

Semester I
General Chemistry Paper 101

Unit I : Inorganic Chemistry (14 Marks)

(a) **Lanthanides:-**

Electron configuration, Oxidation states, Magnetic properties, Color and absorption spectra of lanthanide ions, Lanthanide contraction, Separation and purification of Lanthanides: Ion-exchange and solvent extraction methods.

(b) **Actinides:-**

Electron configuration, Oxidation states, Magnetic properties, Color and absorption spectra of actinide ions, actinide contraction, Nuclear synthesis of trans uranic elements, Chain reaction, importance of Uranium, Comparison with lanthanide.

Unit II : Organic Chemistry (14 Marks)

(a) **Quantitative Analysis & Determination of Molecular Formula:-**

Determination of Nitrogen by Kjeldahl's method and Kjeldahl's method modified with boric acid . Molecular weight of organic acid by Ag-salt method and organic base by Chloroplatinate method, Numerical based on empirical and molecular formula.

(b) **Fundamentals of Organic Reactions:-**

Fission of covalent bond, types of reagents, Substitution Nucleophilic Unimolecular reaction mechanism (SN^1), Substitution Nucleophilic Bimolecular reaction mechanism (SN^2), Electrophilic Aromatic Substitution – Elementary treatment only (Nitration, Sulfonation, Halogenation & Friedel-Crafts Alkylation and Acylation)

Unit III : Organic Chemistry (14 Marks)

(a) **Alkanes:-** (Saturated Hydrocarbons)

Introduction, IUPAC nomenclature, Reduction of R-X, Wurtz's reaction, Hydrolysis of R-Mg-X, Decarboxylation of acid, Kolbe's electrolytic process, Free radical mechanism (Chlorination of Methane).

(b) **Alkenes & Alkynes:-** (Unsaturated Hydrocarbons)

Introduction, IUPAC nomenclature, Preparations (dehydration, dehalogenation, dehydrohalogenation), Reactions with H_2 , X_2 , HX, HOCl, H_2SO_4 , and Hydroboration; Oxidation reactions: (i) with cold alkaline $KMnO_4$ (Baeyer's reagent), (ii) Oxidative cleavage with acidified or hot $KMnO_4$, (iii) Ozonolysis (O_3); Polymerization; Reactions of terminal Acetylenes: (i) Addition of water, (ii) Na / liquid NH_3 .

Unit IV: Physical Chemistry (14 Marks)

(a) **Thermodynamics:-**

Zeroth law, first law, Second law of thermodynamics; proof of 2nd law (Carnot's Cycle); Entropy, of Gas and calculation of entropy for different processes; Kirchhoff's equation.

(b) **Chemical Kinetics:-**

Basic terms: molecularity, order of reactions. Unit for rate constant; Derivation of: first order rate constant, Second order rate constant for (a=b) and (a ≠ b). Third order rate equation (a=b=c). Determination of Half Life Time for 1st, 2nd and 3rd order reactions.

REFERENCE BOOKS

UNIT I :

1. **'Elements of Quantum Mechanics'** by **Michael D. Fayer**, Oxford University Press, Indian Edition.
2. **'Concise Inorganic Chemistry'** by **J. D. Lee**, 5/E, Oxford University Press, Indian Edition.
3. **'Basic Inorganic Chemistry'** by **F. A. Cotton and G. Wilkinson**, Wiley publication.
4. **'Inorganic Chemistry'** by **Shriver & Atkins**, 4/E, Oxford University Press, Indian Edition.
5. **'Introductory Quantum Chemistry'** by **A. K. Chandra**, 4/E, Tata MacGraw Hill Publishing Company Limited, New Delhi.

UNIT II & III :

1. **'Organic Chemistry'** by **G. Marc Loudon**, 4/E, 2010, Oxford University Press, Indian Edition,
2. **'Organic Chemistry'** by **Robert Thornot Morrison, Robert Neilson Boyd**, 6/E, 1992, Prentice Hall of India Pvt Ltd, New Delhi.
3. **'Text book of Organic Chemistry'** by **P. L. Soni and H. M. Chawla**, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
4. **'Text book of Organic Chemistry'** by **P. S. Kalsi**, 1999, MacMillan of India Pvt. Ltd.
5. **'Organic Chemistry'** by **Bhupinder Mehta, Manju Mehta**, Prentice Hall of India Pvt. Ltd, New Delhi.

UNIT IV :

1. **'Elements of Physical Chemistry'** by **Peter Atkins & Julio De Paula**, 5/E, Oxford University Press, Indian Edition.
2. **'Physical Chemistry'** by **P. W. Atkins**, 7/E, 2002, Oxford University Press, Indian Edition.
3. **'Physical Chemistry'** by **W. J. Moore**, MacGraw Hill Publication, 1996, 6/E.
4. **'Principle of Physical Chemistry'** by **Puri, Sharma & Pathania**, 41/E, Vishal Publishers.
5. **'Essentials of Physical Chemistry'** by **Bahl & Tuli**. 22/E, S.Chand publication New Delhi .
6. **'Advanced Physical Chemistry'** by **Gurdeep Raj**, 19/E, Goel Publishing House Meerut.

Semester I

Practical Paper 102

(a) Volumetric Analysis (Acid and Base)

- (1) Preparation and Standardization of NaOH and HCl
- (2) Succinic Acid -----NaOH
- (3) Oxalic Acid ----- NaOH
(Hydrated & Anhydrous)
- (4) Na₂CO₃ -----HCl

(b) Inorganic Qualitative Analysis (Two Radicals) (Minimum Eight Salts)

Water Soluble and Insoluble Inorganic salts of following cations and anions:

Cations : Na⁺, K⁺, NH₄⁺, Mg²⁺, Ba²⁺, Ca²⁺, Sr²⁺, Fe²⁺, Fe³⁺, Al³⁺,
Cr³⁺, Zn²⁺, Mn²⁺, Co³⁺, Pb²⁺, Cu²⁺.

Anions : S²⁻, SO₄²⁻, CO₃²⁻, PO₄³⁻, CrO₄²⁻, Cl⁻, Br⁻, I⁻, NO₃⁻, O²⁻.

Reference Books

1. 'Vogel's Textbook of Quantitative Chemical analysis' Revised by
G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney, 5/E, ELBS (English
Language Book Society) Longman.
2. 'Analytical Chemistry' by Dhruba Charan Dash, PHI Learning Private Ltd, New
Delhi, 2011.
3. 'Analytical Chemistry' by Gary D. Christian, 4/E, John Wiley & Sons
4. 'Advanced Practical Inorganic Chemistry' by Gurdeep Raj, 9/E, Goel Publishing
House, Meerut.
5. 'Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis',
5/E, Orient Longman Ltd.

Semester II
General Chemistry Paper 103

UNIT I : Inorganic Chemistry :- (14 Marks)

(a) Chemical Bonding:-

Covalent bond-Sidgwick Powel Theory, VSEPR Theory, Examples of NH_3 , H_2O , ClF_3 , SF_4 , SF_6 , I_3^- , IF_7 ; Hybridization of atomic orbitals; Rules for Hybridization; Types of Hybridization and shape of some molecules (sp , sp^2 , sp^3 , sp^3d , sp^3d^2).

(b) Complex Compound:-

Werner's Theory; Labile and inert complexes; Stability of complex compounds; Factors influencing the stability of complexes; Spectrochemical Series; V. B. theory for complexes – Examples of ML_4 & ML_6 type (Fe, Co, Ni, Mn).

UNIT II : Inorganic Chemistry:- (14 Marks)

(a) Introduction of Wave Mechanics:-

Wave equation and wave functions, its interpretation, significance of Ψ and Ψ^2 , Limitations of acceptable wave functions, Normalized and orthogonal (orthonormal) wave functions, Eigen values and Eigen functions

(b) Operator Concept in Quantum Chemistry:-

Operators, type of operators, Hamiltonian Operator for H atom, H_2 molecule, H_2^+ ion, He, Li, Be and B atom.

UNIT III : Organic Chemistry:- (14 Marks)

(a) Fundamentals of Stereochemistry:-

Introduction, Stereochemical aspects of organic molecules, Chirality, Optical isomerism, Enantiomers and Diastereomers, R-S nomenclature, E-Z nomenclature.

(b) Conformations:-

Conformational analysis of Ethane, n-Butane & Cyclohexane.

UNIT IV: Physical Chemistry:- (14 Marks)

(a) Ionic equilibrium:-

Definition of basic terms: Electrical conductance, Specific conductance
Equivalent conductance, Molar conductance, Cell constant & degree of
Dissociation; Derivation of Ostwald's dilution law , its applications and
Limitations; pH Scale, Hydrolysis, Relation between K_a , K_b , K_h , & K_w for
Strong acid → Strong base
Strong acid → Weak base
Weak acid → Strong base
Buffer Solution, (Henderson – Hasselbalch equation), Indicator theory,
Useful pH range of indicator for acid base titration.

(b) Nuclear Chemistry:-

Radioactivity, Rutherford's disintegration theory, Soddy's group Displacement
law, Packing fraction, Factors affecting stability of Nucleus (Mass defect,
Binding energy, N / P ratio) .

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SEMESTER II

Practical Paper 104

(a) Organic Spotting :- (06 Solids and 04 Liquids).

List organic compounds having different mono functional groups:

Solids :

Acids : (i) Benzoic acid (ii) Oxalic acid (iii) Succinic acid

Phenols : (i) β -Naphthol (ii) α -Naphthol

Neutral : (i) Urea (ii) Thiourea (iii) Benzamide (iv) Naphthalene

Liquids :

(i) Aniline (ii) Nitrobenzene (iii) Benzaldehyde (iv) Ethanol

(v) Ethylacetate (vi) Chloroform (vii) Chlorobenzene (viii) Acetone

(b) Volumetric Analysis:-

Redox Titrations:-

(1) KMnO_4 $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$

(2) $\text{K}_2\text{Cr}_2\text{O}_7$ FeSO_4 $(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$

Complexometric Titration by EDTA:-

(1) Estimation of Ca^{+2} EDTA

(2) Estimation of Mg^{+2} EDTA

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1. '**Vogel's Textbook of Quantitative Chemical analysis**' Revised by **G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney**, 5/E, ELBS (English Language Book Society) Longman.
2. '**Analytical Chemistry**' by **Dhruba Charan Dash**, PHI Learning Private Ltd, New Delhi, 2011.
3. '**Analytical Chemistry**' by **Gary D. Christian** , 4/E, John Wiley & Sons.
4. '**Comprehensive Practical Organic Chemistry – Qualitative Analysis**' by **V. K. Ahluwalia, Sunita Dhingra** University Press (India) Private Limited, Hyderabad, First Indian Reprint 2010.
5. '**Organic Analytical Chemistry theory and Practice**' by **Mohan Jag**, Narosa Publication, New Delhi. (2003).
6. '**Elementary Practical Organic Chemistry Part-2, Qualitative Organic Analysis**' by **Arthur I. Vogel**, -CBS Publishers & Distributers, New Delhi.(Second edition, reprint 2004)
7. '**Advanced practical Organic Chemistry**' by **J. Leonard, B. Lygo, G. Procter**, (First Indian reprint , 2004),Publication-Stanley Thornes (Publishers) Ltd.