



# K L UNIVERSITY

K L University, 29-36-38, Museum Road, Governorpet  
VIJAYAWADA - 520 002,  
Phone Number 08662577715, [http:// www.kluniversity.in](http://www.kluniversity.in)

## Syllabus for Entrance Test for PhD Admissions Department of Chemistry

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### Section-1 Physical and theoretical Chemistry

**Atomic structure:** Bohr's model – results of wave mechanical model – quantum numbers – shapes of orbitals.

**Chemical kinetics and equilibrium:** Rates of reactions – 1<sup>st</sup> and 2<sup>nd</sup> order reactions – activation energy –  $K_p$ ,  $K_x$ ,  $K_n$ , etc. – homogeneous chemical equilibria – acids and bases –  $pK_a$  of acid – solubility product.

**Thermodynamics and thermo chemistry:** Isothermal and adiabatic processes – carnot cycle, First, second and third laws of thermodynamics and their applications, entropy – free energy and chemical potential – chemical equilibria – phase equilibria,  $C_v$  and  $C_p$ , Hess law – Kirchoff's law – surface chemistry and thermodynamics – adsorption – solid state chemistry with reference to adsorption – solution chemistry – colligative properties – solvation – polar solvents.

**Chemical Dynamics:** Kinetic theory of gases – kinetics of reactions in the gas phase – theories of reactions – collision theory – transition state theory – applications of thermodynamic concepts to reactions – complex reactions such as parallel, consecutive and reversible reactions – chain reactions and their kinetics – kinetics in the liquid phase – effect of medium on reactions – homogeneous and heterogeneous catalysis – photochemistry in the gas phase and in solution – fluorescence – mechanism of photochemical reactions – irreversible processes in solution – fast reactions - viscosity – diffusion – sedimentation – behaviour of large molecules in solution – surfactants and their properties.

**Electrochemistry:** Conductance of electrolytes – transference – cells, half cells – Nernst equation – simple applications of conductivity and potentiometry Electrochemical cells – Nernst equation – theory of strong electrolytes (Debye-Huckel theory) – electrical double layer Lippman equation and structure – electrokinetic phenomena – basic electrode kinetics – Butler Volmer equation – Tafel equation – electroanalytical techniques (e.g polarography etc.)

**Quantum chemistry and Chemical bonding:** Schrodinger equation (SE) - postulates of quantum mechanics – operators – operators (Hamiltonian, angular momentum, spin and ladder) – exact solution of SE for some systems eg. Particle in the box, rigid rotor harmonic oscillator – approximate methods, variations and perturbation methods – LCAO – MO and VB methods. MO of diatomics and correlation diagrams – Huckel MO (HMO) theory and application to simple systems (eg. conjugated polyenes etc.) hybrid orbitals, molecular geometry.



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**Nuclear Chemistry:** Nuclear reactions – fission and fusion – Radioactive decay process – interaction of radiation with matter.

**Spectroscopy:** UV-Vis, IR, Raman spectroscopy – principles of NMR and ESR spectroscopy – spin – spin splitting – hyperfine interactions – fundamental understanding of ESCA and Moss bauer spectroscopy - theories of the above spectroscopies with quantum mechanical approach – applications.

## Section-2 Inorganic and Analytical Chemistry

**Analytical Chemistry:** Principles of volumetric and gravimetric analysis, organic reagents in inorganic analysis, Principles of Instrumental methods in analysis – neutron activation, isotope solution analysis, spectrophotometry and flame photometry, general applications of instrumental methods of chemical analysis – electrochemical and spectroscopic methods in analytical chemistry.

**Chemistry of main group elements:** A comparative account of the Chemistry of alkali, alkaline earth metals, non-transition elements and rare gases.

**Solid State Chemistry:** Crystal systems, Bravais crystal system, crystal symmetry, symmetry elements in a cubic system, laws of crystallography, atomic radius, number of atoms per unit cell, atomic packing factor, Weiss and Miller indices, interplanar spacing, X-ray studies of crystals-Bragg's equation, imperfections in crystals, structure of CsCl, CaF<sub>2</sub>, TiO<sub>2</sub>, diamond and graphite, Electronic properties of solids, band theory.

**Synthetic Inorganic Chemistry:** Synthesis, principles and structures of the following compounds, boron hydrides, boron anions, carboranes, compounds having B-N, B-P, Si-O, P-N, S-N, metal-hydrogen and metal carbon bonds – noble gas compounds.

**Coordination compounds and transition metals:** Coordination number – nomenclature – measurement of stability constants of complexes – mono and polyligated systems. Coordination components, isomerism, Principles of VB, MO and LF approaches, electronic spectrum and magnetic properties. Reaction mechanism of square planar and octahedral complexes. d<sup>n</sup> configurations and their theoretical analysis R – S states – CF and LF theories – state splitting in different fields. Electronic spectra of complexes. Lanthanides – their properties – spectral and magnetic properties of lanthanides and transition and metal complexes.

**Organo-Metallics:** Metal carbonyls – olefin and acetylene complexes – metallocenes – haemoglobin.



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## Section-3 Organic Chemistry

**Reaction Mechanism:** Chemical bonding and structure – nucleophilic substitution reactions at saturated carbon atoms – neighboring group participation – carbonium ion rearrangements – mechanisms of oxidation of alcohols and ketone reductions. Elementary treatment of reaction of type  $S_N1$ ,  $S_N2$ , E1 and E2. Hoffmann and Saytzeff Rules – substitutions at the aromatic ring, electrophilic, nucleophilic and radical – correlation of structure and reactivity – inductive, resonance and steric effects.

**Reactions:** Cycle additions – hydroboration – Hunsdiecker, Dieckmann, reactions, Cope, Fries and Claisen rearrangements and their mechanism – electron deficient carbon and nitrogen mediated rearrangements – Wittig, Wolff, Hoffmann, Curtius, Schmidt reactions – Mannich, Favorski, Michael, Robinson reactions – enolates and enamines.

**Reagents** used in organic synthesis (like  $KMnO_4$ ,  $K_2Cr_2O_7$ ,  $LiAlH_4$ ,  $NaBH_4$ , Wilkinson's catalyst, DCC, etc.)

**Organic Photo Chemistry:** Reactions of carbonyl compounds – dienes, cycloadditions – Woodward –Hoffmann rules – applications.

**Terpenes:** Classification – syntheses – structural elucidation of mono terpenoid and diterpenoids.

**Steroids:** Classification – rearrangements of steroids – photo chemical transformations – Barton reaction – cholesterol – synthesis of aromatic steroids.

**Structural Elucidation by Spectroscopic Methods:** Application of UV, IR and NMR spectroscopy to structural analysis of organic compounds.

IUPAC system of nomenclature, alkanes, alkenes, dienes, ketones, alcohols, amines and carboxylic acids – their preparation and properties.

**Aromaticity** and benzene chemistry.

**Stereo Chemistry:** Optical activity – asymmetric synthesis – conformational analysis of cyclohexanes and decalines – octat rule. Cyclohexane – Conformational analysis geometric isomerism concepts of Z and E, R and S notations.

**Heterocyclic compounds:** Preparation, properties of Thiophene and pyrrole.