SYLLABUS

CHEMISTRY

B.Sc. PART-III

PAPER-I

INORGANIC CHEMISTRY

Unit 1. Metal-ligand Bonding in Transition Metal Complexes

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal field parameters.

Thermodynamic and Kinetic Aspects of Metal Complexes

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

Unit 2. Magnetic Properties of Transition Metal Complexes

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin only formula, L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3*d* metal complexes.

Electronic Spectra of Transition Metal Complexes

Types of electronic transitions, selection rules for *d-d* transitions, spectroscopic ground states, spectro-chemical series. Orgel-energy level diagram for d^1 and d^2 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$complex ion.

Unit 3. Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, a brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and nature of bonding in metal carbonyls.

Unit 4. Bio-inorganic Chemistry

Essential and trace elements in biological processes, metallo-porphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Ca^{2+}, Nitrogen fixation.

Unit 5. Hard and Soft Acids and bases (HSAB)

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis.

Silicones and phosphazenes

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

PAPER-II

ORGANIC CHEMISTRY

Unit 1. A. Organo-metallic Compounds

Organomagnesium Compounds : Grignard reagents-formation, structure and chemical reactions. **Organozinc Compounds :** Formation and

chemical reactions. **Organolithium Compounds :** Formation and chemical reactions.

B. Organosulphur Compounds

Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

Organic synthesis via Enolates

Active methylene group alkylation of diethylmalonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate : the Claisen condensation, Ketoenol tautomerism of ethyl acetoacetate.

Unit 2. Biomolecules

A. Carbohydrates

Configuration of monosaccharides, threo and erythro diastereomers. Formation of glycosides ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D (+) glucose. Structure of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

B. Proteins and Nucleic acids

Classification and structure of protein levels of protein structure, protein denaturation/renaturation, Constituents of amino acids Ribonucleosides and ribonucleotides, double helical structure of DNA.

Unit 3. A. Synthetic Polymers

Addition of chain growth polymerization. Free radical vinyl polymerization, Ziegler-Natta polymerization, Condensation or Step growth polymerization, Polyesters, polyamides, phenols-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes, natural and synthetic rubbers.

B. Synthetic Dyes

Colour and constitution (Electronic Concept). Classification of Dyes. Chemistry of dyes. Chemistry and synthesis of Methyl Orange, Congo red, Malachite green, Crystal Violet, Phenolphthalein, Fluorescein, Alizarine and Indigo.

Unit 4. Spectroscopy

A. Mass spectroscopy : Mass spectrum fragmentation of functional groups.

B. Infra red spectroscopy : IR absorption band, their position and intensity, identification of IR spectra.

C. UV- Visible spectroscopy : Beer Lambert's law, effect of conjugation λ_{max} visible spectrum and colour.

D. Anthocyanin as natural colouring matter (Introduction only)

E. Application of mass. IR, UV-visible spectroscopy to organic molecules.

Unit 5. A. NMR Spectroscopy

Introduction to NMR. Shielding and number of signal in PMR, Chemical shift and characteristic values, splitting of signals and coupling constant, Application to organic molecules.

B. ^{13}CMR Spectroscopy : Principle and Application.

C. Magnetic Resonance Imaging (MRI) : Introductory idea.

PAPER-III

PHYSICAL CHEMISTRY

Unit 1. Quantum Mechanics-I

Black body radiation, Plank's radiation law, photoelectric effect, Compton effect. De-Broglie's idea of matter waves, experimental verification Heisenberg's uncertainty principle, Sinosoidal wave equation, Operators :

Hamiltonian operator, angular momentum operator, laplacian operators, postulate of quantum mechanics, Eigen values, Eigen function. Schrodinger time independed wave equation, physical significance of ψ and ψ^2. Applications of schrodinger wave equation : Particle in one dimensional box Hydrogenation (separation into three equation's) radial wave function and angular wave function.

Unit 2. Quantum Mechanics-II

Quantum mechanical approach of molecular orbit theory; basic idea criteria for forming M.O and A.O, LCAO approximation, formation of H^{2+} ion, calculation of energy levels from wave functions bonding and antibonding wave functions concept of σ, σ^*, π and π^* orbitals and their characteris tics, Hybrid orbital : sp, sp^2, sp^3, Calculation of coefficient AO's used in these hybrid orbitals.

Introduction to valence bond model of H_2, comparison of M.O. and V.B. model, Huckel theory, application of huckel theory to ethane, propene etc.

Unit 3. Spectroscopy-I

A. Introduction, characterization of electromagnetic radiation, regions of the spectrum, representation of spectra width and intensity of spectral transition rotational spectra of calculated diatomic molecules, energy level of rigid rotator, selection rule, determination of bond length qualitative description of non-rigid rotator isotopic effect.

B. Vibrational spectra : Fundamental vibrational and their symmetry, vibrating diatomic molecules, energy levels of simple harmonic oscillator. Selection Rule, Pure vibrational spectrum, determination of force constant, diatomic vibrating operator, Anhormonic oscillator.

C. Raman Spectra : Concept of polarizability, quantum theory of Raman spectra stokes and anti stokes lines pure rotational and vibrational Raman spectra, Application of Raman spectra stokes and antistokes lines, pure rotational and vibrational Raman spectra, Application of Raman spectra.

Unit 4. Spectroscopy-II

A. Electronic spectra : Electronic spectra of diatomic molecule, Franck-Condon principle, types of electronic transitions. Applications of electronic spectra.

B. Photo-chemistry : Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry. Grothus-Drapper law, Stark-Einstein law, Jablonski diagram depicting various process occuring 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).

Unit 5. A. Thermodynamics

Energy refered to absolute zero, third law of thermodynamics, Test of third law of thermodynamics, Nernst heat theorem application and limitation of Nernst heat theorem.

B. Physical properties and molecular structure : Polarization of molecules, Classius-Mosotti equation. Orientation of dipoles in an electric field. Dipole moment, induced dipole moment, measurement of dipole moment. Temperature methods and refractivity methods. Dipole moment and molecular structure.

C. Magnetic properties : Paramagnetism, diamagnetism, ferromagnetism. Determination of magnetic susceptibility, elucidation of molecular structure.