

Shivaji University, Kolhapur

CHEMISTRY – SYLLABUS

B. Sc. Part – II

In force from June-2014

- i. Figures shown in bracket indicate the total lectures required for the respective unit.
- ii. The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective units.
- iii. All units should be dealt with S.I. units.
- iv. Industrial tour is prescribed.
- v. Use of recent editions of reference books is essential.
- vi. Use of scientific calculator is allowed.
- vii. Values required for spectral problems should be provided in the question paper.

Semester- III

Paper V: Organic Chemistry

Unit 1: Stereochemistry

[8]

- 1.1 Conformational isomerism – Introduction.
- 1.2 Representation of conformations of ethane by using Saw- Horse, Fischer (dotted line wedge) and Newmann's projection formulae.
- 1.3 Conformations and conformational analysis of ethane and n-butane by Newmann's Projection formula with the help of energy profile diagrams.
- 1.4 Cycloalkanes relative stability - Baeyer's strain theory, Theory of strainless rings.
- 1.5 Conformations and stability of cyclohexane and monosubstituted cyclohexanes Cyclohexanol, bromocyclohexane and methyl cyclohexane.
- 1.6 Locking of conformation in t-butyl cyclohexane.
- 1.7 Stereoselective and stereospecific reactions:
 - i) Stereochemistry of addition of halogens to alkenes: syn and anti addition.
Example- Addition of bromine to 2-butene. (mechanism not expected)
 - ii) Stereochemistry of elimination reaction: syn and anti elimination.
Example-Dehydrohalogenation of 1-bromo-1,2-diphenylpropane. (mechanism not expected)

Reference Books :

1. Organic Chemistry by Morrison and Boyd 6th Edition. Sec. 3.3,3.5,4.20,10.2,10.4,13.7,13.8,13.11,13.12. Pages-79 to 82, 85,86,149, 150,368 to 371, 377 to 380,450 to 452, 455 to 463.
2. Organic Chemistry Vol.2-Stereochemistry and the Chemistry of Natural Products by I.L.Finar 5th Edition. Sec. 2.4, 4.5, 4.11. ages- 76 to 79, 167 to 180, 187 to 190.

3. Stereochemistry of carbon compounds by Eliel. Relevant pages.
4. Stereochemistry of Organic Compounds by D. Nasipuri. Sec. 1.5,9.1,9.2,10.2,10.3,13.1. Pages- 8,9,193,196 to 198, 230 to 232, 236 to 241, 383,384.

Unit 2: Polynuclear Hydrocarbons

[08]

2.1 Naphthalene - Source, synthesis from benzaldehyde and ethyl succinate (Fitting and Erdmann Synthesis), Haworth synthesis, structure of naphthalene, chemical reactions-Reduction, Oxidation, Sulphonation, Nitration, Halogenation, Chloromethylation, Friedel craft acylation, Friedel craft alkylation, preparation of naphthalene derivative, α -naphthylamine, β -naphthylamine, α -naphthols, β -naphthols.

2.2 Anthracene :-Source and extraction,structure of Anthracene, synthesis from (a) benzene and methylene dibromide& acetylene tetrabromide (b) From naphthaquinone and 1,3-butadiene Chemical reaction :- Reduction, Oxidation, Sulphonation, Nitration, Halogenation, Friedel craft acylation, Formylation by Vilsmeier – Hack method, Diels-Alder reaction,

2.3 Phenanthrene – Synthesis of Phenanthrene 1) Haworth synthesis 2) Bardhan – Sengupta synthesis 3) Bogert – cook synthesis 4) pschorr synthesis

References

1. Advanced general organic chemistry – a modern approach Author – S. K. Ghosh. Page No. – 919-937 Publisher – New central Book Agency (P) Ltd, 8/1, Chintamoni Das Lane, Kolkata 70009, ISBN – 81-7381-141-4
2. Organic Chemistry Vol-I by Finar I. L. Naphthalene (Page No. 793-805), Anthracene (Page No.811) Organic Chemistry Vol. II I. L. Finar Synthesis of Phenanthrene (Page No. 495-499) Fifth Edition

Unit 3: Study of Heterocyclic compounds.

[08]

3.1 Introduction and classification.

3.2 Pyrrole :

Methods of synthesis from acetylene, from furan, from succinamide.

Physical properties; Reactivity of pyrrole -Basic character, Acidic character, Electrophilic substitution with general mechanism, Chemical reactions – Reduction, Oxidation, Nitration, sulphonation and halogenations, Friedel Craft's reaction, Coupling reaction.

3.3 Pyridine :

Methods of synthesis- From acetylene and hydrogen cyanide, from piperidine; Physical properties; Chemical reactions - Basic character, Electrophilic substitution (Nitration, sulphonation & bromination) reactions, Nucleophilic substitution – General mechanism. Reactions with sodamide, sodium hydroxide and n-Butyl lithium.

3.4 Quinoline:

Synthesis - Skraup's synthesis; Physical properties; Reactions of quinoline - Electrophilic substitution reactions - Nitration and sulphonation; Nucleophilic substitution reactions - Reactions with sodamide, alkylation and arylation; Reduction.

3.5 Indole:

Synthesis - Fischer Indole Synthesis; Physical properties; Chemical reactions- Electrophilic substitution reactions (Nitration, bromination, Friedel Craft's acylation), diazo coupling, Mannich reaction, oxidation and reduction.

References:

1. A Textbook of Organic Chemistry (Third Edition)- K.S. Tewari, N. K. Vishnoi - Vikas Publishing House, New Delhi (2007) –Heterocyclic Compounds (Page No 1027-1071)
2. Textbook of Organic Chemistry (Twenty Eighth Edition) - P. L. Soni, H.M.Chawla-Sultan Chand & Sons, New Delhi (2001) –Aromatic Heterocyclic Compounds (Page No. 3.44-92)
3. Organic Chemistry Vol III (First Edition) - S.M.Mukherji, S.P.Singh, R.P.Kapoor, R. Das – New Age International (P) Ltd. Publishers Mumbai (2008) –Heterocyclic Compounds (Page No. 1130-1184)
4. Organic Chemistry (Sixth Edition) - R. T. Morrison and R. N. Boyd Prentice Hall of India private limited New Delhi (1996) - Heterocyclic Compounds (Page No 1057-1076)
5. A Textbook of Organic Chemistry (Fourth Edition) - Raj K. Bansal -New Age International (P) Ltd. Publishers Mumbai (2003) -Heterocyclic Compounds (Page Nos 713-755)
6. Organic Chemistry (Fifth Edition) – Stanley H. Pine-Tata-McGraw-Hill Publishing Company Ltd.- New Delhi (2007)-Heterocyclic Aromatic Compounds (Page No 703-720)

Unit 4: Name Reactions

[8]

Introduction, Statement, General reaction, Important features, Mechanism and two Synthetic applications of following reactions.

- 4.1 Claisen Condensation (Rf. No. 1, P.N.324; Rf. No. 2, P.N.518; Rf. No. 3, P.N. 229; Rf. No. 4, P.N. 830-834)
- 4.2 Perkin reaction (Rf. No.1, P.No.391; Rf. No. 2, P.No 784; Rf. No.3, P No. 227; Rf. No.4, P No. 654,693,698).
- 4.3 Mannich Reaction (Rf. No.1, P.N.410; Rf. No.2, 790; Rf. No.4, 424,670,710).
- 4.4 Knoevengel Condensation (Rf. No.2, P.No.409; Rf. No.3, P.No.228; Rf. No.4, P.No.693,697).
- 4.5 Reformatsky Reaction (Rf. No.4, 687)
- 4.6 Reimer-Tiemann Reaction (Rf. No.1, P.N. 387-399; Rf. No.2, 766,767 Rf. No.3, 290; Rf. No.4, 419).
- 4.7 Clemmensen Reduction (Rf. No.1, P.No. 136; Rf. No.2, P.No. 405; Rf. No.3, P.No.146; Rf. No.4, P.No. 893).
- 4.8 Pinacol –Pinacolone rearrangement (Rf. No.1, P.No. 601; Rf. No. 2, P.No. 351; Rf. No.3, P.No. 113; Rf. No.4, P.No. 798).

- 4.9 Benzilic acid rearrangement (Rf. No.1, P. No. 635; Rf. No.3, P. No. 232; Rf. No.4, P. No. 803).
- 4.10 Benzidine rearrangement (Rf. No.1, P.No.656; Rf. No.2, P.No. 726; Rf. No.4, P.No. 828).
- 4.11 Cannizzaro reaction (Rf. No.1, P.No. 546; Rf. No.2, P.No. 408,783; Rf. No.4, P.No. 908).

References :

1. Mechanism and Structure in Organic Chemistry. April,1963 By Edwin S. Gould
2. A text book of Organic Chemistry –Arun Bahl , B.S.Bhal 18th Revised edition 2006 .
3. A guidebook to mechanism in Organic Chemistry sixth Edition by Peter Sykes.
4. Advanced Organic Chemistry : Reactions, Mechanisms and structure by Jerry March.

Unit 5: Green Chemistry

[8]

- 5.1 Introduction
- 5.2 12 principles of green chemistry
- 5.3 Goals of green chemistry
- 5.4 Green chemicals - Green reagents, green catalyst , green solvents.
- 5.5 Green organic synthesis - Use of Zeolites , Natural catalysts, Biocatalysts.
- 5.6 Emerging green technologies-Microwave chemistry, Sonochemistry , Photochemistry, Electrochemistry. Mechanochemistry.
- 5.7 Green synthesis – Polycarbonate , Carbaryl pesticide, Ibuprofen.

References :

1. Environmental chemistry by Dr.H.Kaur , 6th edition , page no. 669-691
2. Advances in green chemistry: chemical synthesis using MW irradiation by R.S.Varma
- 3.Green chemistry: Environment friendly alternatives by Rashmi Sanghi and M.M.Srivastava

Paper VI: Analytical Chemistry

Unit 1: Introduction to analytical chemistry

[08]

- 1.1 Introduction
- 1.2 Importance of analysis
- 1.3 Analytical process (Qualitative and Quantitative) Classification of analysis
- 1.4 Sampling of solids, liquid, gases
- 1.5 Errors
- 1.6 Types of errors (Determinant and Indeterminate errors)
- 1.7 Methods of expressing accuracy (absolute error and relative error)
- 1.8 significant figures
- 1.9 Mean, Medium, standard deviation, confidence limit
- 1.10 Numerical problems are expected

Reference No. 1-5

Unit 2: Gravimetry

[08]

- 2.1 Introduction
- 2.2 precipitation
- 2.3. nucleation
- 2.4. crystal growth
- 2.5 digestion
- 2.6 Optimum conditions for good precipitation
- 2.7 Physical nature of precipitate
- 2.8 Co-precipitation
- 2.9 Post-precipitation
- 2.10 Role of organic precipitant in gravimetric analysis e.g. DMG, 8-hydroxy quinoline

Reference No. 6-7

Unit 3: Inorganic qualitative analysis

[08]

- 3.1 Theoretical principles involved in qualitative analysis.
- 3.2 Applications of solubility product and common ion effect in separation of cations into groups.
- 3.3 Application of complex formation in
 - a) Separation of II group into IIA and IIB sub-groups.
 - b) Separation of Copper from Cadmium.
 - c) Separation of Cobalt from Nickel.
 - d) Separation of Cl^- , Br^- , I^- .
 - e) Detection of NO_2^- , NO_3^- (Brown ring test).
- 3.4 Application of oxidation and reduction in
 - a) Separation of Cl^- , Br^- , I^- in mixture
 - b) Separation of NO_2^- and NO_3^- in mixture.
- 3.5 Spot test analysis.

Reference No. 1, 6, 11

Unit 4: Conductometric Titration

[07]

- 4.1 Introduction
- 4.2 Definition
- 4.3 Measurement of conductance by whistone bridge method
- 4.4 Direct reading
- 4.5 General procedure of conductometric titration
- 4.6 Different types of titrations
- 4.7 Strong acid vs strong base
- 4.8 Strong acid vs weak base

4.9 Weak acid vs strong base

4.10 Weak acid weak base

4.11 Cell constant

4.12 Types of cells

Reference No.2, 4, 8

Unit 5: Analysis of fertilizer

[07]

5.1 Introduction

5.2 Sampling and sample preparation

5.3 Analysis of nitrogen, phosphorous and potassium

5.3.1 Nitrogen : Determination of nitrogen by total Kjeldas method and Urea nitrogen method

5.3.2 Phosphrous: Total phosphrous available and non available alkalimetric ammonium molybldum phosphate methoum by sodium tetraphenyl borate method

5.3.3 Potassium: Potassium by sodium tetra phenyl borate method

Reference No. 13-14

List of references :

1. Vogel's Text book of qualitative analysis, Revised edition by J. Barret
2. Instrumental methods of Chemical Analysis by H.Kaur 7th edition,
3. Analytical Chemistry, 6th edition by D. Cristen
4. Instrumental Methods of Chemical Analysis,(Recent edition 2012) by Gurudeep R. Chatawal .
5. Fundamentals of Analytical Chemistry , 6th edition , by D.A. Skoog
6. Basic Concept of Analytical Chemistry, 3rd edition, by S.M. Khopakar
7. A text Book of macro and Semi-micro Qualitative Analysis 5th edition by by A.I. Vogel's .
8. Essentional of Physical Chemistry, Revised edition 2012, by Bhal and Tuli,
9. Analytical Chemistry by B.K.Sharma , Krishna Prakashan Media Ltd, Meerut, edition 3rd , 2011
10. Industrial Chemistry By R.K.Das, Part-II, Kalyani Publisher, Ludhiana ,New Delhi
11. Vogel's Text Book of Quantitative Analysis. By J Mendham, R.C. Denney, J.D.Brames, M.Thomous,B.Sivasankar.
12. Industrial chemistry by B.K.Sharma , Goel Publishing Housing, 16th edition 2011
13. Progressive Inorganic Chemistry, 4th edition by T.S. Suratkar, M.M.Thatte and B.R.Pandit
14. Soil and Plant Testing by A. Cottenie

Paper-VII (Physical Chemistry)

Unit 1: Electrochemistry

[16]

- 1.1: Introduction, Conduction of electricity, Types of conductors: Electronic and Electrolytic.
- 1.2: Explanation of the terms: Specific, equivalent and molar conductance, relation between specific and equivalent conductance, variation of conductance with dilution, equivalent conductance at infinite dilution.
- 1.3: Debye-Huckel theory of conductance of strong electrolytes, (relaxation effect, electrophoretic effect , Derivation not expected) Debye-Huckel limiting law (only equation and explanation of terms in it)
- 1.4: Migration of ions, Hittorf's rule, Transport number, Determination of transport number by moving boundary method, Factors influencing transport number (Nature of electrolyte, Concentration, Temperature, Complex formation, Abnormal transport number, Degree of hydration.)
- 1.5: Kohlrausch law and its applications: (i) Relationship between ionic conductance, ionic mobility and transport number. (ii) Determination of equivalent / molar conductance at infinite dilution for weak electrolytes. (iii) Determination of degree of dissociation.(iv) Determination of ionic product of water. (v) Determination of solubility and solubility product of sparingly soluble salts.
- 1.6: Buffer solution, acidic and basic buffers, Henderson's equation.
- 1.7: Numerical problems.

References: 2, 4, 9, 11, 13 and 17.

Unit 2: Thermodynamics

[7]

- 2.1: Concept of entropy: Introduction, Definition, Mathematical expression, Unit, Physical significance of entropy.
- 2.2: Entropy changes for reversible and irreversible processes in isolated systems.
- 2.3: Entropy changes for an ideal gas as a function of V & T and as a function of P & T
- 2.4: Entropy change in mixing of gases.
- 2.5: Entropy change accompanying phase transitions: (i) Solid to liquid (ii) Liquid to vapor (iii) One crystalline form to another.
- 2.6: Third law of thermodynamics: statement, absolute entropy, determination of absolute entropy, entropy change in chemical reactions, standard entropy.
- 2.7: Numerical problems.

References: 1, 3, 4, 6, 9, 11, 13 and 14.

Unit 3: Chemical Kinetics

[08]

- 3.1: Introduction, Third order reactions – derivation of rate constant, characteristics and examples of third order reaction.

- 3.2: Methods to determine order of reaction: i) Van't Hoff differential method
 ii) Integral rate expression method iii) Half life method
- 3.3: Effect of temperature on the rate of reaction: (i) Temperature coefficient,
 (ii) Arrhenius equation, (iii) Energy of activation.
- 3.4: Theories of reaction rate: (i) Collision theory, (only quantitative aspect, derivation
 not expected.) (ii) Transition state theory.
- 3.5: Numerical problems. and NH₄

References : 2,4, 6, 9, 11, 12 and 13.

Unit 4: Physical properties of liquids

[07]

- 4.1: Classification of physical properties.
- 4.2: Surface tension and Chemical constitution, use of parachor in elucidating molecular structure.
- 4.3: Viscosity, coefficient of viscosity, determination of viscosity by Ostwald's
 Viscometer.
- 4.4: Refractive index, measurement of refractive index by Abbe's refractometer, specific
 and molecular refraction, molecular refractivity.
- 4.5: Numerical problems.

References: 9, 11, 13 and 16.

Reference Books :

- Physical Chemistry by G. M. Barrow (*Tata Mc-Graw Hill publishing Co., Ltd.*)
- Elements of Physical Chemistry by S. Glasstone and D. Lewis. (*D. Van Nostrand Co. Inc.*)
- Physical Chemistry by W. J. Moore (*Orient Longman.*)
- Principles of Physical Chemistry by S. H. Maron and C. F. Prutton.
(Oxford & IBH Publishing Co.)
- University General Chemistry by C. N. R. Rao (*Mac-Millan.*)
- Elements of Physical Chemistry by P. W. Atkins. (*Oxford University Press.*)
- Physical Chemistry by R. A. Alberty (*Wiley Eastern Ltd.*)
- Physical Chemistry through problems by S. K. Dogra, D. Dogra (*Wiley Eastern Ltd.*)
- Principles of Chemistry by Puri and Sharma (*S.Nagin.*)
- Physical Chemistry by A. J. Mee. ELBS & Heinemann Educational Books Ltd.)
- Essentials of Physical Chemistry by B. S. Bahl and G. D. Tuli. (*S.Chand.*)
- Chemical Kinetics by K. J. Laidler (*Tata Mc-Graw Hill Publishing Co. Ltd.*)
- Text Book of Physical Chemistry by Soni-Dharmarha.
- A Text Book Physical Chemistry by S. Glasstone, (*Mac Millan.*)
- Advanced Chemistry by Philip Mathews, (*Cambridge University.*)
- Instrumental methods of Chemical Analysis by Chatwal and Anand.
(Himalaya Publishing House, Mumbai.)
- An introduction to electrochemistry by S. Glasstone. (*Mac Millan.*)

Paper-VIII : INORGANIC CHEMISTRY

Unit 1: Chemistry of elements of first transition series [05]

- 1.1 Introduction of d' block elements
- 1.2 Study of transition elements with respect to electronic structure, coloured ions, magnetic properties character, oxidation states, and complex formation.

Unit 2: Study of 'f' block elements [05]

A) Study of lanthanides.

- 2.1 Introduction
- 2.2 Properties of lanthanides with respect to
 - i. Electronic configuration.
 - ii. Oxidation state.
 - iii. Colour and spectra.
 - iv. Lanthanide contraction.
- 2.3 Methods of separation of lanthanides.
(Mention name only, separation of lanthanides by ion exchange method).

Unit 3: Co-ordination chemistry [14]

- 3.1 Definition and formation of co-ordinate covalent bond in $\text{BF}_3 - \text{NH}_3$ and $[\text{NH}_4]^*$
- 3.2 Distinguish between double salt and complex salt
- 3.3 Werner's theory-
 - i. Postulates
 - ii. The theory as applied to cobalt amines viz. $\text{CoCl}_3 \cdot 6\text{H}_2\text{O}$, $\text{CoCl}_3 \cdot 5\text{H}_2\text{O}$, $\text{CoCl}_3 \cdot 4\text{H}_2\text{O}$, $\text{CoCl}_3 \cdot 3\text{H}_2\text{O}$
- 3.4 Description of the terms- ligands, co-ordination compounds
- 3.5 IUPAC nomenclature of coordination compound.
- 3.6 Valence bond theory of transition metal complex with respect to, C.N. = 4, C.N. = 6.
- 3.7 Crystal field theory
 - 3.7.1 Assumption of CFT or An elementary idea of CFT
 - 3.7.2 Crystal field splitting of d' orbital in octahedral, tetrahedral and square planar complex, John- Teller distortion
 - 3.7.3 Factors affecting the Crystal field parameters
 - 3.7.4 High spin and low spin octahedral complexes of Co (II)
 - 3.7.5 Crystal Field stabilization energy (CFSE), Calculation with respect to octahedral, tetrahedral .
 - 3.7.6 Limitation of CFT

Unit 4: Chelation [05]

- 4.1 A brief introduction with respect to ligands, chelating agent chelation and metal chelate
- 4.2 Structural requirements of chelate formation

- 4.3 Difference between metal chelate and metal complex
- 4.4 Classification of chelating agents (with specific illustration of bidentate chelating agents)
- 4.5 Application of chelating with respect to chelating agents EDTA and DMG

Unit 5: Catalysis

[05]

- 5.1. Introduction
- 5.2 Classification of catalytic reaction- Homogenous and Heterogeneous
- 5.3 Types of Catalysis
- 5.4 Characteristics of catalytic reactions
- 5.5 Mechanism of catalysis
 - i. Intermediate compound formation
 - ii. Adsorption
- 5.6 Industrial application of catalysts

Unit 6: Non aqueous solvents

[04]

- 6.1 Introduction: Definition and characteristics of solvents
- 6.2 Types of solvent
- 6.3 Physical properties and acid base reactions in non-aqueous solvents with respect to liquid SO₂

References:

1. Inorganic Chemistry, Principles of structure and reactivity J. E. Huheey & etal.
2. Inorganic Chemistry-Shriver and Atkns, 5th Edition
3. Principles of Inorganic Chemistry by Puri, Sharma, Kalia
4. Advance Inorganic Chemistry by Agrawal, Keemtilal (Pragati Edition)
5. Theoretical Inorganic Chemistry 2nd Edition by C. Day and J. Selbin
6. Principles of Inorganic Chemistry by Puri, Sharma, Jauhar
7. Chemistry in Non – Aqueous Solvents by H. H. Sisler (Chapman and Hall Ltd.)
8. Modern Inorganic Chemistry by R. D. Madan (S. Chand)
9. Inorganic Chemistry by J. D. Lee
10. Basic Inorganic Chemistry by F. A. Cotton, G. Wilkinson and B. L. Gaus Wiley.
11. Concept and Models of Inorganic Chemistry by B. Douglas. D. Mc. Daniel and J. Alexander, John Wiley.
12. Coordination Chemistry by R. Basolo.

Laboratory Course

Note :- i) Use of Electronic / Single pan balance/Chainometric balance/Analytical Balance is allowed.

ii) Use of scientific calculator is allowed.

Physical Chemistry

[A] Instrumental

1. Viscosity :

To determine the percentage composition of a given liquid mixture by viscosity method. (Density data to be given).

2. Refractometry :

To determine the specific and molar refractions of benzene, toluene and xylene by Abbe's refractometer and hence determination of the refraction of $-\text{CH}_2-$ group (Methylene group). (Densities should be determined by students.)

3. Polarimetry :

To determine the specific rotation and unknown concentration of sugar solution.

4. Conductometry:

(i) To determine degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically.

(ii) To determine the normality of the given strong acid by titrating it against strong alkali conductometrically.

(iii) To determine equivalent conductance at infinite dilution of strong electrolyte (any one from KCl, NaCl, KNO_3 and HCl) and verify Onsager equation.

(Taking five different dilutions)

5. Surface Tension:

To determine surface tension of a liquid by using stalagmometer.

[B] Non - Instrumental**1. Chemical Kinetics**

(i) To study the hydrolysis of methyl acetate in presence of HCl and H_2SO_4 and to determine the relative strength of acids.

(ii) To study the effect of acid strength (0.5 M and 0.25 M HCl) on hydrolysis of an ester.

(iii) To study the reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI (unequal concentrations)

Reference Books:

1. Experimental Physical Chemistry by A. Findlay. (Longman.)

2. Advanced Practical Physical Chemistry by J.B. Yadav.

(Goel Publishing house, Meerut.)

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.

5. Experiments in Physical Chemistry by J. C. Ghosh, (S. Chand & Co.)
(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.(S.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.)

Organic Chemistry

A) Organic Qualitative Analysis

Identification of at least Ten Organic compounds with reactions including two from acids, two from phenols, two from bases and four from neutrals.

Acids – Succinic acid, Phthalic acid, Salicylic acid, Aspirin.

Phenols – Alpha-Naphthol, o-nitrophenol, p-nitrophenol.

Bases – o-,m- and p-nitroanilines, Diphenyl amine.

Neutrals – Urea, Acetanilide, Carbon tetrachloride, Bromobenzene, Methyl acetate, Nitrobenzene, Naphthalene, Anthracene, Acetophenone, Ethyl methyl ketone.

Note : A systematic study of an organic substance involves reactions in the determination of elements and functional group.

B) Organic Quantitative Analysis

i) Estimations

- 1) Estimation of ester.
- 2) Estimation of acetone.
- 3) Estimation of vitamin C.

ii) Organic preparations

- 1) p-nitro acetanilide from acetanilide.
- 2) Acetanilide from aniline using anhydrous ZnCl₂ and Zn dust.
- 3) Phthalimide from phthalic anhydride.
- 4) Benzoic acid from benzamide.

iii) Chromatographic separation – Thin layer chromatography.

Separation, identification and determination of R_f values of Nitroanilines and phenols. Solvent system : n-Butanol + Acetic acid + water – 8 : 2 : 2.

Spraying reagent – 0.1M 1:1 Mixture of ferric chloride and potassium ferricyanide.

Reference Books :

1. Practical Organic Chemistry by A. I. Vogel.
2. Hand book of Organic qualitative analysis by H. T. Clarke.
3. A laboratory Hand Book of Organic qualitative analysis and separation by V. S. Kulkarni. Dastane Ramchandra & Co.
4. Practical Organic Chemistry by F. G. Mann and B. C. Saunders. Low – priced Text Book. ELBS. Longman.
5. Experiments in General Chemistry by C. N. R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi.
6. Advanced Practical Organic Chemistry by N. K. Vishnoi. Vikas Publishing House Private Limited.
7. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwalia, Sunita Dhingra. University Press. Distributor – Orient Longman Ltd.
8. Comprehensive Practical Organic Chemistry Preparation and Quantitative Analysis by V. K. Ahluwalia, Renu Aggarwal. University Press. Distributor – Orient Longman Ltd.
9. Practical Chemistry – Physical – Inorganic – Organic and Viva – voce by Balwant Rai Satija. Allied Publishers Private Limited.
10. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
11. College Practical Chemistry by Patel, Jakali, Mohandas, Israney, Turakhia. Himalaya Publishing House, Mumbai.
12. Practice of thin layer chromatography by Joseph C. Touchstone, Murrell F. Dobbins. A Wiley – Interscience Publication John-Wiley & Sons.

Inorganic Chemistry

1) Gravimetric Analysis

- i) Gravimetric estimation of iron as Fe_2O_3 from a solution containing Ferrous ammonium sulphate and free sulphuric acid.
- ii) Gravimetric estimation of barium as BaSO_4 from a solution containing barium chloride and free hydrochloric acid.

2) Titrimetric Analysis :

(Calibration of burette, pipette and volumetric flask is essential)

- i) Fertilizer analysis : To determine percentage of nitrogen in the given sample of a nitrogenous fertilizer (ammonium sulphate). Known weight of the sample to be taken by the student. For preparing its solution which is to be refluxed with known excess of alkali. Standard HCl solution to be supplied.

ii) Quality control : To determine percentage purity of a given sample of soda ash. Standard HCl solution to be supplied. Known weight of the sample to be taken by the student for preparing its solution.

iii) Determination of total hardness of water using 0.01M EDTA solution.

(Students should standardise the given EDTA solution by preparing 0.01M CaCl₂ solution. using CaCO₃ salt.)

iv) Determination of alkali content of antacid tablet using HCl.

(**Note** : These experiments are performed by preparing calibrated sets of burettes, pipettes and volumetric flasks.)

3) Inorganic Preparations

i) Preparations of Ferrous ammonium sulphate (Mohr's salt)

ii) Preparation of Tetrammine copper (II) sulphate.

4) Semi-micro qualitative analysis

Analysis of binary mixtures with non interfering cations and anions (at least 6 mixtures to be analyzed)

i) Following anions are to be given :

Cl⁻, Br⁻, I⁻, NO₃⁻, CO₃⁻, SO₄⁻ – (Only insoluble carbonates are to be given)

ii) Following cations are to be given :

Cu⁺², Cd⁺².

Al⁺³, Fe⁺³, Cr⁺³.

Zn⁺², Mn⁺², Ni⁺², Co⁺².

Ca⁺², Ba⁺².

Mg⁺².

NH⁺⁴, K⁺.

Note:-Use of spot tests to be made whenever possible.

Reference Books :

1. Qualitative Inorganic Chemistry by A. I. Vogel.
2. Quantitative Inorganic Chemistry by A. I. Vogel.
3. Physical Chemistry of Inorganic qualitative analysis by Kuricose & Rajaram.
4. Practical manual in water Analysis by Goyal & Trivedi.
5. Basic Concepts in Analytical Chemistry by S. M. Khopkar. Wiley Eastern Ltd.
6. Practical Chemistry, Physical – Inorganic – Organic and Viva voce by Balwant Rai Satija. Allied Publishers Private Limited.
7. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
8. College Practical Chemistry by Patel, Jakali, Mohandas, Israney, Turakhia.

Himalya Publishing house.

9. Experiments in General Chemistry by C. N. R. Rao. Affiliated East –West Press Private Ltd., Delhi.