Syllabus for Junior Technical Superintendent (JTS) Post in Chemistry

Section 1: Physical Chemistry


**Surfaces and Interfaces:** Physisorption and chemisorption. Langmuir, Freundlich and BET isotherms. Surface catalysis: Langmuir-Hinshelwood mechanism. Surface tension,
viscosity. Self-assembly. Physical chemistry of colloids, micelles and macromolecules.

Section 2: Inorganic Chemistry


Lanthanides and Actinides: Recovery. Periodic properties, spectra and magnetic properties.


Radioactivity: Decay processes, half-life of radioactive elements, fission and fusion processes.

Bioinorganic Chemistry: Ion (Na⁺ and K⁺) transport, oxygen binding, transport and utilization, electron transfer reactions, nitrogen fixation, metalloenzymes containing magnesium, molybdenum, iron, cobalt, copper and zinc.

Solids: Crystal systems and lattices, Miller planes, crystal packing, crystal defects, Bragg's law, ionic crystals, structures of AX, AX₂, ABX₃ type compounds, spinels, band theory, metals and semiconductors.

Instrumental Methods of Analysis: UV-visible spectrophotometry, NMR and ESR spectroscopy, mass spectrometry. Chromatography including GC and HPLC. Electroanalytical methods- polarography, cyclic voltammetry, ion-selective electrodes. Thermoanalytical methods.

Section 3: Organic Chemistry

Stereochemistry: Chirality of organic molecules with or without chiral centres and determination of their absolute configurations. Relative stereochemistry in compounds having more than one stereogenic centre. Homotopic, enantiotopic and diastereotopic
atoms, groups and faces. Stereoselective and stereospecific synthesis. Conformational analysis of acyclic and cyclic compounds. Geometrical isomerism. Configurational and conformational effects, and neighbouring group participation on reactivity and selectivity/specificity.


**Pericyclic Reactions and Photochemistry:** Electrocyclic, cycloaddition and sigmatropic reactions. Orbital correlations - FMO and PMO treatments. Photochemistry of alkenes, arenes and carbonyl compounds. Photooxidation and photoreduction. Di-π-methane rearrangement, Barton reaction.

**Heterocyclic Compounds:** Structure, preparation, properties and reactions of furan, pyrrole, thiophene, pyridine, indole, quinoline and isoquinoline.

**Biomolecules:** Structure, properties and reactions of mono- and di-saccharides, physicochemical properties of amino acids, chemical synthesis of peptides, structural features of proteins, nucleic acids, steroids, terpenoids, carotenoids, and alkaloids.

**Spectroscopy:** Applications of UV-visible, IR, NMR and Mass spectrometry in the structural determination of organic molecules.
Section 4: Laboratory Experiments

Quantitative Analysis: Volumetric (acid-base, redox and complexometric titrations), Colorimetric (e.g., estimating Cu content in brass) and Gravimetric (e.g., estimation of Ni).

Kinetics Study: Examining the order of chemical reactions (such as acid/base catalysed ester hydrolysis).

Viscometry Study: Determine the intrinsic viscosity and the molecular weight of a polymer.

Qualitative Analysis: Determine different radicals (both cations and anions) present in unknown salt.

Functional Group Analysis: Identify different functional groups present in organic compounds using chemical methods and spectroscopic techniques.

Synthesis and Characterization: Synthetic procedures for some commonly used compounds: Urea, Paracetamol, Aspirin and their derivatives and their characterization.

Extraction and Identification: DNA from green peas, caffeine from tea leaves, glucosamine from crab shell.