Subject: CHEMISTRY

Unit 1 INORGANIC CHEMISTRY

1. **Main group elements and their compounds:** Allotropy, synthesis, structure and bonding, industrial properties of compounds.
2. **Transition elements and co-ordination compounds:** Types of transitions, selection rules for electronic transitions, ground states, correlation diagrams, Orgel and Tanabe sugano diagrams for d^1 to d^9 states in Transition metal complexes. Calculation of Dq. B and β parameters. Change transfer spectra, spectroscopic method for assigning absolute configuration (ORD and CD based on cotton effect)
3. **Inner-transition elements:** Electronic configuration, Lanthanide contraction, spectral and magnetic properties of M^{3+} ions, colour of M^{3+} & M^{4+} ions, redox chemistry of lanthanides and actinides. Applications in analytical chemistry of the following compounds-Ceric sulphate Ce $(SO_4)_2$; ceric ammonium sulphate $(NH_4)Ce(S0_4).2H_20$; Thorium nitrate $Th(NO_3)_4$; Uranylacetale $UO_2(CH_3COO)2.2H_2O$
4. **Organometallic compounds:-** Synthesis, bonding and structure, and reactivity. organometallics in homogeneous catalysis.
5. **Cages and metal clusters:** Metal carbonyl and halide type clusters, chevrel phases, Zinti ions or naked clusters Borazines and phosphazenes, Metalloboranes compounds with metal-metal multiple bonds.

Unit 2 ORGANIC CHEMISTRY

1. **IUPAC nomenclature of organic molecules including regio and stereoisomers**
2. **Principals of stereochemistry:** Configurational and conformational isomerism in acyclic and cyclic and cyclic compounds; stereogenicity, enantioselectivity. diasteroselectivity and asymmetric induction.
3. **Organic reactive intermediates:** generation, stability and reactivity of carbocations, carbanions. free radicals, carbene. benzyne and nitrenes.
4. **Organic reaction mechanism:** addition, elemination and substitution reaction with electrophilic, nucleophilic or radical species. Determination of reaction pathways.

5. **Common name reactions and rearrangements-** applications in organic synthesis
6. **Concepts in organic synthesis:** Retrosynthesis. disconnection, synthons. linear and convergent synthesis, umpolung of reactivity and protecting groups.
7. **Asymmetric synthesis:** Chiral auxiliaries, methods of asymmetric induction-substrare, reagent and catalyst controlled reactions; determination of enantiomeric and disteromeric excess; enantiodiscrimination. Resolution-optical and kinetic,
8. **Pericyclic reaction:** electrocyclisation, cycloaddtion, sigmatropic rearrangements

Unit 3 PHYSICAL CHEMISTRY

1. **Basic principals of quantum mechanics:** postulates; operators, partical in a box; harmonic oscillator and the hydrogen atom, orbital and spin angular momenta.; tunning.
2. **Chemical Thermodynamics:** Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependance of thermodynamic quantities; Le Chatelier principle elementary discription of phse transitions; phase equilibria and phase rule. Thermodynamics of ideal and non ideal gases and solutions.
3. **Statisticalcal Thermodynamics:** Boltzmann distribution ; kinetic theory of gases; partition functions and their relation to thermodynamic quantities.
4. **Electrochemistry:** Nernst equation, redox system; electrochemical cells; Deby-Huckel theory; electrolytic conductance-Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
5. **Colloids and surfaces:** Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis
6. **Solid state:** Crystal structure:; Bragg's law and applications; band structure of solids
7. **Polymer Chemistry:** Molar masses; kinetics of polymerization.

Unit 4 ANALYTICAL CHEMISTRY

1. **Data analysis:** Mean and standard deviation: absolute and relative errors; linear regression; covariance and correlation coefficient.
2. **Solvent extraction:** Quantitative and Qualitative treatment of solvent extraction; Organic reagents dithiols. diketones. oxine, dithizone, cuproin. cupferron, dimethylglyoxime and dithiocarbamates in solvent extraction; Synergistic Extraction, Crown ethers for Ion association complexes.
3. **Ion Exchange:** Action of ion exchange resins. Ion Exchange capacity. Ion Exchange Chromatography, Chelating ion exchange resins. Liquid ion exchangers
4. **Separation Techniques:** TLC, Size Exclusion Chromatography. Gel Filiations and Gel Permeation Techniques; Electrophoresis. GC. HPLC. GC-MS. Super Critical Fluid Chromatography.
5. **Nuclear Chemistry:** nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis
6. **Thermoanalytical methods:** Thermogravimetric Analysis (TGA): Differential Thermal Analysis (DTA): Principle. Methodology and interpretation of Data; Aapplication in Polymer Characterization
7. **Electroanalytical Chemistry:** Basic principles of polarography, cyclic voltammetry. Differential Pulse voltammetry and stripping voltammetry

Unit 5 SPECTROSCOPY

1. **UV- Visible** Spectroscopy: Electromagnetic Radiation. Various electronic transitions Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes. conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyctic compounds. Steric effect in biphenyls., , Absorption by inorganic anions, transition metals and lanthanides. effect of ligands on absorption maxima associated with d-d transition.
2. **Infrared (IR) absorption spectroscopy**: Molecular vibrations. Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of alkanes, alkenes. alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides and conjugated

carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FT IR.and interpretation of IR spectra of simple organic compounds.

3. **Raman Spectroscopy:** Quantum Mechanical and classical theories of Raman spectroscopy. Rotational and Vibrational Raman sectra, rule of mutual exclusion.
4. **Mass** Spectrometry:Introduction, ion production - El, Cl, FD and FAB. factors affecting fragmentation, ion analysis, ion abundance. Mass spectral Fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometery. Mass spectral fragmentation of Simple organic compounds.
5. **Nuclear Magnetic Resonance Spectroscopy:General** introduction and definition. chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefmic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Simplification of complex spectra-nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique, nuclear Overhauser effect (NOE). Resonance of other nuclei-F, P.
6. **Carbon-13 NMR Spectroscopy:** General considerations, chemical shift (aliphatic, olefmic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants.
7. **Characteriztion of inorganic compounds** by IR. Raman. NMR.EPR. Mossbauer. UV-vis, NQR, MS. electron spectroscopy and microscopic techniques.