B.Sc. FIRST YEAR-2023

PAPER - I

Paper I CH-101 Inorganic Chemistry

UNIT: I

Chemical Bonding-Covalent bond

Valence bond theory and its limitation, Directional characteristics of covalent bond, Hybridizations-sp, sp^2, sp^3, dsp^2, sp^3d, dsp^3, sp^3d^2 and d^2sp^3 with suitable examples. Shapes of inorganic molecules and ions. Valence shell election pair repulsion (VSEPR) theory and its application to study the geometry of NH_3, H_2O, H_3O^+, SF_4, ICl^-_2, ClF_3, ICl^-_4, XeF_4, XeF_6, molecules. Molecular orbital theory and molecular orbital diagrams for homo and heterodiatomic molecules-H_2, H_2^+,He_2^+,HHe^+, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, O_2^+, O^-_2, O_2^{2-}, O_2^{2+} ,CO and NO.
Bonding in diborane (3c-2e bonding).

UNIT: II

Chemical Bonding- Ionic Bond

Lattice energy and Born-Haber cycle. Solvation energy, solubility of ionic solids, Fajan's rule, polarizing power and polariziblity of ions.
Structures of ionic solids, radius ratio effect and co-ordination number. Limitations of radius ratio rule.
Hydrogen bonding and vander-waal's forces of attractions.

UNIT: III

s-Block elements

Periodicity in properties of alkali and alkaline earth metals. Complexation tendency, Solvation tendency, stability and solubilities of carbonates, bicarbonates and sulphates of Magnesium and Calcium, Synthesis and applications of important hydrides: NaH, $NaBH_4$, LiH, $LiBH_4$, $LiAlH_4$ and CaH_2.
Cement: Composition and types of Cement, Manufacture of Portland cement.
Lime: Industrial preparation, Properties and Uses.

UNIT: IV

p-Block elements

Periodicity in properties of III A, IV A, V A, VI A and VII A group elements.

Silicates, oxides of nitrogen, phosphorous and sulphur- their structure and preparations.

Glass: Types and properties of glasses, coloring agents, Industrial manufacturing of glass.

Nitrogen fixation- Natural and Artificial fixation. Role of nitrogenase in biological nitrogen fixation.

UNIT: V

Qualitative Analysis

Theoretical basis of qualitative analysis, Systematic analysis of Acidic and Basic radicals (including interfering radicals). Chemical reactions involved.

Common- ion effect, solubility product & their applications. Oxidizing and reducing agents and buffers used in analysis.

Books Recommended:

1. Inorganic Chemistry by Satya Prakash
2. Inorganic Chemistry by R.C. Agarwal
3. Inorganic Chemistry by B.R. Puri and L.R. Sharma
4. Inorganic Chemistry by P.L. Soni
5. Inorganic Chemistry by G.C. Shivhare and V.P. Lavania
6. Practical Chemistry by Giri, Bajpai and Pandey

PAPER-II

CH-102 Organic Chemistry

UNIT: I

Mechanism of Organic Reactions

Classification of organic compounds their general characteristics. Types of reagents – electrophiles and nucleophiles. Types of organic reactions. Reactive intermediates – carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reactions mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

UNIT: II

Stereochemistry of Organic Compounds

Concept of isomerism. types of isomerism

Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

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

Conformational isomerism :Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation.

conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives.

UNIT: III

Alkanes , Cycloalkanes, Dienes and Alkynes

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. The case of cyclopropane ring: banana bonds.

Nomenclature and classification of dienes: isolated, conjugated and cumulated 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 in alkynes. Methods of formation. Chemical reactions of alkynes, acidic nature of 1-alkynes. Mechamism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, oxidation and polymerization.

UNIT: IV

Arenes and Aromaticity

Nomenclature of benzene derivatives. Aryl group. Aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.
Aromaticity: the Huckel rule, aromatic ions.
Aromatic electrophilic substitution – general pattern of the mechanism, role of σ- and π- complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.
Methods of formation and chemical reactions of alkylbenzenes, Structure, preparation and properties of naphthalene.

UNIT: V

Alkyl and Aryl Halides

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams. Mechanism of elimination reactions of alkyl halides, regioselectivity in dehydrohalogenation, Saytzeff rule.
Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.
.Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides towards nucleophilic-substitution reactions. Synthesis and uses of DDT and BHC.

Books Recommended:

1. Advanced Organic Chemistry by Mukheri and Kapoor Vol. I & II
2. A Text Book of Organic Chemistry by M.K. Jain

3. A Text Book of Organic Chemistry by R.K. Bansal
4. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall

PAPER – III

CH-103 Physical Chemistry

UNIT: I

Mathematical Concepts

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like a^x, e^x,x^n, sin x, cos x, tan x, log x; maxima and minima, partial differentiation. Integration of some useful functions; like x^n, $1/x$, e^x, constant, sin x, cos x, integration by parts. Permutations and combinations. Probability.

UNIT: II

Gaseous State

Deviation from ideal behavior, Vander Waals equation of state and its discussion.

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

Molecular velocities: Root mean square, average and most probable velocities(No derivation). Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquification of gases (based on Joule-Thomson effect). Numericals.

UNIT: III

Liquid and Colloidal State

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

Structural differences between solids, liquids and gases.

Liquid crystals: Classification-nematic, smectic and cholestric phases. Theory of liquid crystal (Swarm theory).

Colloidal State: Definition of colloids, classification of colloids.

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

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

Liquids in solids (gels): classification, preparation and properties, imbibitions and syneresis. General applications of colloids.

UNIT: IV

Solutions

Types of liquid mixtures, ideal and non-ideal mixtures, vapour pressure of liquid mixtures, distillation of immiscible liquid mixtures. Partially miscible liquids mixtures-phenol-water, triethylamine-water, nicotine-water-systems, consolute temperature-lower and upper, Effect of impurity on consolute temperature-Phenol-water system, immiscible liquids, Principle and Methodology of steam distillation. Numericals

UNIT V

Chemical Kinetics

Rate, order, molecularity and stoichiometry of a reaction, Derivation of Integrated rate law and characteristics of zero, first and second order reactions, Pseudo-first order reaction, Determination of the order of reaction-differential method, method of integration(hit and trial method), half-life method and isolation method.

Theories of Reaction Rate: Simple collision theory and its limitations, transition state theory (equilibrium hypothesis) and derivation of the rate constant, Thermodynamical formulation of rate constant, Comparison of collision theory and transition state theory, Numericals.

Books Suggested:

1. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
2. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wile Eastern Ltd.
3. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Naginchand & Co.
4. Physical Chemistry, Bahl and Tuli, S. Chand & Co.(P) Ltd.
5. Physical Chemistry, Vol. I & II, S. Pahari, New Central Book Agency (P) Ltd.
6. Bhotic Rasayan, K.R. Genwa, RBD Jaipur

B. Sc. I Year (Practicals)

CH – 104 Laboratory Course I

1. Inorganic Chemistry: [20]

Qualitative analysis of inorganic mixture containing 5-radicals (anions and cations), separation and identification of (group 0, I, II, III, IV, V and VI) and anions including interfering radicals and special combination of acidic radicals (CO_3^{2-}, SO_3^{2-}; NO_3^-,NO_2^-; NO_3^- , Br^-; Cl^- , Br^- , I^-; S^{2-} , SO_3^{2-}, SO_4^{2-})

2. Physical Chemistry: [15]

(a) Viscosity:

(I) To determine the viscosity of the given organic liquid by Ostwald Viscometer

(II) To determine the % composition of a binary solution by Viscosity measurement.

(b) Surface Tension:

(I) To determine the surface tension of a given organic liquid by Stalagmometer.

(II) To determine the % composition of a binary solution by surface tension measurement.

3. Volumetric analysis [15]

Redox Titrations:

(i) To determine the strength of given unknown copper sulphate solution iodometrically using starch as indicator.

(ii) To determine the strength of given unknown potassium dichromate solution iodometrically using starch as indicator.

4. Organic Models (Using Ball and Stick Model Box): [5]

R and S configuration of optical isomers

D and L configuration of optical isomers

E/Z configuration of geometrical isomers

Conformation isomerism of ethane and n-butane

Viva-Voce **[5]**

Sessional/Record **[15]**

Books Suggested (Laboratory Courses):

1. Practical Chemistry by S.Giri, D.N.Bajpai and O.P.Pandey Publ. S. Chand

Examination & Marking Scheme

Time: 5 hours	Max. Marks: 75	Min. Pass Marks: 27
	Regular Student	Ex- Student
Inorganic Mixture	20	20
Volumetric Exercise	15	15
Physical Experiment	15	15
Organic Models	05	05
Viva- Voice	05	05
Sessional and Record	15	----
Total	75	60*

*To be converted out of 75

Inorganic qualitative mixture for 5 radicals: Correct Identification of group- 1 mark each, correct radical reporting- 2 marks each and proper reporting of observations- 1 marks.

1. **Volumetric Exercise:** An error up to 0.1% carries full marks. For each subsequent 0.1% error deduct 1 mark, 8 marks reserved for procedure.

2. **Physical Experiment:** Correct Observations- 6 mark, Calculation and Formula-5, Correct Result-4 marks.