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DETAILED SYLLABUS

FOR

DISTANCE EDUCATION

B.Sc. (Chemistry)

(SEMESTER SYSTEM)

B.Sc. Chemistry

COURSE TITLE: B.Sc. (CHEM)
DURATION : 6 SEMESTERS
MODE : SEMESTERS

FIRST SEMESTER

COURSE TITLE	Paper Code	MARKS				
		THEORY		PRACTICAL		TOTAL
		INTERNAL	EXTERNAL	INTERNAL	EXTERNAL	
Inorganic Chemistry	Paper I (Theory)	40	60			100
Physical Chemistry	Paper II (Theory)	40	60			100
Organic Chemistry	Paper III (Theory)	40	60			100

SECOND SEMESTER

COURSE TITLE	Paper Code	MARKS				
		THEORY		PRACTICAL		TOTAL
		INTERNAL	EXTERNAL	INTERNAL	EXTERNAL	
Inorganic Chemistry	Paper IV (Theory)	40	60			100
Physical Chemistry	Paper V (Theory)	40	60			100
Organic Chemistry	Paper VI (Theory)	40	60			100
Volumetric Analysis	Paper VII (Practicals)			40	60	100

B.Sc. Ist Year (Ist Semester)

Paper I (Theory)Inorganic Chemistry Max. Marks: 60+40

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

Max. Marks: 60+40 **Time: 3 Hrs.**

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: 60+40**
Time: 3 Hrs.

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: 60+40**
Time: 3 Hrs.

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 (13^{th} 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, pה– dה 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

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: 60+40**

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: 60+40**

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