Shree H. N. Shukla College of Science

(Affiliated to Saurashtra University)

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SEMESTER - I

SEMESTER-I: CHEMISTRY THEORY COURSE [C -101]

6- Credits: 100 Marks

UNIT-1

1. Atomic Structure and Periodic Properties [4 Hours]

Dual nature of electron: de-Broglie's equation, Heisenberg's Uncertainty Principle, quantum numbers, Aufbau Principle, Pauli's Exclusion Principle and Hund's Rule for electron configuration.

Periodicity in atomic properties and its causes, explanation of general trends of periodic properties: atomic and ionic radii, ionization potential, electronegativity and electron affinity.

2. Chemistry of s and p block elements [4 Hours]

Special characteristics such as metallic character, polarizing power, hydration energy, inert pair effect, relative stability of different oxidation state, Diagonal relationship of (1) lithium with magnesium (2) boron with silicon and (3) beryllium with aluminum, Anomalous behavior of Li, Be, Formation of complex compounds, c

3. Adsorption [4 Hours]

Introduction, types of adsorption (physical and chemical), characteristics and factors affecting adsorption, Adsorption isotherm and Freundlich equation, Langmuir theory of adsorption: assumptions, derivation, modification in equation at very low and high pressure and applications of adsorption.

UNIT-2

4. Chemical bonding in covalent compounds [12 Hours]

Covalent bond: Valence bond theory and its limitations, Concept of hybridization: sp ($BeCl_2$), sp^2 (BF_3), sp^3 (SiH_4), sp^3d (PCl_5) and sp^3d^2 (SF_6).

Stereochemistry of inorganic molecules: Sidgwick Powell rule and VSEPR theory, Structure of molecules: $SnCl_2$, SO_4^{-2}, CO_3^{-2}

Basic concept of MO theory, bonding and anti-bonding molecular orbitals, gerade and ungerade molecular orbitals, σ - molecular orbital and σ* - molecular orbital, π- molecular orbital and π*- molecular orbital, Conditions for effective combinations of atomic orbitals Energy level diagrams of B_2, C_2, N_2, O_2, F_2, CO, NO, CO_2 (with s-p mixing and orbital interaction) with calculation of bond order and magnetic moment Comparison of MO theory and VB theory.

UNIT-3

5. Basic Organic Chemistry and aliphatic hydrocarbons containing σ-bond [12 Hours]

Nomenclature of organic compounds (Only Acyclic - IUPAC-1993)

Electronic displacements: Inductive effect, electromeric effect, mesomeric effect and hyper conjugation. Applications of inductive effect to bond length, dipole-moment, reactivity of alkyl halides, relative strength of acid, basicity of amines.

Homolytic and heterolytic fission, curly arrow rules **Reaction intermediates**: Carbocation, carbanion, free radical, carbenes and benzynes (Formation by cleavage type, structure, relative stabilities, generation)
Types of organic reagents: Nucleophiles and electrophiles.
Types of organic reactions: Substitution, addition, elimination and rearrangement. Nucleophilic substitution reaction mechanism (S_N1 & S_N2) for alkyl halides
Introduction to Stereochemistry: Configuration, Fischer projection formula, homomers and enantiomers, geometrical isomerism: cis–trans, C.I.P rules with E/Z notations.

UNIT-4

6. Aliphatic Hydrocarbons (Acyclic) [12 Hours]

Chemistry of alkanes:
Formation of alkanes: Wurtz reaction, Wurtz-Fittig reaction.
Free radical substitutions: Halogenation-relative reactivity and selectivity.
Hydrocarbons containing Carbon-Carbon π bonds:
Formation of alkene by Elimination reactions, dehydration of alcohol, dehydrohalogenation of alkyl halide, dehalogenation of vicinal and germinal dihalides
Mechanism of E1, E2, E1cb reactions, Saytzeff and Hofmann eliminations
Electrophilic addition reaction and its mechanism (Markownikov/Anti Markownikov rule)
Reactions of alkenes: Oxymercuration-demercuration, Hydroboration oxidation, Ozonolysis, Reduction (catalytic), Syn and anti-hydroxylation (oxidation), 1, 2- and 1,4 -addition reactions in conjugated dienes, Diels-Alder reaction.
Formation of alkynes: Dehydrohalogenation of vicinal and geminal dihalides, Dehalogenation of tetrahalides
Reactions of alkynes: Acidity, electrophilic addition reactions like halogenation, hydrohalogenation, hydration, hydroboration, addition of carbene and catalytic hydrogenation.
Nucleophilic addition with hydrogen cyanide and alcohol, hydration to form carbonyl compounds, alkylation of terminal alkynes.

UNIT-5

7. Catalysis [3 Hours]

Introduction, types of catalysis (homogeneous and heterogeneous), characteristics of catalysis, auto-catalysis, negative catalysis (Inhibitor), promoters, and catalytic poisoning Activation energy and catalysis
Theories of catalysis: (1) Intermediate compound formation and (2) adsorption theory, active centers
Enzyme catalysis and its characteristics

8. Chemical Kinetics [9 Hours]

Concept of chemical kinetic: rate of chemical reaction, concentration dependence of reaction rate specific reaction rate constant, order and molecularity of the reaction. Factors affecting rate of the reaction.
Definition, derivation of integrated rate equations for zero, first and second (same and different reactants) order reactions, their characteristics and half -life periods.
Determination of the order of reaction: (1) Hit and trial method (Integration method) and its limitations (2) Oswald's isolation method (3) Half-life period method (4) Graph method and (5) Van't Hoff differential method, Concept of activation energy, Derivation of Arrhenius equation and determination of activation energy by integrated equation and methods.

Theories of Reaction Rates: Collision theory and absolute reaction rate theory of bimolecular reactions and qualitative comparison.
Numericals

SEMESTER - I

SEMESTER-I: CHEMISTRY PRACTICAL COURSE [C -102]

3- Credits: 50 Marks

Note Practical Examination:

- Total Marks : 50 Marks {35 Marks External & 15 Marks internal}
- Duration : 3½ hrs
- Two exercises to be performed:
  - **Exercise – I:** Organic Qualitative analysis : 20 Marks (2 Hrs)
  - **Exercise – II:** Volumetric Analysis : 15 marks (1½ Hr)

Exercise – I: Organic qualitative analysis [20 marks]
(Minimum 12 compounds should be given)
Compounds containing one functional group such as phenolic, carboxylic acid, ester, amide, nitro, amine, aldehyde, ketone, alcohol, halogen, anilide, carbohydrate and hydrocarbon.
List of compounds: Benzoic acid, cinnamic acid, phenol, α-naphthol, β-naphthol, acetone, ethyl methyl ketone, methyl acetate, ethyl acetate, naphthalene, aniline, nitrobenzene, benzamide, urea, thiourea, chloroform, acetanilide, carbon tetra chloride, chloro benzene, bromo benzene.
Exercise – II: Volumetric analysis [15 Marks]

1. Acid-base titrations

- To prepare a solution by dissolving 'x' g $NaHCO_3$ /Na_2CO_3 in 100 ml solution and determine its concentration in terms of normality and molarity using 0.1 N HCl solution.
- To determine the normality, molarity and g/lit of NaOH and HCl using 0.1 N Na_2CO_3 solution.
- To determine the normality, molarity and g/lit of each component in a given mixture of $NaHCO_3$ and Na_2CO_3 using 0.1N HCl solution.

2. Redox titrations

- To determine the normality, molarity and g/lit of each component in a mixture of $H_2C_2O_4.2H_2O$ and H_2SO_4 using 0.1 N $KMnO_4$ and 0.1N NaOH solution.
- To determine the normality, molarity and g/lit of each component in a mixture of $H_2C_2O_4.2H_2O$ and $K_2C_2O_4.H_2O$ using 0.1N NaOH and 0.1 N $KMnO_4$ solution
- To determine the normality, molarity and g/lit of $KMnO_4$ and $FeSO_4.7H_2O$ solution using 0.1 N $H_2C_2O_4.2H_2O$ solution.
- To determine the normality, molarity and g/lit of $FeSO_4$ $(NH_4)2SO_4.6H_2O$ and $K_2Cr_2O_7$ solutions using 0.1 N $KMnO_4$ solution.