Tamil Nadu Public Service Commission
Syllabus
Chemistry
(PG Degree Standard)

Code: 600

Inorganic Chemistry

Unit I: (25 Questions)

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 hetero nuclear diatomic molecules, shapes of polyatomic molecules Valence Shell Electron Pair Repulsion (VSEPR) theory, symmetry of elements and point groups for simple molecules, bond lengths, bond angles, bond order and bond energies - Types of chemical bonds (weak and strong) inter molecular forces, structure of simple and covalent bonds – partial ionic character – Lattice energy – Born Haber's cycle.

Acids and Bases: Bronsted and Lewis acids and bases - pH and pKa, acid - base concept in non - aqueous media – Hard and Soft Acids and Bases (HSAB) concept - Buffer Solutions - Redox Reactions - Oxidation number, Redox potential, Electro chemical series – Application of Electromotive Force (EMF) measurements - Redox indicators – Conductometric and Potentiometric titrations

Chemistry of Non - Transition Elements: General characteristics, structure and reaction of simple compounds - boranes – silicates, oxoacids of Nitrogen, Phosphorous and Sulphur and halogens – xenon compounds - inter halogens, pseudohalides and noble gas compounds – metal clusters – Sulphur, Nitrogen ring and chain compounds - inorganic polymers such as silicones, Borazines and phosphonitrilic compounds.

International Union of Pure and Applied Chemistry (IUPAC) nomenclature of simple Inorganic compounds.

Unit II: (15 Questions)

Co-ordination Chemistry: Structural aspects, isomerism - octahedral and tetrahedral, crystal - splitting of orbitals – Crystal Field Stabilization Energy (CFSE) - magnetism and colour of transition metal ions - charge transfer spectra - crystal field theory and ligand field theory – Molecular Orbital (MO) theory complexes of pi acceptor ligands - stereochemistry of inorganic co-ordination compounds – Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD) techniques.

Lathanides and Actinides: Electronic configuration - Occurrence and Separation techniques - Oxidation states, Colour - Magnetic and spectral properties – Lanthanide contraction - Shift reagent and other uses.

Unit III: (15 Questions)

Organometallic Compounds and Bio Inorganic Chemistry: 18 electron rule - Metal alkyls, metal carbonyls, metal olefins and metal carbene complexes and metallocenes – Types of organometallic reactions – homogeneous and heterogeneous catalysis - Chemistry of porphyrins - chlorophyll haemoglobin, 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.

Physical Chemistry

Unit IV: (15 Questions)

Chemical Kinetics and Equilibrium

Rate laws - rate constants for first, second, third and zero order reactions - Half life period - Arrhenius theory - Collision theory - Absolute Reaction Rate Theory - Ionic reactions - salt effect - catalysis – Laws of photo chemistry, quantum efficiency - photo physical processes of electronic excited molecules - Photochemical reactions.

Partial molar quantities, Gibbs - Duhem equation, Temperature dependence of equilibrium constant.

Unit V: (20 Questions)

Solid State: Crystal systems and lattices, Miller planes, Crystal packing, Crystal defects, Bragg's law, Ionic crystals, Structure of AX, AX_2, ABX_3 type compounds – Spinels, Band theory of solids – Metals and Semiconductors, Superconductors

Electrochemistry: Types of reversible electrodes - Nernst equation - Calculation of thermo dynamic quantities of cell reactions – over potential and hydrogen over voltage - Determination of pKa of acids by potentiometric methods - Kohlarash's law - Ostwald's dilution law - Debye - Huckel Onsager equation - Primary and Secondary cells - Dry cells and storage batteries – Lithium ion battery – Fuel Cells and its types – Corrosion and prevention

Unit VI: (20 Questions)

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 and three dimensional box - Harmonic oscillator, rigid rotator and hydrogen atom, Angular momentum, Spin-orbit coupling.

Molecular Spectroscopy: Rotational spectra of diatomic molecules - Isotopic substitution and rotational constants - vibrational spectra of linear symmetric, linear asymmetric and bent triatomic molecules - electronic spectra - selection rules.

Chemical Thermodynamics: Laws, Thermodynamic processes – Maxwell's relations – Spontaneity and equilibria – Temperature and Pressure dependence of thermodynamic quantities - LeChatelier principle – Elementary description of phase transition, phase equilibria and Phase rule – Thermodynamics of ideal and non-ideal gases and solution.

Organic Chemistry

Unit VII: (20 Questions)

IUPAC nomenclature of simple organic molecules.

Organic Reaction Mechanism: Addition, Elimination and Substitution reactions with electrophilic, nucleophilic, radical species - Methods of determining reaction mechanism – Isotopic labeling - Aromatic substitution - Stability of reactive intermediate (Carbocations, Carbanions, Free radicals, Carbenes,Benzynesand Nitrenes) - Polar effects - Hammett's equation and its modification.

Common named Reactions and Rearrangements: Aldol condensation - Claisen condensation - Perkin reactions - Cannizzaro reaction - Friedel Crafts reaction - Favorskii reaction - Stork enamine reaction - Michael addition – Baeyer-Villiger rearrangement - Chichibabin reaction - Asymmetric synthesis - Pericyclic reactions - classification and examples - Woodward and Hoffmann rules - use of OsO_4, NBS, Diborane, $NaBH_4$, $LiAlH_4$ in organic synthesis.

Unit VIII: (20 Questions)

Stereochemistry: Optical and geometric isomerism E,Z and R,S notations - 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 monosacharides - Chemistry of glucose, fructose, sucrose and maltose.

Azo, triphenylmethane, and phthalein groups - indigo – alizarin, vitamins, hormones - antibiotics - proteins.

NMR- chemical shifts - spin - spin coupling - election spin resonance and hyperfine splitting theoretical principles of mass spectroscopy - Applications of Ultraviolet-Visible, Infra Red, Nuclear Magnetic Resonance, Electron Spin Resonance and Mass Spectroscopy for structural elucidation of organic compounds, inorganic complexes and free radicals.

Unit IX: (25 Questions)

Instrumentation Methods: Adsorption, partition chromatography - Gas chromatography – High Performance Liquid Chromatography - Solvent extraction and ion exchange methods - atomic absorption and emission spectroscopy.

Analytical techniques: Voltammetry – Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV), Electrochemical Impedance Spectroscopy (EIS), Chronoamperometry, Coulometry and Conductometry, ion - selective electrodes – Thermo Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), X-ray Fluorescence Spectrometer (XRF) and Bomb Calorimeter.

Unit X: (25 Questions)

Polymers: Preparation, properties and uses of Polyolefins, Polyvinyls, Polyamides and Polyurethanes, Fluoro polymers, Epoxy resins - Conducting Polymers – Fire retardant polymers - Ziegler - Natta Polymerization.

Analysis of ores and minerals, water, soaps & detergents, metals & alloys, manures & fertilizer, cement, aggregate, soils, bricks, petroleum products, food products and plastics.

Basics of green chemistry, medicinal chemistry, environmental chemistry, chemistry in nanoscience and nanotechnology.

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