Syllabi and Courses of reading for B.Sc. Part-I, Part-II and Part-III (Chemistry) w.e.f. 2009-2010, 2010-2011 and 2011-2012

B.Sc. Part-I (Ist Semester)

Paper No.	Code No.	Nome nclature	Max. Marks Written + I.A.	Time
I	CH-101	Inorganic Chemistry(Theory)	33 + 4	3 Hrs
II	CH-102	Physical Chemistry(Theory)	33 + 4	3 hrs.
III	CH-103	Organic Chemistry (Theory)	33 + 3	3 hrs

B.Sc. Part-I (IInd Semester)

Paper No.	Code No.	Nomenclature	Max. Marks Written + I.A.	Time
IV	CH-104	Inorganic Chemistry (theory)	33 + 4	3 hrs.
V	CH-105	Physical Chemistry (Theory)	33 + 4	3 hrs.
VI	CH-106	Organic Chemistry (theory)	33 + 3	3 hrs.
VII	CH-107	Practicals	72 + 8	7 hrs.

Note: Practical Exams will be held at the end of 2nd Semester

B.Sc. Part-II (IIIrd Semester)

Paper No.	Code No.	Nomenclature	Max. Marks Written + I.A.	Time
VIII	CH-201	Inorganic Chemistry (Theory)	33 + 4	3 hrs.
IX	CH-202	Physical Chemistry (theory)	33 + 3	3 hrs.
X	CH-203	Organic Chemistry (theory)	33 + 4	3 hrs.

B.Sc. Part-II (IVth Semester)

Paper No.	Code No.	Nomenclature	Max. Marks Written + I.A.	Time
XI	CH-204	Inorganic Chemistry	33 + 4	3 hrs.

		(theory)		
XII	CH-205	Physical Chemistry (theory)	33 + 3	3 hrs.
XIII	CH-206	Organic Chemistry (theory)	33 + 4	3 hrs.
XIV	CH-207	Practicals	73 + 8	7 hrs.

Note: Practical Exams will be held at the end of 4th Semester

B.Sc. III (Vth) Semester

Paper No.	Code No.	Nomenclature	Max. Marks Written + I.A.	Time
XV	CH-301	Inorganic Chemistry (theory)	33 + 3	3 hrs.
XVI	CH-302	Physical Chemistry (theory)	33 + 4	3 hrs.
XVII	CH-303	Organic Chemistry (theory)	33 + 4	3 hrs.

B.Sc. III (VIth Semester)

Paper No.	Code No.	Nomenclature	Max. Marks Written + I.A.	Time
XVIII	CH-304	Inorganic Chemistry (theory)	33 + 3	3 hrs.
XIX	CH-305	Physical Chemistry (theory)	33 + 4	3 hrs.
XX	CH-306	Organic Chemistry (theory)	33 + 4	3 hrs.
XXI	CH-307	Practicals	72 + 8	7 hrs.

Note: Practical Exams will be held at the end of 6nd Semester

B. Sc. Ist Year (Ist Semester)

Paper I (Theory) Inorganic Chemistry **Max. Marks: 33**
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

1. Atomic Structure

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, , 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, Slater's rules.

2.Periodic Properties

Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, methods of determination or evaluation, trends in periodic table (in s & p block elements).

SECTION–B

1. **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 (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7 SO_4^{2-}, ClO_4^-)Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, CIF_3, ICI_2^- and H_2O. MO theoryof heteronuclear (CO and NO) diatomic.

molecules, , bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Ionic Solids

Ionic structures (NaCl,CsCl, ZnS(Zinc Blende), CaF_2) radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy (methamtical derivation excluded) and Born-Haber cycle, solvation energy and

its relation with solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.

B. Sc. Ist Year (Ist Semester)

Paper II (Theory) Physical Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

SECTION – A

Gaseous States

Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity and most probable velocity. Collision diameter, collision number, collision frequency and mean free path. Deviation of Real gases from ideal behaviour. Derivation of Vander Waal's Equation of State, its application in the calculation of Boyle's temperature (compression factor) Explanation of behaviour of real gases using Vander Waal's equation.

Critical Phenomenon: Critical temperature, Critical pressure, critical volume and their determination. PV isotherms of real gases, continuity of states, the isotherms of Vander Waal's equation, relationship between critical constants and Vander Waal"s constants. Critical compressibility factor. The Law of corresponding states. Lequifaction of gases.

Section-B

Liquid States

Structure of liquids. Properties of liquids – surface tension, viscosity vapour pressure and optical rotations and their determination.

Solid State

Classification of solids, Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices

(iii) Law of symmetry. Symmetry elements of crystals. Definition of unit cell & space lattice. Bravais lattices, crystal system. X-ray diffraction by crystals. Derivation of Bragg equation.
Determination of crystal structure of NaCl, KCl.

Liquid crystals: Difference between solids, liquids and liquid crystals,types of liquid crystals. Applications of liquid crystals.

B. Sc. Ist Year (Ist Semester)

Paper III (Theory) Organic Chemistry **Max. Marks: 33**
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

1.Structure and Bonding

Localized and delocalized chemical bond, van der Waals interactions, resonance: conditions, resonance effect and its applications, hyperconjugation, inductive effect, Electromeric effect & their comparison.

2.Stereochemistry of Organic Compounds

Concept of isomerism. Types of isomerism.

Optical isomerism — elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

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

Geometric isomerism — determination of configuration of geometric isomers. E & Z system of nomenclature,

Conformational isomerism — conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds,. Newman projection and Sawhorse formulae, Difference between configuration and conformation.

Section-B

1.Mechanism of Organic Reactions

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

Reactive intermediates — carbocations, carbanions, free radicals, carbenes,(formation, structure & stability).

2. Alkanes and Cycloalkanes
7 Hrs

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms 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.

Mechanism of free radical halogenation of alkanes: reactivity and selectivity.

Cycloalkanes — nomenclature, synthesis of cycloalkanes and their derivatives – photochemical (2+2) cycloaddition reactions, , dehalogenation of α,ω-dihalides, , pyrolysis of calcium or barium salts of dicarboxylic acids, Baeyer's strain theory and its limitations., theory of strainless rings.

B. Sc. Ist Year (IInd Semester)

Paper IV (Theory) Inorganic Chemistry **Max. Marks: 33**
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

1.Hydrogen Bonding & Vander Waals Forces

Hydrogen Bonding – Definition, Types, effects of hydrogen bonding on properties of substances, application

Brief discussion of various types of Vander Waals Forces

2. **Metallic Bond and Semiconductors**

Metallic Bond- Brief introduction to metallic bond, band theory of metallic bond

Semiconductors- Introduction, types and applications.

3. **s-Block Elements**

Comparative study of the elements including , diagonal relationships, salient features of hydrides (methods of preparation excluded), solvation and complexation tendencies including their function in biosystems.

Chemistry of Noble Gases

Chemical properties of the noble gases with emphasis on their low chemical reactivity, chemistry of xenon, structure and bonding of fluorides, oxides & oxyfluorides of xenon.

SECTION – B

p-Block Elements

Emphasis on comparative study of properties of p-block elements (including diagonal relationship and excluding methods of preparation).

Boron family (13th gp):-

Diborane – properties and structure (as an example of electron – deficient compound and multicentre bonding), Borazene – chemical

properties and structure Trihalides of Boron – Trends in fewis acid character structure of aluminium (III) chloride.

Carbon Family (14th group)

Catenation, pπ– dπ bonding (an idea), carbides, fluorocarbons, silicates (structural aspects), silicons – general methods of preparations, properties and uses.

Nitrogen Family (15th group)

Oxides – structures of oxides of N,P. oxyacids – structure and relative acid strengths of oxyacids of Nitrogen and phosphorus. Structure of white, yellow and red phosphorus.

Oxygen Family (16th group)

Oxyacids of sulphur – structures and acidic strength H_2O_2 – structure, properties and uses.

Halogen Family (17th group)

Basic properties of halogen, interhalogens types properties, hydro and oxyacids of chlorine – structure and comparison of acid strength.

B. Sc. Ist Year (IInd Semester)

Paper V (Theory) Physical Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

SECTION – A

Kinetics

Rate of reaction, rate equation, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction. Half life period of a reaction. Methods of determination of order of reaction, effect of temperature on the rate of reaction – Arrhenius equation. Theories of reaction rate – Simple collision theory for unimolecular and bimolecular collision. Transition state theory of Bimolecular reactions.

Section-B

Electrochemistry

Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, molar conductance,equivalent conductance and relation among them, their vartion with concentration. Arrhenius theory of ionization, Ostwald's Dilution Law. Debye-Huckel – Onsager's equation for strong electrolytes (elementary treatment only) Transport number, definition and determination by Hittorfs methods, (numerical included), Kohlarausch's Law, calculation of molar ionic conductance and effect of viscosity temperature & pressure on it. Application of Kohlarausch's Law in calculation of conductance of weak electrolytes at infinite diloution. Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids determination of solubility product of sparingly soluble salts, conductometric titrations. Definition of pH and pK_a, Buffer

solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action.

B. Sc. Ist Year (IInd Semester)

Paper VI (Theory) Organic Chemistry **Max. Marks: 33**

Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

1.Alkenes

Nomenclature of alkenes, , mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides,. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes — mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration–oxidation, oxymercuration-reduction, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, ,

*2.*Arenes and Aromaticity

Nomenclature of benzene derivatives:. Aromatic nucleus and side chain.

Aromaticity: the Huckel rule, aromatic ions, annulenes up to 10 carbon atoms, aromatic, anti - aromatic and non - aromatic compounds.

Aromatic electrophilic substitution — general pattern of the mechanism, mechansim of nitration, halogenation, sulphonation, and Friedel-Crafts reaction. Energy profile diagrams. Activating , deactivating substituents and orientation.

Section-B

Dienes and Alkynes

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of butadiene,. Chemical reactions — 1,2 and 1,4 additions (Electrophilic & free radical mechanism),

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 of alkynes,

Alkyl and Aryl Halides

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

Methods of formation and reactions of aryl halides, The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.

B.Sc. I Year

Paper VII (Practicals) **Max. Marks: 72**

Time: 7 Hrs.

Section-A (Inorganic)

Volumetric Analysis

1. **Redox titrations**: Determination of Fe^{2+} , $C_2O_4^{2-}$ (using $KMnO_4$, $K_2Cr_2O_7$)
2. **Iodometic titrations:** Determination of Cu^{2+} (using standard hypo solution).
3. **Complexometric titrations:** Determination of Mg^{2+} , Zn^{2+} by EDTA.

Paper Chromatography

Qualitative Analysis of the any one of the following Inorganic cations and anions by paper chromatography (Pb^{2+} , Cu^{2+} , Ca^{2+} , Ni^{2+} , Cl^- , Br^- , I^- and PO_4^{3-} and NO_3^-).

Section-B (Physical)

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetatecatalyzed by hydrogen ions at room temperature.
2. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.
3. To determine the surface tension of a given liquid by drop number method.
4. To determine the viscosity of a given liquid**.**
5. To determine the specific refractivity of a given liquid

SECTION – C (Organic)

1. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point
   (i) Iodoform from ethanol (or acetone)
   (ii) *m*-Dinitrobenzne from nitrobenzene (use 1:2 conc. HNO_3-H_2SO_4 mixture if fuming HNO_3 is not available)

iii) p-Bromoacetanilide from acetanilide

iv) Dibenzalacetone from acetone and benzaldehyde

v) Aspirin from salicylic acid

1. To study the process of) sublimation of camphor and phthalic acid,

Distribution of marks

1.	Section I	18 marks
2.	Section II	18 marks
3.	Section III	18 marks
4.	Viva-voce	06 marks
5.	Lab Record	12 marks

B. Sc. II Year (IIIrd Semester)

Paper VIII (Theory) Inorganic Chemistry **Max. Marks: 33**

Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all,

selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

Section-A

Chemistry of d-Block Elements

Definition of transition elements, position in the periodic table, General characteristics & properites of d-block elements, Comparison of properties of 3d elements with 4d & 5d elements with reference only to ionic radii, oxidation state, magnetic and spectral properties and stereochemistry. Structures & properties of some compounds of transition elements – TiO_2, $VOCl_2$, $FeCl_3$, $CuCl_2$ and $Ni(CO)_4$

Section-B

1. Coordination Compounds

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

2. 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. IInd Year (IIIrd Semester)

Paper IX (Theory) Physical Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

SECTION – A

Thermodynamics

Definition of thermodynamic terms: system,surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

Zeroth Law of thermodynamics, 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 for ideal gass and real gas: and inversion temperature. Calculation of w.q. dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Temperature dependence of enthalpy, Kirchoffs equation.

Bond energies and applications of bond energies.

Section-B

Chemical Equilibrium

Equilibrium constant and free energy, concept of chemical potential, Thermodynamic derivation of law of chemical equilibrium. Temperature dependence of equilibrium constant; Van't Hoff reaction isochore, Van't Hoff reaction isotherm.

Le-Chatetier's principle and its applications Clapeyron equation and clausius – clapeyrou equation its applications.

Distributioln Law

Nernst distribution law – its thermodynamic derivation, Modification of distribution law when solute undergoes dissociation, association and chemical combination. Applications of distribution law: (i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride. (ii) Determination of equilibrium constant of potassium tri-iodide complex and process of extraction.

B. Sc. IInd Year (IIIrd Semester)

Paper X (Theory) Organic Chemistry **Max. Marks: 33**
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

1.Alcohols

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.

2.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, Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbe's reaction and Schotten and Baumann reactions.

3.**Epoxides**

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

Section-B

1. Ultraviolet (UV) absorption spectroscopy

Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and

enones,Woodward- Fieser rules, calculation of λ_{max} of simple conjugated dienes and α,β-unsaturated ketones. Applications of UV Spectroscopy in structure elucidation of simple organic compounds.

2.**Carboxylic Acids &Acid Derivatives**

Nomenclature of Carboxylic acids, 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. Reduction of carboxylic acids. Mechanism of decarboxylation.

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

Mechanisms of esterification and hydrolysis (acidic and basic).

B. Sc. II Year (IVth Semester)

Paper XI (Theory) Inorganic Chemistry **Max. Marks: 33**

Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

Section-A

Chemistry of f – block elements

Lanthanides

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

Actinides

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U,

Comparison of properties of Lanthanides and Actinides and with transition elements.

Section-B

Theory of Qualitative and Quantitative Inorganic Analysis

Chemistry of analysis of various groups of basic and acidic radicals, Chemistry of identification of acid radicals in typical combinations, Chemistry of interference of acid radicals including their removal in the analysis of basic radicals. Theory of precipitation, co-precipitation, Post- precipitation, purification of precipitates.

B. Sc. IInd Year (IVth Semester)

Paper XII (Theory) Physical Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

Section-A

Thermodynamics

Second law of thermodynamics, need for the law, different statements of the law, Carnot's cycles and its efficiency, Carnot's theorm, Thermodynamics 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, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third law of thermodynamics: Nernst heat theorem, statement of concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz 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.

Section-B

Electrochemistry

Electrolytic and Galvanic cells – reversible & Irreversible cells, conventional representation of electrochemical cells. EMF of cell and its measurement, Weston standard cell, activity and activity coefficients.

Calculation of thermodynamic quantities of cell reaction (▲G, ▲H & K).

Types of reversible electrodes – metal- metal ion gas electrode, metal –insoluble salt- anion and redox electrodes. Electrode reactions, Nernst equations, derivation of cell EMF and single electrode potential. Standard Hydrogen electrode, reference electrodes, standard electrodes potential, sign conventions, electrochemical series and its applications.

Concentration cells with and without transference, liquid junction potential, application of EMF measurement i.e. valency of ions, solubility product activity coefficient, potentiometric titration (acid- base and redox). Determination of pH using Hydrogen electrode, Quinhydrone electrode and glass electrode by potentiometric methods.

B. Sc. IInd Year (IVth Semester)

Paper XIII (Theory) Organic Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

1. Infrared (IR) absorption spectroscopy

Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Applications of IR spectroscopy in structure elucidation of simple organic compounds.

2. Amines

Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction.

electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.

Section-B

1. Diazonium Salts

Mechanism of diazotisation, structure of benzene diazonium chloride, Replacement of diazo group by H, OH, F, Cl, Br, I, NO_2 and CN groups, reduction of diazonium salts to hyrazines, coupling reaction and its synthetic application.

2. Aldehydes and Ketones

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, advantage of oxidation of alcohols with chromium trioxide (Sarett reagent) pyridinium chlorochromate (PCC) and pyridinium dichromate., Physical properties. Comparison of reactivities of aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction.Oxidation of aldehydes, Baeyer–Villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions.

B.Sc. II Year

Paper XIV (Practicals) **Max. Marks: 72**

Time: 7 Hrs.
(Spread over two days)

SECTION – I (Inorganic)

1**. Gravimetric Analysis**

Quantitative estimations of, Cu^{2+} as copper thiocyanate and Ni^{2+} as Ni – dimethylglyoxime.

2**. Colorimetry:**

To verify Beer - Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given $KMnO_4/K_2Cr_2O_7$ solution.

3. Preparations: Preparation of Cuprous chloride, prussion blue from iron fillings, tetraammine cupric sulphate, chrome alum, potassium trioxalatochromate(III).

Section-B (Physical)

1. To determine the CST of phenol – water system.
2. To determine the solubility of benzoic acid at various temperatures and to determine the ▲H of the dissolution process
3. To determine the enthalpy of neutralisation of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
4. To determine the enthalpy of solution of solid calcium chloride
5. .To study the distribution of iodine between water and CCl_4.

Section-C (Organic)

Systematic identification (detection of extra elements, functional groups, determination of melting point or boiling point and preparation of at least one pure solid derivative) of the following simple mono and bifunctional organic compounds: Naphthalene, anthracene, acenaphthene, benzyl chloride, *p*-dichlorobenzene, *m*-dinitrobenzene, *p*-nitrotoluene, resorcinol , hydroquinone,

α-naphthol, β-naphthol, benzophenone, ethyl methyl ketone, benzaldehyde, vanillin, oxalic acid, succinic acid, benzoic acid, salicyclic acid, aspirin, phthalic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide, aniline hydrochloride, p-toluidine, phenyl salicylate (salol), glucose, fructose, sucrose, *o-, m-, p-* nitroanilines, thiourea.

Distribution of marks

1.	Section I	18 marks
2.	Section II	18 marks
3.	Section III	18 marks
4.	Viva-voce	06marks
5.	Lab Record	12 marks

B. Sc. III Year (Vth Semester)

Paper XV (Theory) Inorganic Chemistry **Max. marks: 33**

Time:Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

SECTION–A

1. Metal-ligand Bonding in Transition Metal Complexes

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

2. Thermodynamic and Kinetic Aspects of Metal Complexe

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes of Pt(II).

SECTION-B

1. Magnetic Properties of Transition Metal Complexe

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

2. **Electron 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.

B. Sc. IIInd Year (Vth Semester)

Paper XVI (Theory) Physical Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

Quantum Mechanics-I

Black-body radiation, Plank's radiation law, photoelectric effect, heat capacity of solids, Compton effect,wave function and significance of , postulates of quantum mechanics, quantum mechanical operator, commutation relations, Hamiltonial operator, Hermitian operator, average value of square of Hermitian as a positive quantity, Role of operators in quantum mechanics, To show quantum mechanically that position and momentum cannot be predicated simultaneously, Determination of wave function & energy of a particle in one dimensional box, Pictorial representation and its significance,

Physical Properties and Molecular Structure

Optical activity, polarization – (clausius – Mossotti equation). Orientation of dipoles in an electric field, dipole moment, included dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, Magnetic permeability, magnetic susceptibility and its determination. Application of magnetic susceptibility, magnetic properties – paramagnetism, diamagnetism and ferromagnetics.

Section-B

Spectroscopy:

Introduction: Electromagnetic radiation, regions of spectrum,

basic features of spectroscopy, statement of Born-oppenheimer approximation, Degrees of freedom.

Rotational Spectrum

Diatomic molecules. Energy levels of rigid rotator (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, effects of anharmonic motion and isotopic effect on the spectra., idea of vibrational frequencies of different functional groups.

Raman Spectrum:

Concept of polarizibility, pure rotational and pure vibrational Raman spectra of diatomic molecules, selectin rules, Quantum theory of Raman spectra.

B. Sc. IIIrd Year (Vth Semester)

Paper XVII (Theory) Organic Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

NMR Spectroscopy

Principle of nuclear magnetic resonance, the PMR spectrum,number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift,shielding and deshielding of protons, proton counting,splitting of signals and coupling constants, magnetic equivalence of protons.Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide, 1,1-dibromoethane, 1,1,2-tribromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde and acetophenone..Simple problems on PMR spectroscopy for structure determination of organic compounds.

SECTION – B

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 into mannose. Formation of glycosides, ethers and esters. Determination of ring size of glucose and fructose. Open chain and cyclic structure of D(+)-glucose & D(-) fructose. 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.

Organometallic Compounds

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

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

B. Sc. III Year (VIth Semester

Paper XVIII (Theory) Inorganic Chemistry **Max. marks: 33**

Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

Section-A

1. Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, and bonding of alkyls of Li, Al, Hg, and Sn a brief account of metal-ethylenic complexes, mononuclear carbonyls and the nature of bonding in metal carbonyls.

2. Acids and Bases, HSAB Concept

Arrhenius, Bronsted – Lowry, the Lux – Flood, Solvent system and Lewis concepts of acids & bases, relative strength of acids & bases, Concept of Hard and Soft Acids & Bases.

Section—B

1. 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 special reference to Ca^{2+}. Nitrogen fixation.

2. Silicones and Phosphazenes

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

B. Sc. IIInd Year (VIth Semester)

Paper XIX (Theory) Physical Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Section-A

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 and pie and n molecular orbital (MO) their energy level and respective transitions.

Photochemistry

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grotthus-Drapper law, Stark-Einstein law (law of photochemical equivalence) Jablonski diagram depiciting 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).

Section-B

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, Raolut's law, relative lowering of vapour pressure, molelcular 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 point, 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, degree of dissociation and association of solutes.

Phase Equillibrium

Statement and meaning of the terms – phase component and degree of freedom, thermodynamic derivation of Gibbs phase rule, phase equilibria of one component system –Example – water and Sulpher systems.

Phase equilibria of two component systems solid-liquid equilibria, simple eutectic

Example Pb-Ag system, desilerisation of lead

B. Sc. IIIrd Year (VIth Semester)

Paper XX (Theory) Organic Chemistry

Marks: 33
Time: 3 Hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

SECTION – A

Organosulphur Compounds

Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine. Synthetic detergents alkyl and aryl sulphonates.

Heterocyclic 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 reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six- membered heterocycles. Prepration 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, quinoline and isoquinoline.

SECTION – B

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.

Amino Acids, Peptides& Proteins

Classification, of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation 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: Primary & Secondary structure.

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, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes.

Natural and synthetic rubbers.

B.Sc. III Year

Paper XXI (Practical) **Max. Marks: 72**

Time: 7 Hrs. (Spread over two days)

<u>SECTION – I</u> (Inorganic)

Semimicro qualitative analysis of mixture containing not more than four radicals (including interfering, Combinations and excluding insoluables):

Pb^{2+}, Hg^{2+}, Hg_2^{2+}, Ag^{+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, As^{3+}, Sb^{3+}, Sn^{2+}, Fe^{3+}, Cr^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH_4^{+}, CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_2^{-}, CH_3COO^{-}, Cl^{-}, Br^{-}, I^{-}, NO_3^{-}, SO_4^{2-}, $C_2O_4^{2-}$, PO_4^{3-}, BO_3^{3-}

Section-B (Physical)

1. To determine the strength of the given acid solution (mono and dibasic acid) conductometrically.
2. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically
3. To determine the strength of given acid solution (mono and dibasic acid) potentiometrically.
4. To determine the molecular weight of a non-volatile solute by Rast method.
5. To standardize the given acid solution (mono and dibasic acid) pH metrically.

Section-C (Organic)

1. Laboratory Techniques

(a) Steam distillation (non evaluative)

Naphthalene from its suspension in water

Separation of *o*-and *p*-nitrophenols

(b) Column chromatography (non evaluative)

Separation of fluorescein and methylene blue

Separation of leaf pigments from spinach leaves

2. Thin Layer Chromatography

Determination of R_f values and identification of organic compunds

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

(b) Separation of a mixture of coloured organic compounds using common organic solvents.

3. Synthesis of the following organic compounds:

(a) To prepare o-chlorobenzoic acid from anthranilic acid.

(b) To prepare p-bromoaniline from p-bromoacetanilide.

© To prepare m-nitroaniline from m-dinitrobenzene.

(d) To prepare S-Benzyl-iso-thiouronium chloride from thiourea.

1.	Section I	18 marks
2.	Section II	18 marks
3.	Section III	18 marks
4.	Viva-voce	06 marks
5.	Lab Record	12 marks