From – 2013-14

B.Sc. - THIRD YEAR

CHEMISTRY

There shall be three written papers and a practical examination as follows:

		Max. Marks
Paper – I	Inorganic Chemistry	75
Paper – II	Organic Chemistry	75
Paper – III	Physical Chemistry	75
	TOTAL	**225**
	PRACTICAL	75
	GRAND TOTAL	**300**

Candidate will be required to pass in Theory and Practical Separately.

B.Sc. – III Chemistry (Paper-I)

Inorganic Chemistry :

Unit – I

I. Metal-ligand bonding in Transition Metal Complexes

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

II. Thermodynamic and Kinetic Aspects of Metal Complexes

A brief outline of thermodynamics stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes.

Unit – II

III. Magnetic Properties of Transition Metal Complexes

Types of magnetic behavior, 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 3d-metal complexes.

IV. Electronic spectra of Transition Metal Complexes

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

Unit – III

V. Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds,

Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Snl.

Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear carbonyls.

VI. Silicones and Phosphazenes

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

Unit – IV

VII. 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, theoretical basis of hardness and softness, electro negativity and hardness and softness.

VIII. Bioinorganic Chemistry

Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin, Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}.

B.Sc. – III Chemistry (Paper-II)

Organic Chemistry :

Unit – I

I. Spectroscopy

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of ^{1}H NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structures elucidation of simple organic compounds using UV, IR and ^{1}H NMR spectroscopic, techniques.

Unit – II

II. Organometallic Compounds

Organomagnesium compounds : the Grignard reagents, formation, structure and chemical reactions.

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

III. Organosulphur Compounds

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

IV. Hetrocyclic 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 reaction in pyridine derivatives, Comparison of basicity 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-Nepieralski synthesis, Mechanism of electrophilc substitution reactions of indole, quinoline and isoquinoline.

Unit – III

V. Carbohydrates

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

VI. Amino Acids, Peptides, Proteins and Nucleic Acids:

Classification, structure and stereochemistry of amino acids, Acid-base behaviour isoelectric point and electrophoresis, Preparation and reactions of α-amino acids, Structure and 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, 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 – IV

VII. Fats, Oils and Detergents

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.

VIII. Synthetic Polymers

Addition or chain-growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers,

Condensation or step growth-polymerization, Polyesters, plyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes, Natural and synthetic rubbers, Elementary idea of organic conducting polymers.

IX. Synthetic Dyes

Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.

X. Organic Synthesis via Enolates

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate.

Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines.

B.Sc. – III Chemistry (Paper-III)

Physical Chemistry :

Unit – I

(Introductory Quantum Mechanics, Spectroscopy, Physical Properties and Molecular Structure)

I. **Introductory Quantum Mechanics:**
Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (without derivation) their solution of overall solution and its defects, Compton effect, de-Broglie's hypothesis, the Heisenberg's uncertainty principle, Hamiltonian Operator.

II. **Spectroscopy:**
Introduction : electromagnetic radiation, regions of the spectrum, basic features of different spectrophotometers, statement of the born-oppenheimer approximation, degrees of freedom.

III. **Physical Properties and Molecular Structure:**
Optical activity, 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 structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetic, Magnetic susceptibility, its measurements and its importance.

Unit – II

IV. **Elementary Quantum Mechanics:**
Schrödinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

Molecular orbital theory, basic ideas – criteria for forming M.O. from A.O., construction of M.O's by LCAO – H_2^+ ion, calculation of energy levels from wave functions, physical picture of bonding and anti-bonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics, Hybrid orbitals – sp, sp^3, sp^2, calculation of coefficients of A.O's used in sp and sp^2 hybrid orbitals and interpretation of geometry.

Introduction to valence bond model of H_2, comparison of M.O. and V.B. models.

Unit – III

V. **Rotational Spectrum:**
Diatomic Molecules: Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope 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 anharmonic 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 energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.

Qualitative description of σ, π and η M.O. their energy levels and the respective transition.

Unit – IV

(Photochemistry, Solutions, Dilute Solutions and Colligative Properties)

VI. 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), Kinetics of Photo chemical reaction.

Solutions, Dilute Solutions and Colligative Properties:

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

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, Elevation of boiling point and depression of freezing, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.

B.Sc. III

Chemistry Practical

Inorganic Chemistry:

1. Estimate the following ions gravimetrically
   (i) Barium as barium sulphate in barium chloride solution
   (ii) Zinc as zinc oxide from zinc chloride or zinc sulphate solution
   (iii) Copper as cupric oxide in a solution of copper sulphate or as CuSCN
   (iv) Nickel as $Ni(dmg)_2$
2. Inorganic Preparation
   (i) $K_3[Fe(ox)_3]$
   (ii) $[Cu(NH_3)_4]SO_4.H_2O$
   (iii) Potash alum
   (iv) $Ni(dmg)_2$

Organic Chemistry

1. Separation of two component organic mixture (water separable). Systematic analysis of each component leading to their final identification laying emphasis on solubility, element detection, melting point determination, ignition test, unsaturation test, functional group test, specific test if any and preparation of a suitable derivative.
2. Preparation of the following organic compounds
   (i) Phenyl benzoate from phenol, Naphthyl benzoate from β- naphthol
   (ii) Aspirin from salicylic acid
   (iii) Benzoic acid from ethyl or methyl benzoate
   (iv) Oxalic acid from cane sugar
   (v) Picric acid from phenol
   (vi) Benzanilide from aniline
   (vii) Methyl orange
   (viii) Phenyl – azo – β – naphthol
   (ix) Aniline yellow
   (x) Soap

Minu Sanyal 25.10.17 25/10/17

Biochemistry

1. Qualitative analysis of the fruit and vegetable juice for the contents present in them – Ascorbic acid, carbohydrate, protein
2. Separation of amino acid by paper chromatography
3. Determination of total hardness of water by chromatography
4. Determination of permanent and temporary hardness of water
5. Determination of alkalinity of water
6. Determination of dissolved oxygen (DO) in a water sample
7. Determination of amino acid by paper chromatography and thin layer chromatography

Physical Chemistry

1. Determination of molar mass by Rast method.
2. To study the kinetics of reaction between acetone and iodine.
3. To determine the velocity constant for the hydrolysis of methyl acetate catalysed by hydrogen ions.
4. To determine the solubility of benzoic acid by titration method.
5. To determine the solubility product of calcium hydroxide.
6. Estimation of acetic acid in vinegar by Potentiometry
7. Estimation of acetic acid in vinegar by conductometry
8. Determination of pH by EMF method
9. Determination of solubility product of AgCl from EMF measurement
10. Preparation of buffer solution and measurement of pH by pH meter

Minu Sanjay

25.10.17

25/10/17

System of Marking

Duration: 08h (1 day)	**M.M: 75**
Exercise 1: Any one gravimetric estimation	15
Exercise 2: Any one inorganic preparation	10
Exercise 3: Separation of binary organic mixture and identification of each component	10
Exercise 4: Any one organic preparation	05
Exercise 5: Any one exercise from Biochemistry	10
Exercise 6: Any one exercise from Physical Chemistry	10
Viva- voce	10
Record (including chart/model/project)	05

Minu Saigal

25.10.'17

25/10/17