

**UNIT 1.**Reaction Kinetics:-

Rate laws - rates constant for first, second, third and zero order reaction - Half life period - Arrhenius theory - collision theory - Absolute reaction rate theory - ionic reaction - salt effect - catalysis – Laws of photo chemistry, quantum efficiency - photo physical processes of electronic excited molecules. Green Chemistry – reactions and reagents

Chemical Equilibrium:-

partial molar quantities, gibbs - Duhem equation, Equilibrium constant - temperature dependence of equilibrium constant - phase rule and its applications to two and three components systems.

**UNIT 2.**Solid State:-

crystal systems - designation of crystal faces, lattice structure and unit cell - law of rational indices - Bragg's law and x rays diffraction by crystals - schottky and Frenkel defects - Electrical properties - Insulators and semiconductors - band theory of solids –Superconductors – nano materials preparations and properties.

Electrochemistry:-

Types of Reversible electrodes - Nernst equation - calculation of thermo dynamic quantities of cell reactions - overpotential and hydrogen over voltage - Determination of pka of acids by potentiometric methods - Kohlrausch's law - Ostwald's dilution law - Debye - Huckel Onsager equation for Strong electrolytes - (no derivation required) - Primary and Secondary fuelcells - corrosion and prevention – drycells and storage batteries

**UNIT 3.**Structure and Bonding:-

Electronic configuration of atoms, Term symbols and periodic properties of elements, Ionic radii, ionisation potential electron affinity, electronegativity, concept of Hybridization, molecular orbitals and electronic configuration of homonuclear and heter nuclear diatomic molecules, shapes of polyatomic molecules VSEPR theory,

symmetry elements and point groups for simple molecules, Bond lengths, Bond angles, bond order and bond energies Types of chemical bond (weak and strong) inter molecular forces, structure of simple and covalent bonds – covalent character in ionic bond and partial ionic character – lattice energy.

#### Acids and Bases:-

Bronsted and Lewis acids and bases - pH and pKa acid - base concept in non - aqueous media – HSAB concept - Buffer Solutions. Redox Reactions:- Oxidation numbers, Redox potential, Electro chemical series – application of EMF measurements - Redox indicators.

#### Chemistry of Non - transition elements:-

General characteristics, structure and reaction of simple compounds - boranes - silicates Oxoacids of N,P,S and halogens - xenon compounds - inter halogens, Pseudohalides and noble gas compounds – metal clusters – S,N ring and chain compounds - inorganic Polymers such as silicones, Borazines and phosphonitrilic compounds.

#### IUPAC Nomenclature of simple organic and Inorganic compounds.

### **UNIT 4.**

#### Organic reaction mechanism:-

General methods (Kinetic and non Kinetic) of study of reaction mechanisms Methods of determining reaction mechanism. – isotopic labelling SN1, SN2 mechanisms - addition substitution, elimination and rearrangements -free radical mechanism - aromatic substitution - and stability of reactive intermediate (Carbocations, Carbanion's free radicals, nitrates and benzyne) - Polar effects - Hammett's equation and its modification.

#### Chemistry of important organic reaction:-

Aldol condensation - Claisen condensation - perkin reactions - cannizzaro reaction - Fridel craft reaction - Favorski reaction - Stork enamine reaction - Michael addition - Baeyer - villiger reaction - Chichibabin reaction - Asymmetric synthesis pericyclic reactions - classification and examples - woodward and Hoffmann rules. - use of OsO<sub>4</sub>, NBS, diborane, NaBH<sub>4</sub>, LiAlH<sub>4</sub> in organic Synthesis.

## **UNIT 5.**

### Quantum Chemistry:-

Planck's quantum theory wave - particle duality, uncertainty principle, operators and commutation relations, postulates of quantum mechanics, schrodinger wave equation, particle in one dimensional box and three dimensional box - harmonic oscillator, rigid rotator and hydrogen atom, angular momentum, spin - orbit coupling.

### Classical thermodynamics and elements of statistical thermodynamics:-

First law of thermodynamics:- heat capacity - isothermal adiabatic processes - Thermo chemical laws - Kircheff's equation second law of thermodynamics, entropy, in reversible and irreversible processes - Gibe's free energy and Helmholtz free energy - Third law of thermodynamics

## **UNIT 6.**

### Spectroscopy:-

Rotational spectra of diatomic molecules - Isotopic substitution and rotational constants - vibrations spectra of linear symmetric, linear asymmetric and bent triatomic molecules - electronic spectra - selection rules - nuclear magnetic resonance - chemical shifts - spin - spin coupling - electron spin resonance and hyperfine splitting theoretical principles of mass spectroscopy.

Application's of UV, IR, NMR, ESR and mass spectroscopy for structural elucidation of organic compounds, inorganic complexes and free radicals.

## **UNIT 7**

### Chemistry of Co-ordination Compounds:-

structural aspects, isomerism - octahedral and tetrahedral, crystal - splitting of orbitals - CFSE - magnetism and colour of transition metal ions - charge transfer spectra - crystal field theory and ligand field theory – MO theory complexes of pi acceptor ligands - stereochemistry of inorganic co-ordination compounds – ORD and CD Techniques.

### Chemistry of lathanides and actinides:-

Electronic configuration - occurrence and Separation techniques -oxidation states, colour. magnetic and spectroscopic properties – lanthanide contraction , use of lanthanide compounds as shift reagents.

## **UNIT 8**

### Organometallic compounds and bio inorganic chemistry:-

Metal carbonyls, Metal nitrosyls, metal alkyl, alkenes and arene compounds - organometallic compounds in catalysis - Chemistry of porphyrins - chlorophyll, hemoglobin, myoglobin, ferredoxin, rubredoxin, and cytochromes, copper proteins, enzymes, zinc enzymes, toxicity of metals and the effect of excess and deficient levels, metal complexes in therapy

## **UNIT 9.**

### Stereochemistry:-

Elements of symmetry - optical and geometric isomerism E, Z and R, S notation's - Conformational analysis of simple cyclic and acyclic systems - Effects of conformation on reactivity in acyclic compounds and cyclohexanes.

### Carbohydrates:-

Classification - configuration and general reactions of monosaccharides - Chemistry of glucose, fructose, Sucrose and Maltose, Important compounds in chemistry - Dyes - azo, triphenylmethane, and phthalic groups - indigo - alizarin vitamins, hormones - antibiotics - proteins. Polymers: Preparation and uses of polyethylene, poly butylene PVC, Nylon - Ziegler - Natta catalysts -

## **UNIT 10**

### Instrumental methods of analysis:-

Adsorption, partition chromatography - Gas chromatography - HPLC - Solvent extraction and ion exchange methods - atomic absorption spectroscopy - Electroanalytical techniques voltammetry, cyclic voltammetry, polarography, amperometry, Coulometry and conductometry, ion - Selective electrodes- TGA, DTA, DSC and ICP-AES. Analysis of industrial products such as ores and Minerals, Coal, Water, Soaps & Detergents, Metals & Alloys, Manures & fertilizer, cement, Aggregate, Bricks, petroleum products, food & products, plastics.