Final merit list will be prepared by considering the marks obtained in Written test & Interview.

**SYLLABUS**

1. Quantum Chemistry, Planck’s quantum theory, wave-particle duality, Uncertainty Principle, operators and commutation relations, postulates of quantum mechanics and Schrodinger equation, free particle, pastick in a box, degeneracy, harmonic oscillator, rigid rotator and the hydrogen atom. Angular momentum including spin coupling of angular momenta including spin-orbit coupling.

2. **The variation method and perturbation theory**: Application to the helium, atom, antisymmetry and Exclusion Principle, Slater determinantal wave functions. Term symbols and spectroscopic states.

3. **Born-Oppenheimer approximation, Hydrogen molecule ion**: LCAO-MO and VB treatments of the hydrogen molecule, electron density, forces and their role in chemical binding. Hybridisation and valence MO, of H₂O, NH₃ and CH₄. Hückel pi-electron theory and its applications to ethylene, butadiene and benzene, idea of self-consistent fields.


6. **Thermodynamics**: First law of thermodynamics, relation between Cᵥ and Cₛ; enthalpies of physical and chemical changes, temperature dependence of enthalpies. Second law of thermodynamics, entropy, Gibbs-Helmholtz equation. Third law of thermodynamics and calculation of entropy.

7. **Chemical Equilibrium**: Free energy and entropy of mixing, partial molar quantities, Gibbs-Duhem equation. Equilibrium constant, temperature dependence of equilibrium constant, phase diagram of one and two-component systems, phase rule.


9. **Equilibria in Electrochemical Cells**: Cell reactions, Nernst equation, application of cell EMF measurements.

10. **Surface Phenomena**: Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetic micelles and reverse micelles; solutions. Applications of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.


12. **Non-equilibrium Thermodynamics**: Postulates and methodologies, linear laws, Gibbs equation, Onsager reciprocal theory.

14 **Fast Reactions**: Study of kinetics by stop-flow technique, relaxation method, flash photolysis and magnetic resonance method.


17 **Nuclear Chemistry**: Radioactive decay and equilibrium. Nuclear reactions, Q value, cross-sections, types of reactions. Chemical effects of nuclear transformations, fission and fusion, fission products and fission yields. Radioactive techniques, tracer techniques, neutron activation analysis, counting techniques such as G.M., ionization and proportional counters.

18 **Chemistry of Non-transition Elements**: General discussion on the properties of the non-transition elements, special features of individual elements, synthesis, properties and structure of their halides and oxides, polymorphism of carbon, phosphorus and sulphur. Synthesis, properties and structure of boranes, carboranes, borazines, silicates, carbides, silicenes, phosphazenenes, sulphur, oxycacids of nitrogen, phosphorus, sulphur and halogens. Interhalogens, pseudohalides and noble gas compounds.


20 **Chemistry of Lanthanides and Actinides**: Spectral and magnetic properties, use of lanthanide compounds as shift reagents.

21 **Organometallic Chemistry of Transition Elements**: Synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogeneous catalytic reactions (hydrogenation, hydroformylation, isomerisation and polymerisation), pi-metal complexes, activation of small molecules by coordination.

22 **Topics in Analytical Chemistry**: Adsorption, partition, exclusion, electrochromatography. Solvent extraction and ion exchange methods. Application of atomic and molecular absorption and emission spectroscopy in quantitative analysis. Light scattering techniques including nephelometry and Raman spectroscopy. Electroanalytical techniques, voltammetry, cyclic voltammetry, polarography, amperometry, coulometry and conductometry. Ion-selective electrodes. Anodic stripping voltammetry, TGA, DTA, DSC and on-line analysers.


24 **Aromaticity**: Huckel’s rule and concept of aromaticity: annulenes and heteroannulenes, fullerenes. (C_{60})

25 **Stereochemistry and Conformational Analysis**: Newer methods of assymetric synthesis (including enzymatic and catalytic nexus), enantio-and diastereo selective synthesis. Effects of conformation on reactivity in acyclic compounds and cyclohexanes.

26 **Selective Organic Name Reactions**: Favorskii reaction, Strok enamine reaction, Michael addition, Mannich reaction, Sharpless asymmetric epoxidation, ene reaction, Barton reaction, Hofmann Loffler-Freytag reaction, Shapiro reaction, Baeyer-Villiger reaction, Chichibabin reaction.

27 **Mechanisms of Organic Reactions**: Labelling and kinetic isotope effects, Hammet equation, \(\sigma-\delta\) (sigma-rho) relationship, non-classical carbonium ions, neighbouring group participation.

28 **Pericyclic Reactions**: Selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts, Sommelet-Hauser, Cope and Claisen rearrangements.

29 **Heterocycles**: Synthesis and reactivity of furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline and indole. Skraup synthesis, Fischer indole synthesis.
Reagents in Organic Synthesis: Use of following reagents in organic synthesis and functional group transformations-Complex metal hydride, Gilman’s reagent, lithium, dimethylcuprate, lithium disopropylamide (LDA) dicyclohexylcarbodiimide, 1, 3-dithiane (reactivity umpolung), Trimethyliodide, tri-n-butyltin hydride, Woodward and Prevost hydroxylation, osmium tetraoxide, DDQ, selenium dioxide, phase transfer catalysts, crown ethers and Merrifield resin. Peterson’s synthesis, Wilkinson’s catalyst, Baker’s yeast.

Chemistry of Natural Products: Familiarity with methods of structure elucidation and biosynthesis of alkaloids, terpenoids, steroids, carbohydrates and proteins, Conformations of proteins and nucleic acids.

Bioorganic Chemistry: Elementary structure and function of biopolymers such as proteins and nucleic acids, Genetic code, Mechanism of enzyme action.

Photochemistry: Principles of energy transfer, cis-trans isomerization, Patern-Buchi reaction, Norrish Type I and II reactions, phoreduction of ketones, di-pi-methane rearrangement, photochemistry of arenes.

Spectroscopy: Combined applications of mass, UV-VIS, IR and NMR spectroscopy for structural elucidation of compounds.