

B.Sc. Semester III

Chem. – 201 [Organic Chemistry]

Unit:- I

[A] Carbohydrates

[Marks -8]

Introduction, classification of carbohydrates, osazone formation, epimerization, step up and step down reactions of monosaccharides, simple structures of glucose and fructose, Fischer's proof of configuration of D-glucose.

[B] Amino acid :

[Marks -6]

Introduction of amino acid, Classification and properties of amino acids, Zwitter ion , Isoelectric point, Strecker's and Gabriel phthalimide synthesis of amino acids.

Unit:- II

[A] Electrophilic aromatic Substitution:

[Marks -8]

Introduction, effect of substituent groups, determination of orientation and relative reactivity, classification of substituent groups, electrophilic substitution (ES) reactions. (Nitration, Sulfonation, Halogenation, Friedel Craft alkylation and acylation), Orientation in mono and disubstituted benzene.

[B] Polynuclear hydrocarbon

[Marks -6]

Nomenclature, structure and synthesis of Naphthalene and its derivatives. Reactions (oxidation, reduction and electrophilic substitution reaction (ESR)) of naphthalene.

Unit III

[A] Heterocyclic Compounds

[Marks -8]

Introduction, structure of Pyrrole, Furan and Thiophene, Paal Knorr synthesis and electrophilic substitution of Pyrrole, Furan and Thiophene, reactivity and orientation of electrophilic substitution reactions (ESR) in five membered heterocycles (Pyrrole, Furan and Thiophene) Structure of Pyridine, Electrophilic and Nucleophilic substitution reactions of pyridine. Basicity of pyridine.

[B] β -dicarbonyl compounds

[Marks -6]

Introduction, synthesis of Ethyl acetoacetate (EAA) and Diethylmalonate Acidic and ketonic hydrolysis of β -dicarbonyl compounds, Synthetic applications of β -dicarbonyl compounds. (i) Crotonic acid from EAA (ii) Valeric Acid from diethyl malonate

Unit-IV

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

[Marks-14]

Acid-Bases, scale of acidity-basicity, Resonance effect, drawing of structures and the condition for resonance, Effect of change of hybridization on acidity and basicity, Inductive and electronic effects, steric effect and hydrogen bonding, Lewis acid and bases, Keto – enol tautomerism . Difference between resonance and tautomerism.

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1. Robert Thornot Morrison and Robert Neilson Boyd, "***Organic Chemistry***", Prentice Hall of India Pvt Ltd, New Delhi, Sixth Edition, 1992.
2. Bhupinder Mehta, Manju Mehta, "***Organic Chemistry***", Prentice Hall of India Pvt Ltd, New Delhi, 2005.
3. James B Hedrickson Donald J. Cram and George S. Hammond, "***Organic Chemistry***", Mc-Graw-Hill Kogakusha,Ltd., Third Edition.
4. Arun Bahl, B. S. Bahl, "***Advance Organic Chemistry***", S. Chand & Company Ltd., New Delhi, First Edition, 2003.
5. I. L. Finar, "***Organic Chemistry***", Pearson Education Pet Ltd, New Delhi, First Edition, 2002.
6. G. Marc Loudon, "***Organic Chemistry***", Oxford University Press, Forth Indian edition, 2010.
7. P.S.Kalsi, "***Text book of Organic Chemistry***", MacMillan of India Pvt. Ltd., 1999.
8. P.L. Soni and H.M. Chawala, "***Text book of Organic Chemistry***", Sultan Chand & Sons Publication, New Delhi, 26th Edition, 1995.

B.Sc. Semester III
Chem. – 202 [Physical Chemistry]

Unit:- I

(A) Thermodynamics [8 marks]

Physical significance of entropy; Entropy change during phase change - solid to liquid and liquid to vapor; Entropy of mixing of ideal gases; Entropy change in reversible and irreversible process; Work and free energy functions; Helmholtz function and variation of free energy change with temperature and pressure; Gibbs Helmholtz equation, derivation.

(B) Chemical Kinetics [6 marks]

Theories of reaction rates: Collision theory of bimolecular gaseous reactions and Activated Complex theory of bimolecular reactions; Effects of temperature on reaction rates; Derivation of Arrhenius equation.

Unit:- II

(A) Electrochemistry [8 marks]

Transport number; Determination of transport numbers by moving boundary method; Conductometric titrations: Principle and advantages; Titration of Strong acid against strong base (HCl vs NaOH); Titration of Weak acid against strong base (CH₃COOH vs NaOH); Titration of Strong acid against weak base (HCl vs NH₄OH); Titration of very weak acid against strong base (H₃BO₃ vs NaOH); Titration of mixture of acids against strong base (HCl + CH₃COOH vs NaOH); Activity and activity coefficient; Ionic strength.

(B) Phase Rule [6 marks]

Theoretical derivation of phase rule; One component system : water system and sulphur system; Condensed phase rule; Silver – lead (Ag-Pb) system;

Unit:- III

(A) Adsorption [8 marks]

Definition of terms, Types of adsorption (physical, chemical and their difference), Types of adsorption isotherms (5 types), Derivation of Freundlich adsorption isotherm, Derivation of Langmuir adsorption isotherm, Applications of adsorption

(B) Catalysis

[6 marks]

Characteristic of catalysis, Homogenous and heterogeneous catalysis, Enzyme catalysed reaction and derivation mechanism, Marten reaction

Unit –IV

(A) Polymer Chemistry

[8 marks]

Definition: Monomer, Polymer, Polymerization, Classification of Polymers; Chain polymerization: Free radical and Ionic polymerization [cationic and anionic], Coordination polymerization, Step polymerization: Polycondensation and Polyaddition and Ring Opening Polymerization.

(B) Colloids

[6 marks]

Colloidal Systems; Preparation of Colloidal Solutions; General Properties of Colloidal Systems; Properties of hydrophobic Colloidal Systems

REFERENCES

1. B.R. Puri, L.R. Sharma, Madan S. Pathania, *“Principles of physical chemistry”*, Vishal publishing-Jalandhar, 44th Edition, 2010-2011.
2. S. Glasstone, *“Thermodynamics for chemistry”*.
3. S. Glasstone, *“An introduction to electrochemistry”*, Affiliated East-West press Pvt. Ltd, New Delhi, Madras.
4. B.S.Bahl, G.D.Tuli and Arun Bahl, *“Essential of physical chemistry”*, S.Chand-New Delhi, Reprint, 2006.
5. V.R. Gowarikar, *“Polymer chemistry”*, New Age International(P) Ltd, Fifteen Reprint, Sep.,1999.

B Sc Semester III

Chem.Pract. – 203 [Inorganic & Physical Practicals]

[A] Inorganic Mixture

Semi micro method of analysis of inorganic mixture containing four radicals (excluding phosphate, arsenite, arsenate and borate)

Minimum eight mixtures should be performed.

Mixture may be partly soluble in water and soluble in acid.

[B] Physical Experiment

1. To determine the relative strength between HCl and H₂SO₄ by studying hydrolysis of methyl acetate.
2. To determine the temperature coefficient and energy of activation of hydrolysis of methyl acetate catalyzed by acid.
3. To study the adsorption of an organic acid by Animal Charcoal. (Acetic acid /Oxalic acid).
4. Conductometric titration.
 - (i) Strong acid → Strong base (HCl → NaOH)
 - (ii) Weak acid → Strong base (CH₃COOH → NaOH)
 - (iii) Mixture of acids → Strong base (HCl+CH₃COOH → NaOH)
5. To determine specific refraction and molar refraction of liquid A,B and its Mixture
6. To determine absolute viscosities of liquid A, B and its Mixture

REFERENCES

1. Vogel's "*Textbook of Quantitative chemical Analysis*", Pearson Education Ltd. Sixth Edition, 2008.
2. Vogel's "*Qualitative Inorganic Analysis*", Pearson Education Ltd. Seventh Edition, 2009.
3. Gurdeep Raj, "*Advanced Inorganic Chemistry*", Goel Publishing House, Meerut, Volume –I, 24th Revised Edition, 1998.
4. J .B.Yadav , "*Advance Physical Practical Chemistry*", Goel Publishing House, Meerut
6. P.H.Parsania, "*Experiments in Physical Chemistry*", Neminath Printers Rajkot First Edition 2004.
7. A.M.. James and F.E.Prichard "*Practical Physical Chemistry*", Longman Group Limited London Third Edition Reprinted 1979

B.Sc. Semester IV
Chem. – 204 [Inorganic Chemistry]

Unit:- I Wave –Mechanics [14 marks]

Basic postulates of quantum mechanics (Postulates 1,2,3 and 4); Operators: their addition, subtraction and multiplication; Commutators; Particle in a box (One dimensional); Zero potential energy; Characteristics of the wave functions; Electron in a ring.

Unit:-II Coordination Compounds [14 marks]

Application of valence bond theory to some complexes; Shortcoming of valence bond theory; Crystal Field Theory; Orientation of d-orbitals and Crystal Field Splitting of Energy levels; Crystal Field Splitting in Octahedral complexes; Crystal Field Stabilization Energy (CFSE); Crystal Field Splitting in Tetrahedral Complexes; Crystal Field Splitting in Tetragonal and square Planar Complexes; Magnetic Properties of Metal Complexes and Crystal Field Theory; Factors influences the magnitude of Crystal Field Splitting; Color of Transition Metal Complexes; Crystal Field Effects on Ionic Radii; Crystal Field Effects on Lattice Energies; Jahn- Teller Effect.

Unit:- III Chemical Bonding [14 marks]

Molecular orbital Theory; LCAO Molecular Orbital Theory; Energy Level Diagram for Molecular Orbitals; Mixing of Orbitals; Filling up of Molecular Orbitals; Electronic Configuration of Heteronuclear Diatomic molecules (CO, NO, HF, HCl); Molecular orbitals of Polyatomic Species (BeH₂, CO₂, NH₃) (Excluding Walsh diagram); M.O. Theory of [Co (NH₃)₆]³⁺ and [CoF₆]³⁻; Molecular orbital or Band Theory for metals.

Unit:- IV

[A] Non Aqueous Solvents

[08 marks]

Introduction; Classification of Solvents; General Properties of Ionising Solvents

(a) Liquid Ammonia (NH_3): Physical Properties, Auto-ionization, Acid-Base reactions, Ammonia as a proton –acceptor, Precipitation reactions, Complex formation reaction, Ammonolysis reactions, Reactions of Metal-Ammonia solution, Reduction –Oxidation (Redox) reactions; Advantages and disadvantages of using liquid Ammonia as a solvent.

(b) Liquid SO_2 : Physical Properties, solubility of Inorganic materials and Organic Compounds, Electrolytic conductance behavior of solutions, Acid-Base reactions, Solvolysis, Precipitation reactions, Complex formation reactions, Reduction –Oxidation (Redox) reactions

(c) Liquid HF: Physical Properties, Solvent effect, Amphoteric behavior, Precipitation reactions, Reduction –Oxidation (Redox) reactions, Solutions of Compounds of Biological Interest.

[B] Physico chemical principles

[06 marks]

Physico chemical principles of Sodium carbonate (Na_2CO_3); Sodium bicarbonate (NaHCO_3); Sodium hydroxide (NaOH)

REFERENCES

1. Gurdeep Raj, “*Advanced Inorganic Chemistry*”, Goel Publishing House, Meerut, Volume –I, 24th Revised Edition, 1998.
2. R.D. Madan, “*Modern Inorganic Chemistry*”, S. Chand & Co. Ltd., New Delhi, 2nd Edition, 2006.
3. J.D. Lee, “*Concise Inorganic Chemistry*”, Wiley India Publication, 5th Edition, 1996, Reprint 2011.
4. W.V. Malik, G.D. Tuli, R.D. Madan, “*Selected Topics in Inorganic Chemistry*”, S.Chand & Co. Ltd., New Delhi, 7th Edition, 2007.
5. A.K. Chandra, “*Introductory Quantum Chemistry*”, Tata- McGraw Hill Pub. Co. Ltd., New Delhi, 4th Edition.
6. Puri, Sharma, Kalia, “*Principles of Inorganic Chemistry*”, Milestone Publishers & Distributors, New Delhi, 3rd Edition, 2006.
7. R.K.Prasad, “*Quantum chemistry*”, New Age International (P) Ltd., Publishers, 4th Edition, 2010.
8. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, “*Shriver & Atkins’ Inorganic Chemistry*”, Oxford University Press, 2011.

B.Sc. Semester IV
Chem. – 205 [Analytical Chemistry]

Unit:- I

[A] Basic concepts of Qualitative and Quantitative Analysis [8 marks]

Introduction, Solubility product principle, Common ion effect, Separation of cations of each groups and separation of anions (acid radicals), Introduction of volumetric titration based on normality and morality of the solution, Conditions for volumetric analysis and types of titrimetric analysis.

[B] Redox titration [6 marks]

Theory of redox titration, study of redox titration by electrochemical potential method, Ways of locating the end point for redox titration

Unit:- II Acid Base Titration [14 marks]

Theory of acid-base titration, Ways of locating the end point of an acid-base titration, Titration of strong acid with strong base, Titration of weak acid with strong base, Titration of weak base with strong acid, Titration of weak base with weak acid, Factors determining the exact form of a pH curve.

Unit:- III

[A] Complexometric Titrations [8 marks]

Theory of complexometric titration involving EDTA, Study of EDTA complex formation taking disodium salt of EDTA and effect of pH, Ways of locating the end point, Estimation of calcium and magnesium by complexometric titration by EDTA

[B] Precipitation Titration [6 marks]

Titration curves, Feasibility, Indicators, Mohr, Volhard and Fajans' Methods, Factors affecting solubility

Unit:- IV Precipitation Gravimetric [14 marks]

Introduction, Precipitation, Digestion, Filtration, Washing of the precipitate, Drying and/or incineration of the precipitate, Weighing, Specific and selective precipitation, Organic precipitants, Masking or sequestering agent, Problems involved in precipitation gravimetry.

REFERENCES

1. Dhruva Charan Dash, "*Analytical Chemistry*", PHI Learning Pvt. Ltd., New Delhi, 2011.
2. R.A.Day, A.L.Underwood, "*Quantitative Analysis*", Prentice-Hall of India Pvt.Ltd., New Delhi, 2004. (Sixth edition)
3. Gary D. Christian, "*Analytical Chemistry*", John Wiley & Sons, INC, New York, 1994. (Fifth edition)
4. Douglas A. Skoog, Donald M. West, F.James Holler, "*Analytical Chemistry An Introduction*", Saunders College Publishing, Harcourt Brace College Publishers, Philadelphia, 1994. (Sixth edition)
5. Y.Anjaneyulu, K.Chandrasekhar, Valli Manickam, "*A Textbook of Analytical Chemistry*", Pharma Book Syndicate, Hyderabad, India, 2006.

B Sc Semester IV

Chem.Pract. – 206 [Organic & Analytical Practicals]

[A] Organic Spotting and Estimation

Organic spotting minimum eight compounds (5 solids and 3 liquids)

Acids: Salicylic acid, Cinnamic acid, Anthranilic acid, Sulfanilic acid

Phenols: p-Nitrophenol, β -Naphthol

Bases: m and p – Nitroanilines, p-Toludine

Neutral : Solids:- Acetanilide, Glucose

Liquids:- Acetophenone, Carbon tetrachloride (CCl₄), Methylacetate

Estimations: 1) Glucose

2) Acetamide

3) Phenol/Aniline

[B] Volumetric and Gravimetric Analysis

Volumetric Analysis :

(a) Nitrite by back titration.

(b) Hardness of Water , Ca & Mg (Total Hardness) by EDTA

(c) Estimation of Ni by using EDTA , MgCl₂ and Eriochrome Black – T (Back Titration)

Gravimetric Analysis :

(a) Fe as Fe₂O₃

(b) Ba as BaSO₄

(c) Al as Al₂O₃

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1. I Vogel, "*Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis*", CBS Publishers & Distributers, New Delhi, Second Edition, 2004.
2. I Vogel, "*Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis*", CBS Publishers & Distributers, New Delhi, Second Edition, 2004.
3. V.K. Ahluwalia, Sunita Dhingra, "*Comprehensive Practical Organic Chemistry – Qualitative Analysis*", University Press (India) Private Limited, Hyderabad, First Indian Edition, 2010.
4. Mohan Jag, "*Organic Analytical Chemistry theory and Practice*", Narosa Publication, New Delhi, 2003.
5. J Leonard, B Lygo, G Procter, "*Advanced Practical Organic Chemistry*", Stanley Thornes (Publishers) Ltd., First Indian Edition, 2004.
6. John H. Kennedy, "*Analytical Chemistry : Practice*", Saunders College Publishing, New York, Second Edition, 1990.
7. R.A.Day, A.L.Underwood, "*Quantitative Analysis*", Prentice-Hall of India Pvt.Ltd., New Delhi, Sixth Edition, 2004.
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