



**DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
LUCKNOW**

**Ph.D. Course work Syllabus
PAPER II: Advanced Chemistry**

Maximum Marks: 100

Written Examination: 70

Internal Assessment: 30

(A) INORGANIC CHEMISTRY:

(i) Organometallics:

- Definition and classification of Organometallic compounds and their stability. General synthetic routes to the formation of M-C linkages.
- Synthetic and structural aspects of main group elements.
- Organotransition Compounds -18- and 16- electron rules, Transition Metal- Carbon multiple bond compounds, Transition Metal- Carbon - bonded compounds. A brief introduction of Organometallic compound of Lanthanide & Actinides.

(ii) Coordination Chemistry:

- Macrocyclic Complexes: Types of macrocyclic ligands-design and synthesis by coordination template effect, di- and poly- nuclear macrocyclic complexes: macrocyclic polyamines and polyethers; applications of macrocyclic complexes.

(iii) Supramolecular Chemistry:

- Secondary bonds M---X (M = S, Se, Te; X= N, O, P, S) and weak noncovalent interactions C-H---X (X= O, Cl, Br, I, S).
- Self Process- Programmed Supramolecular Systems: Self assembly of Double-Helical and Triple Helical metal complexes; the Helicates. Physico-chemical methods of Investigation of supramolecular associations.

(iv) Bioinorganic Chemistry:

- Transition metal storage, Transport and Biomineralization Ferritin, Transferrin and Siderophores.
- Biological significance of metal ions Fe, Zn, Cu, Mo, Co, Cr, V & Ni, Metals in medicine, Metal imbalances, diseases and toxicity, organometallics in living organism, Biomethylation,



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(B) ORGANIC CHEMISTRY:

- (i) Applications of Spectroscopy in Structural Identification
 - IR Spectroscopy
 - UV Spectroscopy
 - ^1H , ^{13}C , ^2D , NMR Spectroscopy
 - Mass Spectrometry
- (ii) Convenient method of isolation, structural & stereochemical studies, identifications of following:
 - Steroid
 - Carbohydrate
 - Alkaloids
 - Terpenoids.
- (iii) Use of the following reagents in Organic Synthesis
 - DIBAL
 - 9-BBN
- (iv) Coupling reaction involving Organometallic/Metallic Reagents
 - Suzuki Reaction
 - Heck reaction
 - Negishi reaction
- (v) Newer Oxidative & Reductive reagent in Chemical research



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(C) PHYSICAL CHEMISTRY

Electrochemistry

- Electro catalysis, electro catalytic scales, apparent and true current densities, electrochemical active surface area and its determination,
- Electrochemical reaction order, oxygen reduction. Butler-Volmer (BV) equation for equilibrium and non-equilibrium systems.
- Discussion of the BV equation under low and high potential/overpotential conditions, Tafel plots and its applications, exchange current density, cyclic voltammetry, structure of the electrified interface.

Thermodynamics and Solution Chemistry:

- Thermodynamics Functions, Partial Molar Quantities and their significance with special reference to Partial Molar Volume, its experimental determination, Volume Changes in Solutions,
- Concept of Apparent molar Volumes and experimental determination. Apparent Molar Adiabatic Compressibility and Apparent Molar Volume Expansibility, Volume of Transfer.
- Kohlrausch Relation of Apparent Molar Volume with density of solvent in Solutions. Masson's Equation, Redlich and Rosenfeld's Equation.
- Different Approaches of Measurement of Densities of Solvents and Solutions. Measurement of Ultrasonic Velocity in Different Solutions, Acoustic Parameters, Ion-Ion and Ion Solvent Interactions in Solutions.

Chemical Kinetics and Surface Chemistry

- Theory of reaction rate in solution, comparison between gas phase and solution phase reactions. Thermodynamics treatment of theory of reaction rate, reaction between ions. Primary and secondary salt effects.
- Kinetics of ligand substitution reaction and its classification. Volume of activation and its experimental determination, catalysis and its mechanism. Kinetics of enzymes catalyzed reactions, effect of temperature and pH on enzyme catalyzed reaction, Ping Pong mechanism.
- Surface Chemistry and Heterogeneous Catalysis: Adsorption Isotherms; Surface Area Determination Kinetics of Heterogeneous reactions. Inhibitory unimolecular surface reactions, Surfactants, CMC and its determination