

**S.Y.B.Sc. [REVISED SYLLABUS] 2004**  
**CHEMISTRY PAPER-III**  
**INORGANIC CHEMISTRY**  
**(Total Marks : 70)**

**Unit I :**

[A] **Wave mechanics** : Wave postulates of quantum mechanics, wave function and its interpretation, operators (linear, hermitian, their addition, subtraction and multiplication) commutators, setting up of Hamiltonian operator upto carbon, Eigen function, Eigen values and its significance, mean or expectation value. Schrodinger equation Particle in a box. [10 Marks]

[B] Inert Gas compounds. [4 Marks]

**Unit II :**

[A] **Structure of complexes** : Valence bond theory of complexes, principles and its application to determine structure and Magnetic properties of complexes, limitations of V.B. theory. [4 Marks]

[B] **Crystal field theory** : 'd' orbital splitting of octahedral, Tetrahedral complexes in strong and weak crystal field. Effect and application of crystal field splittings, magnetic properties of high spin and low spin complexes, HSP and LSP configuration, their relative stabilities. Thermodynamic properties of crystal field splitting-Enthalpy of Hydration of  $M^{+2}$  ions, Lattice energies of  $MCl_2$  compounds of First row transition elements [10 Marks]

**Unit III :**

[A] **Chemical Bonding** : Molecular orbital treatment, LCAO Principle for sigma ( $\sigma$ ) and Pi ( $\pi$ ) bonds, Bonding, Antibonding and Non bonding molecular orbitals, calculation of bond order, MO representation of homopolar molecules- $C_2$ ,  $N_2$ ,  $O_2$  and  $F_2$  and heteropolar molecules - CO, NO and  $CN^-$  ion, M.O. treatment of metal  $1^0C$  bond. [10 Marks]

[B] M.O. theory as applied to complexes and MO's of  $[CoF_6]^{-3}$  and  $[Co(NH_3)_6]^{+3}$  complex. [4 Marks]

**Unit IV :**

[A] Non aqueous solvents :  $SO_2$ ,  $NH_3$  and HF [6 Marks]

[B] Physico-chemical principles of  $Na_2CO_3$ ,  $NH_3$  and NaOH [4 Marks]

[C] Nuclear Fission [4 Marks]

**Unit V :**

[A] **Fertilizers** : Industries in India, manufacture of ammonical fertilizers, ammonium salts, Urea, Nitrates, phosphates and super phosphates, mixed Fertilizers, Micronutrients and their role in fertilizers. [5 Marks]

[B] Deuterium and its compounds. [4 Marks]

[C] Types of pollutions particular for water pollution, C.O.D., D.O.D., and D.O. and their methods of determination. [5 Marks]

**Reference Books :**

- ( 1 ) Introductory quantum Chemistry,  
- A.K. Chandra, 4th edn, Mc Graw Hill, (1994).
- ( 2 ) Quantum Mechanics in Chemistry.  
- M.W. Hanna, 3<sup>rd</sup> edn, Benjamin, Monlo Park, California, 1981
- ( 3 ) Basic Inorganic Chemistry.  
- F. Albert, Cotton, G. Wilkinson, P. L. Gaus, 3<sup>rd</sup> edn, John Willey, New York, 1995.
- ( 4 ) Advanced Inorganic Chemistry F. A. Cotton, G. Wilkinson and P. L. Gaus 5th Edition, John Willey and Sons, New York, 1988.

- ( 5 ) Valency and Molecular Structure-E. Cartmell and G.W.A. Fowles, 3rd edn, ELBS, Bucter worths, 1970.
- ( 6 ) Theoretical Inorganic Chemistry M. C. Day & J. Selbin, 2nd Ed., East West Press, 1985.
- ( 7 ) A New concise Inorganic Chemistry - J. D. Lee IVth Edition, 1991, ELBS & D. Van Nostrand Company Ltd.
- ( 8 ) Molecular quantum Mechanics, P. W. Atkins, 2<sup>nd</sup> Edn., Orford Uni., Press New York, 1988.
- ( 9 ) The Importance of Antibonding orbitals, Jaffe.
- (10) Inorganic Chemistry Principles and structure and reactivity, J. Huheey, J. A. Keiter and R. L. Keiter, 4th ed. Hauper collins college, Publishers, 1993.
- (11) Vogells Quantitative Analysis 6th ed., Orient Longman, London 1987.
- (12) Introduction to Advanced Inorganic Chemistry, P. J. Durant and B. Durant.

**CHEMISTRY - Paper IV**  
**(Organic Chemistry)**  
**(Total Marks : 70)**

**Unit I :**

[ A ] Chemical Reactivity and Molecular Structure (Acid - Base Properties) :

Proton acid - bases, scale of acidity - basicity, Resonance effect, drawing of resonance structures and the conditions for resonance, Effect of change of hybridisation on acidity and basicity, Inductive and electronic effects, steric effects and hydrogen bonding, Lewis acids and bases. Keto-enal Tautomerism and factors affecting its equilibrium, Acid and base catalysed mechanism of inter conversion of the Keto and enol forms of EAA.

(Reference Book : Organic Chemistry by cram Hendrik son and Hamand, Sec. 8, 1 to 8.9 Expect 8.8). [8 Marks]

[ B ] (i) Confirmational Analysis of Mono & Dimethylcyclohexanes (Finar Vol. II).

(ii) Stereo chemistry of Oximes

**Oximes :** Nomendature of oximes. Determination of configuration of aldoximes. Determination of configuration of Ketoximes. Beckmann transformation and its mechanism (Finar Vol II) [6 Marks]

**Unit II :**

[ A ] Electrophilic Substitution (Aromatic). Introduction, Effect of Substituents groups, Determination of orientation, Determination of relative reactivity, classification of the substituent groups, orientation of disubstituted benzenes, orientation and synthesis. Mechanism of nitration, Sulfonation, Friedul - craft alkylation, halogenation; acylation, Desulfonation, Isotope effect. Mechanism of electrophilic Substitution, two steps, Reactivity and orientation. Theory of orientation, Electron release via resonance. Effect on halogen on electrophilic aromatic substitution.

(Chapter - 14 of Organic Chemistry 5th eddition by Monison & Boyd) [8 Marks]

[ B ] Polynuclear Aromatic Hydrocarbons Fusedring compounds, Nomendature of Naphthalene derivatives. Structure of Naphthalenes., Reactions of Naphthalene. Oxidation, reduction, dehydrohalogenation, nitration, halogenation. Orientation of electrophilic substitution (SE) in naphthalence. Friedal craft (alkylation and acylation). Sulfonation. Naphthols. Orientation of electrophilic substitution in naphthalence and its derivatives. Synthesis of Naphthalene derivatives. Howarth synthesis, Anthraeene, Phenanthrene. Reactions; Preparations of both and their derivatives (by ring closure) Carcinogenic hydrocarbons.

(Chapter 34 of Organic Chemistry Morrison & Boyd 5th eddition) [6 Marks]

**Unit III :**

[ A ] **Carbohydrates** : Defination and classification. (+) Glucose : an aldose; (--) Fructose : 2-Ketose. Stereo isomers of (+) glucose. Nomenclature aldose derivatives. Oxidation, effect of alkaliosazones. Formation of epimers. Lengthening of carbon chain of aldoses. Ruff - degradation. Conversion of aldose into its epimers, configuration glucose - fischer's proof for configuration of the aldoses-optical families of D & L absolute configuration. Formation of Glucoside, Cyclic structure of D (+) Glucose and conformation. (as per Morrison & Boyd 5th addition) [10 Marks]

[ B ] **Synthesis and Reactions of B-dicarbonyl compounds** :

Introduction, The claisen condensation, Synthesis of EAA and Malonic ester. Their synthetic applications. (Page qul organic chemistry Finar) [4 Marks]

**Unit IV : Heterocyclic compounds :**

[ A ] Heterocyclic systems, Structure of pyrrole, furan and thiophene. Source of pyrrole, furan & thiophene, Electrophilic substitution in pyrrole furan and thiophene. Reactivity and orientation in SE reactions in five membered heterocycles structure of pyridine. Source of pyridine. Reactions of pyridine. Electrophilic substitution in pyridine. Nucleophilic substitution in pyridine Basicity of pyridine. Quinoline, isoquinotine and Indole. (Org. chemistry 5th Eddition by Morrison & Boyed) [7 Marks]

[ B ] **Cyclohexanes** :

Open chain and cydic compounds Nomenclature, Physical properties, Industrial sources. Preparations and Reactions : Reactions of small ring compounds. Bacyer strain theory. Heats of conbustions and relative stability of cydoaikanes :

Orbital pictures angle-strain, Factors affecting stability of conformations.

(Organic chemistry 5th Eddition. Marrison & Boyed)

Organic chemistry Finar Vol I page 558 to 560.

[7 Marks]

**Unit V : Ultraviolet Spectroscopy :**

The nature of electronic transitions. The origin of UV Bond structure. Principles of absorption spectroscopy. Presentation of spectra, Solvents. What is chromophore? The effect of conjugation on alkenes. Problemes of dienes using woodward-Fieser. Rules for dienes, Carbonyl compounds Enones and Problemes of enones using the woodward rules. Aromatic compounds and polynuclear hydrocabones. Problems of Aromatic Ketones, Aldehydes, acids esters using emipirical rules. [14 Marks]

**CHEMISTRY PAPER-V**  
**PHYSICAL CHEMISTRY**  
**(TOTAL MARKS : 70)**

**Unit - I :**

**Thermodynamics** : Spontaneous processes, carnot cycle, efficiency of heat engines, Entropy change for an ideal gas, Entropy chnges at constant pressure and constant volume, Entropy of mixing of ideal gases, Entropy change, during a phase change, Entropy change in irreversible processes. The physical significance of entropy. Free energy amd maximum work function. Helmholtz equation for constant volume processes and Gibbs-Helmholtz equation (Derivation only) clapeyron-clausius equation (Derivation only). [14 Marks]

**Unit II :**

( a ) **Electro Chemistry** : Transference numbers, its determination by Hittorf method, moving boundary method, Results of Transport number measurements. Determination of solubilities by

conductance measurements Conductometric Titrations. Activity and activity coefficients. Ionic strength Debye-Huckel limiting law (No. derivation). [5 Marks]

( b ) **Nuclear Chemistry** : Units of radio activity-curies, Rutherford, Becquerel, Nuclear radius. Detection of ionising radiations by G. N. counter. Scintillation counter. and proportional counter. Acceleration of charged particles by cyclotron, linear accelerator. [5 Marks]

( c ) **Solid State Chemistry** :

X-Ray and crystal structure. millers Indices, hkl-notation. Bragg's equation, X-Ray study of NaCl and KCl crystal, Determination of Avogadro number (N) by X-Ray methods. [4 Marks]

### Unit III :

( a ) **Colloids** : Colloidal state, preparation, purification, stabilising of colloids, optical and electro chemical properties of colloids, Electrophoresis precipitation by electrolytes, Hardy-schulge rule, Electokinetic phenomenon, gels and emulsions, molecular weights of colloidal substances by osmotic pressure methods, Donnan equilibrium methods, ultracentrifuge method, light scattering method, viscosity method. [7 Marks]

( b ) **Chemical Kinetics** : Effects of temperature on reaction rates. Energy activation. Reaction occurring in stages, opposing reaction, consecutive reactions, chain reaction ( $H_2 + Cl_2$  system), simple collision theory of reaction. [7 Marks]

### Unit - IV :

( a ) **Polymer Chemistry** : Polymerization, step (condensation) Polymerization, chain (addition) Polymerization, Free radical addition Polymerization. molecular weight averages, measurement of molecular weights. [5 Marks]

( b ) **Catalysis** : Criteria of catalysis, Types of catalysis, negative catalysis, Homogeneous catalysis. Heterogeneous catalysis. Inhibition, Properties of catalytic surfaces, active centres, Promoters, retardation and poisoning. Enzyme catalyzed reactions. [4 Marks]

( c ) **Adsorption** : Types of adsorption, adsorption of gases. Freundlich and Langmuir isotherms, adsorption, from solutions. unimolecular insoluble films. Gibb's equation (No. derivation) [5 Marks]

### Unit - V :

( a ) **Physical Properties and Nuclear Structures** : Molar volume, surface tension and parachor. viscosity. Molar Refractions. Optical rotation. Polar and non-polar molecules. Dielectric constant. Dipole moment. Its measurement only by Temp. Method and its application. Diamagnetism and paramagnetism. Magnetic susceptibility, Magnetic moment and its determination by Gouy method. [7 Marks]

( b ) **Phase Rule** : Theoretical derivation of phase rule, system of one component water and sulphur systems. systems of two components. condensed (Reduced) phase rule. Zn-cd system, eutectic points, solid solutions, Zeotropic and azeotropic freezing mixtures, Triethyl amine-water system. phenol-water system, Nicotine-water, vapour pressure of a mixture of immiscible liquids, steam distillation. [7 Marks]

### Reference Books :

1. Introduction to spectroscopy ; Pavla, Lampman and Kriz. W. B. Saunders Company.
2. Organic spectroscopy- william kemp, 3rd ed. Macmillan & Co. 1991.
3. Introduction to organic spectroscopy : Lambert, Shurvell, Lightner and Cooks - Macmillan Press
4. Spectroscopic Methods in organic Chemistry : D. H. Williams & Fleming, 4th ed. McGraw-Hill
5. Application of Absorption spectroscopy of organic compounds. J. R. Dyer, 5th ed., Prentice-Hall

of India, Delhi, 1984, Reprint, 1996.

6. Organic Chemistry : cram, Hammond & Hendrickson, McGraw-Hill series 3rd ed.
7. Organic Chemistry : R. J. Morrison & R. N. Boyd, 6th ed. Prentice Hall of India, Ltd., 1996
8. Fundamentals of Organic Chemistry, 3rd ed., T. W. Graham Soloman, John wiedy, New York

### Chemistry Paper V (Physical Chemistry)

#### Reference Books :

1. Elements of physical Chemistry : Glasstone and Lewis, 3rd ed., Macmillan & Co.
2. Principles of Physical Chemistry : Maron & London IV th ed.
3. Physical Chemistry : Water moore IV th ed., Orient Longman.
4. Physical Chemistry : Daniels & Albeoty IV the ed.
5. Physical Chemistry : G. M. Barrow, 5th ed., McGraw-Hill, New York, 1988.
6. Physical Chemistry : P. W. Atkins, 5th ed., Oxford Uni. Press, 1984.
7. Physical Chemistry : Lavine
8. Thermodynamics : Glasstone.
9. Electro Chemistry : Glasstone.
10. Vogel's Quantitative Inorganic Analysis G. Svehla, 6th ed., Orient Longman, 1987.
11. Analytical Chemistry : D. A. Skoog, D. M. West, F. J. Holler, 5th ed., Saunders College Publishers, London, 1990.

### Three practical of 55 minutes

#### Inorganic Practicals :

1. ( a ) Calibration of burette, pipette etc.  
( b ) Testing of purity of the reagent e. g. Chloride in nitric acid, carbonate in alkalies and nitrate in sulphuric acid.
2. **Inorganic qualitative analysis** : Semimicro method of Analysis of mixture of powders Containing Four radicals excluding phosphate (soluble & insoluble), arsenite, arsenate and borate (minimum eight mixture should be performed by the student). Mixture may be partly soluble in water & soluble in acid charcol test to be omitted. Semimicro methods must be followed.
3. **Volumetric Analysis** :  
( a ) Nitrite by back titration.  
( b ) Hardness of water, Ca & Mg (Total Hardness) by EDTA.  
( c ) Estimation of Ni by using EDTA,  $MgCl_2$  and Erichrome Black-T (Back titration)
4. **Gravimetric Analysis** :  
( a ) Fe as  $Fe_2O_3$  ( b ) Ni as Ni (DMG)<sub>2</sub> ( c ) Ba as  $BaSO_4$  ( d ) Al as  $Al_2O_3$ .

#### Organic Practicals :

Organic spotting of atleast Fourteen substances including minimum four liquids from the following list should be performed by the student with one derivative wherever possible (All types of functional groups should be covered)

#### 1. List of Substances Recommended :

- ( a ) **Acids** : Cinnamic acid, phthalic acid, Anthranilic acid, Sulphanilic acid, P-nitro benzoic acid, Oxalic acid, Succinic acid.
- ( b ) **Phenols** :  $\alpha$ -naphthol,  $\beta$ -naphthol, o-nitro phenol,  $\rho$ -nitro phenol,  $\rho$ -amino phenol.
- ( c ) **Bases** : p-toludine, m-nitro aniline, p-nitro aniline, Aniline.
- ( d ) **Neutral** : Glucose, Acetanilide, Acetamide, Benzamide, Thiurea, m-di-nitro bezene, Naphthalene, Anthracene.
- ( e ) **Liquids** : Aceto phenone, chlorobenzene, Bromobenzene, Chloroform, Carbontetrachloride, Methylacetate, Ethyl acetate, Cyclohexanol.

**2. Estimation :**

- ( a ) Estimation of amide ( b ) Estimation of Glucose  
 ( c ) Estimation of Amine/Phenol by brominating method.

**Practical Examination for Principal B.Sc.**

(Two days; six hours every day examinations)

( 1 )	( a ) Gravimetric exercise	20 marks
	( b ) Organic spotting (including crystalization & Derivative)	20 marks
	( c ) Volumetric/Organic Estimation	20 marks
( 2 )	( a ) Physical Exercise	20 marks
	( b ) Inorganic Qualitative	20 marks
	( c ) Journal	5 marks

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 Total 105 marks

(\*Gravimetric results should be collected on the same day at the end of six hour)

*Note :* In Gravimetric and Volumetric or wherever applicable the 10 ml pipette, 100 ml measuring flask & 25 ml Burette must be used.

**Physical Practical :**

- To determine the relative strength between HCl and H<sub>2</sub>SO<sub>4</sub> by studying hydrolysis of methyl acetate catalysed by acid.
  - To determine the Temperature co-efficient and energy of activation by hydrolysis of methyl acetate catalysed by acid.
  - To study the adsorption of an organic acid by animal charcoal method.
  - To study distribution Law.  
Benzoic acid + benzene  
Benzoic acid + kerocene
  - To determine cell-constant and Normality  
( 1 ) HCl → NaOH ( 2 ) CH<sub>3</sub>COOH → NaOH ( 3 ) HCL + CH<sub>3</sub>COOH → NaOH
  - To determine specific refraction and molar refraction of Liquid A, B and mixture of (A+B).  
(Calculation method, No Graph)
  - To determine the specific rotation of optically active substance such as Glucose or sucrose.
  - To determine absolute viscosities of A, B and Mix (A+B). (Calculation method, No Graph)
  - To determine water equivalent and determine the ionisation of weak acid.
  - Demonstration Experiments :  
( i ) To determine the surface tension of liquids by using stalagmometer  
( ii ) To compare coagulating power of NaCl, MgCl<sub>2</sub>, AlCl<sub>3</sub> for arsenious sulphide solution.
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