Inorganic Chemistry

B. Sc. III year **60 hrs (2 hrs/week)**

CHE301 **Paper I** **Max Marks 33**

1. Hard and Soft Acid-Base Theory **07 hrs**

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

2. Metal-Ligand bonding in transition metal complexes **10 hrs**

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

3. Magnetic Properties of Transition Metal Complexes **07 hrs**

Types of magnetic behaviour, methods of determining magnetic susceptibility; Gouy's and Quincke's methods, spin only formula, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

4. Electronic Spectra of Transition Metal Complexes **07 hrs**

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel energy level diagram for d^1, d^2 and d^8, d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

5. Thermodynamic and Kinetic Aspects of Coordination Compounds. **05 hrs**

A brief outline of thermodynamic and kinetic stability of metal complexes and factors affecting the stability of coordination compounds. Substitution reactions in square planar complexes.

6. **Organometallic chemistry** **10 hrs**

Definition, nomenclature and classification based on nature of metal-carbon bond. Metal carbonyls. Mononuclear carbonyls, nature of bonding, structure and preparation. EAN and 18-electron rule. Definition, nomenclature, classification, general methods of preparation of organometallic compounds and a brief account of metal-ethylenic complexes.

7. **Bioinorganic Chemistry** **10 hrs**

Role of metal ions in biology, essential and trace elements in biological systems, toxic elements, elementary idea of structure and oxygen binding mechanism in metallo-porphyrins with special reference to haemoglobin and myoglobin. Alkali and alkaline earth metal ions in biological system-mechanism of transport across cell membrane, biochemistry of magnesium and calcium.

8. **Inorganic Polymers of Silicon and Phosphorus** **04 hrs**

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

Organic Chemistry

B. Sc. III year **60 hrs (2 hrs/week)**

CHM302 **Paper II** **Max Marks 33**

1. Spectroscopy **08 hrs**

Nuclear magnetic resonance (NMR) spectroscopy; Proton magnetic resonance (1H NMR) 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, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

2. **Organo-metallic Compounds** **04 hrs**

Organomagnesium compounds; the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds; formation and chemical reactions.

3. **Organo-sulphur compounds** **04 hrs**

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

4. Hetrocyclic compounds **08 hrs**

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. Mechnism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction of condensed five- and six membered heterocycles. Preparation and reactions of quinolene and isoquinolene with special reference to Fischer-Indole synthesis, Skraups synthesis and Bischler-Napieralski synthesis. Mechnaism of electrophilic substitution reactions of quinolene and isoquinolene.

2 Carbohydrates 08 hrs

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, inetrconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. General study of disaccharides (structure determination not required). General introduction of structure of ribose and deoxyribose.

5. **Amino Acids, Peptides, Proteins and Nucleic Acids 08 hrs**

Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids. Nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Levels of protein structure. Protein denaturation/renaturation.

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

6. **Fats, Oils and Detergents 02 hrs**

Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value and acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

7. **Synthetic Polymers 04 hrs**

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. Natural and synthetic rubber.

8. **Synthetic Dyes** 06 hrs

Colour and constitution (electronic concept), classification of dyes. Synthesis and uses of Methyl orange, Malachite green, Phenolphthalein, Fluorescein, Alizarin and Indigo.

9. Natural Products 08 hrs

Classification, extraction and general methods of structure determination of terpenoids (limonene, citral) and alkaloids (nicotine, cocaine).

Physical Chemistry

B. Sc. III year **60 hrs (2 hrs/week)**

CHM303 **Paper III** **Max Marks 34**

1. **Elementary Quantum Mechanics** **12 hrs**

   Black-body radiation, Plank's radiation law, photoelectric effect, Bohr's model of hydrogen atom (no derivation) and its defects. Compton effect, de Broglie hypothesis, Heisenberg's uncertainty principle, operator concept, Hamiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function.

2. **Spectroscopy** **20 hrs**

   Introduction; electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer apporoximation. Degrees of freedom, types of energies in linear and non-linear molecules, derivation and applications of Maxwell-Boltzmann distribution law.

   Rotational spectrum

   Diatomic molecules, energy levels of a rigid rotor (semi-classical principle), selection rules, special intensity, determination of bond length, qualitative description of non-rigid rotor, isotopic effect.

   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 harmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

   Raman spectrum, concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

   Electronic spectrum

   Concept of potential curves for bonding and antibonding molecular orbitals, qualitative description od selection rules and Frank-Condon principle, Qualitative description of σ, π, and n M.Os, their energy levels and the respective transitions.

3. **Photochemistry** **08 hrs**

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry; Grothuss-Drapper law, Lambert's law, Lamber-Beer's 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).

4. **Physical Properties and Molecular Structure 06 hrs**

Optical properties and their relation with chemical constitution, polarization, Clausius-Mossotti equation, orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and its application in determining the structure of molecules.

5. **Solutions and Colligative Properties 08 hrs**

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solutions, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular mass determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular mass from osmotic pressure. Elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

6. **Thermodynamics III 06 hrs**

Statement and concept of residual entropy, third law of thermodynamics, unattainability of absolute zero, Nernst heat theorem. Evaluation of absolute entropy from heat capacity data.

Lab Course B. Sc. Chemistry III year Max Marks 50

06 hrs/week

1. Laboratory hazards and safety precautions.
2. Organic qualitative analysis; binary mixture of organic compounds separable by H_2O and $NaHCO_3$
3. Organic synthesis; through nitration, halogenation, acetylation, sulphonation and simple oxidation.
4. Physical chemistry experiments based on solubility, transition temperature and phase equilibria, thermochemistry and electrochemistry
5. Demonstrative chromatographic experiments; Paper chromatography/TLC (analytical separation of simple organic molecules).

One exercise each from organic binary mixture, organic synthesis and physical chemistry experiments shall be given in the examination.

Distribution of marks shall be as given below:

i.	Organic qualitative analysis	16
ii.	Organic synthesis	07
iii.	Physical chemistry experiment	10
iv.	*Viva-Voce test	05
v.	Annual record and attendance (06 for each)	12

*Viva-Voce test for ex-students shall carry 17 marks.

Note:

- *The lab work of the student has to be evaluated and assessed carefully and periodically. A minimum of 12 experiments covering all the kind of exercises has to be performed during an academic year. The annual record has to be maintained by the department/college as an official record.*
- *Less than zero mark will not be awarded.*
- *The total number of students to be examined per batch shall not be more than sixty.*
- *Duration of the practical examination shall be of 06 (six) hours.*
- *Marks have to be submitted to the Registrar/Controller examination in a sealed envelop making a copy to the Principal/Head of the department.*