B.Sc. Part - I (Semester - I)

1S Chemistry

Total Lectures: 84 **Marks: 80**

Unit I (14L)

A) Periodicity of Elements:

s and p block elements: Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle. Shapes of s and p orbitals. Electronic configuration for s and p block elements. Detailed discussion of the following properties of the elements, with reference to s and p-block. (a) Nuclear charge and number of shell and its variations (b) Atomic and ionic radii and their variations (d) oxidation states (e) Ionization potential, Successive ionization potential and its variations. (f) Electron affinity and its trends. (g) Electronegativity and its variations. Effect of ionization energy and electronegativity on different properties of elements namely metallic and non-metallic character, relative reactivity, oxidizing and reducing properties. Diagonal relationships: Li with Mg, B with Al. Abnormal behavior of nitrogen.

Unit II (14L)

A) Acids and Bases-

Arrhenius, Bronsted-Lowry, and Lewis's theory of acids and bases, Theory of solvent systems and Lux-Flood concept of acids and bases. Hard and soft acids and bases. Pearson's HSAB or SHAB principle with important applications.

B) Nonaqueous Solvents-

Requirements of a good solvent. Water as a universal solvent. Physical properties of solvents namely liquid range, dielectric constant, dipole moment, heat of vaporization and solubility behavior. Classification of solvents. Acid base, precipitation, redox, solvolysis and complexation reactions in liquid ammonia. Merits and demerits of liquid ammonia as a solvent.

Unit III (14L)

Basics of Organic Chemistry:

A) Electronic Displacement and Reactive Intermediates:

Inductive, Electromeric, Resonance, Mesomeric effects, Hyperconjugation and their

applications, dipole moment, homolytic and heterolytic fission with suitable examples. Electrophiles and nucleophiles. Types, shape and their relative stability of carbocations, carbanions, free radicals and carbenes and nitrene.

B) Aliphatic Hydrocarbons:

Formation and reaction of alkanes, Formation of alkenes and alkynes by elimination reactions (with mechanism of E1, E2, E1cb), Saytzeff and Hofmann eliminations, Reactions of alkenes and alkynes, Diels-Alder reaction.

C) Structural isomers: Definition, classification, and examples.

Unit IV - Aromatic Hydrocarbons (14L)

A) Structural Properties:

Aromaticity and Huckel's rule (Benzenoid and Non- Benzenoid compounds), Kekule and Dewar structures, Molecular orbital diagram of benzene, Anti-aromatic and non-aromatic compounds.

B) Orientation effect:

Effect of substituent groups, Activating and deactivating group, Theory of reactivity and orientation on the basis of inductive and resonance effects.

C) Electrophilic aromatic substitution:

Halogenation, nitration, sulphonation and Friedal Craft's alkylation/acylation with their mechanism.

Unit V Gaseous State

Postulates of kinetic theory of gases, Maxwell-Boltzmann distribution of velocities (only qualitative treatment), RMS velocity, Average velocity, Most probable velocity, Relationship between RMS velocity and Average velocity, RMS velocity and Most probable velocity, Mean free path, Collision diameter, Collision number or Collision frequency, Deviation of real gases from ideal behaviour, Explanation of deviations, Derivation of van der Waal's equation for real gases. Critical phenomenon, Andrew's experiment (isotherms of carbon dioxide) Critical constant Pc, Tc, Vc in terms of van

der Waal's constant (a, b) Derivation of reduced equation of state, Law of corresponding state, Numerical.

Unit VI (14L)

A) Liquid State:

Definition of surface tension, Its SI unit and effect of temperature on surface tension, Derivation of expression for relative surface tension by stalagmometer method. Applications of surface tension. Viscosity, definition of coefficient of viscosity, Its SI unit and effect of temperature on viscosity, Derivation of expression for relative viscosity by Ostwald's viscometer method, Applications of viscosity.

B) Physical Properties and Molecular Structure:

1. Electrical Properties:

i) Polar and non-polar molecules. Dipole moment.

ii) Induced polarization and orientation polarization. Clausius Mossotti equation (only qualitative treatment).

iii) Measurements of dipole moment by temperature and refractivity methods.

Iv) Application of dipole moment for the determination of molecular structure. i.e., percentage ionic character of covalent bonding, molecular geometry, cis-trans isomers, ortho, meta and para isomers of a disubstituted benzene.

2. Magnetic Properties:

i) Paramagnetic and diamagnetic substances, origin of paramagnetism, diamagnetism, ferromagnetism and antiferromagnetism.

ii) Volume, specific, mass and molar susceptibility. Relationship between molar magnetic susceptibility and magnetic moment.

iii) Relationship between magnetic moment and number of unpaired electrons.

iv) Gouy's balance method for determination of magnetic susceptibility.

v) Application of magnetic moment in the determination of molecular structure.

vi) Numerical

*SEM:

A) Create models for periodic table or periodic properties, or shape of orbitals, categorization of acids and bases on the basis of various theories, Compare applications of non-aqueous solvents.

B) Analyze the role of reaction intermediates in different organic reactions,

classification of aromatic and non-aromatic compounds with justification.

C) Numerical associated with gaseous and liquid state, Applications of van der Waal's equation for other gaseous constants and parameters, Prediction of molecular structures using physical properties, Data collection and analysis for surface tension and viscosity coefficient of different liquids.

Semester I

1S Chemistry Practical

Total Laboratory Sessions: 26 **Marks: 50**

❖ List of Practical/Laboratory Experiments/Activities etc.

1. Preparation of Acetyl derivative of aromatic primary amine (aniline or toluidine).
2. Preparation of Benzanilide (Benzoylation).
3. Preparation of Benzoic acid from Benzamide (Hydrolysis).
4. Preparation of Benzoic acid from benzaldehyde (Oxidation).
5. Preparation of phenyl–azo–β–naphthol dye (Diazotisation)
6. Base catalysed Aldol Condensation (Synthesis of dibanzal propanone).
7. Preparation of p-nitroacetanilide from acetanilide.
8. Determination of surface tension of a given liquid using Stalagmometer
9. Determination of the parachor value of -CH_2- group (methylene) using Stalagmometer
10. Determination of coefficient of viscosity of aqueous solution of ethanol or polymer at room temperature
11. Determination of unknown percentage composition of given glycerol solution from standard 2%, 4%,6%,8% and 10% solutions of glycerol
12. Determination of the heat of solution of KNO_3 (5% solution)

Distribution of Marks for Practical Examination

Time: 6 hours (One Day Examination) **Marks: 50**

Exercise-I …….. **18**

Exercise-II ……. **18**

Viva-Voce.…….. **07**

Record.…….. **07**

Total: **50**

B.Sc. Part - I (Semester - II)
2S Chemistry

Total Lectures: 84 **Marks: 80**

Unit I (14L)

A) Ionic bonding: Definition of ionic bond. Factors affecting ionic bond formation (energetic of ionic bond formation ionization energy, electron affinity and lattice energy). Born-Haber's cycle to determine lattice energy. Solvation and solvation energy, factors affecting solvation energy.

B) Polarization: Definition, polarizing power, polarizability, effect of polarization on nature of bond. Fajan's rules of polarization and its applications.

C) Valence bond theory: Directional nature of covalent bond. Hybridization, types of hybridization to explain geometries of $BeCl_2$, BF_3, CH_4, PCl_5, SF_6 and IF_7

Unit II (14L)

A) VSEPR Theory: Various rules under VSEPR theory to explain molecular geometry (following examples may be taken to explain various rules- $SnCl_2$, CH_4, NH_3, H_2O, SF_4, ClF_3, XeF_4, XeO_3, PCl_3. Limitations of VSEPR theory

B) Molecular Orbital Theory: Postulates of MO theory. LCAO approximation. Formation of bonding and antibonding MOs. Rules for LCAO. MO energy level diagram. Concept of bond order. MO structure of homonuclear diatomic molecules of namely He_2, H_2, N_2 and O_2. Stability sequence of species of O_2 i.e O_2^{+2} O_2^{+} O_2 O_2^{-} O_2^{-2}.Paramagnetic nature of O_2. Mo structure of heteronuclear diatomic molecules viz. NO, HF and CO (Coulson's structure). Explanation of important properties of CO viz. – triple bond, almost nonpolar nature, electron donor and acceptor behavior. Comparison of VB and MO theories.

Unit III (14L)

A) Haloalkanes: Vinyl chloride - Synthesis from acetylene and ethylene dichloride, reactions with aqueous and alcoholic KOH, polymerization. Allyl chloride - Synthesis

from propylene, reactions with aqueous and alcoholic KOH. Allyl bromide - Synthesis from propylene using NBS, reaction with HBr. Comparison of reactivity of vinyl and allyl chloride.

B) Haloarenes: Chlorobenzene - Synthesis from phenol, reaction with acetonitrile. Bromobenzene - Synthesis from silver salt of benzoic acid (Hunsdiecker reaction), Wurtz-Fittig reaction. Iodobenzene - Synthesis from benzene diazonium chloride, Ullmann reaction. Benzyl chloride - Synthesis from toluene and benzene, reactions with Mg and NaCN. Comparison of reactivity of chlorobenzene and benzyl chloride, benzyne intermediate mechanism.

C) Polyhydric alcohols: Ethylene glycol - Synthesis from ethylene and ethylene dibromide, reactions with PCl_5, CH_3COOH and acetone, dehydrations using conc. H_2SO_4, $ZnCl_2$ and phosphoric acid. Pinacol - Synthesis from acetone and α- diketone, Pinacol-Pinacolone rearrangement (mechanism). Glycerol - Synthesis from propylene and 3-chloropropylene, reactions with HNO_3, HCl and Na, dehydration using $KHSO_4$

Unit IV 14L

A)Phenols:

Phenol - Synthesis from toluene, cumene and salicylic acid, Kolbe's carboxylation reaction, Fries rearrangement, Reimer-Tiemann reaction, bromination, acidity of phenol.

B) Ethers and epoxides:

Diethyl ether - Synthesis from ethanol, Williamson's synthesis, reactions with cold and hot HI and acetic anhydride. Crown ethers - Brief introduction to crown ethers and its applications. Ethylene oxide - Synthesis from ethylene, ring opening reactions with Grignard reagent, HCN and H_2S, reduction with Zn + CH_3COOH, dimerization to dioxane (mechanism). Styrene oxide - Synthesis from styrene, ring opening reactions with acid and alkali, reduction with $LiAlH_4$.

C) Thiols and thioethers:

Ethanethiol - Synthesis from ethyl iodide, oxidations with I_2 and H_2O_2. Diethyl sulphide - Synthesis from ethyl bromide, Williamson's synthesis, desulphurization with Raney Ni, decomposition with alkali.

Unit V (14)

Crystalline state

Symmetry in crystal, plane of symmetry, axis of symmetry and point of symmetry. Law of constancy of interfacial angles. Elements of symmetry in cubic crystals. Laws of symmetry. Law of rational indices, Weiss and Miller indices of a lattice planes, calculation of interplanar distance d(h,k,l) from Miller indices in a cubic system. Seven crystal systems and fourteen Bravais lattices, Bravais lattices of cubic system. Simple cubic system (S.C.C.), body centered cubic system (B.C.C.) and face centered cubic system (F.C.C.). Calculation of number of constituent units in S.C.C., B.C.C. and F.C.C. Ratio of interplanar distances for 100, 110 and 111 lattice planes in S.C.C., B.C.C. and F.C.C. (No geometrical derivation).

Derivation of Bragg's equation for X-ray diffraction, Bragg's X-ray spectrometer method for the determination of crystal structure of NaCl and KCl. Anomalous behavior of KCl towards X-ray. Numerical.

Unit VI - Chemical Kinetics 14L

Explanation of terms like rate of reaction, order of a reaction and molecularity. Definition with one example of zero, first and second order reaction. Half-life period of a reaction. Derivation of rate equation for first and second order reaction with equal initial concentration and different initial concentration of a reactant. Characteristics of first and second order reaction. Examples of first and second order reaction and their kinetics study with modified rate equation viz. the reactions (i) decomposition of H_2O_2, (ii) reaction between $K_2S_2O_8$ and KI, (iii) hydrolysis of methyl acetate catalyzed by acid, (iv) saponification of ethyl acetate by NaOH and (v) inversion of cane sugar. Determination of order of a reaction by integration, graphical, equifractional change, vant Hoff's differential method and Ostwald's isolation method. Effect of temperature on reaction rates. Arrhenius equation, activation energy and its determination using Arrhenius equation. Numerical.

*SEM:

A) Classify molecules using hybridization, VSEPR theory to predict molecular geometries, sketch Molecular orbital diagram for different molecules.

B) Comparative reactivity of halobenzene and benzyl halide, determine industrial uses of phenol, diethyl ether and ethylene epoxide.

C) Numerical associated with crystalline state and chemical kinetics, Determination of

crystal structure of NaCl and KCl, Determination of order of reactions, and reaction kinetics.

Semester II

2S Chemistry Practical

Total Laboratory Sessions: 26 **Marks: 50**

❖ List of Practical/Laboratory Experiments/Activities etc.

Complete analysis of simple organic compounds (like urea, thiourea, benzoic acid, Salicylic acid, oxalic acid, glucose, naphthalene, para-toluidine, benzamide, etc.) containing one or two functional groups involving following steps.

i) Preliminary examination

ii) Detection of elements

iii) Detection of functional groups

iv) Determination of melting point

v) Preparation of derivative and determination of its melting point
Performance of spot test, if any

1. Qualitative analysis of compound-1
2. Qualitative analysis of compound-2
3. Qualitative analysis of compound-3
4. Qualitative analysis of compound-4
5. Qualitative analysis of compound-5
6. To determine the strength of oxalic acid by titration with $KMnO_4$
7. To determine strength of FAS by titration with $KMnO_4$ using internal indicator.
8. Determination of temporary hardness of water sample.
9. To determine the strength of oxalic acid by titration with $KMnO_4$
10. To determine strength of FAS by titration with $KMnO_4$ using internal indicator.
11. Determination of order of reaction of hydrolysis of methyl acetate by an acid.
12. To study kinetics of saponification of ethyl acetate by NaOH.

Distribution of Marks for Practical Examination

Time: 6 hours (One Day Examination) **Marks: 50**

Exercise-I ……..	**18**
Exercise-II …….	**18**
Viva-Voce.…….	**07**
Record.…….	**07**
Total:	**50**