

Shivaji University, Kolhapur

B.O.S. In Chemistry

B.Sc. Part –I New Syllabus

In force from June - 2008

INTRODUCTION

This syllabus is prepared to give the sound knowledge and understanding of chemistry to undergraduate students at first year of the B.Sc. degree course. The goal of the syllabus is to make the study of chemistry as stimulating, interesting and relevant as possible. The syllabus is prepared by keeping in mind the aim to make students capable of studying chemistry in academic and industrial courses. Also to expose the students and to develop interest in them in various fields of chemistry. The new and updated syllabus is based on disciplinary approach with vigour and depth taking care the syllabus is not heavy at the same time it is comparable to the syllabi of other universities at the same level.

The syllabus is prepared after discussions of number of faculty members of the subject and by considering the existing syllabi of B.Sc. Part-I, II & III, new syllabi of XIth & XIIth standards, syllabi of NET and SET exams. U.G.C. model curriculum, syllabi of different entrance examination and syllabi of other Universities.

The units of the syllabus are well defined and the scope is given in detail. The periods required for units are given. The lists of reference books are given in detail.

OBJECTIVES

To enable the students-

- To promote understanding of basic facts and concepts in Chemistry while retaining the excitement of Chemistry.
- To make students capable of studying Chemistry in academic and Industrial courses.
- To expose the students to various emerging new areas of Chemistry and apprise them with their prevalence in their future studies and their applications in various spheres of chemical sciences.
- To develop problem solving skills in students.
- To expose the students to different processes used in Industries and their applications.
- To develop ability and to acquire the knowledge of terms, facts, concepts, processes, techniques and principles of subjects,
- To develop ability to apply the knowledge of contents of principles of chemistry.
- To inquire of new knowledge of chemistry and developments therein.
- To expose and to develop interest in the fields of chemistry
- To develop proper aptitude towards the subjects.
- To develop the power of appreciation, the achievements in Chemistry and role in nature and society.
- To develop interest in students to study chemistry as a discipline.
- To develop skills required in chemistry such as the proper handling of apparatus and chemicals.

List of Laboratory equipments & Chemicals required :-

Apparatus & equipments and chemicals required.

1. Viscometer
2. Stop watch
3. Eudiometer
4. Digital balance with 1 mg accuracy
5. Burette, pipette and conical flask
6. $1/10^{\circ}\text{C}$ thermometer
7. Polythene bottles
8. Measuring cylinder
9. Stopper bottle
10. Test tube, Beaker
11. Thile's tube
12. Capillary tube
13. Evaporating dish
14. Glass rod
15. Wire gauze
16. Burner
17. Water bath
18. Chromatography paper
19. Gas jar
20. Watch glass
21. Tripod stand
22. Burette stand
23. Iron stand
24. Test tube holder
25. Test tube stand
26. Spot tile
27. Dropper
28. Dryer

Chemicals:-

All the chemicals required for experiments are mentioned in the syllabus.

CHEMISTRY
B.Sc. Part – I (Theory) Course structure
Paper – I (Physical and Inorganic Chemistry)

Time :- 3 hours

Marks:- 100

Section No. & subject	Unit No.	Title	Periods	Marks	Option
I (Physical)	Unit - 1	Mathematical concepts	06	08	05
	Unit - 2	General concept in chemistry	06	08	06
	Unit – 3	Thermodynamics	06	08	06
	Unit – 4	Colloidal state	10	13	10
	Unit – 5	Chemical kinetics	11	15	11
	Unit – 6	Gaseous state	11	15	11
Total			50	67	49
II (Inorganic)	Unit - 1	Chemical bonding	07	09	06
	Unit - 2	Covalent bonding (MOT)	09	12	07
	Unit – 3	Ionic solids	09	12	08
Total			25	33	21
Grand Total			75	100	60

Paper – II (Organic and Inorganic Chemistry)

Time :- 3 hours
100

Marks:-

Section No. & subject	Unit No.	Title	Periods	Marks	Option
I (Organic)	Unit - 1	Qualitative and quantitative chemical analysis	09	12	09
	Unit - 2	Stereochemistry of organic compounds	05	07	05
	Unit – 3	Fundamentals of organic reaction mechanism	07	09	07
	Unit – 4	Aromaticity	07	10	07
	Unit – 5	Carboxylic acids and their derivatives	07	10	07
	Unit – 6	Cycloalkanes, Cycloalkenes and Alkadienes	05	05	04
	Unit – 7	Diazonium salts	03	05	03
	Unit - 8	Organosulphur compounds	04	05	04
	Unit – 9	Petroleum	03	04	03
Total			50	67	49
II (Inorganic)	Unit - 1	s-block elements	06	08	06
	Unit - 2	p-block elements	10	13	08
	Unit – 3	Chemistry of Noble gases	05	07	04
	Unit – 4	Environmental chemistry	04	05	03
Total			25	33	21
Grand Total			75	100	60

Total contact hours :-
 Theory - 120 hrs.
 Practicals - 75 hrs.
 Total - 195 hrs.

SHIVAJI UNIVERSITY, KOLHAPUR

Chemistry

New Syllabus for B.Sc. Part – I

In force from June, 2008

General Structure:

There will be two theory papers of 100 marks each. Each paper will have two sections. Their titles & marks distribution are as under.

1) Paper – I : Physical and Inorganic Chemistry – 100 Marks.

Section – I : Physical Chemistry – 67 Marks.

Section – II : Inorganic Chemistry – 33 Marks.

2) Paper – II : Organic and Inorganic Chemistry – 100 Marks.

Section – I : Organic Chemistry – 67 Marks.

Section – II : Inorganic Chemistry – 33 Marks.

Practical will be of 50 marks. Physical, Inorganic and Organic sections carry 15 marks each. Five marks are reserved for journal. The duration of practical examination will be of six hours.

CHEMISTRY – SYLLABUS

- N. B. (i) Figures shown in bracket indicate the total lectures required for the respective units.
- (ii) The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective to 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.

PAPER – I

(Physical and Inorganic Chemistry)

Section – I Physical Chemistry

UNIT - 1. Mathematical Concepts: - - - - - [6]

- 1.1 Graphical representation: Graph paper, co-ordinates of a point, equation of straight line, intercept, slope and nature of the graph. Plotting of graph based on experimental data.
- 1.2 Derivative: Rules of differentiation (without proof) pertaining to algebraic and exponential functions. Examples related to chemistry.
- 1.3 Integration: Rules of integration (without proof) pertaining to algebraic and exponential functions. Example related to chemistry.
- (Numerical Problems not expected)

UNIT - 2. General Concepts in Chemistry - - - - [6]

- 2.1 Definitions of the terms: Solute, solvent, solution and dilute solution.
- 2.2 Concentration units: Normality, Molarity, Molality, Mole fraction, Weight fraction, Percentage composition by weight and by volume.
- 2.3 Concentrations of Bulk Solutions used in Laboratory and preparation of standard solutions from them (HCl, H₂SO₄, HNO₃ and Ammonia)
- 2.4 Numerical Problems.

UNIT - 3. Thermodynamics: - - - - [6]

- 3.1 Spontaneous & non-spontaneous processes – Definitions, distinguishing

points and examples. Second law of thermodynamics and its different statements.

3.2 Carnot's cycle, its efficiency and Carnot's Theorem (Heat engine).

3.3 Numerical Problems.

UNIT - 4. Colloidal State: - - - -

[10]

4.1 Definition of colloids

4.2 Types of colloidal systems.

4.3 Solids in liquids (sols):

i) Preparation of sols: Dispersion and Aggregation methods

ii) Purification of Sols: Dialysis, Electrodialysis and Ultrafiltration.

iii) Properties of sols : Colour, optical, kinetic and electrical properties.

iv) Stability of sols, protective action, Hardy-Schulze law, gold number

4.4 Liquids in liquids (emulsions):

Types of emulsions, preparation, Emulsifier.

4.5 Liquids in solids (gels):

Classification, preparation and properties, inhibition,

4.6 General applications of colloids.

UNIT - 5. Chemical Kinetics: - - - -

[11]

5.1 Introduction: Rate of reaction, Definition and units of rate constant, Factors affecting rate of reaction, Order and Molecularity of reaction,

5.2 First order reaction: Rate expression (Derivation not expected), Characteristics of first order reaction.

5.3 Pseudounimolecular reactions such as, (i) Hydrolysis of methyl acetate in presence of acid, (ii) Decomposition of hydrogen peroxide (KMnO₄ method).

5.4 Second order reaction: Derivation of rate constant for equal and unequal concentrations of the reactants. Characteristics of second order reaction.

Examples: (i) Saponification of ethyl acetate,

(ii) Reaction between $K_2S_2O_8$ and KI.

5.5 Numerical problems.

UNIT - 6. Gaseous State : - - - -

[11]

6.1 (a) Ideal and Non – ideal gases.

(b) Deviation from ideal behaviour. (only Boyle's law)

(c) Causes of deviation, van der Waal's equation, Explanation of real gas behaviour by van der Waal's equation.

6.2 Critical Phenomena: PV-Isotherms of real gases (Andrew's isotherms),

Continuity of state, Relationship between critical constants and van der Waal's constants.

6.3 The law of corresponding states and reduced equation of state.

6.4 Liquefaction of gases, Joule-Thomson effect.

6.5 Numerical Problems.

Reference Books :

- 1) Mathematical preparation of Physical Chemistry : F. Daniel,
Mc-Graw Hill Book company.
- 2) Elements of Physical Chemistry : S. Glasstone and D. Lewis
(D. Van Nostrand Co-Inc)
- 3) Physical Chemistry : W. J. Moore (Orient Longman)
- 4) Principles of Physical Chemistry : Maron – Prutton
- 5) University Chemistry : B. H. Mahan (Addision – Weseley Publ. Co.)
- 6) Chemistry – Principle & Applications : P. W. Atkins, M. J. Clugsto,
M. J. Fiazer, R. A. Y. Jone (Longman)
- 7) Physical Chemistry : G. M. Barrow (Tata Mc-Graw Hill)

- 8) Essentials of Physical Chemistry : B. S. Bahl & G. D. Tuli (S. Chand)
- 9) Physical Chemistry : A. J. Mee
- 10) Physical Chemistry : Daniels – Alberty.
- 11) Principles of Physical Chemistry : Puri – Sharma (S. Nagin)
- 12) Text Book of Physical Chemistry : Soni – Dharmarha.
- 13) University General Chemistry : CNR. Rao (McMillan)
- 14) Chemistry : Sienko – Plane (Recent Edn.)
- 15) Basic Chemical Thermodynamics : V. V. Rao.
- 16) Physical Chemistry through Problems : Dogra and Dogra (Wiley Eastern Ltd.)
- 17) Physical Chemistry : S. Glasstone.
- 18) A Text Book of Physical Chemistry: A.S. Negi and S.C. Anand (New Age International (P) Ltd.)
- 19) A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.) (ELBS)

PAPER – I

Section – II (Inorganic Chemistry)

UNIT – 1 Chemical Bonding :

----- [7]

- 1.1 Introduction and definition with example of each.
 - (a) Ionic bond.
 - (b) Covalent bond.
 - (c) Coordinate bond.
 - (d) Metallic bond.
 - (e) Hydrogen bond.
 - (f) van der Waal's forces.
- 1.2 Covalent Bonding : Valence Bond Theory (VBT)
 - (a) Valence bond theory : Heitler–London theory and Pauling–Slater theory.
Limitations of valence bond theory.
 - (b) Types of hybridisation and shapes of simple inorganic molecules –
BeCl₂, BF₃, SiCl₄, PCl₅, SF₆, IF₇
 - (c) Valence Shell Electron Pair Repulsion (VSEPR) Theory with respect to NH₃, H₂O, and ClF₃ molecules.

UNIT – 2 Covalent Bonding : Molecular Orbital Theory (MOT) ----- [9]

2.1 Atomic & Molecular orbitals.

2.2 L. C. A. O. principle.

2.3 Bonding, Antibonding & Nonbonding Molecular Orbitals.

2.4 Conditions for successful overlap.

2.5 Different types of overlap.

s-s, s- p_x , p_x - p_x & p_y - p_y or p_z - p_z .

2.6 Energy level sequence of molecular orbitals for $n = 1$ and $n = 2$.

2.7 M. O. diagrams for homonuclear diatomic molecules such H_2 , Li_2 , Be_2 , C_2 , N_2 & O_2 and heteronuclear diatomic molecules such a CO and NO with respect to bond order, stability and magnetic properties.

UNIT –3 Ionic Solids : ----- [9]

3.1 Ionic Bonding :

(a) Formation of ionic bond, Energetics of ionic bonding : Ionisation potential, Electron affinity and Lattice energy.

(b) Born–Haber Cycle for Alkali metal halide (NaCl) (Numerical problems not expected)

(c) Characteristics of ionic compounds.

(d) Fajan’s rule.

3.2 Radius ratio & Crystal structure :

(a) Definitions of Radius ratio (r^+ / r^-), co-ordination number, stoichiometry and unit cell.

(b) Concept and calculation of radius ratio (r^+ / r^-) for ionic solid with octahedral geometry.

(c) Radius ratio effect on geometry.

(d) Crystal structure of NaCl and CsCl, w.r.t. unit cell, radius ratio, coordination number and stoichiometry.

(e) Stoichiometric defects in ionic solids and their consequences.



PAPER – II

(Organic Chemistry and Inorganic Chemistry)

Section – I (Organic Chemistry)

UNIT – 1. Qualitative and Quantitative elemental analysis : - - - - - [9]

- 1.1 Qualitative analysis of Carbon, Hydrogen, Nitrogen, Sulphur and Halogen.
- 1.2 Quantitative analysis of,
 - (i) Carbon and Hydrogen by Combustion method.
 - (ii) Nitrogen by Kjeldahl's method.
 - (iii) Halogen, Sulphur and Phosphorus by Carius method.
- 1.3 Determination of molecular weight of an acid by titration method and of base by platinichloride method.
- 1.4 Numerical problems.

UNIT – 2 Stereochemistry of organic compounds : - - - - - [5]

- 2.1 Stereoisomerism – Introduction.
- 2.2 Optical isomerism – Introduction.
- 2.3 Elements of symmetry.
- 2.4 Chiral centre. (Explanation with lactic acid.)
- 2.5 Optical isomerism in tartaric acid and 2:3 dihydroxybutanoic acid.
- 2.6 Enantiomers and diastereoisomers.
- 2.7 Racemic modification.
- 2.8 Geometrical isomerism – Cause of geometrical isomerism.
- 2.9 Geometrical isomerism with respect to $\begin{array}{c} \diagdown \\ \text{C} \\ \diagup \end{array} = \text{C} \begin{array}{c} \diagup \\ \text{C} \\ \diagdown \end{array}$, $\begin{array}{c} \diagdown \\ \text{C} \\ \diagup \end{array} = \text{N} \begin{array}{c} | \\ \text{C} \\ | \end{array}$ – and alicyclic compounds (Introduction). Geometrical isomerism in maleic acid and fumaric acid.

UNIT – 3 Fundamentals of Organic reaction mechanism : - - - - - [7]

- 3.1 Meaning of reaction mechanism.
- 3.2 Curved arrow notation; drawing electron movements with arrows. Half headed and double headed arrows.
- 3.3 Nature of fission – Homolytic and Heterolytic.
- 3.4 Types of reagents – Electrophiles and Nucleophiles.

3.5 Types and sub types of following organic reactions with definition and at least one example of each.

(a) Substitution (b) Addition (c) Elimination (d) Rearrangement.

(Mechanism is not expected)

3.6 Reactive intermediates with examples – Carbocations, Carbanions, Free radicals, Carbenes, Arynes and Nitrenes.

UNIT – 4 Aromaticity :

----- [7]

4.1 Introduction.

4.2 (a) Kekule structure of benzene.

(b) Resonance structures of benzene.

(c) Molecular orbital picture of benzene.

(d) Representation of benzene ring.

4.3 Modern theory of aromaticity –

Fundamental concepts – delocalisation of pi electrons, coplanarity and Huckel's (4n+2) rule.

Applications of Huckel's rule to Naphthalene, Anthracene, Pyrrole, Furan, Thiophene and Pyridine.

4.4 Mechanism of electrophilic aromatic substitution in benzene w.r.t. Nitration, Sulphonation, Halogenation and Friedel-Crafts reaction. (Alkylation and Acylation)

4.5 Electrophilic substitution reactions of monosubstituted Benzene with special reference to nitration of Nitrobenzene and nitration of Phenol.

UNIT – 5 Carboxylic acids and their derivatives

----- [7]

5.1 Monocarboxylic acids:

Introduction, Method of formation of halo acids, mono-, di- and trichloroacetic acids. Substitution reactions of monochloroacetic acids by nucleophiles CN^- , OH^- , I^- and NH_3

5.2 Hydroxy acids: Malic acid and citric acid.

Methods of formation of maleic acid from maleic acid, from α – bromo succinic acid and moist Ag_2O . Reactions of malic acid- action of heat, oxidation and reduction with HI. Uses of Malic acid.

Method of formation of citric acid from glycerol.

Reactions of citric acid- acetylation by acetic anhydride, reduction by HI and action of heat at 422K. Uses of citric acid.

5.3 Unsaturated acids: Acrylic acid and Cinnamic acid.

Methods of formation of acrylic acid from acrolin and by dehydration of β – hydroxy Propionic acid. Reactions of acrylic acid – addition of H_2O , reduction by Na/C_2H_5OH . Uses of acrylic acid.

Methods of formation of cinnamic acid from benzaldehyde using diethyl malonate and by using acetic anhydride and sodium acetate.

Reactions of cinnamic acid - Bromination and oxidation. Uses of cinnamic acid.

5.4 Dicarboxylic acids: Succinic acid and Phthalic acid.

Methods of formation of succinic acid from ethylene bromide, maleic acid

Reactions of succinic acid:- action of heat, action of $NaHCO_3$, C_2H_5OH in presence of acid. Uses of succinic acid.

Methods of formation of Phthalic acid from o-xylene, naphthalene.

Reaction of phthalic acid- action of heat, reaction with sodalime, NH_3 . Uses of phthalic acid.

5.5 Carboxylic acid derivatives:- Acetyl chloride and Acetic anhydride.

Acid halide derivative:- acetyl chloride: methods of formation from acid by action with PCl_5 and $SOCl_2$. Reactions with H_2O , alcohol and NH_3 . Uses of acetyl chloride.

Acid anhydride derivative:- Acetic anhydride: Method of formation by dehydration of acetic acid. Reactions with H_2O , alcohol and NH_3 . Uses of acetic anhydride.

UNIT – 6 Cycloalkanes, cycloalkenes and Alkadienes.

----- [5]

6.1 Cycloalkanes: - (1) Introduction.

(2) Method of formation.

- By addition of carbene to alkene
- Action of metallic sodium on dihaloalkane
- Diels – Alder reaction
- By reduction of aromatic compounds

(3) Chemical properties.

- Photohalogenation
- Catalytic halogenation
- Catalytic hydrogenation
- Effect of heat

- e) Reaction with hydrogen halide
- 6.2 Cycloalkenes:- (1) Introduction
- (2) Method of formation from cyclic compounds
- (3) Chemical Properties
 - a) Hydrogenation
 - b) Addition of Halogens and halogen acids.
 - c) Allylic halogenation
- 6.3 Alkadienes : - (1) Introduction
- (2) Classification
- (3) Buta-1,3-diene
 - a) Structure
 - b) Methods of formation
 - i) From cyclohexane
 - ii) From Butane by dehydrogenation
 - iii) From acetylene
 - iv) From Butane-1,3-diol
 - v) From ethanol and acetaldehyde (Industrial method)
- (4) Chemical Properties
 - a) Reaction with hydrogen halide
 - b) Reaction with halogens
 - i) With one molar equivalent of halogens(Cl_2 or Br_2)
 - ii) With two molar equivalent of halogens(Cl_2 or Br_2)
 - c) Diels- Alder reaction
 - d) Reduction – hydrogenation
 - e) Oxidation – Ozonolysis
 - f) Polymerization

UNIT – 7 Diazonium salts

----- [3]

7.1 Introduction

7.2 Formation of Benzene diazonium chloride

7.3 Reactions – formation of Benzene, formation of iodobenzene, reduction, Sand Meyer's reaction azo coupling – Synthesis of methyl orange and congo red.

UNIT – 8 Organosulphur compounds:

----- [4]

8.1 Introduction and nomenclature

8.2 Thiols (simple examples).

8.3 Methods of formation- (i) from sodium hydrosulphide and alkyl halide

(ii) from alcohol vapors and hydrogen sulphide

(iii) from Grignard reagent and sulphur.

8.4 Physical properties

8.5 Chemical reactions (i) Acidity-formation of mercaptide

(ii) Reaction with sodium

(iii) Reaction with carboxylic acids and acid chlorides

(iv) Reaction with aldehyde and ketones

(v) Oxidation

8.6 Thioethers (simple examples)

8.7 Method of formation (i) from potassium sulphide and alkyl halide

(ii) from salt of thiol and alkyl halide

(iii) from thiols and alkynes

8.8 Physical properties.

8.9 Chemical reactions: (i) Reaction with alkyl halides

(ii) Oxidation to sulphoxide and sulphone

(iii) Addition to halogens.

UNIT – 9 Petroleum:

----- [3]

9.1 Origin of petroleum.

9.2 Constituents and refining of Petroleum.

9.3 Cracking.

9.4 Hydroforming.

9.5 Knocking.

9.6 Octane number.

9.7 Cetane number

Reference Books :

- 1) Organic Chemistry : Hendrickson, Cram, Hammond.
- 2) Organic Chemistry : Morrison and Boyd.
- 3) Organic Chemistry : Volume I & II. I. L. Finar.
- 4) Organic Chemistry : Pine
- 5) Advanced Organic Chemistry : Sachin Kumar Ghosh.
- 6) Advanced Organic Chemistry : B. S. Bahl & Arun Bahl.
- 7) A Guide book to Mechanism in Organic Chemistry : Peter Sykes.
- 8) Stereochemistry of Organic Compounds : Kalsi.
- 9) Stereochemistry of Carbon Compounds : Eliel.
- 10) Text Book of Organic Chemistry : P. L. Soni.
- 11) Practical Organic Chemistry : By A. I. Vogel.
- 12) Advanced Organic Chemistry - Reactions, Mechanism & Structure : Jerry March.
- 13) Organic Chemistry : M. R. Jain.

- 14) Organic Chemistry : J. M. Shaigel.
- 15) Organic Chemistry : Vol-I, II, and III by S.M. Mukharji, S.P. Singh, R.P. Kapoor (New Age International Pvt. Ltd. Publishers)
- 16) Organic Chemistry : By Bhupinder Mehta, Manju Mehta
(Prentice-Hall of India Pvt. Ltd., New Delhi 110001)

PAPER – II

Section – II (Inorganic Chemistry)

UNIT – 1 s – block elements : ----- [6]

- 1.1 General electronic configuration.
- 1.2 Comparative study of group 1(IA) & group 2(IIA) with respect to (i) Family relationship, (ii) Chemical properties, (iii) Hydroxides and (iv) Halides.
- 1.3 Diagonal relationship between – (i) Li – Mg, (ii) Be – Al

UNIT – 2 p – block elements : ----- [10]

- 2.1 General electronic configuration
- 2.2 Comparative study of group 13, 14, 15, 16, 17 (IIIA, IVA, VA, VIA & VIIA) elements with respect to atomic & ionic radii, oxidation states, ionisation potential, electronegativity and reactivity.
- 2.3 Study of compounds like oxides and halides of carbon and silicon w.r.t. preparation and properties of CO, CO₂, CCl₄, SiO₂, SiCl₄.

UNIT –3 Chemistry of Noble Gases ----- [5]

- 3.1 Electronic configuration
- 3.2 Physical and chemical properties
- 3.3 Clathrate compounds
- 3.4 Structure and bonding of XeF₂, XeF₄ and XeF₆ (according to V.B.T.)

UNIT – 4 Environmental Chemistry : ----- [4]

- 4.1 Introduction :
- Meaning of terms – Environment, Pollution, Pollutant, Threshold Limit Value (TLV), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD).

4.2 Types of pollution (only brief introduction) : Air pollution, water pollution, sound pollution, soil pollution, automobile pollution and nuclear pollution.

4.3 Air Pollution : Classification of air pollutants, oxides of carbon, sulphur and nitrogen as air pollutants w.r.t. source and health hazards.

Reference Books :

- 1) Basic Inorganic Chemistry – F. A. Cotton, G. Wilkinson and P. L. Gaus Wiley.
- 2) Concise Inorganic Chemistry – J. D. Lee. ELBS 4th Edn.
- 3) Concepts and Models of Inorganic Chemistry – B. Dauglas, D. McDaniel and J.Alexander. John Wiley.
- 4) Inorganic Chemistry – D. E. Shriver, P. W. Atkins and C. H. Langford. Oxford.
- 5) Inorganic Chemistry – W.W. Porter field. Addison–Wesley.
- 6) Inorganic Chemistry – A. G. Sharpe. ELBS.
- 7) Inorganic Chemistry – G. L. Miessler and D. A. Tarr. Prentice Hall.
- 8) Inorganic Chemistry – G. S. Manku. Tata Mc Graw Hill.
- 9) Advanced Inorganic Chemistry – Satyaprakash, Tuli, Basu. (S.Chand & Co.)
- 10) Inorganic Chemistry – Puri and Sharma. (S.Chand & Co.)
- 11) Environmental Pollution Analysis – S. M. Khopkar. (Willey Estern Ltd.)
- 12) Environmental Chemistry – A. K. De. (Willey Estern Ltd.)
- 13) Text Book of Environmental Chemistry – O. D. Tyagi and M. Mehra.
- 14) Air Pollutin : Origin and Control – Wark and Werner.
- 15) Progressive Inorganic Chemistry - Thatte and Pandit.
- 16) Basic concepts of Analytical Chemistry – S. M. Khopkar.
- 17) University General Chemistry – CNR Rao. (McMillan)
- 18) Text book of Inorganic Chemistry – P.L.Soni

Laboratory Course (Practicals)

- N.B.:** (i) Use of analytical or chainometric or. Digital balance with 1mg sensitivity is allowed.
(ii) Use S.I. units wherever necessary.

Physical Chemistry

1. Determination of viscosity of given liquids A and B. (Density data of liquids, viscosity of water to be given) [Any two liquids from: Acetone, CCl_4 , Chloroform, Ethyl alcohol. Benzyl alcohol, Ethylene glycol and n-propyl alcohol.]
2. Determination of equivalent weight of Mg by Eudiometer.
3. Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl.
4. Study of reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI (Equal concentrations).
5. Determination of heat of ionization of weak acid by using polythene bottle.
6. Preparation and standardization of HCl and H_2SO_4 solutions from bulk.

References:

- 1) Practical book of Physical Chemistry: Nadkarni, Kothari & Lawande.
- 2) Experimental Physical Chemistry: A. Findlay.
- 3) Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar. (Anjali Publ.)
- 4) Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata Mc Graw Hill)
- 5) Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)
- 6) Practical Physical Chemistry: B. D. Khosala. (R. Chand & Sons)
- 7) Experiments in Chemistry: D. V. Jagirdar.
- 8) A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.) (ELBS)

Organic Chemistry

1) Estimations :

1.1 Estimation of aniline.

1.2 Estimation of acetamide.

2) Organic Qualitative analysis :

Identification of at least **Six** organic compounds with reactions including **one** from acids, **one** from phenols, **one** from bases and **three** from neutrals from the list of compounds given below :

2.1 Acids : Oxalic acid, Benzoic acid and Cinnamic acid.

2.2 Phenols : β -Naphthol, Resorcinol.

2.3 Bases : Aniline, p-Toluidine.

2.4 Neutrals : Acetone, Ethyl acetate, Glucose, Chloroform, Chlorobenzene, m-Dinitrobenzene, Thiourea.

Note : A systematic study of an organic compound involves the following operations which should be taught in details with reactions in the detection of elements and functional group.

- 1) Preliminary tests and Physical examination.
- 2) Physical constant.
- 3) Detection of Elements.
- 4) Detection of Functional group.
- 5) A Search into the literature.
- 6) Special Test.
- 7) Summary.
- 8) Result.

Reference Books :

- 1) Vogel's Text Book of Quantitative Chemical Analysis. (Longmann) ELBS Edition.
- 2) Vogel's Text Book of Qualitative Chemical Analysis. (Longmann) ELBS Edition.
- 3) Hand book of Organic Qualitative Analysis : Clarke.
- 4) Comprehensive Practical Organic Chemistry – Qualitative Analysis by V. K. Ahluwalia, Sunita Dhingra. University Press. Distributor – Orient Longman Ltd.

- 5) Comprehensive Practical Organic Chemistry preparation and Quantitative Analysis : V. K. Ahluwalia, Renu Aggarwal. University Press. Distributor – Orient Longman Ltd.
- 6) A Laboratory Hand - Book of Organic Qualitative Analysis and Separation : V. S. Kulkarni. Dastane Ramchandra & Co. Pune.

Inorganic Chemistry

A) Inorganic Quantitative Analysis :

1) Determination of amount of acetic acid in commercial vinegar using NaOH..

2) Water analysis :

To determine alkalinity of water sample by using phenolphthalein and methyl orange indicator. Standard HCl solution to be supplied.

3) Volumetric Analysis :

3.1 To prepare a standard solution of Oxalic acid and determine the strength of Potassium permanganate solution in terms of normality and Kg/dm³.

3.2 To prepare standard solution of Potassium dichromate and determine strength of Ferrous Ammonium Sulphate solution in terms of normality and Kg/dm³. (Use internal indicator)

B) Qualitative Analysis :

1) Spot Tests :

Detection of following cations using spot tests : Cu²⁺, Co²⁺, Ni²⁺, Fe³⁺, Zn²⁺, Mg²⁺, Al³⁺, Pb²⁺, Mn²⁺ and Hg²⁺.

2) Chromatography :

Separation and identification of cations by Paper Chromatographic technique from the following mixtures :

a) Ni²⁺ Cu²⁺

b) Ni²⁺ Co²⁺

c) Cu²⁺ Co²⁺

Reference Books:

1) Vogel's Text Book of Quantitative Chemical Analysis
(Longman ELBS Edition).

2) Vogel's Text Book of Qualitative Chemical Analysis
(Longman ELBS Edition)

3) Basic Concepts in Analytical Chemistry (Wiley Eastern Ltd.) : S. M. Khopkar.