SYLLABUS FOR B.Sc. III YEAR COURSE

CHEMISTRY

THIRD YEAR

2023-24

B.Sc. III YEAR-2024

PAPER - I

CH – 301 Inorganic Chemistry – III

UNIT I

Metal-Ligand bonding in transition metal complexes:

Valence bond theory of complexes and its limitation, Crystal field theory, Crystal field splitting of energy levels in octahedral, tetrahedral and square planer complexes, crystal-field stabilization energy of octahedral complexes (Calculation Only).

UNIT II

Hard and soft Acid Base Concept (HSAB): Classification of acid and base as hard and soft. Pearson's HSAB concept and its application.

Magnetic properties of transition metal complexes: Types of magnetic behaviour, magnetic properties of metal complexes, spin only formula, methods of determining magnetic moment and magnetic susceptibility.

UNIT III

Stability of metal complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability. Kinetic stability, labile and inert complexes, colour of transition metal complexes, effective atomic number (EAN), pi accepter ligands, experimental determination of stability constant and composition of complex (Job's Method and Bjerrum's Method).

UNIT IV

Organometallic Chemistry: Defination, nomenclature and classification of organometallic compounds, bonding, preparation, properties and application of organometallic compounds of Li, Al, Hg and Sn (alkyls and aryl).

Bioinorganic Chemistry: Essential and trace elements in biological processes, Biological role of alkali (Na, K, Li) and alkaline earth (Mg, Ca) metals.

UNIT V

Basic principles of Metallurgy and metallurgical processes.

Metallurgy of Copper, Zinc, Platinum and Uranium from their main ores.

Books Recommended:

1. Inorganic Chemistry Part I and part II by N.C.Sogani, M.L.Sharma, G.K.Rastogi
2. Inorganic Chemistry by G.C.Shivhare, V.P.Lawania
3. Text Book of Inorganic Chemistry by P.L.Soni
4. Text Book of Inorganic Chemistry by Satya Prakash, Tuli & Madan

PAPER – II

CH-302 Organic Chemistry

UNIT : I.

Spectroscopy

Nuclear magnetic resonance (NMR) spectroscopy.

Proton magnetic resonance (^{1}H PMR) spectroscopy , nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

UNIT : II

Heterocyclic Compounds

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basic nature of pyridine, piperidine and pyrrole.

Introduction to condensed five and six – membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

UNIT : III.

Carbohydrates

Classification and nomenclature. Monosaccharides, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. , mechanism of osazone formation, Formation of glycosides, ethers and esters. Cyclic structure of D(+)-glucose. Determination of ring size of monosaccharides, Mechanism of mutarotation. Structures of ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides(starch and cellulose)without involving structure determination.

UNIT – IV.

Amino Acids, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids; Acid-base behavior, isoelectric point, electrophoresis and separation of amino acids by chromatography.

Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Peptide structure determination, end group analysis, Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation.

Nucleic acids: introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

UNIT –V:

Fats, Oils, Detergents and Synthetic Polymers : Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates. Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes

Books Recommended:

1. Advanced Organic Chemistry by Morrisom & Boyd
2. Organic Chemistry by Behal & Behal
3. Text Book of Organic Chemistry by M.K.Jain
4. Polymer Chemistry by P. Bahadur and N.V. shastri.

PAPER – III

CH-303 Physical Chemistry – III

UNIT I

Elementary Quantum Mechanics
Black-body radiation, Planck's radiation law, photoelectric effect. Compton effect, De Broglie hypothesis, the Heisenberg's uncertainty principle, Schrodinger wave equation and its importance, physical interpretation of wave function.
Adsorption: Difference between adsorption, absorption and sorption, Chemisorption, adsorbent and adsorbate, reversible and irreversible adsorption, characteristics of adsorption, adsorption of gases by solids, factors affecting adsorption, types of adsorption, types of adsorption isotherms, Freundlich and Langmuir adsorption isotherms. Numericals

UNIT II

Spectroscopy
Introduction: electromagnetic radiation, regions of the spectrum, Basic features of different Spectrometers, Born-Oppenheimer approximation, degrees of freedom.
Rotational Spectrum: Diatomic molecules, Energy levels of a rigid rotator (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotator, isotope effect. Numericals.

UNIT III

Vibration and Raman Spectroscopy
Vibrational Spectrum:Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum.
Raman Spectroscopy: concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules. Numericals.

UNIT IV
Electronic Spectrum: Origin of electronic spectrum, Selection rules, vibrational course structure and rotational fine structures considering no interaction of rotational and vibrational energies. qualitative description of selection rules and Franck-Condon principle.
Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions – energy transfer processes (simple examples). Numericals

UNIT V

Solid State

Crystal state, classification of crystals, space lattice, unit cell.

Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements in crystals.

X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method). Numericals.

Books Suggested:

1. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
2. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.
3 Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Nagin Chand & Co.
4 Physical Chemistry by S.C.Ameta, A.V.Singh, R.Ameta, R.Mathur
5 Bhotic Rasayan, K.R. Genwa, RBD Jaipur

CH – 304 Laboratory Course – III

Inorganic Chemistry:

Preparations: [5]

Micro cosmic salt., Tetraammine copper(II) sulphate, Nickel ammonium sulphate, Sodium thiosulphate, Chrome Alum, Ferrous Sulphate, Ferrous Ammonium Sulphate

Organic Chemistry:

(a) Qualitative Analysis: - Analysis of an organic mixture is containing two solid components, using water, $NaHCO_3$ and NaOH for separation. **[15]**

(b) Synthesis of organic compounds:- **[10]**

(i) Acetylation of salicylic acid, aniline and p-nitroacetanilide.

(ii) Preparation of iodoform from ethanol and acetone.

(iii) Diazotization/Coupling of primary aromatic amines (aniline).

(iv) Preparation of methyl orange.

(c) Thin Layer Chromatography **[10]**

(i) Separation of dyes

(ii) Separation of green leaf (Spinach) pigments.

Physical Chemistry **[15]**

(a) Colloids: To determine precipitation value for the following sols and also verify Hardy's Schultz law (i)As_2S_3 Sol (ii)$Fe(OH)_3$ Sol .

(b) Distribution law: To determine the partition coefficient of benzoic acid between water and benzene at R.T.

(c) Adsorption: To study the adsorption of acetic acid by activated charcoal and verify the Freundlich **a**dsorption isotherm.

Viva **[5]**

Record **[15]**

Books Suggested (Laboratory Courses):

1. Practical Chemistry, S.Giri, D.N.Bajpai and O.P.Pandey Publ. S. Chand
2. Experimental Organic Chemistry Vol I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
3. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
4. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
5. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.
6. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill.
7. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
8. Advanced Experimental Chemistry, Vol. I-Physical, J.N. Gurtu and R. Kapoor, S. Chand & Co.

Examination & Marking Scheme

Time: 5 hours Max. Marks: 75 Min. Pass Marks: 27

	Regular Student	Ex Student
Inorganic Preparation	05	05
Qualitative Analysis	15	15
Organic Synthesis	10	10
Chromatography	10	10
Physical Experiment	15	15
Viva- Voice	5	5
Sessional and Record	15	…
Total	75	60*

*To be converted out of 75