

# Shivaji University

## Kolhapur



**Accredited By NAAC with 'A++' Grade**

Revised Syllabus for Bachelor of Science

Part-II

Chemistry

(As per NEP-2020)

To be implemented from

June, 2023 onwards

### Structure of B. Sc. II Chemistry

<b>Sr. No.</b>	<b>Semester</b>	<b>Title of Paper</b>
1	<b>III</b>	DSC-3C Paper-V (Physical Chemistry) (2 credit: 30 Hours, 37 Lectures)
2		DSC-4C Paper -VI (Analytical Chemistry) (2 credit: 30 Hours, 38 Lectures)
4	<b>IV</b>	DSC-3D Paper -VII (Inorganic Chemistry) (2 credit: 30 Hours, 37 Lectures)
5		DSC-4D Paper -VIII (Organic Chemistry) (2 credit: 30 Hours, 38 Lectures)

**B.Sc. Part II (NEP) Semester- III**

**DSC-3C: Paper V (PHYSICAL CHEMISTRY)**

**(Credits: 02, 30 hours, 37 Lectures)**

<b>Name of the Topics</b>	<b>Expected Learning Outcome</b>
1. Electrolytic Conductivity	Learning and coherent understanding of conductivity and transport number of the aqueous solutions with different applications. Experimental determination of transport number and numerical problems
2. Thermodynamics	Knowledge and coherent understanding of basic concepts in thermodynamics and concept of Entropy will be gained by the student.
3. Chemical Kinetics	Learning and understanding the knowledge about basic concepts in kinetics and third order reaction with characteristics, suitable examples, and methods for determination of order of reactions and numerical problems.
4. States of Matter	Learning and coherent understanding of behavior of gases, ideal gas as model system and its extension to real gases. The dependence of physical state on P, V and T. Liquid crystals are essentials in all common and research devices, hence they are introduced with suitable examples.
5. Surface Chemistry	Learning and understanding of theoretical basis of adsorption phenomenon, dynamic nature of surface and its applications.

## **Unit 1: Electrolytic Conductivity**

**(6 hours)**

1.1 Introduction, Migration of ions.

1.2 Hittorf's rule, Transference number, determination of transport number using Hittorf's method and moving boundary method, factors affecting transport number: nature of electrolyte, concentration, temperature, complex formation and degree of hydration.

1.3 Kohlrausch law of independent migration of ions and its applications such as relations between ionic conductance, ionic mobility and transport number, determination of equivalent conductance at infinite dilution of weak electrolytes, determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts.

1.4 Conductometric titrations (only acid -base titrations with mixture of strong and weak acid). Advantages of conductometric titrations.

1.5 Numerical problems.

## **Unit 2: Thermodynamics**

**(6 hours)**

2.1 Introduction, Concept of Entropy: Definition, mathematical expression, unit.

2.2 Physical significance of Entropy.

2.3 Entropy changes for reversible and irreversible processes in isolated systems.

2.4 Entropy changes for an ideal gas as a function of V & T and as function of P & T.

2.5 Entropy change in mixing of gases.

2.6 Entropy change in phase transformations.

2.7 Third law of thermodynamics, standard entropy, application of third law of thermodynamics in determination of absolute entropy, Entropy changes in chemical reactions

2.8 Numerical problems.

### **Unit 3: Chemical kinetics**

**(4 hours)**

3.1 Introduction.

3.2 Third order reactions: derivation of rate constant considering reaction with Equal initial concentration, characteristics, and examples of third order reaction.

3.3 Determination of order of reaction by: i) Integration method, ii) Graphical method and iii) Half-life method.

3.4 Effect of temperature on rate of reaction, Arrhenius equation. Concept of energy of activation.

3.5 Numerical problems.

### **Unit 4: States of Matter**

**(8 hours)**

4.1 Introduction, States of matter and their properties.

A) Gaseous state:

4.2 Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

4.3 Ideal and Non ideal gases, Deviation of real gases from ideal behavior, compressibility factor, causes of deviation.

4.4 Van der Waals equation of state for real gases. Explanation of real gas behavior by Van der Waal's equation, Boyle temperature (derivation not required).

4.5 Critical Phenomena: PV-isotherms of real gases (Andrew's isotherms), Continuity of state, Critical constants and their calculation from Vander Waals equation.

B) Liquid state:

4.6 Liquid crystals: Difference between liquid crystal, solid and liquid.

4.7 Classification, structure of nematic, smectic and cholestric liquid crystal.

4.8 Thermography and seven segment cell.

4.9 Numerical Problems.

### **Unit 5: Surface Chemistry**

**(6 hours)**

5.1 Introduction, Adsorption as a surface phenomenon, Definition of adsorption, adsorbent, adsorbate. Characteristics of adsorption.

5.2 Factors affecting adsorption, Types of adsorption, Distinction between physical and chemical adsorption,

5.3 Adsorption isotherms: Freundlich adsorption isotherm, Langmuir adsorption isotherm. BET equation.

5.4 Applications of adsorption.

### **Reference Books:**

- 1) Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- 2) Castellan G.W. Physical Chemistry 4 th Ed. Narosa (2004).
- 3) Kotz, J.C. Treichel, P.M.& Townsend, J.R. General Chemistry, Cengage Learning India Pvt Ltd: New Delhi (2009).
- 4) Mahan ,B.H. University Chemistry, 3rd Ed. Narosa (1998).
- 5) Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
- 6) Elements of Physical Chemistry, S., Glasstone, D. Lewis.(2010)
- 7) Principles of physical Chemistry, Marron and Prutton. (2007).
- 8) Elements of Physical Chemistry, P.W. Atkins (2017-18)
- 9) Essentials of Physical Chemistry, Bahl and Tuli. S. Chand, 2010.
- 10) Physical Chemistry, Danials and Alberty ( 2016)
- 11) University General Chemistry C.N.R.Rao (2016)
- 12) Principals of Physical Chemistry Puri, Sharma and Pathania 47ThEdison, Vishal Publishing Co. Daryaganj Delhi. 110002 (2017-18)
- 13) Physical Chemistry A.J.Mee.(2015)
- 14) Advanced Physical Chemistry Gurudeep Raj (2017-18)
- 15) Physical Chemistry R.A.Aleberty. (2017-18)
- 16) Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

## B.Sc. II Semester III

### DSC 4C- Chemistry Paper VI (Analytical Chemistry)

(Theory- Credits: 02, 30 hours, 38 Lectures)

Name of the Topics	Expected Learning Outcome
1. Gravimetric Analysis	Learning and understanding of basic concepts in gravimetric analysis
2. Water Analysis	Students will learn the different water analysis techniques
3. Corrosion and electroplating	Learning and understanding the knowledge about basic concepts in corrosion and electroplating, mechanism of corrosion, principle of electroplating
4. Chromatographic techniques	Learning and coherent understanding of column and ion exchange chromatography
5. Petroleum industry, biofuels and IPR	Learning of working of petroleum industries, understanding of biofuels, copyrights and trademarks

#### Unit I Gravimetric Analysis

[6 hours]

Introduction, Gravimetric analysis by precipitation: nucleation, crystal growth, digestion/ageing, filtration, drying, ignition, weighing, optimum condition for good precipitation, Physical nature of precipitate, Purity of precipitate: co-precipitation, post-precipitation Organic precipitates and their applications.

#### Unit II Water Analysis

[4 hours]

Physical analysis of water: pH, Conductance, Color, Odor, Turbidity and taste, Chemical Analysis Total dissolved solids, Hardness and its determination, Salinity, Alkalinity, Acidity Sulphates, Nitrates, Dissolved oxygen, Chemical oxygen demand, Biological oxygen demand.

### **Unit III Corrosion and electroplating**

**[6 hours]**

A) Corrosion -Introduction of corrosion, Electrochemical theory of corrosion, Factors affecting on corrosion -i. Position of metals in the electrochemical series on the basis of standard reduction potential ii. Purity of metal iii. Effect of moisture iv. Effect of oxygen (differential aeration principle) v. Hydrogen overvoltage, Methods of protections of metals from corrosion alloy formation, making metal cathodic, controlling external condition. Coating-galvanising, Tinning, electroplating, metal cladding, organic coating,

**B) Electroplating:** Electrolysis, Faraday's laws, Cathode current Efficiency, Basic principles of electroplating, cleaning of articles, Electroplating of chromium, Anodising

### **Unit IV. Chromatographic techniques**

**[7 hours]**

Introduction, classification. Column chromatography: Introduction, types, Principle of adsorption column chromatography, solvent system, stationary phases, Methodology-Column packing, applications of sample, development, detection methods, recovery of components, Applications. Ion exchange chromatography: Introduction, Principle, Types and properties of ion exchangers, Methodology-Column packing, application of sample, elution, detection/analysis, Applications.

### **Unit V. Petroleum industry, biofuels and IPR**

**[7 hours]**

A] Petroleum industry Introduction, occurrence, composition of petroleum, resources, processing of petroleum, calorific value of fuel, cracking, octane rating (octane number), cetane number, flash point, petroleum refineries, applications of petrochemicals, synthetic petroleum, lubricating oils & additives.

B] Biofuels: Biodiesel, Bio-ethanol

C] IPR- Introduction to copyright and Trademark



### **Reference Books:**

- 1) Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal Publishing company Jalindhar
- 2) Essential of Physical Chemistry by Bahl B.S., Tuli G.D. and Bahl Arun, S.Chand and Company Ltd.New Delhi
- 3) Modern Analytical Chemistry By David Harvey, McGRAW-Hill International Edition, 2000
- 4) Industrial chemistry by B.K.Sharma, Goel Publishing Housing, 16th edition 2011
- 5) Advanced Inorganic Chemistry, Vol.No.1, by Gurudeep Raj, Krishna Prakashan Media Ltd, Goel Publication, Meerut
- 6) Analytical chemistry by B.K. Sharma, Krishna Prakashan Media Ltd, Meerut, edition 3rd 2011
- 7) Principles of electroplating and electroforming by Blum and Hogaboom
- 8) Chemical Process Industries by Shreve and Brink
- 9) Industrial Chemistry by Loutfy Madkor and Helen Njenga
- 10) Elementary Principles of Chemical Processes by Richard Felder and Ronald Rousseau, John Wiley and Sons

**B. Sc. Part II (CBCS) (NEP 2020) Sem IV**

**Paper No. DSC-D3- Chemistry paper No. VII (Inorganic Chemistry)**  
**(Theory Credits: 02, 30 hours, 37 Lectures)**

Expected learning Outcomes:

<b>Name of the topic</b>	<b>Expected Learning Outcome</b>
1. Co-ordination Chemistry	Learning and understanding basic concepts about coordination complexes.
2. Chelation	Gain knowledge about applications of chelates in Analytical chemistry.
3. Chemistry of elements of 3d series elements	Student will be capable of understanding the properties of 3d series elements.
4. Chemistry of 4f elements (Lanthanides).	Understanding the properties of 4f elements.
5. Inorganic Semi - micro Qualitative Analysis	Student will learn the basic knowledge about the qualitative analysis of inorganic compounds.

**Unit 1: Co-ordination Chemistry**

**(8 hours)**

1.1 Introduction-Definition and formation of co-ordinate covalent bond in  $\text{BF}_3\text{-NH}_3$ ,  $[\text{NH}_4]^+$  and  $\text{H}_2\text{O}$

1.2 Terminology- Description of the terms- ligand, co-ordination number, co-ordination sphere

1.3 Effective atomic number rule.

1.4 Distinguish between double salt and complex salt.

1.5 Werner's theory

1.5.1 Postulates.

1.5.2 The theory as applied to cobalt amines viz.  $\text{CoCl}_3 \cdot 6\text{NH}_3$ ,  $\text{CoCl}_3 \cdot 5\text{NH}_3$ ,  $\text{CoCl}_3 \cdot 4\text{NH}_3$ ,  $\text{CoCl}_3 \cdot 3\text{NH}_3$

1.6 IUPAC nomenclature of coordination compounds.

1.7 Isomerism in complexes with C.N. 4 and 6

1.7.1 Geometrical Isomerism,

1.7.2 Optical Isomerism

1.7.3 Structural Isomerism-Ionization Isomerism, Hydrate Isomerism, Coordination Isomerism, Linkage Isomerism and Co-ordination position Isomerism

1.8 Valence bond theory of transition metal complexes with respect to, C.N. = 4, complexes of Cu and Ni, C.N. = 6 complexes of Fe and Co

## **Unit 2: Chelation**

**(4 hours)**

2.1 A brief introduction with respect to ligands, chelating agent, chelation and metal chelates.

2.2 Structural requirements of chelate formation

2.3 Difference between metal chelate and metal complex

2.4 Classification of chelating agents (with specific illustration of bidentate chelating agents)

2.5 Application of chelation with respect to chelating agents - EDTA and DMG

## **Unit 3: Chemistry of Elements of 3d Series Elements**

**(6 hours)**

3.1 Position of elements in periodic table

3.2 Characteristics of d-block elements with special reference to

i) Electronic structure

ii) Oxidation states, stability of oxidation states of Fe with respect to Latimer diagram

iii) Magnetic character

- iv) Colored ions
- v) Complex formation.

#### **Unit-4. Chemistry of 4f Elements (Lanthanides)**

**(5 hours)**

- 4.1 Position of lanthanides in periodic table
- 4.2 Occurrence
- 4.3 Characteristics of 4f elements with special reference to
  - 4.3.1 Electronic configuration
  - 4.3.2 Oxidation states
  - 4.3.3 Magnetic properties
  - 4.3.4 Lanthanide contraction
- 4.4 Separation of lanthanides by ion exchange method.

#### **Unit-5. Inorganic Semi-micro Qualitative Analysis**

**(7 hours)**

- 5.1 Theoretical principles involved in qualitative analysis.
- 5.2 Applications of solubility product and common ion effect in separation of cations into groups.
- 5.3 Applications 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  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ .
  - e) Detection of  $\text{NO}_2^-$ ,  $\text{NO}_3^-$  (Brown ring test).
- 5.4 Application of oxidation and reduction in
  - a) Separation of  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$  in mixture
  - b) Separation of  $\text{NO}_2^-$  and  $\text{NO}_3^-$  in mixture.
- 5.5 Spot test analysis.

**Reference Books:**

1. Inorganic chemistry, Principles of structure and reactivity by J.E. Huheey and etal
2. Inorganic Chemistry by Shriver and Atkins 5<sup>th</sup> edition
3. Vogels text book of Qualitative Inorganic analysis by A. I. Vogel .3rd and 6th edition
4. Advanced Inorganic Chemistry by Agrawal Keemtilal (Pragati Prakashan)
5. Theoretical Inorganic chemistry by C.Day & J.Selbin IInd edition
6. Principles of inorganic chemistry by Puri Sharma & Kalia
7. Modern Inorganic chemistry by R.D.Madan (S.Chand)
8. Inorganic Chemistry by J.D.Lee
9. Basic Inorganic Chemistry by F.A.Cotton,G.Wilkilson & B.L.Gaus wiley
10. Chemistry for Degree students by R.L.Madan (S.Chand Publication
11. Concise Coordination Chemistry by Ramlingam, Ramgopalan

**B. Sc. Part II Sem IV, NEP-2020**

**Paper No. DSC- D4 - Chemistry Paper No. VIII (Organic Chemistry)**

**(Theory Credits: 02, 30 hours, 38 Lectures)**

Expected Learning Outcomes:

<b>Name of the topic</b>	<b>Expected Learning Outcomes</b>
1. Carboxylic acids and their derivatives.	To impart knowledge about the synthesis, reactivity and applications of carboxylic acids.
2. Amines and Diazonium Salts	Knowledge about classification, preparation and applications of amines and diazonium salts.
3. Carbohydrates	Understanding the classification, configuration and structure of carbohydrates.
4. Carbonyl Compounds - Aldehydes and Ketones	Student will be capable of understanding the nomenclature and reactivity of aldehydes and ketones.
5. Stereochemistry	Student will learn the basic knowledge of conformational analysis of some organic compounds.

**Unit 1: Carboxylic Acids and Their Derivatives.**

**[6 hours]**

1.1 Monocarboxylic acid: Introduction, Methods of Formation from Alcohols, Aldehydes, Ketones, Nitriles and Alkyl benzenes.

1.2 Halo acids: a) Synthesis of halo acids-Mono, Di, Tri- chloro acetic acid by HVZ reaction b) Reactions - Substitution reaction of Monochloro acetic acid by Nucleophile OH<sup>-</sup>, I<sup>-</sup>, CN<sup>-</sup> and NH<sub>3</sub>

1.3 Hydroxy acids: Citric acid

a) Methods of formation of Citric acid from glycerol.

b) Chemical Reactions: Reaction of citric acid: acetylation by acetic anhydride,

reduction by HI, action of heat.

#### 1.4 Di carboxylic acids:

a) Introduction

b) Method of formation of succinic acid from ethylene dibromide, maleic acid

c) Chemical Reactions: Action of heat, Action of  $\text{NaHCO}_3$ ,  $\text{C}_2\text{H}_5\text{OH}$  in presence of acid.

d) Method of formation Phthalic acid from o-xylene and Naphthalene

e) Chemical Reactions of Phthalic acid : Action of heat, reaction with sodalime, ammonia.

#### 1.5 Carboxylic acid derivatives:

a) Introduction

b) Acid halide derivative: Acetyl chloride: i) Synthesis from acid, by action with  $\text{PCl}_3$  and  $\text{SOCl}_2$ .

ii) Reaction with water, alcohol ( Mechanism of esterification is expected) and ammonia.

c) Acid anhydride derivative:

i) Synthesis of acetic anhydride by dehydration of acetic acid.

ii) Reactions with water, alcohol and ammonia.

### **Unit 2: Amines and Diazonium Salts:**

**[5 hours]**

#### 2.1 Amines

i) Introduction, Classification and Nomenclature

ii) Methods of preparation:

a) From alkyl halide by amination

b) By reduction of nitriles or cyanides

c) From unsubstituted amides (Hoffmann degradation),

d) By Gabriel synthesis ( From Phthalamide).

iii) Reactions: Carbylamine reaction, Schotten-Baumann reaction, Electrophilic

substitution (Aniline) - Nitration, Bromination, Sulphonation.

## 2.2 Diazonium salt:

i) Introduction

ii) Preparation of Benzene diazonium chloride.

iii) Reactions of Benzene diazonium chloride.

a) Replacement reaction -Sandmeyer's reaction.

b) Coupling reactions: Synthesis of Congo red.

## **Unit 3: Carbohydrates**

**[6 hours]**

3.1 Introduction.

3.2 Classification of carbohydrates, reducing and non-reducing sugars.

3.3 Physical properties of glucose and fructose.

3.4 Killiani's synthesis of Glucose from D- Arabinose.

3.5 Determination of structure of D- Glucose.

a) Open chain structure of D- Glucose.

b) Configuration of D- Glucose from D- Arabinose.

c) Ring structure of D- Glucose.

d) Size of ring in D- Glucose by methylation Method.

e) Haworth projection for D- Glucose.

3.6 Cyclic structure of Fructose

3.7 Structures of Disachharides

a) Linkage between Monosachharides

b) Open chain and Haworth cyclic structures of Sucrose, Lactose and Maltose.

3.8 Structures of Polysachharides: a) Starch b) Cellulose

## **Unit 4: Carbonyl Compounds- Aldehydes and Ketones**

**[6 hours]**

4.1 Introduction, Nomenclature of aliphatic and aromatic aldehydes and ketones.

4.2 Structure and reactivity of Carbonyl group.



#### 4.3 Reactions of Carbonyl Compounds- Mechanism and applications of -----

- i) Aldol condensation, ii) Claisen and Benzoin Condensation, iii) Perkins reaction, iv) Cannizaros reaction, v) Knoevenagel condensation and vi) Reformatsky reaction.

### **Unit 5: Stereochemistry**

**[7 hours]**

5.1 Conformational isomerism – Introduction.

5.2 Representation of conformations of ethane by using Saw- Horse, Fischer (dotted line wedge) and Newmann's projection formulae.

5.3 Conformations and conformational analysis of ethane and n-butane by Newmann's Projection formula with the help of energy profile diagrams.

5.4 Relative stability cycloalkanes - Baeyer's strain theory and Theory of strainless rings.

5.5 Conformations and stability of cyclohexane

5.6 Conformation and stability of methyl cyclohexane.

5.7 Locking of conformation in t-butyl cyclohexane.

#### **Reference Books:**

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Stereochemistry conformation & Mechanism, 9th Edition, By P.S.Kalasi, Publisher: New Age International, 2017
3. Stereochemistry of carbon compounds by Eliel..
4. Stereochemistry of Organic Compounds by D. Nasipuri.
5. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd.

7. Organic Chemistry. Volume I, II, III by S.M. Mukharjee, S.P. Singh and R.P. Kapoor. Wiley Eastern Limited (New Age International)
8. Advanced Organic Chemistry by, B.S. Bahl, ArunBahl. S.Chand& Company, Ltd.
9. Chemistry by R. L. Madan, S. Chand and Company Ltd.

**B.Sc. II Practical Paper Course**  
**(Credit: 04, 8 hours per week)**

**A] Physical chemistry:**

- 1) To study the hydrolysis of methyl acetate in presence of HCl and H<sub>2</sub>SO<sub>4</sub> and to determine the relative strength of acids.
- 2) To study the effect of acid strength on hydrolysis of an ester by using 0.5M HCl and 0.25M HCl.
- 3) To study the reaction rate of hydrolysis of an ethyl acetate by an alkali.
- 4) To study the reaction between potassium persulphate and Potassium iodide in Solution with unequal concentration of the reactants.
- 5) To determine the degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically.
- 6) To determine the normality of the given strong acid by titrating it against the strong alkali conduct metrically.
- 7) To determine the normality of the given weak acid by titrating it against the strong alkali conductometrically.
- 8) To determine the percentage composition of a given liquid mixture by viscosity method (Density data to be given).
- 9) To determine the specific and molar refractions of benzene, toluene and xylene by Abbe's refractometer and to determine the refraction of CH<sub>2</sub> Group (Methylene group) (Densities should be determined by students).
- 10) To determine the specific rotation and unknown concentration of sugar solution.

11) Determination of adsorption coefficient of acetic acid-charcoal system.

## **B) Inorganic Chemistry**

1) Gravimetric Analysis (Any two)

- i) Gravimetric estimation of iron as  $\text{Fe}_2\text{O}_3$  from a solution containing Ferrous ammonium sulphate and free sulphuric acid.
- ii) Gravimetric estimation of barium as  $\text{BaSO}_4$  from a solution containing barium chloride and free hydrochloric acid.
- iii) Gravimetric estimation of nickel as  $\text{Ni}(\text{DMG})_2$  from a solution containing  $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$  and free sulphuric acid.
- iv) Gravimetric estimation of aluminium as Aluminium oxinate from a solution containing aluminium sulphate or potash alum and free sulphuric acid.

2) Inorganic Preparations (Any Two)

- i) Preparations of sodium cuprous thiosulphate
- ii) Preparation of tris (ethylene diamine) nickel (II) thiosulphate
- iii) Preparation of hexammine nickel (II) chloride
- iv) Preparation of tetrammine copper (II) sulphate.

3) 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 :

$\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{CO}_3^{2-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{S}^{2-}$ , (insoluble  $\text{CO}_3^{2-}$  may be given)

ii) Following cations are to be given :

$\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$

$\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Cr}^{3+}$ .

$\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Ba}^{2+}$ .

$\text{Mg}^{2+}$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$

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

#### 4) Titrimetric Analysis (Any Four):

- 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) Analysis of Synthetic /Commercial Sample: To estimate Magnesium from talcum powder.
- iii) Determination of alkali content from antacid tablet using HCl solution .
- iv) Estimation of Calcium from chalk: To estimate amount of calcium from the chalk by titrimetric method. (By redox titration using  $\text{KMnO}_4$  solution )
- v) Determination of total hardness of water using 0.01M EDTA solution. (Students should standardize the given EDTA solution by preparing 0.01M  $\text{CaCl}_2$  solution. using  $\text{CaCO}_3$  salt.)

#### C) Organic Chemistry:

1) Organic Qualitative Analysis : Identification of at least Eight Organic compounds with reactions including two from acids, two from phenols, two from bases and two from neutrals.

Acids – Succinic acid, Phthalic acid, alicyclic 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, Ethyl methyl ketone.

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

2) Organic Quantitative Analysis:

1) Estimations (Any Three)

i) Estimation of acetone.

- ii) Estimation of vitamin C.
- iii) Estimation of Phenol by Bromination method
- iv) Estimation of formaldehyde by sodium sulphite method
- v) Estimation of ester.

## II) Organic preparations

- i) p-nitro acetanilide from acetanilide.
- ii) Acetanilide from aniline using anhydrous  $ZnCl_2$  and Zn dust.
- iii) Phthalimide from phthalic anhydride.
- iv) Benzoic acid from benzamide.

3) Demonstration of Thin layer chromatography. Separation, identification and determination of  $R_f$  values

### Reference Books :

- 1) Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson 2009.
- 2) Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co: New Delhi (2011).
- 3) Findlay' Practical Physiccal Chemistry (Longmann)2015.
- 4) Practical Physical Chemistry :Gurtu (S Chand) 2014.
- 5) Systematic Experimental Physical Chemistry :Rajbhoj, Chandekar(Anjali Publication) 2016.
- 6) Advanced Practical Physical Chemistry: J.B. Yadav (Goel Publishing House) 2015.
- 7) Vogel's text book of Qualitative Inorganic analysis by A. I. Vogel .3rd and 6th edition
- 8) Vogel's text book of Quantitative Inorganic Chemistry by A. I. Vogel.
- 9) Physical Chemistry of Inorganic qualitative analysis by Kuricose & Rajaram.
- 10) Practical manual in water Analysis by Goyal & Trivedi
- 11) Practical Organic Chemistry by A.I. Vogel.
- 12) Hand book of Organic qualitative analysis by H.T. Clarke.
- 13) A Laboratory Hand Book of Organic qualitative analysis and separation by V.S. Kulkarni. Dastane Ramchandra& Co.

14) Practical Organic Chemistry by F.G. Mann and B.C. Saunders. Low – priced Text Book. ELBS. Longman

15) Advanced Practical Organic Chemistry by N.K. Vishnoi. Vikas Publishing House Private Limited.

16) Advanced practical chemistry by J. Singh, L. D. S. Yadav, R. K. P. Singh, I. R. Siddiqui et.al, Pragati prakashan.

**Shivaji University, Kolhapur**  
**B.Sc. II Chemistry Revised Syllabus (NEP-2020)**  
**from June 2023 onwards**  
**Semester III & IV Nature of Question paper**  
**Total Marks 40**

**Q.1 Choose the correct alternative and rewrite the sentence again. 08 Marks**

- i)
- ii)
- iii)
- iv)
- v)
- vi)
- vii)
- viii)

**Q.2. Attempt any TWO of the following (Out of Three)**

**16 Marks**

- a)
- b)
- c)

**Q.3. Answer any FOUR of the following (Out of SIX)**

**16 Marks**

- a)
- b)
- c)
- d)
- e)
- f)

**Shivaji University, Kolhapur**  
**B.Sc. II Chemistry Revised Syllabus (NEP-2020)**

**From June 2023 onwards**

**Total Marks 100**

**Nature of Practical Examination**

Q. 1 Physical Section Experiment	25 Marks
Q. 2 Organic Section Experiment	30 Marks
Q. 3 Inorganic Section Experiment	35 Marks
Q. 4 Journal	10 Marks