B.Sc. – I Chemistry (Paper-I)

Inorganic Chemistry :

Unit – I

I. Atomic Structure:

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

II. Periodic Properties:

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

Unit – II

III. Chemical Bonding:

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

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

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

Unit – III

IV. s-Block Elements:

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

V. Chemistry of Noble Gasses:

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

Unit – IV

VI. p-Block Elements:

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

Organic Chemistry :

Unit – I

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

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

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

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

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

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

Unit – II

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

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

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

Conformational isomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation.

Unit – III

V. Alkenes, Cycloalkenes, Dienes and Alkynes:
Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halids, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.
Chemical reactions of alkenes – mechanism involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration- oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes, Industrial applications of ethylene and propene.
Methods of formation, conformation and chemical reactions of cycloalkenes;
Nomenclature and classification of dienes : isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, chemical reaction – 1, 2 and 1, 4 additions, Diels-Alder reaction.
Nomenclature, structure and bonding in alkynes, Methods of formation, Chemical reactions of alkynes, acidity of alkynes, Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

Unit – IV

VI. Arenes and Aromaticity:
Nomenclature of benzene derivatives, The aryl group, Aromatic nucleus and side chain, Structure of benzene; molecular formula and kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.
Aromaticity: The Huckle rule, aromatic ions.
Aromatic electrophilic substitution – general pattern of the mechanism, role of 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, alkynylbenzenes and biphenyl, naphthalene and Anthracene;

VII. Alkyl and Aryl Halides:
Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams;
Polyhalogen compounds : Chloroform, carbon tetrachloride;
Methods of formation of aryl halides, nuclear and side chain reactions;
The addition-elimination and the elimination-addition mechanisms of nucleophilc aromatic substitution reactions;
Relative reactivities of alkyl halides vs allyl, vingl and aryl halides, Synthesis and uses of DDT and BHC.

Physical Chemistry :

Unit – I

I. Mathematical Concepts and Computers:

(A) Mathematical Concepts:

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

(B) Computers:

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

Unit – II

II. Gaseous States:

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

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

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

III. Liquid State:

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

Structural differences between solids, liquids and gases;

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

Unit – III

IV. Solid States:

Definition of space lattice, unit cell;

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

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

V. Colloidal States:

Definition of colloids, classification of colloids;

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

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

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

Unit – IV

VI. Chemical Kinetics and Catalysis:

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

Radioactive decay as a first order phenomenon;

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

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

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

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

B.Sc. I

Chemistry Practical

Inorganic Chemistry:

Qualitative analysis of inorganic mixture containing five radicals (including insoluble substances, interfering anions and combination of anions) preferably by semimicro technique.

Organic Chemistry

Organic Compound preparation

1. Acetanilide
2. p - Bromoacetanilide
3. p- Nitroacetanilide
4. Dibenzalacetone
5. Picrate
6. α - Naphtholpicric acid
7. Phenyl – azo – β – naphthol (an azo dye)
8. Aniline Yellow

Physical Chemistry

Chemical Kinetics

1. To study the kinetics of dissolution of Mg in dil HCl.
2. To study the kinetics of decomposition of $Na_2S_2O_3$ by mineral acid.

Surface Tension

1. To determine the relative surface tension of liquid with respect to water at room temperature by stalgnometer.
2. To determine the percentage composition of a given binary mixture (non – interacting) by surface tension method.
3. (i) To determine surface tension of an aqueous solution of a detergent.
   (ii) To study the variation of surface tension with the concentration of a detergent.

25.10.17

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Viscosity

1. To determine the relative viscosity of liquid with respect to water at room temperature by Ostwald's viscometer.
2. To determine the percentage composition of a given binary mixture (non-interacting) by viscosity method.
3. To determine the Coefficient of viscosity of 30% cane sugar solution by Ostwald viscometer.

System of Marking

Duration: 6h (1day)	**M.M: 50**
Exercise 1: Inorganic Mixture Analysis (five radicals)	15
Exercise 2: Organic Preparation (one compound)	15
Exercise 3: Any one Exercise from Physical Chemistry	10
Viva- voce	05
Record (including chart/model)	05

Minu Saigal

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25/10/17