There will be two papers in the subject:
Paper I: Theory- 3 hours ... 70 marks
Paper II: Practical - 3 hours ... 15 marks
Project Work ... 10 marks
Practical File ... 5 marks

PAPER 1- THEORY: 70 Marks

S.No.	UNIT	TOTAL WEIGHTAGE
1.	Some Basic Concepts of Chemistry	**Physical Chemistry 32 Marks**
2.	Structure of Atom	
3.	Classification of Elements and Periodicity in Properties	
4.	Chemical Bonding and Molecular Structure	
5.	States of Matter: Gases and Liquids	
6.	Chemical Thermodynamics	
7.	Equilibrium	
8.	Redox Reactions	**Inorganic Chemistry 15 Marks**
9.	Hydrogen	
10.	s-Block Elements	
11.	Some p-Block Elements	
12.	Organic Chemistry: Some basic Principles and Techniques	**Organic Chemistry 23 Marks**
13.	Hydrocarbons	
14.	Environmental Chemistry	
	TOTAL	**70 Marks**

PAPER I –THEORY – 70 Marks

1. Some Basic Concepts of Chemistry

General introduction: Importance and scope of chemistry.

Study of matter. Understanding laws of chemical combination. Dalton's atomic theory: concept of elements, atoms and molecules.

Isotopic (atomic) and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula. Stoichiometry and calculations based on chemical reactions.

  i.   *Precision and accuracy:*

       Quantities and their measurements in Chemistry, significant figures, SI units.

 ii.   *Dimensional analysis:*

       Conversion of units, numericals and applications of units.

iii.   *The concept of atoms having fixed properties in explaining the laws of chemical combination.*

Study about atoms. Dalton's atomic theory: Main postulates of the theory; its limitations.

Laws of chemical combinations:

♣ *Law of conservation of mass.*

♣ *Law of definite proportions.*

♣ *Law of multiple proportions.*

♣ *Law of reciprocal proportions.*

♣ *Gay Lussac's law of gaseous volumes.*

Statement, explanation and simple problems based on these laws.

i. *Atomic (isotopic masses) and molecular mass.*

Relative molecular mass and mole:

The atomic mass unit is one of the experimentally determined unit. It is equal to 1/12 of the mass of the carbon 12 isotope.

Numerical problems based on mole concept, Avogadro's number and gram molecular volume.

ii. *Empirical and molecular formula: Numericals based on the above.*

iii. *Chemical equivalents, volumetric calculations in terms of normality. C = 12.00 should be taken as a standard for expressing atomic masses.*

Equivalent weight expressing the combining capacity of the elements with the standard elements such as H, Cl, O, Ag, etc.

Variable equivalent weight. Gram equivalent weights, relationship between gram equivalent weight, gram molecular mass and valency.

Determination of equivalent weight of acids, alkalis, salts, oxidising and reducing agents. (experimental details not required).

Terms used in volumetric calculations such as percentage (w/w and w/v), normality, molarity, molality, mole fraction, etc. should be discussed. Students are required to know the formulae and normality and molarity equations.

Simple calculations on the above topics.

iv. *Chemical reactions – stoichiometric calculations based on mass-mass, mass-volume, volume-volume relationships and limiting reagent.*

2. Structure of Atom

Discovery of fundamental particles electron, proton and neutron), atomic number, isotopes and isobars. Thomson's model and its limitations. Rutherford's experimental model and its limitations. Dual nature of matter and light. Bohr's atomic model and its

limitations (de Broglie's equation, Heisenberg's uncertainty principle), concept of shells, subshells, orbitals. Quantum numbers, shapes of s, p and d orbitals. Rules for filling electrons in orbitals - aufbau principle, Pauli's exclusion principle and Hund's rule of maximum multiplicity. Electronic configuration of atoms, stability of half- filled and completely filled orbitals.

i. *Subatomic particles (electrons, protons and neutrons) their charges and masses: Concept of indivisibility of atom as proposed by Dalton does not exist. The atom consists of subatomic fundamental particles. Production of cathode rays and their properties. Production of anode rays and their properties.*

    Chadwick's experiment for the discovery of neutron and properties of neutron.

ii. *Rutherford's nuclear model based on the scattering experiment: Rutherford's scattering experiment. Discovery of nucleus. Rutherford's nuclear model of atom. Defects of Rutherford's model. Electromagnetic wave theory and its limitations (Black body radiation and photoelectric effect) Planck's quantum theory.*

    Numericals based on the above.

iii. *Types of spectra: emission and absorption spectra. Band and line spectra to be discussed.*

iv. *Bohr's atomic model.*
    Postulates of Bohr's theory – based on Planck's quantum theory.
    Merits of Bohr's atomic model and explanation of hydrogen spectra.
    Calculations based on Rydberg's formula.
    Numericals on Bohr's atomic radii, velocity and energy of orbits (derivation not required).
    Defects in Bohr's Model.

v. *Quantum mechanical model of an atom - a simple mathematical treatment. Quantum numbers; shape, size and orientation of s, p and d orbitals only (no derivation). aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity. Electronic configuration of elements in terms of s, p, d, f subshells.*

- ♣ *de Broglie's equation. Numericals.*
- ♣ *Heisenberg's Uncertainty Principle. Numericals.*
- ♣ *Schrodinger Wave Equation – physical significance of Ψ and $|\Psi|^2$.*
- ♣ *Quantum numbers – types of quantum numbers, shape, size and orientation of the s, p and d subshells. Information obtained in terms of distance of electron from the nucleus, node, nodal planes and radial probability curve, energy of electron, number of electrons present in an orbit and an orbital.*
- ♣ *aufbau principle, (n+l) rule.*
- ♣ *Pauli's exclusion principle.*
- ♣ *Hund's rule of maximum multiplicity.*
- ♣ *Electronic configuration of elements and ions in terms of s, p, d, f subshells and stability of half-filled and completely filled orbitals.*

3. Classification of Elements and Periodicity in Properties

Significance of classification; study of Mendeleev's periodic law and its limitations; Modern Periodic Law and the present form of periodic table leading to periodic trends in properties of elements - atomic radii, ionic radii, valency, ionisation enthalpy, electron gain enthalpy, electronegativity. Nomenclature of elements with atomic number greater than 100.

i. *Modern Periodic Law*

   Mendeleev's periodic law, defects in the Mendeleev's periodic table. Advantages and disadvantages. Modern periodic law (atomic number taken as the basis of classification of the elements).

ii. *Long form of Periodic Table.*

   General characteristics of groups and periods. Division of periodic table as s, p, d and f blocks. IUPAC nomenclature for elements with Z> 100.

iii. *Periodic trends in properties of elements.*

   Atomic radius, ionic radius, ionisation enthalpy, electron gain enthalpy, electronegativity, metallic and non-metallic characteristics.

   ♣ *Periodic properties such as valence electrons, atomic and ionic radii and their variation in groups and periods.*
   ♣ *The idea of ionisation enthalpy, electron gain enthalpy and electronegativity must be given and their variation in groups and periods may be discussed.*
   ♣ *The factors (atomic number, screening effect and shielding effect, the number of electrons in the outermost orbit) which affect these periodic properties and their variation in groups and periods.*

iv. *Periodic trends in chemical properties – periodicity of valence or oxidation states. Anomalous properties of second period elements.*

   Diagonal relationship; acidic and basic nature of oxides.

   NOTE: *Recommendations of the latest IUPAC for numbering of groups to be followed. Numbering 1 – 18 replacing old notation of I – VIII. Details given at the end of the syllabus.*

4. Chemical Bonding and Molecular Structure

Valence electrons, ionic bond character, covalent bond of ionic bond, covalent bond, bond parameters, lewis structure, polar character of covalent bond, VSEPR theory, geometry of covalent molecules, valence bond theory, concept of hybridisation involving s, p and d orbitals and shapes of some simple molecules. Coordinate bond. Molecular orbital theory of homonuclear diatomic molecules (qualitative idea only). Resonance and hydrogen bond.

i. *Kossel-Lewis approach to chemical bonding. Octet rule, its application to electrovalent and covalent bonds.*

ii. *Electrovalent or ionic bond: Lewis structures of $NaCl$, Li_2O, MgO, CaO, MgF_2, and $Na_2 S$.*

Definition of ionic bond.

The conditions necessary for the formation of ionic bonds such as:

- *low ionisation enthalpy of metals.*
- *high electron gain enthalpy of non-metals.*
- *high lattice energy.*
- *electronegativity difference between the reacting atoms.*

All these points must be discussed in detail. The formation of cations and anions of elements and their positions in the periodic table.

Variable electro valency; reasons for variable electro valency i.e, due to inert electron pair effect and unstable core, by using suitable examples.

Calculation of lattice enthalpy (Born-Haber cycle).

Characteristics of electrovalent bond.

iii. *Covalent Bond – Bond parameters, Lewis structure, polar character of covalent bond, shapes.*
Sigma and pi bonds e.g. formation of ammonia, nitrogen, ethene, ethyne, and carbon dioxide.
Definition of covalent bond, conditions for formation of covalent bonds, types of covalent bonds, i.e single, double and triple bonds. Sigma and pi bonds: H_2, O_2, N_2.
Classification of covalent bonds based on electronegativity of atoms - polar and nonpolar covalent bond, dipole moment.
Formation of CH_4, NH_3, H_2O, ethane, ethene, ethyne and CO_2, etc. and their electron dot structure or Lewis structure.
Characteristics of covalent compounds.
Comparison in electrovalency and covalency.
Reason for variable covalency e.g. Phosphorus 3 & 5 and sulphur 2, 4, 6 & chlorine 1, 3, 5 and 7.
Formal charge of ions.

iv. *Deviation from octet rule and Fajan's rules.*

Definition of octet rule.

Failure of octet rule, due to either incomplete octet or exceeding of octet with suitable examples.

Fajan's rules: statements, conditions for electrovalency and covalency. Polar and non-polar bonds should be correlated with Fajan's rules.

v. *Valence Shell Electron Pair Repulsion (VSEPR) Theory; Hybridisation and shapes of molecules: hybridisation involving s, p and d orbitals only.*

Concept of electron-pair repulsion and shapes of molecules using suitable examples.

Hybridisation and molecular shapes – definition, hybridisation of orbitals involving s, p and d orbitals (using suitable examples).

vi.   *Molecular orbital theory: Qualitative treatment of homonuclear diatomic molecules of first two periods (hydrogen to neon), Energy level diagrams, bonding and antibonding molecular orbitals, bond order, paramagnetism of O_2 molecule. Relative stabilities of O_2, O_2^-, O_2^{2-}, O_2^+ and N_2, N_2^+, N_2^-, N_2^{2-}.*

vii. *Co-ordinate or dative covalent bond, e.g. formation of oxy-acids of chlorine: Co-ordinate or dative covalent bonding: definition, formation of chlorous acid, chloric acid, perchloric acid, ammonium ion, hydronium ion, nitric acid, ozone.*

viii. *Resonance in simple inorganic molecules: Resonance in simple inorganic molecules like ozone, carbon dioxide, carbonate ion and nitrate ion.*

ix.   *Hydrogen bonding: the examples of hydrogen fluoride, water (ice), alcohol, etc. may be considered.*

      H-bonding – definition, types, condition for hydrogen bond formation, examples of inter-molecular hydrogen bonding in detail taking hydrogen fluoride, water and ice and ethanol into account. Intramolecular hydrogen bonding.

5. States of Matter: Gases and Liquids

States of matter and their characteristic properties to establish the concept of the molecule. Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, Avogadro's number, ideal behaviour of gases and derivation of ideal gas equation. Kinetic Theory of gases, kinetic energy and molecular speeds (elementary idea). Deviation from ideal behaviour, van der Waal's equation, liquefaction of gases, critical temperature. Liquid state - vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).

(i)   *Intermolecular interactions (van der Waals forces), types of van der Waals forces, melting and boiling points.*

(ii) *The Gas Laws.*
      Boyle's law, Charles' law, Absolute temperature, pressure temperature law, Avogadro's law and Avogadro's constant. Relationship between the mole and Avogadro's number.
      Simple numerical problems based on the above laws.
      Dalton's law, Graham's law of diffusion.
      Dalton's law of partial pressures and its application.
      Graham's Law of diffusion and its application.
      Numerical problems based on the above.

(iii) *Ideal gas equation and application of this equation.*

      Ideal gas equation $PV = nRT$; its application in calculation of relative molecular mass and in the calculation of the value of R.

(iv) *Kinetic Theory of gases.*

      Characteristics of gases, comparison between solid, liquid and gas. Properties of gases on the basis of kinetic theory of gases.

Postulates of kinetic theory must be discussed to explain gas laws. Concept of average, root mean square and most probable velocities (numericals not required). Non ideal behaviour of gases i.e. deviation from ideal gas equation may be discussed at low and at high temperature and pressure.

van der Waals' equation $(P + a/V^2)$ $(V-b) = RT$ for one mole of a gas. (numericals not required). The pressure correction and volume correction may be explained. Significance and units of 'a' and 'b' (van derWaals' constant). Liquefaction of gases, critical temperature. (v) Liquid State - vapour pressure, viscosity and surface tension. Qualitative idea only, no mathematical derivations.

6. Chemical Thermodynamics

(i)   Introduction, concepts, types of system, surroundings, extensive, intensive properties and state functions.

Types of system – ideal system, real system, isolated system, closed system, open system. Meaning of surroundings.

Properties of the system: macroscopic, intensive and extensive properties.

State of the system.

Main processes the system undergoes: reversible, irreversible, adiabatic, isothermal, isobaric, isochoric, cyclic.

Meaning of thermodynamic equilibrium. Meaning of thermodynamic process.

(ii) First Law of Thermodynamics and its significance, work, heat, internal energy, enthalpy (ΔU or ΔE and ΔH), heat capacity and specific heat. Hess's law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomisation, sublimation, phase transition, ionisation, solution and dilution.

Meaning of: internal energy of the system, work done by the system, by the surroundings at constant temperature, heat absorbed by the system and by the surroundings at constant temperature.

The sign convention for change in internal energy, heat given out or gained, work done by the system or by the surroundings.

State function and path function - meaning with examples. Internal energy change, work done and heat absorbed in a cyclic process.

Internal energy change in an isolated system and in a non-isolated system. Total internal energy change of a system and surroundings. Mathematical statement of the first law.

Significance of first law of thermodynamics. Need for enthalpy – constant pressure or open vessel processes. Enthalpy - a thermodynamic property, state function. Mathematical form of enthalpy.

Heat - the energy in transit. Conditions for the transfer of heat. Limitations in conversion of heat into work. Condition at which heat transfer ceases, unit of heat.

Meaning of work, capacity to do work, types of work. Mathematical form of reversible work and irreversible work. Difference between the reversible and irreversible work done – graphically.

Relationship between C_v and internal energy change. Relationship between C_p and C_v. Definitions of the following:

Heat of reaction: Heat of formation – standard heat of formation, Heat of solution, Heat of dilution, Heat of neutralization, Heat of combustion.

Constancy in the heat of neutralisation:

Experimental verification in case of strong acids and strong bases. Reason for that observation – ionic neutralisation and the heat evolved.

Definition of Calorific value of a fuel.

Statement of Hess' Law and its application.

Problems based on Hess' Law.

(iii) Second Law of Thermodynamics and its significance, spontaneity of a chemical change; Entropy, Free Energy. Inadequacy of First Law and need for Second Law; Ideas about reversible (recapitulation), spontaneous and non-spontaneous processes.

Meaning of entropy – derived from Second Law – statement of Second Law in terms of entropy; Physical significance of entropy;

State function and not path function. Entropy change of the universe, reversible isothermal process and irreversible process.

Meaning of thermal death, Gibb's free energy of the system and Helmholtz free energy. Relationship between Gibb's free energy and Helmholtz's free energy.

Relationship between change in Gibb's free energy and equilibrium constant of a chemical reaction. Defining the criteria for spontaneity of a chemical change in terms of Gibb's free energy.

Note*: Numericals based on the First Law, Second Law of Thermodynamics and Hess' Law.*

(iv) Third Law of Thermodynamics – statement only.

Self-explanatory.

7. Equilibrium

(i) Chemical Equilibrium.

Introduction of physical and chemical equilibrium and its characteristics.

Dynamic nature of equilibrium, law of mass action, equilibrium constant and factors affecting equilibrium. Le Chatelier's principle and its applications.

Irreversible and reversible reactions.

Physical equilibrium: solid-liquid, liquid vapour, solid-vapour; Characteristics of Physical equilibrium.

Chemical equilibrium: Characteristics of chemical equilibrium; dynamic nature. Law of mass action; Equilibrium constant in terms of concentration K_c. Gaseous reactions; Equilibrium constant in terms of partial pressures K_p. Relationship between K_p and K_c

(derivation required); Characteristics of equilibrium constant; Units for equilibrium constant; Simple calculations of equilibrium constant and concentration.

The following examples should be considered to show maximum yield of products:

- *Synthesis of ammonia by Haber's process.*
- *The dissociation of dinitrogen tetra oxide.*
- *Hydrolysis of simple esters.*
- *The contact process for the manufacture of sulphuric acid.*

Le Chatelier's Principle. Statement and explanation.

Factors affecting chemical and physical equilibria should be discussed in the light of Le Chatelier's principle.

- *Change of concentration.*
- *Change of temperature.*
- *Change of pressure.*
- *Effect of catalyst.*
- *Addition of inert gas.*

(ii)   Ionic equilibrium

Introduction, electrolyte (strong and weak), non-electrolyte, ionisation, degree of ionisation of polybasic acids, acid strength, concept of pH, pH indicators, buffer solution, common ion effect (with illustrative examples). Henderson equation, hydrolysis of salts, solubility and solubility product.

Ostwald's dilution law and its derivation. Strength of acids and bases based on their dissociation constant. Problems based on the Ostwald's dilution law.

Arrhenius, Brönsted-Lowry and Lewis concept of acids and bases, multistage ionisation of acids and bases with examples.

Ionic product of water – definition, pH, pOH, pK_w of solutions.

pH indicators and their choice in titrimetry.

Numericals on the above concepts.

Common ion effect – definition, examples (acetic acid and sodium acetate; ammonium hydroxide and ammonium chloride), applications in salt analysis.

Salt hydrolysis – salts of strong acids and weak bases, weak acids and strong bases, weak acids and weak bases and the pH formula of the solutions of these salts in water with suitable examples.

Buffer solutions: definition, examples, action; its interpretations based on Le Chatelier's principle. Henderson equation.

Solubility product: definition and application in qualitative salt analysis (Group II, III and IV cations).

Numericals on pH, buffer solutions, solubility and solubility product.

8. Redox Reactions

Concept of oxidation and reduction, redox reactions, oxidation number, change in oxidation number, balancing redox reactions (in terms of loss and gain of electrons). Applications of redox in various types of chemical reactions.

- *Concept of oxidation and reduction in terms of oxygen, hydrogen, electrons.*
- *Redox reactions - examples.*
- *Oxidation number: rules for calculation, simple calculations of oxidation state in molecules and ions like $K_2Cr_2O_7$, $\underline{S}_2O_3^{2-}$, etc.*
- *Oxidation and reduction in terms of change in oxidation number.*
- *Balancing of redox reactions in acidic and basic medium by oxidation number and ionelectron method.*

9. Hydrogen

Hydrogen and its compounds: hydrides, water, heavy water, hydrogen peroxide.

Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen, hydrides (ionic covalent and interstitial); hydrogen as a fuel.

Physical and chemical properties of water, soft and hard water, and removal of hardness of water, heavy water.

Hydrogen peroxide:

Preparation from peroxide, structure, oxidising properties: reaction with KI, PbS, acidified $FeSO_4$; reducing properties – reaction with acidified $KMnO_4$ and chlorine. Calculation of strength of hydrogen peroxide.

10. s-Block Elements (Alkali and Alkaline Earth Metals)

(i)   Group 1 and 2 elements

General characterises of Group 1 and 2 should include the following:

Occurrence; physical state; electronic configuration; atomic and ionic radii; common oxidation state; electropositive /electronegative character; ionisation enthalpy; reducing/oxidising nature; distinctive behaviour of first member of each group (namely Lithium, Beryllium); nature of oxides, hydroxides, hydrides, carbonates, nitrates; chlorides, sulphates.

(ii)   Preparation and properties of some important compounds.

Sodium chloride, sodium hydroxide, Sodium carbonate, sodium bicarbonate, sodium thiosulphate; biological importance of sodium and potassium.

Magnesium chloride hexahydrate, calcium oxide, calcium hydroxide, calcium carbonate, plaster of paris and cement. Industrial uses of the above, biological importance of magnesium and calcium.

Group 1:

- *Sodium chloride - uses.*
- *Sodium hydroxide - only the principle of preparation by Castner-Kellner cell. Uses.*
- *Sodium carbonate – principal and equation of Solvay's process. Uses.*
- *Sodium bicarbonate - preparation from sodium carbonate. Uses.*
- *Sodium thiosulphate - preparation from sodium sulphite and its reaction with iodine, dilute acids and silver nitrate. Uses.*

Group 2:

- *Magnesium chloride hexahydrate -preparation from magnesium oxide. Effect of heat. Uses*
- *Calcium oxide - preparation from limestone; reaction with water, carbon dioxide and silica. Uses.*
- *Calcium hydroxide – preparation from calcium oxide and uses.*
- *Calcium carbonate – preparation from calcium hydroxide and uses.*
- *Plaster of Paris - preparation from gypsum. Uses.*
- *Manufacture of cement. Uses.*

11. Some p -Block Elements

(i)   Group 13 Elements

General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group, Boron – physical and chemical properties.

(ii)   Preparation and properties of some important compounds, borax, boric acid, boron hydrides, aluminium: Reactions with acids and alkalies. Lewis acid character of boron halides; amphoteric nature of aluminium, alums.

Borax- reaction with water and action of heat on hydrated compound (preparation not required).

Borax Bead Test.

Diborane - Preparation properties, structure and uses.

Boric acid – preparation and action of heat. Aluminium: Reactions with acids and alkalies. Alums – preparation and uses.

(iii)   Group 14 Elements

General characteristics, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first elements.

Carbon-catenation, allotropic forms. Structure of diamond graphite and fullerene; stability of +2 oxidation state down the group in terms of inert pair effect.

(iv)   Some important compounds; oxides of carbon and silicon, silicon carbide, silicon tetra chloride, silicones, silicates and zeolites.

Preparation and properties of:

Carbon monoxide - preparation from incomplete combustion of carbon. Hazards of CO. Reducing nature of CO.

Carbon dioxide - preparation from limestone and carbon, limewater test. Uses.

Silicon dioxide - structure, comparison with carbon dioxide. Uses.

Silicon carbide - preparation from silica. Uses.

Silicon tetra chloride - preparation from silicon and uses.

Silicones - general method of preparation. Uses.

Silicates – structure and uses.

Zeolites – formula and use.

12. Organic Chemistry - Some Basic Principles and Techniques

General introduction, classification and IUPAC nomenclature of organic compounds and isomerism.

Methods of purification, qualitative and quantitative analysis. Electron displacement in a covalent bond: inductive effect, electromeric effect, resonance and hyperconjugation.

Homolytic and heterolytic bond fission of a covalent bond: free radicals, carbocations, carbanions, electrophiles and nucleophiles, types of organic reactions.

(i)   *Introduction to organic chemistry:*

        Vital force theory, reason for separate study of organic chemistry and its importance, characteristics of carbon atoms (tetra valency), Reasons for large number of organic compounds: catenation, isomerism and multiple bonding, etc.

(ii)   *Classification of organic compounds: (definition and examples): open chain, closed chain, homocyclic, hetrocyclic, aromatic, alicyclic compounds, homologous series and its characteristics, functional groups.*

(iii)   *IUPAC rules for naming organic compounds. Aliphatic, alicyclic and aromatic compounds.*

(iv)   *Definition and classification of isomerism:*

        Structural isomerism: definition, classification, examples.

        Chain isomerism, Positional isomerism, Functional isomerism, Metamerism, Tautomerism - examples for each of the above.

        Stereoisomerism: definition and classification, examples.

        Geometrical isomerism: Definition. Conditions for compounds to exhibit geometrical isomerism; types and examples, cis and trans, syn and anti. Examples.

        Optical isomerism: Definition, Nicol prism, plane polarised light. polarimeter. Method of measuring angle of rotation. Specific rotation. Conditions for optical activity. d, l form; External compensation, Internal compensation, racemic mixture & meso form. Examples – lactic acid and tartaric acid.

(v) *Analysis of organic compounds:*

Detection of elements (qualitative analysis) such as carbon, hydrogen, nitrogen, halogens and sulphur should be considered by using Lassaigne's test and reactions involved in it.

(vi) *Estimation of carbon, hydrogen, nitrogen, halogens, sulphur and phosphorous:*

Estimation of carbon and hydrogen – Leibig's method.

Estimation of nitrogen - Kjeldahl's method.

Estimation of halogens sulphur and phosphorous - Carius method. Numericals included. Experimental details required.

(vii) *Types of chemical reactions and their mechanisms.*

Substitution, addition, elimination reactions: definition and examples.

Homolytic and heterolytic fission – definition and examples. Free radicals, carbocation, carbanion (their reactivities and stabilities).

Electrophiles and nucleophiles – definition and examples (including neutral electrophiles and nucleophiles).

Inductive, electromeric, mesomeric effect and hyperconjugation – definition, examples.

(viii) *Free radicals and polar mechanisms*

In terms of fission of the bonds and formation of the new bonds including SN1, SN2, E1 and E2 mechanisms. Explain with relevant examples and conditions.

13. Hydrocarbons

Classification of Hydrocarbons

I. Aliphatic Hydrocarbons

(i) Alkanes - Nomenclature, isomerism, conformation (methane and ethane), physical properties, chemical properties including free radical mechanism of halogenation, combustion and pyrolysis.

Occurrence, conformation (Sawhorse and Newman projections of ethane).

General methods of preparation: from sodium salts of carboxylic acids (decarboxylation and Kolbe's electrolytic method); from alcohols and alkyl halides (Wurtz reaction, Coreyhouse Synthesis). From aldehydes and Grignard's Reagent.

Physical and chemical properties of alkanes.

Physical properties: state, freezing point, melting point, boiling point, density.

Chemical properties: combustibility, reaction with chlorine (free radical mechanism), reaction with oxygen in presence of catalyst (formation of alcohol,

aldehyde, and carboxylic acid). Cyclisation, aromatisation, isomerisation and pyrolysis.

Uses of alkanes.

(ii) Alkenes - Nomenclature, structure of double bond (ethene), isomerism; methods of preparation; physical properties, chemical properties; addition of hydrogen, halogen, water, hydrogen halides (Markownikoff's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

General methods of preparation – dehydration of alcohols, dehydrohalogenation of alkyl halides (from vicinal dihalides), Kolbe's electrolytic method and from alkynes.

Physical Properties: State, freezing point, melting point, boiling point, dipole moment, density.

Chemical properties - addition reactions (hydrogen, halogens, hydrogen halides, sulphuric acid, water).

Markownikoff's rule and antiMarkownikoff's rule with mechanism and examples.

Oxidation: complete combustion, hot and cold alkaline $KMnO_4$ (Baeyer's reagent), ozonolysis.

Polymerisation.

Saytzeff's rule and its application.

Uses of alkenes.

(iii) Alkynes - Nomenclature, structure of triple bond (ethyne), methods of preparation; physical properties, chemical properties: acidic character of alkynes, addition reactions - hydrogen, halogens, hydrogen halides and water.

General methods of preparations of alkynes. Manufacture of ethyne by calcium carbide and from natural gas. Dehydrohalogenation and Kolbe's electrolytic method.

Physical properties of alkynes: State of existence, freezing point, melting point, boiling point, density.

Chemical properties of alkynes – addition reactions (hydrogen, halogens, hydrogen halides and water), acidic nature of alkynes, formation of acetylides.

Oxidation: complete combustion, hot and cold alkaline $KMnO_4$ (Baeyer's reagent), ozonolysis.

Polymerisation.

Uses of alkynes.

Distinguishing test between Alkane, Alkene and Alkyne.

II. Aromatic Hydrocarbons

Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of electrophilic substitution. Nitration, sulphonation, halogenation, Friedel Crafts alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity.

Structure: Resonance structures (Kekule's) of benzene.

Benzene: Preparation from sodium benzoate and from phenol.

Physical properties: State of existence, freezing point, melting point, boiling point, density.

Chemical properties:

- *Electrophilic substitution reactions with mechanism (halogenation, nitration, sulphonation).*
- *Alkylation, acetylation*
- *Friedel Crafts reaction.*
- *Directive influence (o-, p-, and m-) of substituents in electrophilic and nucleophilic substitutions (with mechanism).*
- *Oxidation: catalytic oxidation, reaction with ozone.*
- *Addition reactions with hydrogen, chlorine, bromine.*
- *Pyrolysis (formation of bi-phenyl).*

Carcinogenicity and toxicity of benzene may be discussed.

Uses.

14. Environmental Chemistry

Types of environmental pollution (air, water and soil pollution); various types of pollutants: smog, acid rain; effects of depletion of ozone layer, greenhouse effect and global warming. *Pollution due to industrial wastes, green chemistry as an alternative tool for reducing pollution; strategies for control of environmental pollution.*

Gaseous pollutants: oxides of nitrogen, carbon, sulphur, hydrocarbons; their sources, harmful effects and prevention; Greenhouse effect and global warming; acid rain;

Particulate pollutants: smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention.

Water pollutants: pathogens, organic waste, chemical pollutants; their harmful effects and prevention.

Soil Pollutants: pesticides, herbicides. Green chemistry as an alternative tool for reducing pollution.

PAPER II PRACTICAL WORK- 15 Marks

PROJECT WORK AND PRACTICAL FILE - 15 Marks