

Swami Ramanand Teerth Marathwada University, Nanded



B. O. S. IN CHEMISTRY

**B. SC. THIRD YEAR (CHEMISTRY)
REVISED SYLLABUS**

IN FORCE FROM JUNE - 2010

B. Sc. Third Year
Paper – X [CH-301]
Inorganic Chemistry

Periods:-54

Marks: 65

Unit:-I

1.1 Coordination chemistry (Part-I) 10

- a) Introduction: addition or molecular compound, double salt, coordination compound. Comparison of double salt and coordination compound.
- b) Terminology: complex ion, central metal atom, ligand, types of ligand, coordination number and coordination sphere.
- c) Nomenclature: Rules of nomenclature of coordination compound, and its applications to nomenclature of simple and bridging complex compounds.
- d) Werner's theory of coordination compound, postulates, applications with reference to $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$, $\text{CoCl}_3 \cdot 3\text{NH}_3$.
- e) Chelating agents and its classification, difference between metal complex and metal chelate complex.
- f) Isomerism: Structural isomerism, ionization, hydrate, linkage, coordination isomerism, geometrical isomerism, optical isomerism in 4 and 6 coordination complex.
- g) E. A. N. of metal complexes.

1.2 Coordination theory (Part-II) 10

- a) Valence bond theory of coordination compounds: Postulates, inner orbital and outer orbital complexes of coordination number 4 and 6. Limitations of VBT.
- b) Crystal field theory: Shape of d-orbital's, postulates, splitting of d-orbital in octahedral complexes, tetrahedral complexes, tetragonal and square planar complex.
Definition of CFSE, calculations of CFSE for octahedral and tetrahedral complexes.
- c) Factors affecting $10 Dq$ or magnitude of crystal field splitting : Nature of ligand, oxidation state of metal ion, size of d orbital, geometry of complexes.
- d) Applications of CFT.
- e) John teller effect in octahedral complexes of Cu^{++} .
- f) Limitations of CFT.

Unit-II

2.1 Chemistry of inner transition elements 12

- a) Introduction; definition of inner transition elements, lanthanides and actinides. Position in periodic table.
- b) Electronic configuration of lanthanides; oxidation state; magnetic moment; color.
- c) Separation of lanthanides by ion exchange method.
- d) Lanthanide contraction, cause and consequences.
- e) Absorption spectra of lanthanides. Lanthanides act as shift reagents.
- f) Electronic configuration and oxidation state of actinides.
- g) Chemistry of uranium: occurrence; extraction from pitchblend by acid digestion process, properties and uses.

2.2 Theory of gravimetric analysis **08**

- a) Introduction; definition of gravimetric analysis.
- b) Steps involved in gravimetric analysis;
- c) Precipitation, types of precipitates, factors affecting the precipitation such as temperature, pH and complex.
- d) Purity of the precipitate: Post precipitation, co precipitation and fractional precipitation.
- e) Condition for the completion of precipitation.
- f) Digestion of precipitate, filtration, washing, drying, ignition, and weighing along with conversion factor.

Unit-III

3.1 Metal carbonyls **06**

- a) Definition, types 1) Mononuclear carbonyl, characteristics and examples; 2) Polynuclear carbonyl, characteristics and examples.
- b) Preparation properties and structure of Nickel tetra carbonyl.
- c) Nature of metal carbon bond in metal carbonyl and their evidences.
- d) Structure of $\text{Fe}_2(\text{CO})_9$, $\text{Fe}_3(\text{CO})_{12}$, $\text{Ir}_4(\text{CO})_{12}$, $\text{Co}_2(\text{CO})_8$.

3.2 Inorganic Spectroscopy **08**

- a) Introduction, types of electronic transitions, calculations of spectroscopy ground state term symbol and number of microstate for P^1 , P^2 , P^3 , d^1 , d^2 , d^3 configuration.
- b) Orgel diagram of d^1 and d^9 configuration for tetrahedral and octahedral.
- c) Electronic spectra of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex.

Reference books:-

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia.
2. Inorganic Chemistry by Gurudeep Raj Chatwal.
3. Advanced inorganic chemistry vol. II by Satyaprakash, Tuli, Basu and Madan.
4. Inorganic Chemistry by Huheey, Keiter and Keiter.
5. Concise Inorganic Chemistry by J. D. Lee.
6. A text book of Practical Chemistry for B. Sc. By V. V. Nadkarny, A. N. Kothare and Y. V. Lawande.
7. Advanced practical inorganic Chemistry by O. P. Agarwal.

B. Sc. III Year
Paper – XI [CH-302]
Organic Chemistry

Periods:-54

Marks: 70

UNIT:-I

1.1 Ultra-Violet Spectroscopy: 08P

- a) Introduction.
- b) Electromagnetic radiation.
- c) Units used in spectroscopy: a) Wave length b) Wave number c) Frequency.
- d) Beer-Lambert law and Molar absorption.
- e) Types of electronic transitions.
- f) Concept of chromophore and auxochrome, Bathochromic, Hypsochromic, Hyperchromic, Hypochromic shift.
- g) Differentiate spectral characteristics between conjugated dienes and enones and calculate λ_{\max} (maximum absorption) for it.

1.2 Infra-Red spectroscopy: 04P

- a) Molecular Vibration, Hooks law.
- b) Measurement of IR Spectrum, Finger print region, Functional group region.
- c) Interpretation of IR spectra of simple organic compounds.
(a) Ethane (b) Ethene (c) Ethyne (d) Benzene (e) 1-Propanol (f) 2-Propanol
(g) t-Butyl alcohol (h) Phenol. (i) Acetone (j) Acetophenone (k) Acetaldehyde
(l) Benzaldehyde (m) Benzoic acid (n) Methyl benzoate (o) Phenyl cyanide

1.3 PMR Spectroscopy: 08P

- a) Introduction.
- b) Principles of NMR Spectroscopy.
- c) Orientation of hydrogen nucleus.
- d) Pressional motion of nucleus.
- e) Shielded proton in acetylene.
- f) Deshielded protons in benzene.
- g) Number of signals (equivalent and non-equivalent protons) in following compounds: a) Acetone (b) Cyclobutane (c) Methanol (d) Ethyl benzene (e) Ethyl amine (f) Mesitylene (g) Diethyl ether.
- h) Chemical Shift.
- i) Spin-spin coupling, coupling constant.
- j) Interpretation of PMR spectra of simple organic molecules such as Ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, Toluene, acetophenone, ethylamine, acetic acid, benzoic acid.
- k) Problems based on UV, IR, and PMR simple organic compounds using spectroscopic technique.

UNIT-II

2.1 Synthetic Drugs and Dyes: 10P

A] Synthetic Drugs:

- a) Introduction.
- b) Definition: i) Pharmacy ii) Pharmacology iii) Chemotherapy iv) Metabolites and anti-metabolites v) Bacteria vi) Gram positive and Gram negative.
- c) Classification on the basis of:
(1) Chemotherapeutics: (Antimalerials, Antiseptic, Antibacterial, Antibiotics, Antifungal.)

- (2) Functional: (Analgesics, Antipyretics, Sedatives, Anaesthetics)
- d) Synthesis and Uses:
- i) Sulphanilamide from acetanilide.
 - ii) Sulphadiazine from 2-aminopyrimidine.
 - iii) Chloroquine from 4,7-dichloroquinoline and N,N-diethyl,1,4-pentanediamine.
 - iv) Aspirin from Salicylic acid.
 - v) Paracetamol from phenol.

B] Synthetic Dyes:

- a) Introduction.
- b) Classification of dyes on the basis of structure.
- c) Synthesis of dyes and their applications:
 - i) Methyl Orange.
 - ii) Phenolphthalein.
 - iii) Fluorescein.
 - iv) Congo red.

2.2. Aromatic Carboxylic Acids:

06P

Introduction and Classification of aromatic carboxylic acids.

A) Benzoic Acid.

- i) Preparations from: a) phenyl cyanide; b) toluene.
- ii) Reactions of benzoic acids.
 - a) Acyl-halide formation, b) Reduction, c) Decarboxylation, d) Nitration.

B) Anthranilic Acid:

- i) Preparations from: a) from phthalimide, b) from O-nitro toluene.
- ii) Properties of anthranilic acid.

C) Salicylic Acid:

- i) Preparations by: a) Kolbe's method, b) Reimer-Tiemann reaction.
- ii) Reactions of Salicylic acid.
 - a) bromination, b) nitration, c) decarboxylation, d) Reaction with Zn-dust.

D) Phthalic Acid:

- i) Preparations from: a) From O-Xylene, b) From Naphthalene.
- ii) Reactions of Phthalic acid.
 - a) Action of heat, b) Action of PCl_5 , c) Action of ethanol.

UNIT:-III

3.1 Alkaloids:

05P

- a) Introduction, Occurrences, general properties.
- b) General methods for determination of structure of alkaloids.
- c) Constitution of Ephedrine.
- d) Synthesis of i) Nicotine from nicotinonitrile, ii) Papaverine from 1, 2-diacetyl benzene iii) Piperonal from catechol.

3.2 Vitamins:

04P

- a) Introduction.
- b) Classification.
- c) Occurrence, structure, and deficiency diseases of Fat soluble vitamins. A, D, E K and Water soluble vitamins B_1 , B_2 , B_6 , B_{12} .

3.3 Amino Acids and Proteins

A] Amino Acids:

- a) Introduction, Classification (acidic, basic, neutral).
- b) Acid-base behavior, Zwitter-ion formation.

- c) Preparation of α -amino acids, i) α -halogenated acids, ii) Gabriel phthalimide synthesis iii) Strecker's synthesis.
- d) Reactions due to i) NH_2 ii) COOH iii) NH_2 and COOH group.

B] Proteins

- a) Introduction, Classification, Structure of proteins (primary and secondary)
- b) Properties of proteins.
- c) Importance of proteins.

3.4 Pesticides:

03P

- a) Introduction, Classification.
- b) Synthesis and Uses of
 - i) DDT, ii) BHC, iii) Methoxychlor, iv) 2,4-D, v) Baygon (from 2-isopropyl phenol)

Reference books:

1. Synthetic drugs by Gurudeep and Chatwal.
2. Synthetic dyes by Gurudeep and Chatwal.
3. Organic Chemistry by S. M. Kapoor. vol. II and III.
4. Organic Chemistry by Morrison and Boyd.
5. T. B. of organic chemistry by Arun Bahl and B. S. Bahl.
6. Synthetic organic chemistry by O. P. Agrawal.
7. T. B. Organic chemistry by P. L. Soni and H. M. Chawla.
8. Organic chemistry by M. K. Jain.
9. Organic chemistry by Tewari Mehrotra.
10. Organic chemistry by Solomon.
11. Organic chemistry by Carey.

**B. Sc. Third Year
Paper-XII (CH-303)
Physical chemistry**

Periods: 54

Marks: 65

Unit -I

1.1 Spectroscopy: 12P

- a) Introduction, Electromagnetic radiation and characteristics, Region of the spectrum. Width and intensity of spectral lines. Factors affecting width and intensity of spectral lines. Brief introduction to molecular spectra.
- b) **Rotational Spectra:**
Rotational spectra of diatomic molecules: Rigid rotator model; moment of inertia; energy levels of rigid rotator, selection rules; spacing between spectral lines of diatomic rigid rotator, isotope effect, qualitative description of non rigid rotator. Numericals on bond length.
- c) **Vibrational Spectra:**
Infrared spectrum, Simple Harmonic oscillator model, 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. Numericals on force constant.
- d) **Raman Spectra:**
Concept of polarizability. Classical and quantum theory of Raman scattering. Rotational Raman spectrum of a diatomic molecule, Rotation-vibration Raman spectrum, selection rules. Experimental Raman spectroscopy.
- e) **Electromagnetic spectra:**
Concept of potential energy curve, Frank-Condon principle, types of electronic transitions.

1.2 Chemical kinetics 07P

- a) Introduction, Third order reaction with equal concentration of all reactants, their characteristics.
- b) Kinetics of complex reactions: i) Opposing reaction ii) Consecutive reaction iii) Chain reaction.
- c) Kinetics of photochemical reactions: 1. Hydrogen-chlorine reaction.
2. Decomposition of HI. 3. Dimerization of Anthracene

Unit II:

2.1 Distribution Law 08P

- a) Introduction, Nernst distribution law, solubility and distribution law, Limitation of distribution law.
- b) Association and dissociation of solute in solvent.
- c) Henry's law.
- d) Determination of equilibrium constant from distribution coefficient.
- e) Extraction with solvent.
- f) Liquid-liquid chromatography.
- g) Applications of distribution law.
- i) Numerical on Nernst distribution law.

2.2 Electrochemistry 10P

- a) Introduction to electrochemistry, concept of electrode potential, single electrode potential and standard electrode potential, oxidation and reduction potential.
- b) Electrochemical cells: Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells.
- c) EMF of cell, measurement of EMF.

- d) Reference electrodes, indicator electrodes, calomel electrode.
- e) Relation between EMF and ΔG , ΔH and ΔS .
- f) Nernst equation, application of Nernst equation to oxidation half cell and reduction half cell.
- g) Electrolyte concentration cell: Concentration cell with transport and Concentration cell without transport.
- h) Application of EMF measurement in determination of pH by using a) Quinhydrone electrode and b) glass electrode.
- i) Potentiometric titrations.
- j) Numerical on Nernst equation and on concentration cell.

Unit III:

3.1. Thermodynamics: 12P

- a) Introduction
- b) Work Function and Free Energy Function: Helmholtz function (A) or work function, change of A at constant temperature, Gibb's free energy (G) or free energy function, relation between G and A, change of G at constant temperature, variation of work function with temperature and volume, variation of free energy function with temperature and pressure. The Gibb's-Helmholtz equation.
- c) The Nernst heat theorem. Third law of thermodynamics.
- d) Thermodynamics of open system: partial molar properties; concept of chemical potential, partial molar free energy. Gibb's-Duhem equation. Variation of chemical potential with temperature and pressure. Chemical potential in case of a system of ideal gases.
- e) Vant-Hoff's isotherm. Vant-Hoff's reaction isochore. Integrated form of Vant-Hoff's equation.
- f) Clapeyron equation. Clausius- Clapeyron equation and its applications.
- g) Thermodynamic derivation of law of mass action. Relation between ΔG° and Kp.
- h) Numericals on Vant-Hoff's equation.

3.2 Surface Chemistry 05P

- a) Introduction: Adsorption, mechanism of adsorption, factors affecting adsorption, difference between adsorption and absorption.
- b) Types of adsorption: Physical adsorption and chemical adsorption.
- c) Adsorption of gas by solid.
- d) Types of adsorption isotherm: i) Freundlich adsorption isotherm, ii) Langmuir adsorption isotherm. (Derivation).

Reference Books:

1. Physical Chemistry by G. M. Barrow (Tata Mc-Graw Hill publishing Co., Ltd.)
2. Elements of Physical Chemistry by S. Glasstone & D. Lewis (D.van nostrand co. inc.)
3. Physical Chemistry by W. J. Moore (Orient Longman).
4. Principles of Physical Chemistry by S. H. Maron and C. F. Prutton.
5. University General Chemistry by C. N. R. Rao (Mc-Millan).
6. Elements of Physical Chemistry by P. W. Atkins. (Oxford University Press).
7. Physical Chemistry by R. A. Alberty (Wiley Eastern Ltd.).
8. Physical Chemistry through problems by S. K. Dogra, D. Dogra(Wiley Eastern Ltd)
9. Principles of Physical Chemistry by Puri, Sharma and Pathania (Vishal Publication Jalandher, Delhi)
10. Physical Chemistry by A. J. Mee. ELBS & Heinemann Educational Books Ltd.
11. Essentials of Physical Chemistry by Arun Bhal, B. S. Bahl and G. D. Tuli. (S. Chand)
12. Chemical Kinetics by K. J. Laidler (Tata Mc-Graw Hill Publishing Co. Ltd).
13. Text Book of Physical Chemistry by Soni-Dharmarha.
14. A Text Book Physical Chemistry by S. Glasstone, (Mac Millan.)
15. Advanced Physical Chemistry by D.N.Bajpai. (S.Chand)
16. Advanced Physical Chemistry by Gurdeep Raj. (Goel publishing house, Meerut).

**B. Sc. Third Year
Paper-XIII (CH-304)
Organic and Inorganic Chemistry**

Periods: 120

Marks: 100

Note: At least sixteen experiments should be taken.

- 1. Only demonstration.**
 - i) Column Chromatography.
 - a. Separation of fluorescein methylene blue.
 - b. Separation of leaf pigment from spinachleaves.
- 2. Qualitative analysis :(any seven)**

Separation of organic binary mixture and analysis of each compound with preparation of one derivative.

Acids: Salicylic acid, cinnamic acid, phthalic acid, benzoic acid.

Phenols: β -Naphthol. α -naphthol.

Base:- P-nitroaniline, M-nitroaniline, P-toluidine.

Neutral: Urea, glucose, M-dinitrobenzene, Anthracene, Naphthalene.
- 3. Synthesis of organic compounds, with determining its physical constant and % yield. (Reactions to be carried out in molar quantities and its mechanism is to be determined) (Any five)**
 - 1) Preparation of 2,4,6-tribromoaniline from aniline.
 - 2) Preparation of p-nitroacetanilide from acetanilide.
 - 3) Preparation of phenyl benzoate from phenol / β -Naphthol.
 - 4) Preparation of p-nitroaniline from p-nitroacetanilide.
 - 5) Preparation of m-nitroaniline from m-dinitrobenzene.
 - 6) Preparation of fluorescein from phthalic anhydride.
 - 7) Preparation of phenolphthalein from phthalic anhydride.
 - 8) Preparation of benzoic acid from toluene.
 - 9) Preparation of pyrimidone from ethyl acetoacetate and urea / thiourea.
 - 10) Preparation of pyrazolone derivative from ethyl acetoacetate and Phenylhydrazine.

Inorganic Section

1. Gravimetric estimation of Iron as Fe_2O_3 .
2. Gravimetric estimation of Sulphate as BaSO_4 .
3. Gravimetric estimation of Nickel as $\text{Ni}(\text{DMG})_2$.
4. Gravimetric estimation of Aluminium as $\text{Al}(\text{Oxinate})_3$.

B. Sc. Third Year
Paper-XIV, [CH-305]
Laboratory Course-V
Physical and Inorganic Chemistry

Periods: 120

Marks: 100

Note: At least sixteen experiments should be taken.

Instrumental

1. Determine the normality and strength of oxalic acid conductometrically using standard solution of strong base (NaOH / KOH).
2. Determine the concentration of KCl solution by titrating it with standard solution of AgNO_3 conductometrically.
3. Determine the equivalent conductance of a strong electrolyte at several concentration and hence verify the Onsager's equation.
4. Determine the normality and strength of acids in mixture [strong acid (HCl / HNO_3) and weak acid (CH_3COOH / HCOOH)] potentiometrically using standard solution of strong base (NaOH / KOH).
5. Determine the dissociation constant a weak acid (CH_3COOH / HCOOH) potentiometrically using standard solution of strong base (NaOH / KOH).
6. Determination of empirical formula of a complex between Fe^{3+} and 5-sulphosalicylic acid by Jobs method colorimetrically.
7. Determination of dissociation constant of an organic acid (CH_3COOH) using various buffers ($\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$) pH metrically.
8. To study inversion of cane sugar by polarimetrically.

Non-Instrumental

1. Determine the rate constant of the reaction between potassium per sulphate and potassium iodide having equal concentrations of reacting species ($a = b$).
2. Determine energy of activation of hydrolysis of an ester by acid / base.
3. Investigate the reaction between bromic acid and hydroiodic acid.
4. Determine molecular weight of non volatile solute by Rast method / Beckmann's freezing point method.
5. Determine enthalpy change of neutralization of a strong acid by a strong base.
6. Determine interfacial tension between immiscible liquids, benzene and water by stalagmometer.
7. Determine molecular weight of a polymer by viscosity measurement.
8. Separation of mixture of o- & p-nitro anilines on an alumina column.

Inorganic Section:

1. Preparation of complexes and estimation of metal ion.
 - a) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
 - b) $[\text{Ni}(\text{NH}_3)_6]\text{SO}_4$
 - c) $\text{CoCl}_3 \cdot 4\text{NH}_3$
 - d) Sodium trioxalato ferrate.
 - e) $\text{Co}[\text{Hg}(\text{SCN})_4]$.

Reference Books:

1. Experimental Physical Chemistry by A. Findlay. Longman.
2. Advanced Practical Physical Chemistry by J.B. Yadav.
3. Experiments in Physical Chemistry by R. C. Das and B. Behra. Tata Mc Graw Hill.
4. Advanced experimental Chemistry Vol. I. Physical by J. N. Gurtu and R. Kapoor. S. Chand & Co.
5. Experiments in Physical Chemistry by J. C. Ghosh, Bharati Bhavan.
6. Practical book of Physical Chemistry – by Nadkarni Kothari & Lawande. Bombay Popular Prakashan.
7. Systematic Experimental Physical Chemistry – by S. W. Rajbhoj, Chondhekar. Anjali Publication.
8. Practical Physical Chemistry – by B. D. Khosala & V. C. Garg. R. Chand & Sons.
9. Experiments in Chemistry by D. V. Jagirdar.
10. Practical Chemistry, Physical – Inorganic – Organic and Viva – voce by Balwant Rai Satija. Allied Publishers Pvt. Ltd.
11. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
12. College Practical Chemistry by Patel, Jakali, Mohandas, Israney, Turakhia. Himalaya Publishing Housing, Mumbai.