogel's Text Book of Qualitative Inorganic Analysis (revised), J.Bassett,R.Cdenney, G.H.Jettery and J.Mendham,ELBS

2 Standard Methods of Chemical Analysis, W.W.Scott

3 Experimental Inorganic Chemistry, W.G.Paimer

4 Laboratory Manual in Organic Chemistry,R.K.Bansal

5 Experiments in Physical Chemistry, R.C. Das and B.Bhera

6 Selected Experimental Chemistry,Vol.-I-Physical,J.N.Gurtu and R.Kapoor

7 Experiments in Physical Chemistry, J.C.GhoshS

B.Sc (Pass/Hons Course combined) Second Year
Paper-IV (Inorganic Chemistry)

M.Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

2. The candidates will be required to attempt 5 questions in all i.e. selecting one questions from each section and the compulsory question.

3. All questions will carry equal marks.

SECTION-A (15 Hrs)

Chemistry of d-Block elements:
Transition elements: Definition, position in periodic table, division of d and f block transition elements, electronic configuration of atoms and ions, general characteristics such as different oxidation state, size, density, melting point, boiling points, reactivity, ionization energies, magnetic behaviour, ability to form complexes, Comparison of the properties of first transition metal series with 2^{nd} and 3^{rd} transition series, Brief chemistry of the extraction of elements Ti, V, Cr, Mn and Co.

SECTION-B (15 Hrs)

Transition Metal Compounds:
Preparation, properties and structures of the following compounds: $TiCl_4$, TiO_2, Ziegler-Natta catalyst, chromyl chloride, potassium permanganate, Prussion blue, sodium nitroprusside, sodium cobaltinitrite and hexaammminecobalt (III) chloride.

Chemistry of Lanthanide Elements:
Electronic structure and position in periodic table, oxidation states, ionic radii, spectral and magnetic properties, lanthanide contraction, and similarity in properties, separation of lanthanides by ion exchange method.

Chemistry of Actinides:
Actinides: electronic structure and comparison with lanthanides, oxidation states, extraction of thorium and uranium from their ores, use as nuclear fuels, preparation of transuranic elements.

SECTION-C (15 Hrs)

Coordination Chemistry

Werner's coordination theory and its experimental verification, Effective atomic number, concept, (chelates, Nomenclature of coordination compounds, Isomerism in Coordination compounds, Structural Isomerism, Stereo isomerism, Geometrical isomerism in 4-6- coordination compounds , Optical Isomerism in 4-6- coordination compounds . Resolution of racemic mixtures, Valence bond theory of transition metal complexes, Applications of coordination compounds.

SECTION-D (15 Hrs.)

Acids and Bases:

Arrhenius, Bronsted-Lowry, Lux-Flood, and Lewis concepts of acids and bases. Classification of acids and bases as hard and soft. Pearson's HSAB concept, Applications of HSAB principle, Symbiosis, Theoretical basis of hardness and softness and limitations.

Relative strength of acids and the effect of substituents and solvent on their strength.

Non-aqueous Solvents:

Introduction to non-aqueous solvents, Their classification, Effect of physical properties of the solvents on the role of solvents in chemical reactions, Solvent system, concept of acids and bases, Elementary study of NH_3 and SO_2 as non- aqueous solvents, Failure of solvent system and concept of coordination model.

Books Recommend:

1.AdvancdInorganicChemistry By Cotton&Wilkinson
2. Concise Inorganic Chemistry By J.D. Lee
3. Chemistry of Lathanides ByT. Moeller
4. Coordination Chemistry By S.F.A Kettle
5. Theoretical Inorganic Chemistry By Day & Selbin
6. Inorganic Chemistry By T. Moeller
7. Non- aqueous solvents By H. Sisler
8. Non aqueous solvents By T.C Wadington,

B.Sc (Pass/Hons Course combined) **Second Year**
Paper-V (Organic Chemistry)

M.Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

2. The candidates will be required to attempt five questions in all i.e. selecting one questions from each section and the compulsory question.

3. All questions will carry equal marks.

SECTION-A (15 Hrs.)

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 and methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinaclone rearrangement.
Trihydric alcohols-nomenclature and methods of formation, chemical reactions and uses of glycerol.

Phenols:
Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion, reactions of phenols-Electrophilic aromatic substitution acylation and carbonylation, Mechanism of Fries rearrangement, Claisan rearrangement. Gatteman synthesis, Hauben-Hoesch reaction, Lederer-Meanasse reaction and Reimer-Tiemann synthesis.

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 epoxide.

SECTION-B (15Hrs)

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 using 1,3,-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.

Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and knoevenegel 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, Clemmenesen, Wolff-kishner, $LiALH_4$ and $NaBH_4$ reduction. Halogenation of enolizable ketones.

An introduction to α and β unsaturated aldehydes and ketones.

SECTION-C (15Hrs)

Carboxylic Acids:

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acidic 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 reaction of halo acids. Hydroxy acids: malic, tartaric and citric acids.

Methods of formation and chemical reaction of unsaturated monocarboxylic acids.

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

Carboxylic Acid Derivatives:

Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides Relative stability of acyl derivatives. Physical properties inter conversion of acid derivatives by nucleophilic substitution.

Formation of carboxylic acid derivatives, chemical reactions, Mechanism of esterification and hydrolysis (acidic and basic).

SECTION-D (15Hrs.)

Organic Compounds of Nitrogen:

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitro arenes and their reduction in acidic, neutral and alkaline medium.

Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, stereochemistry of amines, separation of 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, nitriles). Reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction.

Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Diazotization with mechanism, Synthetic applications of diazonium salts.

Organometallic Compounds:

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

Books Recommended:

1.Reaction and Mechanism:By Singh&Mukherjee,
2. Oraganic Chemistry (Reaction and Mechanism) By P.S. Kalsi
3. Organic Chemistry By I.L. Finar(Vol-I)
4. Organic ChemistryBy Paula Yurkanis Bruice
5. Organic Chemistry, By Baeyer and Walter

B.Sc (Pass/Hons Course combined) **Second Year** Class
PAPER-VI (Physical Chemistry)

M.Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

2. The candidates will be required to attempt five questions in all i.e. selecting one questions from each section and the compulsory question.

3. All questions will carry equal marks.

SECTION-A (15 Hrs)

Thermodynamics: The second law of Thermodynamics: The need for second Law, different statements, Carnot cycle and its efficiency, Carnot theorem, the thermodynamic scale of temperature.

Concept of entropy: The evaluation of entropy changes in reversible and irreversible processes for ideal gases, dependence of entropy on variables of a system: variation of entropy with T and V, T and P, P and V, entropy change for phase changes, Clausius inequality, entropy as a criteria of spontaneity and equilibrium, entropy changes in mixing of gases.

Free energy and work function: Gibb's function (G) and Helmholtz function (A) as thermodynamic state function, variation in A and G with volume, temperature and pressure, A & G as criteria for thermodynamic equilibrium and spontaneity, Max Well relations, standard free energies, the Gibbs-Helmholtz equation and its applications.

Third law of thermodynamic: The Nernst heat theorem, evaluation of absolute entropy from heat capacity data, entropy of real gases, applications of third law.

SECTION-B (15 Hrs)

Partial molar Properties: Systems of variable composition, relationships among molarity, molality and mole fraction, partial molar quantities chemical potential (μ) and Gibbs – Duhem equations, Variation of Chemical potential with T and P.

Phase equilibria: Chemical potential and phase equilibria, Clapeyron equation, the Claussius - Clapeyron equation, meaning of the terms: phase, component and degree of freedom. Thermodynamic derivation of phase rule and its application Phase equilibria for one component system: water and sulphur, Phase equilibria for two component system: solid-liquid equilibria, simple Pb-Ag system, desilverisation of lead.

Solid Solutions: Compound formation with congruent melting point (Mg-Zn) and incongruent melting ($NaCl-H_2O$, $CuSO_4-H_2O$) systems , freezing mixture, acetone-dry ice.

Partially miscible liquids: Phenol -water ,triethyl amine- water, nicotine-water systems, Lower and upper consolute temperature, effect of impurity on consolute temperature.

SECTION-C (15 Hrs)

Fugacity and Activity: Fugacity, method of determining fugacity of a real gas, variation of fugacity with temperature and pressure.

The activity coefficient: Determination of activity and activity coefficients of non-electrolytes.

Ideal solutions and Raoult's Law: Thermodynamics of mixing, dilute solutions, deviations form Raoult's law, Henry's law and solubility of gases. Nernst distribution Law and its applications.

Colligative properties: Lowering of vapour pressure, elevation in boiling point, depression in freezing point and Osmotic pressure.

Chemical equilibria: Equilibrium constant and free energy, thermodynamic derivation of Law of Mass action, and its application. Lechatelier's principle, the reaction isotherms and reaction isochore.

SECTION-D (15 Hrs)

Electrochemistry: Electrical transport, conduction in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

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

Applications of conductivity measurements: determination of degree of dissociation determination of dissociation constant of weak acids, determination of solubility product of sparingly soluble salts, conductometric titrations.

Types of reversible electrodes: Nearnst equation, derivation of cell EMF, and single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conversions.

Electrolytic and Galvanic Cells: Reversible and irreversible cells, conventional representation of electrochemical cells, E.M.F of a cell and its measurements, calculation of thermodynamic quantities of cell reactions (ΔG. ΔH. ΔS).Definition of pH and pK_a values, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Buffers mechanism of buffer action. Henderson- Hazel equation, Hydrolysis of salts.

Books Recommeded:

1. Thermodynamics for students of Chemistry, By J. Rajaram, & J. C.Kuriacose
2. An Introduction of Physica Chemistry, Ishwar Dass, Archana Sharma aqnd Namita Rani Aggarwal
3. Electro Chemistry,By B.K. Sharma

B.Sc (Hons) Chemistry, Second Year
Paper: HS-II(Inorganic,Organic,Physical Chemistry)

M.Marks: 40 Duration: 60 Hrs

Note for examiners and students

1. Examiner will set ten questions in all, selecting three questions from each section of the syllabus, and one question consisting of four short questions will be set to cover the entire syllabus and that will be compulsory.

2. The candidates will be required to attempt five questions in all i.e. selecting at least one question from each section.

3. All questions will carry equal marks.

4. Pass percentage is 40 percent but to get Hon's Degree the aggregate percentage should be 50 percent.

Section A (Inorganic Chemistry) (20hrs)

Coordination Chemistry : Reaction kinetics and mechanism:
The trans effect, Theories and mechanism of trans effect, Kinetics of substitution reactions in square planar complexes, Lability, Inertness, Stability and Instability.

Metal II- Acid complexes
Preparation, structure ,bonding and uses of metal alkyne complexes, Carbonyl halides, Carbonyl hydrides and carbonylate anions, Metal nitrosyls and Metal dinitrogen complexes.

Analytical Chemistry :

Data Analysis – Types and effect of errors, propagation of errors, detection and minimization of various types of errors, Accuracy and precision, average and standard deviation tests of significance(t-test and F-test), criteria for rejection of analytical data, least square analysis.

SECTION- B
(Organic Chemistry)

Lipids:
Biological functions and type of lipids.Edible and industrial oils of vegetable origin. Common fatty acids present in fats and oils. Extraction, refining and hydrogenation of fats and oils. Identification of fats and oils. Physical and chemical properties, saponification value, acid value, and iodine number. Flavour changes in oil and fats. Reversion and rancidity, soaps and detergents.

Vitamins and Hormones:
Vitamins, General introduction, Types, Biological importance of vitamins A, B_1, C, D, E, K. Hormones, General introduction, Biological importance of anterior pituitary hormones, thyroid, insulin, sex hormones (gonadotropins, estrogens and progestins)

Terpenes
Essential oils: Occurrence, isolation, classification of terpenes, chemical composition. Isoprene rule, structure and synthesis of citral and dipentene. Classical & non-classical carbonium ions.

Alkaloids
Occurrence, importance, general structural features and properties. Hofmann's exhaustive methylation. Isolation, structure and synthesis of nicotine, atropine and cocaine.

Section-C Physical Chemistry (20Hrs)

Thermodynamics of aqueous solutions of electrolytes:

Fugacity and activity of electrolytes, mean ionic activity, mean ionic activity coefficient, determination of activities and activity coefficients of strong electrolytes [cryoscopic method and e.m.f measurements], ionic strength, activity coefficients from solubility measuremtns, activity coefficients from Debye-Huckel theory, applications of the Debye-Huckel limiting law, verification of limiting law, thermodynamics of ions in solution.

Electrochemistry and surface Chemistry

Ion-solvent interactions- Born model, enthalpy, free energy and entropy of ion-solvent interactions, primary and secondary solvations (salting in and salting out), electrode kinetics-Butler volumer equation, Tefel equation.

Surface electrochemistry: Electrical double layer, Helmholtz, Perkin, Goug, Chapman, Stern Theories, Lipmann equation.

Adsorption from solutions: Gibb's adsorption isotherm, study of surface films: surface area determination, applications of adsorption- adsorption indicators, surfactants and detergents, micelle, critical micellar concentrations applications.

Basic concepts of Polymer Chemistry:

Classification of polymers on the basis of composition, degree of polymerization and molecular weight, classification of polymers on the basis of molecular weight, homopolymers, co-polymers, graft copolymers, crystalline polymers, amorphous polymers, classification of polymers on the basis of structure of polymers i.e. linear, branched and cross linked polymers, biopolymers, condensation polymers, addition polymers photopolymerization, mechanism of polymerization, polymer degradation

(chemical and photochemical), dilute polymer solutions, molecular weight of polymers: number average and weight average molecular weights.

Books Recommended:

1. Mechanism of Inorganic Reaction By Basolo and Pearson
2. Advanced Inorganic Chemistry By Cotton & Wilkinson
3. Analytical Chemistry By Skoog & West
4. Organic Chemistry Volume-II By I.L. Finar
5. National Products Vol-II By O.P. Aggarwal
6. Electrochemistry By B.K. Sharma
7. Thermodynamics for students of-Chemistry By J. RajaRam & J.C. Kuriacose,
8. Thermodynamics By R. C. Srivastava

B.Sc (Pass/Hons Course combined) Second Year Practical Examination M.Marks:50

Practical examination shall be of six hours duration and shall be held in two Sessions:

Evening Session Inorganic mixture analysis + Organic preparations

Morning session Volumetric analysis + Organic chemistry experiment

The contents of the practical shall consist of the following:

1. Inorganic qualitative analysis: Six ions including interfering (PO_4^{-3}, $C_2O_4^{-2}$ and tartarate) and similars.
2. Organic compounds preparation: Iodoform, Aspirin, Glucosazone, p-bromoacetanilide.
3. Volumetric analysis:

(a) Determination of acetic acid in commercial vinegar using NaOH.
(b) Determination of alkali content-antacid table using HCl.
(c) Estimation of calcium content in chalk as calcium oxalate by permangarometry.
(d) Complexometric titration-EDTA (Ca, Mg and hardness of water)
(e) Estimation of ferrous and ferric by dichromate method.

4. Physical Chemistry

(a) Determination of heat of solution (KNO_3, KCl)
(b) Determination of heat of neutralization (acids and bases)
(c) Determination of heat of hydration ($CuSO_4$)
(d) Molecular weight determination by Rast method.

Distribution of marks

1.	Inorganic mixture analysis	12
2.	Organic preparation	06
3.	Volumetric analysis	09
4.	Physical chemistry practical	08
5.	Note Book	05
6.	Viva voce	05
7.	Internal assessment	05
	Total	50

Books Recommended

1 Vogel's Text Book of Qualitative Inorganic Analysis (revised), J.Bassett,R.Cdenney, G.H.Jettery and J.Mendham,ELBS
2 Standard Methods of Chemical Analysis, W.W.Scott
3 Experimental Inorganic Chemistry, W.G.Paimer
4 Laboratory Manual in Organic Chemistry,R.K.Bansal
5 Experiments in Physical Chemistry, R.C. Das and B.Bhera
6 Selected Experimental Chemistry,Vol.-I-Physical.J.N.Gurtu and R.Kapoor
7 Experiments in Physical Chemistry, J.C.Ghosh

8 Handbook Preparative Inorganic Chemistry Vol. I & IIA.P.Brauer
9 Experimental Organic Chemistry, Vol. I & II P.R>Singh.D.S.Gupta and K.S.Bajpai

B.Sc (Pass/Hons Course combined) Third Year
Paper-VII (Inorganic Chemistry)

M.Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

2. The candidates will be required to attempt five questions in all i.e. selecting one questions from each section and the compulsory question.

3. All questions will carry equal marks.

SECTION-A (15 Hrs)

Metal-ligand Bonding in Transition Metal Complexes:
Limitations of Valence bond theory, the electrostatic crystal field, Splitting of d-orbitals in octahedral, tetrahedral, square planar and tetragonally distorted octahedral stereochemistry. Factors affecting the crystal-field parameters, CFSE, Spectrochemical series, Origin of color in transition metal complexes, Explanation of color of (Ti $(H_2O)_6)Cl_3$ and $CuSO_4$, $5H_2O$ and lack of color in Cu_2SO_4 in terms of d-orbital splitting.

Magneto chemistry
Origin and types of magnetic behaviour: Diamagnetism, Paramagnetism, Ferromagnetism and Antiferromagnetism. Types of magnetic behavior shown by transition elements and compounds. Gouy's method for measuring magnetic susceptibility. Applications of magnetic susceptibility measurements to first row transition metal complexes. Qualitative idea of orbital contribution and subnormal magnetic moments.

SECTION-B(15 Hrs)

Thermodynamic and Kinetic Aspects of Metal Complexes:
Definition of stability, Stepwise formation constants and overall formation constants, Kinetics Vs Thermodynamic stability, Labile and inert octahedral complexes according to VBT. Labile and inert octahedral complexes according to CFT. Factors affecting the stability of complexes.

Introductory Analytical Chemistry:
Theory of titrimetry, redox and complexometric titrations, indicator theories, Errors in titrimetry and their rectifications.
Principles of ion exchange, Solvent extraction, Theories of adsorption, Different type of chromatography (adsorption and column).

SECTION-C (15 Hrs)

Organometallic Compounds

Definition, types of organometallic compounds, classifications, EAN and nomenclature. Bonding; metal carbon bonding, metal carbon multiple bonding. Metal alkyl complexes of groups 1,2 and 13 , Metal-olefin complexes and nature of bonding in these complexes. Preparation and reactions of ferrocene, simple structure of ferrocene. Preparation and reactions of carbonyl compounds of transition elements, Bonding in linear carbonyls (simple spectral evidences), Structures of mono and polynuclear carbonyls.

Bioinorganic Chemistry:

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

SECTION-D ((15Hrs).

Inorganic polymers

Preparation, reactions and bonding in Borazines , Silicones and Phosphazenes.

Environmental Pollution:

Study of environmental pollution in air and water, Chemical and photochemical reactions in atmosphere, Acid rain, Photochemical smog, Green house effect.

Books Recommended:

1. Inorganic Chemistry By Siver ,Atkin & Long ford
2. Theoretical Inorganic Chemistry By Day& Selbin
3. Inorganic Chemistry By J.D. Lee & J.E Huheey
4. Mechanisms of Inorganic Reactins By Basolo & Pearson
5. Advanced Inorganic Chemistry By Cotton & Wilkinson
6. Environmental Chemistry By A.K. De

BSc (Pass/Hons Course combined) Third year
Paper-VIII (Organic Chemistry)

M.Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

2. The candidates will be required to attempt five questions in all i.e. selecting one questions from each section and the compulsory question.

3. All questions will carry equal marks.

SECTION-A (15 Hrs)

Spectroscopy:

Electromagnetic Spectrum: Absorption Spectra

Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transition, effect of conjugation. Concept of chromophore and auxochrpme. Bathochromic, hypsochromic, hyperchromic and hypochromic shift. UV spectra of conjugated enes and enones.
Infrared (IR) absorption spectroscopy-molecular vibrations. Hook's law selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds.

SECTION-B (15 Hrs)

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, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethylacetate, toluene and acetophenone.
Problem pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

SECTION-C (15 Hrs)

Heterocyclic Compounds:

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

Introduction to condensed five and six- membered heterocyclic compounds, preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

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.

SECTION-D (15 Hrs)

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 disteromers, conversion of glucose into mannose, formation of glycosides, ether and esters, determination of ring size of monosaccherides, cyclic structure of D (+)-glucose, mechanism of mutarotation. Structure of ribose and deoxyribose.

An introduction of disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) and structure elucidation

Amino Acids, Peptides, Proteins and Nuclec Acids:

Classification structure and stereochemistry of aminoacids, acid base behaviour isoelectric point and electrophoresis, preparation and reactions of α -amino acid.

Structure and nomenclature of peptides and proteins classification of proteins peptide structure determination and group analysis selective hydrolysis of peptides, classical peptide synthesis, solid phase peptide synthesis structure of peptide and proteins levels of protein structure, protein denaturation renaturation.

Introduction nucleic acids, ribosnuelosides and ribonucleotides, structure of RNA and DNA.

Books Recommended:

1. Organic Chemistry, By I.L. Finar(Volume-II)
2. Natural Products Vol I &.II By O.P. Aggarwal
3. Elementary Organic Spectroscopy By Y.R.Sharma
4. Organic Spectroscopy By Jagmohan
5. Organic Chemistry By P.S. Kalsi

(BSc Pass/Hons Course combined) Third year
Paper-IX (Physical Chemistry)

M.Marks:40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set nine questions in all, selecting two questions from each section of the syllabus and one question consisting of four short answer questions will be set to cover the entire syllabus and that will be a compulsory question.

2. The candidates will be required to attempt five questions in all i.e. selecting one questions from each section and the compulsory question.

3. All questions will carry equal marks.

SECTION-A (15 Hrs)

Elementary Quantum Mechanics: Plank,s hypothesis of quantum mechanics and its implications to black body radiation, photoelectric effect, and heat capacity of solids. De Broglie hypothesis, the Heisenberg's uncertainty principle. Operators (introduction and principle). Time independent Schrondinger wave quation. Interpretation of wave function. Schrondinger wave quation for hydrogen atom and qualitative interpretation of the solution (quantum number, radial, probability and angular wave function)

SECTION-B (15 Hrs.)

Statistical Thermodynamics: Thermodynamic probability and entropy; statistical thermodynamic formulation of the Boltzmann equation, Bose-Einstein and Fermi Dirac Statistics. Partition function and thermodynamic functions. Molecular partition function, translational partition function, rotational partition function, vibrational partition function and electronic partition function, calculations of thermodynamic properties and equilibrium constant in terms of partition functions.

Heat capacity of solids: Heat capacity equipartion of energy, Heat-Capcities from the classical theory, Quantum statistical theory of specific heat, diatomic molecules, rotational heat capacity for the hydrogen molecule.

SECTION-C (15 Hrs.)

Spectroscopy: Introduction: electromagnetic radiation, regions of spectrum, Born oppenheimer approximation (qualitative interpretation only), degree of freedom.

Rotational Spectrum: diatomic molecules, energy levels of a rigid rotator, selection rules, spectral intensity, Maxwell-Boltzmann distribution of population of quantum states and its application for bond length determination, effect of isotopic substitution on rotational spectra.

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.

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

SECTION-D (15 hrs.)

Photochemistry: Laws of Photochemistry, quantum yield, Grothus-Drapper Law, Stark-Einstein law, Jablonsky diagram, qualitative description of fluorescence, phosphorescence, photo sensitized reactions, photo electric effect and photoelectric cell. Photochemical equilibrium and equilibrium constant.

Molecular Structure and Physical Properties: Optical activity, polarization,Clausius Mossoti equation, orientation of dipoles, in an electric field, dipolement, induced dipolemoment, measurement of dipole moment, dipole moment and structure of molecules, magnetic properties, Paramagnetism, diamagnetism and ferromagnetism.

Books Recommended:

1. Physical Chemistry By Puri Sharma and Pathania
2. Quantum Mechanics By G. Aruldhas
3. Introduction to Statiscal Thermodytnamics, By S. Glasstone

B.Sc (Hons) Chemistry -Third Year.
Paper: HS-III (Inorganic,Organic,Physical Chemistry)

M.Marks: 40 **Duration: 60 Hrs**

Note for examiners and students

1. Examiner will set ten questions in all, selecting three questions from each section of the syllabus, and one question consisting of four short questions will be set to cover the entire syllabus and that will be compulsory.

2. The candidates will be required to attempt five questions in all i.e. selecting at least one question from each section.

3. All questions will carry equal marks.

4. Pass percentage is 40 percent but to get Hon's Degree the aggregate percentage should be 50 percent.

Section -A (Inorganic Chemistry) 20hrs

Bioinorganic Chemistry
Metal ions present in biological systems: classification of elements according to their action in biological system and their role in ion transport across the membrane (molecular mechanism) Is. Sodium/potassium pump. Biochemistry of Mg and Ca.
Ionophores, Photosynthesis, Nitrogen fixation .

Role of Organometallic compounds in Catalysis
General principle, Description of catalysts, properties of catalysts, Homogeneous catalysis-catalytic steps (Ligand co-ordination and dissociation, Insertion and elimination, Nucleophilic attack on coordinated ligands, oxidation and reduction, Oxidative addition and reductive elimination), Hydroformylation of alkenes, Wackers process and Monsanto process.

Section –B (Organic Chemistry) 20hrs

Pyrimidines and Purines
Synthesis and reactions, Simple ureids: reactions and synthesis, Structure, synthesis and reactions of adenine, guanine, cytosine, uracil, thymine, uric acid, caffeine, barbituric acid. Elementary idea of nucleic acids.

Enzymes

Nomenclature, Coenzymes, difference between enzymes and coenzymes. Cofactors. Factors that influence enzyme action. Specificity and stereospecificity of enzymes mechanism of enzyme action enzyme inhibitors. Alcoholic fermentation, glycolysis, the Kreb's cycle:

Pharmaceutical Chemistry

Pharmacokinetics and pharmocodynamics of the drugs. Synthesis and therapeutic importance of sulfanilamide, aspirin, phenacetin, paracetamol, chloroquine, chloramphenicol. Chemotherapy of sexually transmitted disease.

Green Chemistry:

Basic concepts about waste generation, pollution, atom economy, use of renewable resources; Twelve principle of green chemistry. Designing a green synthesis: Choice of starting materials, reagents, catalysts and solvents; choice of water as solvent; microwave and ultrasonic assisted synthesis, Biocatalysis.

Natural renewable resource such as forest waste, agro waste and polysaccharides as source of chemicals and biodegradable polymers.

Examples of green synthesis: recyclization of poly(ethylene terepthalate), synthesis of methyl methacrylate, synthesis of adipic acid and catechol and furfural from biomass.

Section-C (Physical Chemistry) (20Hrs)

Quantum Mechanics

Postulates of quantum mechanics (introduction and principles). Operators and commutative relation. Quantum mechanical treatment of some simple systems: Schrondinger equation for free particle and particle in one, and three dimentional box. Degeneracy and tunneling effect.

Statistical Mechanics

Configuration and weight, the molecular and canonical partition functions and thermodynamic information in these partition functions. Factorization of partition functions into translational, rotational and vibrational modes.

Spectroscopy

Rotatioanl spectrum of non, rigid diatomic molecular anharmonic oscillator , zero point energy, overtones, and hot bands, the spectrum of diatomic vibrating- rotator, combination frequencies.

Raman Spectroscopy: pure rotational and vibrational Raman spectroscopy, selection rules, Stokes and anti Stokes spectral lines, mutual exclusion principle.

Books Recommended:

For Section-A

1. Inorganic Chemistry of Biological Processes By M.N. Hughes
2. Mechanism of Inorganic Reactions By Basolo & Pearson
3. Inorganic Chemistry By J.E Huheey
4. Homogeneous Transition Metal Catalysis By Christopher & Masters

For Section-B

I. Organic spectroscopy By Y.R. Sharma

II. New Tends in Green Chemistry By V.K. Ahluwalia

III. Pharmaceutical Chemistry By S.Lakshmi

For Section-C

1. A Text Book of Physical Chemistry By Puri Sharma and Kalia
2. An Introduction to Statistical Mechanics By S. Glassstone
3. Quantam Mechanics By G. Aruldhas

B.Sc (Pass/Hons Course combined) Third Year Practical Examination M.Marks:50

Practical examination shall be of six hours duration and shall be held in two Sessions:

Evening Session Gravimetric Analysis + physical chemistry experiment

Morning session Inorganic preparation + Organic compound analysis

The contents of the practical shall consist of the following:

1 Gravemetric Analysis:

Ba^{2+}/ SO_4^{2-}, Fe^{3+}/Al^{3+} as oxides, Ni^{2+} as DMG complex and Cu^{2+} CuNCS

2 Physical Chemistry Practicals:

A. Distribution Law:

i. Determination of distribution coefficient of iodine between water and CCl4

ii. Determination of association of benzoic acid in its distribution between benzene and water

B. Chemical Kinetics

i. Determination of order of reaction of ester hydrolysis in acidic medium

ii. Saponification of esters

C. Colorimetry

Verification of Lambert-Beer's law using cpper sulfate, cobalt chloride and potassium dichromate solutions in water and determine the concentration of the given solution of the substance

3. Inorganic Preparations:

$CuCl_2$, $[Cu(NH_3)SO_4$, $K_3[Al(C_2O_4)_3]$ and $[Ni(NH_3)_6]Cl_2$

4. Organic Analysis:

Qualitative analysis of organic compounds shall include detection of elements, functional groups, melting points, one specific test and preparation of one solid derivative.

For identification of unknown compounds, following compounds may be done:

Benzoic acid, Succinic acid, Cinnamic acid, Salicylic acid, Phthalic acid, Urea, Thiourea, Benzamide, Naphthol, Glucose, Fructose, Sucrose, Naphthelene, β-naphthylamine, Acetanilide,Benzoquinone, m-dinitrobenzene, Benzanilide and Iodoform.

Distribution of Marks

1 Gravimetric Analysis	07
2 Physical Chemistry practical	10
3 Inorganic preparation	06
4 Organic Analysis	12
5 Note Book	05
6 Viva voce	05
7 Internal assessment	05
Total	50

Books Recommended

1 Vogel's Text Book of Qualitative Inorganic Analysis (revised), J.Bassett,R.Cdenney, G.H.Jettery and J.Mendham,ELBS
2 Standard Methods of Chemical Analysis, W.W.Scott
3 Experimental Inorganic Chemistry, W.G.Paimer
4 Laboratory Manual in Organic Chemistry,R.K.Bansal
5 Experiments in Physical Chemistry, R.C. Das and B.Bhera
6 Selected Experimental Chemistry,Vol.-I-Physical.J.N.Gurtu and R.Kapoor
7 Experiments in Physical Chemistry, J.C.Ghosh