As per NEP 2020

S. Z. S. P. Mandal's

Shri Pancham Khemraj Mahavidyalaya,

Sawantwadi-416510

(Autonomous)

Affiliated to University of Mumbai

Title of the Programme Science

B.Sc. (Chemistry)

1. F.Y.B.Sc. 2023-2024
2. S.Y.B.Sc. 2024-2025
3. T.Y.B.Sc. 2025-2026

Syllabus for

Semester - III
and
Semester - IV

Reference: GR dated **16th May 2023** for **Credit structure**

Sr. No.	Headings	Particulars
1	Title of the Program	**Science- Chemistry**
2	Eligibility	H.S.C. with Science Stream
3	Duration of the Programme	1- Certificate 2- Diploma 3- Advance Diploma 4- Research Degree
4	Scheme of Examination	60 External : 40 Internal Separate passing in External and Internal examination
5	Standard of Passing	40.00%
6	Programme Academic Level	4.5 Certificate 5.0 Diploma 5.5 Advance Diploma 6.0 Research Degree
7	Pattern	Semester Pattern
8	Status	New
9	To Be Implemented from the academic year	4.5 Certificate **2023-2024** 5.0 Diploma **2024-2025** 5.5 Advance Diploma **2025-2026** 6.0 Research Degree **2026-2027**

Preamble

1. Introduction

Shri Pancham Khemraj Mahavidyalaya (S.P.K.M.), Sawantwadi (Autonomous) believes in implementing several measures to bringequity, efficiency and excellence in higher education systemin conformity to the guidelines laid down by the University Grants Commission (UGC). In order to achieve these goals, all efforts are made to ensure high standards of education by implementing several steps to enhance the teaching- learning process, examination and evaluation techniques and ensuring the all-round development oflearners.

The four-year course in B.Sc. Chemistry has been designed to have a progressive and innovative curriculum in order to equip our learners to face the future challenges in the field of highereducation. In semesters I and II learners are introduced to the basic areas of Chemistry such as Thermodynamics, Periodic table, Chemical Kinetics, Reaction and Mechanism.

In semesters III and IV the course content is made more rigorous by introducing the details ofeach of the above area. In semesters V and VI, course are designed to help in specialization in the core areas of Chemistry such as Molecular spectroscopy, Nuclear Chemistry, Chemical thermodynamics, Chemical kinetics, Molecular Symmetry and Chemical Bonding, Solid state Chemistry, Electrochemistry polymers, Quantum chemistry with Renewable energy resources Chemistry of inner transition elements, Theories of the metal-ligand bond, Organometallic chemistry, Mechanism of organic reactions , Stereochemistry, Synthesis of organic compounds, Quality in Analytical Chemistry, Chemical Calculations, Optical Methods, Electro analytical techniques and Applied components dyes and drugs. The practical course has been designed to helpthe student havea firm grip on the theoretical concepts through relevant experiments in each course.

2. Objectives:

- To help learners in developing a scientific attitude through the Chemistry curriculum that involves basic and core areas of Chemistry along with the recent scientific and technologicaladvancements in applied areas of Chemistry
- To enhance knowledge of Chemistry through problem solving, tutorials and seminars
- To develop practical skills in Chemistry using a range of an activities such as projectsinexperimental Chemistry, study tours, industrial and research institutes visit.
- To inculcate a research attitude by involving learners in simple research projects review ofresearch articles/papers, participation in scientific events etc.
- To help learners in developing analytical abilities and skills so as to address real worldproblems
- To help learners to plan a progressive and successful career in Chemistry, education and industry

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA SAWANTWADI

DIST: SINDHUDURG- 416 510, MAHARASHTRA

Syllabus for Approval

Programme:- S. Y. B. Sc. Major Chemistry

w.e.f. Academic Year 2024-25

Choice Based Credit System S.Y.B.Sc. Chemistry Syllabus

University of Mumbai

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA

SAWANTWADI

(An Autonomous College)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

DEPARTMENT OF CHEMISTRY

Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	S. Y. B. Sc.
2.	Eligibility for Admission	F. Y. B. Sc. Passed/ A.T. K. T.
3.	Passing Marks	
4.	Ordinance/Regulations (if any)	
5.	No. of Years/Semesters	Two Semesters
6	Level	UG
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic Year	From Academic Year 2024-2025

Date:

Signature
HoD,
Dept. of Chemistry

Shri Pancham Khemraj Mahavidyalaya, Sawantwadi

Proposed First Year Curriculum as per NEP 2020

Department of Chemistry

Proposed Structure for Major / Minor/OE/VSE/SEC/VEC/IKS/VEC

Semester	Paper Code	Paper Title	Type	Credits
I (Level 5.0)	**S201 CHT (Major)**	Physical Chemistry -I	**Theory**	**2**
	S202 CHT (Major)	Organic Chemistry -I	**Theory**	**2**
	S203 CHT (Major)	Inorganic Chemistry -I	**Theory**	**2**
	S204 CHP (Major)	Practical's of Chemistry	**Practical**	**2**
	S205 CHT (Minor)	Fundamental Chemistry-I	**Theory**	**2**
	S206 CHT (Minor)	Fundamental Chemistry - II	**Theory**	**2**
	CHOE 04 (GE/OE)	Air Pollution : Case Studies	**Generic Ele**	**2**
	CHVS 02 (VSC)	Experimental Chemistry-III	**Voc. Skill**	**2**
	CHVE 01 (VEC)	Environmental Impacts of Volatile Oxides	**Value**	**2**
II (Level 5.0)	**S207 CHT (Major)**	Physical Chemistry -I	**Theory**	**2**
	S208 CHT (Major)	Organic Chemistry -I	**Theory**	**2**
	S209 CHT (Major)	Inorganic Chemistry -I	**Theory**	**2**
	S210 CHP (Major)	Practical's of Chemistry	**Practical**	**2**
	S211 CHT (Minor)	Fundamental Chemistry-I	**Theory**	**2**
	S212 CHT (Minor)	Fundamental Chemistry - II	**Theory**	**2**
	CHOE 05 (GE/OE)	Water Pollution : Case Studies	**Generic Ele**	**2**
	CHVS 04 (VSC)	Experimental Chemistry-IV	**Voc. Skill**	**2**
	CHVE 02 (VEC)	Green Chemistry	**Value**	**2**

UNIVERSITY OF MUMBAI

Essentials Elements of The Syllabus

1	**Title of Course**	Syllabus for two semester S. Y. B. Sc. course in chemistry
2	**Course Code**	S201CHT,S202CHT,S203CHT,S204CHP, S207CHT,S208CHT,S209CHT, S210CHP
3	**Preamble**	Attached
4	**Objective**	• To infuse in the learner a spirit of inquiry into the fundamental aspects of the various core areas of Chemistry. • To make the learner proficient in analyzing the various observations and chemical phenomena presented to him during the course. • To make the learner capable of solving problems in the various units of this course • To give the learner an opportunity to get hands on experience of the various concepts and processes in the various branches of chemistry • To impart various skills of handling chemicals, reagents, apparatus, instruments and the care and safety aspects involved in such handling • To make the learner capable of analysing and interpreting results of the experiments he conducts or performs
5	**Eligibility**	Pass F. Y. B. Sc.
6	**Fee Structure**	As Per Guidelines issued from the University
7	**No. of Lectures**	6 lectures per week (two lectures per paper)

8	**No. of Practicals**	4 periods per week
9	**Duration of Course**	Two Semester
10	**Notional Hours**	90 hours per paper per semester Theory and 60 hours per semester for laboratory sessions
11	**No of students per batch**	120 students per division (20 Students for laboratory sessions)
12	**Selection**	As per merit.
13	**Assessment**	End of semester examination of 60 marks per paper for theory, 40 marks Internal evaluation and 50 marks for laboratory sessions
14	**Syllabus Detail**	Attached
15	**Title of the Unit**	As given in the Syllabus text
16	**Title of the Sub-**	As given in the syllabus text.
17	**Semester wise**	As prescribed in the syllabus text
18	**Semester wise**	As prescribed in the syllabus text.
19	**Question Paper**	As prescribed by the Faculty of Science
20	**Scheme of evaluation of**	N.A.
21	**List of suggested**	--
22	**List of websites**	--
23	**List of You Tube**	--
24	**List of MOOCs**	--

REGULATIONS

1. Preamble and objectives of the Course:

In the first two semesters of the six semester graduation program of B. Sc.(Chemistry) the learner was introduced to some basic aspects in the various core branches of chemistry like Physical Chemistry, Organic chemistry and Inorganic chemistry. Concepts about the structure of atom, distribution of electrons, Thermodynamics, Formation of organic compounds and basic ideas in reactivity of molecules in general and organic compounds in particular were introduced to the learner. He was made inquisitive about why and how should atoms combine to give molecules or ions. The non-orbital approach to appreciating the shapes of polyatomic species in general and molecules in particular. The story of chemistry is taken further in the coming two semesters of the second year of the B. Sc. (Chemistry) Program. However it is also realised that some students opting for the course on Chemistry may not continue with the subject subsequently as such the syllabus is designed to retain the interest of the serious learner of chemistry as well as be helpful to non-chemistry learners. With such students who would want to pursue other branches of science but would want to acquire a basic appreciation and experience of chemistry a separate paper (Paper-III) is designed. This paper along with the laboratory session unit that goes with it deals with the basics of chemical analysis, separating components from a given sample, basic concepts like pH, experimental techniques like Titrimetry, Gravimetry, using instruments to carry out analysis, the various techniques like chromatography, electrophoresis, Instrumentation in general is felt to be of interest to learners of various branches like physics, botany, zoology, and microbiology.

The major objectives of B.Sc. Chemistry course are

- To infuse in the learner a spirit of inquiry into the fundamental aspects of the various core areas of Chemistry.
- To make the learner proficient in analysing the various observations and chemical phenomena presented to him during the course.
- To make the learner capable of solving problems in the various units of this course
- To give the learner an opportunity to get hands on experience of the various concepts and processes in the various branches of chemistry.
- To impart various skills of handling chemicals, reagents, apparatus, instruments and the care and safety aspects involved in such handling.
- To make the learner capable of analyzing and interpreting results of the experiments he conducts or performs.
- To make the learner capable of acquiring or pursuing a source of livelihood like jobs in chemical industry.
- To arouse the interest to pursue higher levels of learning in chemistry,

2. Condition for Admission

A candidate who has passed the F. Y. B. Sc. of Mumbai University or an examination of some other university accepted by the syndicate as equivalent there to with Chemistry, Physics, Maths, Botany, Zoology or Life Science shall be eligible for admission into S. Y. B. Sc., course in Chemistry.

3. Duration of the Course: one year

4. Course of study:

Draft copy of the proposed revised syllabus for Choice Based Credit System S. Y. B. Sc. - Chemistry To be implemented from the Academic year 2024-2025

For the subject of chemistry there shall be three papers for 30 lectures each comprising of three units of 10 L each.

Semester-III

1. Paper-I Physical Chemistry
2. Paper-II Organic Chemistry
3. Paper III Inorganic Chemistry

Semester-IV

1. Paper-I Physical Chemistry
2. Paper-II Organic Chemistry
3. Paper III Inorganic Chemistry

Choice Based Credit System
S. Y. B. Sc. Chemistry Syllabus
To be implemented from the Academic year 2024-2025
Course Content

Semester - III

Course Code	Unit	Topics	Credits	L/Week
S201 CHT (Physical Chemistry)	I	Chemical Thermodynamics-II, Electrochemistry	2	2
	II	Chemical Kinetics-II, Solutions, Polymer Chemistry-I		
	III	Titrimetric Methods		
S202 CHT (Organic Chemistry)	I	Reactions and reactivity of halogenated hydrocarbons, alcohols, phenols and epoxides	2	2
	II	Carbonyl Compounds		
	III	Spectrometry		
S203 CHT (Inorganic Chemistry)	I	Chemical Bonding	2	2
	II	Selected topics on p-block elements		
	III	Gravimetric Analysis		
S204 CHP	Chemistry Practicals		2	8

Semester - IV

Course Code	Unit	Topics	Credits	L/Week
S207 CHT (Physical Chemistry)	I	Electrochemistry-II, Phase Equilibria	2	2
	II	Solid state, Catalysis		
	III	Separation Techniques in Analytical Chemistry		
S208 CHT (Organic Chemistry)	I	Carboxylic Acids and their Derivatives	2	2
	II	Amines, Diazonium salts, Heterocyclic compounds		
	III	Instrumental Methods-II		
S209 CHT (Inorganic Chemistry)	I	Comparative Chemistry of the transition metals & Coordination Chemistry	2	2
	II	Ions in aqueous medium		
	III	Statistical Treatment of Analytical Data—II		
S210 CHP	Chemistry Practicals		2	8

Semester - III

Paper I: Physical Chemistry [S201 CHT]

Credit: 02 **Theory: 30 Lectures**

Unit-I : Chemical Thermodynamics-II(5L)

1.1.1 Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy, Variation of Gibb's free energy with Pressure and Temperature.

1.1.2 Gibbs-Helmholtz equation, van't Hoff reaction isotherm and van't Hoff reaction isochore.
(Numericals expected).

1.1.3 Thermodynamics of Open System: Partial Molal Properties, Chemical Potential and its variation with Pressure and Temperature, Gibb's Duhem equation.

Electrochemistry: (5L)

1.2.1 Electrolytes: Definition, Strong and Weak electrolytes and their conductance measurement, ions and electrical conductivity by ions.

1.2..2 Kohlrausch law of independent migration of ions.

1.2.3 Applications of conductance measurements: determination of degree of ionization and ionization constant of weak electrolyte, solubility and solubility product of sparingly soluble salts, ionic product of water. (Numerical expected).

1.2.4 Transference number and its experimental determination using Moving boundary method. (Numericals expected).Factors affecting transference number.

Unit II:

2.1 Chemical Kinetics-II (3L)

2.1.1 Introduction to reaction mechanism (concept of elementary steps, intermediates, and the overall reaction mechanism with an example of Thermal chain reactions: H_2. and Br_2. reaction.

2.1.2 Types of Complex Chemical reactions: Reversible or opposing, consecutive and parallel reactions
(No derivations, only examples expected),

2.2 Solutions: (4 L)

2.2.1 Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law–non-ideal solutions. Vapour pressure-composition and temperature -composition curves of ideal and non-ideal solutions.

2.2.2 Partial miscibility of liquids: Definition, Effect of Temperature, effect of impurity and intermolecular interactions on partial miscibility, Critical solution temperature; Phenol-Water, Triethanolamine – Water

2.3 Polymer Chemistry – I (3L)

2.3.1 Basic Terms: Macromolecule, monomer, repeat unit, Polymerisation, (addition and condensation polymerization) Degree of Polymerisation

2.3.2 Polymer structures linear, branched and cross-linked

2.3.3 Molecular weight of Polymers: Definition and formulae of Number average molecular weight, weight average molecular weight Z- average molecular weight, and viscosity average molecular weight.
(numerical expected)

Unit III :

3.1. Titrimetric Methods [05 L]

3.1.1. Terms involved in Titrimetric methods of analysis. Comparing volumetry and Titrimetry

3.1.2. The Conditions suitable for titrimetry

3.1.3. Types of titrimetry

i) Neutralisation (Acidimetry, alkalimetry) ii) Redox (Iodometry, Iodimetry,)

iii) Precipitation

iv) Complexometric titrations

3.1.4. Tools of Titrimetry: Graduated glassware and Calibration

3.2. Standard solutions [02L]

3.2.1 Primary and Secondary standards in Titrimetry

2.1.2 Calculations based on preparation of primary and secondary standards

3.3 Neutralization Titration [03 L]

3.3.1 Concept of pH and its importance in Neutralization Titrations

3.2.2 Endpoint and Equivalence point of Neutralization titrations

3.3.3 Determination of End point by using Indicators causing colour change

3.3.4 Selection of indicators – Ostwald's theory of indicators

Paper II**: Organic Chemistry [S202 CHT]**

Credit: 02 **Theory: 30 Lectures**

Unit I:

1.1. Reactions and reactivity of halogenated hydrocarbons: [**10L]**

1.1.1. Alkyl halides: Nucleophilic substitution reactions: SN^1, SN^2 and SN^i mechanisms with Stereo chemical aspects and factors affecting nucleophilic substitution reactions, nature of substrate, Solvent, nucleophilic reagent and leaving group.

1.1.2. Aryl halides: Reactivity of aryl halides towards nucleophilic substitution reactions. Nucleophilic aromatic substitution (SNAr) addition-elimination mechanism and benzyne mechanism.

1.1.3. Organomagnesium and organolithium compounds:

Nomenclature, nature, type and reactivity of carbon-metal bond. Preparation using alkyl / aryl halide. Structure, stability and reactions with compounds containing acidic hydrogen, carbonyl compounds, CO_2, cyanides and epoxides.

Unit II: Carbonyl Compounds: [10L]

2.1 Structure, reactivity of aldehydes and ketones and methods of preparation; hydration of alkynes, Rosenmund reduction and Gattermann – Koch formylation

2.2 General mechanism of nucleophilic addition, and acid-catalysed nucleophilic addition reactions.

2.3 Reactions of aldehydes and ketones with $NaHSO_3$, HCN, RMgX, alcohol, amine, phenyl hydrazine, 2, 4-Dinitrophenyl hydrazine, $LiAlH_4$ and $NaBH_4$.

2.4 Mechanisms of following reactions: Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt and Cannizzaro reaction.

Unit III: Spectrometry [10 L]

3.1 Interaction of electromagnetic radiation with matter: Absorption and Emission spectroscopy

3.2 Basic Terms: Radiant Power, Absorbance, Transmittance, Monochromatic light, Polychromatic light, Wavelength of maximum absorbance, Absorptivity and Molar Absorptivity

3.3 Statement and derivation of Beer's Law and Lambert's Law, Combined Mathematical Expression of Beer Lambert's Law,

3.4 Validity and Deviations from Beer-Lambert's Law *(Numerical problems based on Beer-Lambert's Law)*

3.5 Block Diagrams for Single beam and double beam Colorimeter (Principle, Construction and Working (Details of Components expected, i.e. source, Sample holder, Filter, Detectors)

3.6 Block Diagrams for double beam Spectrophotometer (Principle, Construction and working (Details of Components expected i.e., source, Sample holder, Monochromator, Detectors)

Semester - III: Paper-II: Inorganic Chemistry

Credit: 02 Theory: 30 Lectures

Unit-I: Chemical Bonding (10L)

1.1 Non-Directional Bonding (2L)

2.1.1 Types of Ionic Crystals

2.1.3 Radius Ratio Rules

2.1.4 Born-Haber Cycle and its Application

1.2. Directional Bonding: Orbital Approach.(4L)

2.2.1 Covalent Bonding,

2.2.2 Interaction between two hydrogen atoms and the Potential energy diagram of the resultant system.

2.2.3 Definition, concept of Homonuclear diatomic molecules only for He_2 & Ne_2 molecules.

2.2.4 Resonance and the Concept of Formal Charge; Rules for Resonance or Canonical Structures.

2.2.5 Bonding in Polyatomic Species: The Role of Hybridization. And types of hybrid orbitals- sp^3, sp^3d, sp^2d^2 and sp^2d sp^3d^2.

1.3 Molecular Orbital Theory (4L)

2.3.1. Comparing Atomic Orbitals and Molecular Orbitals.

2.3.2. Linear combination of atomic orbitals to give molecular orbitals LCAO-MO approach for diatomic homonuclear molecules).

2.3.3 Molecular orbital Theory and Bond Order and magnetic property: with reference to O_2, O_2^+ , O_2^-, O_2^{2-}(Problems and numerical problems expected wherever possible)

Unit-II: Selected topics on p-block elements (10L)

2.1 Chemistry of Boron Compounds

2.1.1 Electron deficient compounds–BH_3,BF_3,BCl_3 with respect to Lewis acidity and applications.

2.1.2 Preparation of simple boranes like diborane and tetraborane.

2.1.3 Structure and bonding in diborane and tetraborane

2.1.4 Synthesis of Borax.

Unit-III: Gravimetric analysis [05L]

3.1 Introduction and Principle of Gravimetric analysis

3.3 Precipitation Gravimetry:

i) Steps involved in precipitation gravimetric analysis

ii) Factors affecting precipitation

iii) Concept of Nucleation (Homogenous and Heterogeneous) and crystal growth

iv) Impurities involved in precipitates

a)Simultaneous precipitation b) Post precipitation c) Co-precipitation

3.4 Digestion and its importance

3.5 Filtration, Washing, Drying and Ignition of Precipitate.

3.6 Applications of Gravimetric Analysis:

Estimation of Nickel in Cu-Ni alloy using dimethyl glyoxime

3.7 Results of Analysis [05 L]

3.7.1. Errors in Analysis and their types

i) Determinate Errors

ii) Indeterminate Errors

3.7.2 Methods of minimizing Determinate errors in analysis

i) Calibration of apparatus

ii) Carrying out Control determination

iii) Carrying out Blank determination

3.7.3 Concept of Precision and Accuracy in Analysis and evaluation involved in the study of Precision and accuracy

i) Mean, Median, Mode, Absolute deviation, Average deviation, Relative average deviation, standard deviation, variance and coefficient of variation

ii) Absolute error and Relative error

[Numerical problems on precision and accuracy expected]

Semester - IV

Paper I: Physical Chemistry [S207 CHT]

Credit: 02 **Theory: 30 Lectures**

Unit I:

1.1Electrochemistry-II: (5 L)

1.1.1 Electrochemical cells, Nernst equation and its importance in generating electricity through chemical reactions. Types of electrochemical cells - Reversible and irreversible cells (Definition, example, characteristics)

1.1.2 Types of electrodes, Standard electrode potential, Electrochemical series.

1.1.3 Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data.

1.1.4 Equilibrium constant and pH measurement using Hydrogen electrode and quinhydrone electrode, from EMF data.

1.2 Phase Equilibria: (5L)

1.2.1 Introduction to Phase equilibria, Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule.

1.2.2 Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. 1.2.3 Phase diagrams of one-component systems (water and sulphur).

1.2.4 Two-component systems involving eutectics – Condensed Phase rule, Definition of eutectic Phase diagram of Lead-Silver system.

Unit-II

Solid State: (5L)

2.1.1 laws of Crystallography and Types of Crystals

2.1.2 Characteristics of simple cubic, face-centered cubic and body-centered cubic systems, interplanar distance in a cubic lattice (only expression for ratio of interplanar distances are expected)

2.1.3 Use of X-rays in the study of crystal structure, Bragg's equation (derivation expected), X-rays diffraction method of studying crystal lattice structure, structure of NaCl and KCl.

Catalysis: (5 L)

2.2.1 Types of catalysis, catalytic activity, specificity and selectivity, inhibitors, catalyst poisoning and deactivation, enzyme catalyst

2.2.2 Mechanisms and kinetics of acid-base catalyzed reactions, effect of pH.

2.2.3 Nanoparticles as catalyst – basic concepts, their importance in chemical reactions, properties. Challenges associated with nanoparticles as catalyst.

Unit III: Methods of Separation[10L]

Objectives

The learner is expected to understand

- The importance of separation in sample treatment
- Various methods of separations
- How to select a method of separation of an analyte from the matrix
- How a solute gets distributed between two immiscible phases

- Principle of solvent extraction and various terms involved therein
- Effect of various parameters on solvent extraction of a solute
- Classification of Chromatographic methods
- Paper and thin layer chromatography and using them in practice.

Separation Techniques in Analytical Chemistry

3.1. An Introduction to Analytical Separations and its importance in analysis.

3.2. Estimation of an analyte without affecting separation.

3.3. Types of separation methods

3.3.1. Based on Solubilities (Precipitation, Filtration Crystallisation)

3.3.2. Based on Gravity-Centrifugation

3.3.3. Based on volatility-Distillation;

3.3.4. Based on Electrical effects-Electrophoresis

3.3.5. Based on retention capacity of a Stationary Phase -Chromatography;

3.3.6. Based on distribution in two immiscible phases-Solvent Extraction;

3.3.7. Based on capacity to exchange with a resin-Ion Exchange;

3.4. Study of types of separation methods

3.4.1 **Electrophoresis:**

Principles, Basic Instrumentation, Working and Application in separation of biomolecules like enzymes and DNA.

References:

1. D.A. Skoog, D.M. West, F.J. Holler and CX.R. Crouch – Fundamentals of Analytical Chemistry, 8th edition.
2. G. H. Morrison and H. Freiser, Solvent extraction in analytical chemistry
3. P.G. Swell and B. Clarke, Chromatographic separations, Analytical chemistry by open Learning, John Wiley and sons, 1987.
4. Modern Analytical Chemistry, David Harvey (page numbers 596-606) 5. Modern Analytical Chemistry, David Harvey (page numbers 215-217).

Paper II: Organic Chemistry [S208 CHT]

Credit: 02 **Theory: 30 Lectures**

Unit I:

1.1 Carboxylic Acids and their Derivatives: **(10L)**

1.1.1. Nomenclature, structure and physical properties, acidity of carboxylic acids, effects of substituents on acid strength of aliphatic and aromatic carboxylic acids.

1.1.2. Preparation of carboxylic acids: oxidation of alcohols and alkyl benzene, carbonation of Grignard and hydrolysis of nitriles.

1.1.3. Reactions: Acidity, salt formation, decarboxylation, Reduction of carboxylic acids with $LiAlH_4$, diborane, Hell-Volhard-Zelinsky reaction, Conversion of carboxylic acid to acid chlorides, esters, amides and acid anhydrides and their relative reactivity.

1.1.4. Mechanism of nucleophilic acyl substitution and acid-catalysed nucleophilic acyl substitution. Interconversion of acid derivatives by nucleophilic acyl substitution.

1.1.5. Mechanism of Claisen condensation and Dieckmann condensation

Unit II: 2.1: Nitrogen containing compounds (4L)

2.1.1 Amines:

Nomenclature, effect of substituent on basicity of aliphatic and aromatic amines Preparation: Reduction of aromatic nitro compounds using catalytic hydrogenation, chemical reduction using Fe-HCI, Sn-HCl, Zn-acetic acid, reduction of nitriles, ammonolysis of halides, reductive amination, Hoffmann bromamide reaction Reactions- Salt Formation, N-acylation, N-alkylation, Hofmann's exhaustive methylation (HEM), Hofmann-elimination reaction, reaction with nitrous acid, carbylamines reaction.

2.1.2 Diazonium Salts:

Preparation and their reactions/synthetic application - Sandmeyer reaction, Gattermann reaction, Gomberg reaction, Replacement of diazo group by -H,-OH.

2.2 Heterocyclic Compounds: (6L)

2.2.1. Classification, nomenclature of 5- and 6-membered rings containing one heteroatom

2.2.2. Synthesis of Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, and Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis)

2.2.4. Reactions of furan, pyrrole and thiophene: halogenation, nitration, sulphonation, Vilsmeier-Haack reaction, Friedel-Crafts reaction. Furan: Diels-Alder reaction, Ring opening. Pyrrole: Acidity and basicity of pyrrole. Comparison of basicity of pyrrole and pyrrolidine.

Unit–III-Instrumental Methods-II [10 L]

Objectives

On completing this unit, the learner is

- Expected to appreciate the nature of interaction between applied electrical potential and the concentration of the analyte.
- The nature of chemical reactions that influence potential of a given cell.
- Familiar with the various types of electrodes or half cells.

- Appreciate the nature, need and importance of pH
- Expected to know the applications of the various instrumental methods dealt with in this unit.

3. Instruments based on the electrochemical properties of the analytes

3.1. Potentiometry:

3.1.1. Principle.
3.1.2. Role of Reference and indicator electrodes
3.1.3. Applications in Neutralization reactions with reference to the titration of Strong acid against Strong Base (using quinhydrone electrode)
3.1.4. Graphical methods for detection of endpoints
i) Graph of EMF against Volume of titrant added

3.2. pH metry:

3.2.1. Principle
3.2.2. Construction, working and maintenance of Combined Glass electrode
2.2.3. Application In Titrimetry (Strong acid-Strong Base)

3.3. Conductometry:

3.3.1. Principle
3.3.2. Conductivity cell: Construction
3.3.3. Applications in Neutralization Titrimetry with respect to
i. Strong Acid-Strong Base
ii. Weak Acid- Weak Base**.**
3.3.4. Advantages and limitations of conductometric titrations.

References:

1) Principles of Instrumental Analysis, D. A. Skoog, 3rd edition, Saunders College publishing. Chapters:20, 23Page Nos: 600 -605, 631, 704 - 711.
2) Vogel's Textbook of quantitative inorganic analysis, 4thedition, ELBS / Longman. Chapters: XIV, XV Page nos:566 - 601, 615– 625.
3) Instrumental method of analysis, B.K. Sharma, Goel publishing house. Miscellaneous methods: Chapters:1,3,4 Page Nos: 1-14, 21 - 57.

Paper III: Inorganic Chemistry [S 209 CHT]

Credit: 02 **Theory: 30 Lectures**

Unit-I:

1.1 Comparative Chemistry of the transition metals [6L]

1.1.1 Position in the periodic table

1.1.2 Significance of special stability of d^0, d^5 and d^{10} leading to variable oxidation states; Unusual oxidation states and their stabilities in aqueous solutions (with special reference to vanadium, and chromium.)

1.1.3 Origin of colour for transition metals and their compounds: such as reflectivity, surface coatings, particle size and nature of d-orbitals, number of electrons in the d-orbitals, geometry, and ability for charge transfer).

1.1.4 Magnetic properties of transition metal compounds: Origin of magnetism-spin and orbital motion of electrons; equation for spin only and spin-orbital magnetism in terms of Bohr magnetons (No derivation of relevant equations expected)

1.2 Co-ordination Chemistry: [6L]

1.2.1 Introduction to Chemistry of Coordination Compounds

i. Historical perspectives : Early ideas on coordination compounds

ii. Basic terms and nomenclature.

iii. Types of ligands

iv. Isomerism: General Types with special reference to stereoisomerism of coordination compounds (C.N=6)

v. Evidence for the formation of coordination compounds.

1.2.2 Theories of coordination compounds

Werner's Theory of coordination compounds

1.2.3 Nature of the Metal-Ligand Bond:

i. Valence Bond Theory; Hybridisation of the central metal orbitals-sp^3d^2/d^2sp^3

ii. Inner and outer orbital complexes

Unit-II: Ions in aqueous medium

2.1 Acidity of Cations and Basicity of Anions [8L]

i. Hydration of Cations; Hydrolysis of Cations predicting degree of hydrolysis of Cations-effect of Charge and Radius.

ii. Classification of cations on the basis of acidity category – Non-acidic, Moderately acidic, strongly acidic, very strongly acidic with pKa values range and examples

iii. Hydration of Anions; Effect of Charge and Radius; Hydration of anions-concept, diagram classification on the basis of basicity

Unit III: Statistical Treatment of Analytical Data—II [10L]

Objectives: On completing this unit the learner is expected to understand

i) The use of statistical methods in chemical analysis.

ii) Therandomnessofsucherrorsanditsdistributionaroundacorrectoracceptableresult

iii) Computation of Confidence limits and confidence interval

iv) Test for rejection of doubtful result
v) Method to draw best fitting straight line

3.1. Concept of Confidence limits and confidence interval and its computation using

(i) Population standard deviation
(ii) Student's
test (iii) Range

3.2. Criteria for rejection of doubtful result

(i) 2.5 d rule
(ii) 4.0 d rule
(iii) Q test

3.3. Test of Significance

(i) Null hypothesis
(ii) F-test (variance ratio test)

3.4. Graphical representation of data and obtaining best fitting straight line

(i) For line passing through origin
(ii) For line not passing through origin

Note: Numerical problems on 3.2 to 3.5 are expected

References:

1. Modern Analytical Chemistry, David Harvey (page numbers 53-84)
2. Fundamentals of analytical chemistry –Skoog and West

Semester III:
Chemistry Practicals:[S 204 CHP]

Credit: 02 **Theory: 60 Hr.**

Unit I: Physical Chemistry

1. To verify Ostwald's dilution law for weak acid conductometrically.
2. To determine dissociation constant of weak acid conductometrically.
3. Determination of energy of activation of acid-catalyzed hydrolysis of methyl acetate.
4. To investigate the reaction between $K_2S_2O_8$ and KI with equal initial concentrations of the reactants

Unit II: Inorganic Chemistry

1. Identification of cations in a given mixture and Analytically separating them [From a mixture containing not more than two of the following: Pb(II), Ba(II), Ca(II), Sr (II), Cu(II), Cd(II), Mg(II), Zn(II), Fe(II), Fe(III), Ni(II), Co(II) Al(III), Cr(III)] (Any 4
2. Investigation of the reaction between Copper sulphate and Sodium Hydroxide (Standard EDTA solution to be provided to the learner).

Unit III: Organic Chemistry

Short organic preparation and their purification: Use 0.5-1.0g of the organic compound. Purify the product by recrystallization. Report theoretical yield, percentage yield and melting point of the purified product.

Preparation of:

1. Cyclohexanone oxime from cyclohexanone.
2. Glucosazone from dextrose or fructose
3. Tribromoaniline from aniline.
4. β-Naphthylbenzoate
5. m-Dinitrobenzene from nitrobenzene
6. Phthalic anhydride from phthalic acid by sublimation
7. Acetanilide from aniline
8. p-Bromoacetanilide from acetanilide
9. Iodoform from acetone

(Any eight preparations)

Semester IV
Chemistry Practicals:[S 210 CHP]

Credit: 02 **Theory: 60 Hr.**

Unit I: Physical Chemistry

1. To determine standard EMF and the standard free energy change of Daniel cell potentiometrically.
2. To determine the amount of HCl in the given sample potentiometrically.
3. Compare the strengths of HCl and H_2SO_4 by studying kinetics of acid hydrolysis of methyl acetate.
4. Industrial visit report.

(Any Three)

Unit II: Inorganic Chemistry

1. Inorganic preparation – Nickel dimethyl glyoxime using microscale method.
2. Complex cation – *Tris* (ethylene diamine) nickel (II) thiosulphate.
3. Complex anion – Sodium Hexanitrocobaltate (III) The aim of this experiment is to understand the preparation of a soluble cation (sodium)and a large anion hexanitrocobaltate (III) and its use to precipitate a large cation (potassium)
4. Inorganic salt – Calcium or magnesium oxalate using PFHS technique

Unit III: Organic Chemistry

Qualitative Analysis of bi-functional organic compounds on the basis of

1. **Prelimenary examination**
2. **Solubility profile**
3. **Detection of elements C, H, (O), N, S, X.**
4. **Detection of functional groups**
5. **Determination of physical constants (M.P/B.P)**

Solid or liquid Compounds containing not more than two functional groups from among the following classes may be given for analysisto be given: Carboxylic acids, phenol, carbohydrates, aldehydes, ketones, ester, amides, nitro, anilides, amines, alkyl and aryl halides.

Students are expected to write balanced chemical reactions wherever necessary. (Minimum 8 compounds to be analyzed)

Reference Books for Practicals:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)
5. *Practical Inorganic Chemistry* by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)
6. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009) 2. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
7. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5 Ed., Pearson (2012)
8. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996

EXAMINATION PATTERN FOR MAJOR SUBJECTS

A) Continuous Internal Assessment (40 Marks):

Sr. No.	Particulars	Marks
1	One Assignment.	10
2	One offline class test.	20
3	Active participation in routine class/practical's.	05
4	Overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	05

B) Semester End Examination (60 Marks):

Question Paper Pattern

1. These examinations shall be of **Two Hours** duration. Maximum marks **60**.
2. There shall be four questions each of **15 marks**. **Question 1** will be based on entire syllabus with **Six MCQs**, **Six questions** on match the column and **Six questions** basedon true/false. **Questions 2** and **3** will be based on **Unit-I and Unit-II respectively**.**Questions 4** will be based on **Unit-I and II**.
3. All questions shall be compulsory with internal choice within the questions. (Each question will be of **18 to 20 marks** with options.)
4. Question may be subdivided into sub-questions A, B, C, D & E the allocation of marks depends on the weight age of the topic.

Distribution of external 60 marls

Qn.	Sub-Qn	Particulars	Unit	Marks with options	Total Marks for qn
1	**A**	Choose the Correct answer and rewrite the statement**. (Attempt any five out of seven)**	**I, II**	07	15
	B	Match the Columns**. (Attempt any five out of seven)**		07	
	C	State whether the statement is true or false. **(Attempt any five out of six)**		06	
2	**A,B,C,D , E**	Answer the following (Attempt **any three out of five**)	**I**	20	15
3	**A,B,C, D,E**	Answer the following (Attempt **any three out of five**)	**II**	20	15
4	**A,B,C,D ,E**	Answer the following (Attempt **any three out of five**)	**I& II**	20	15
		Total		**80**	**60**

C) Semester End Practical Examination (50 marks):
Scheme of examination:

- There will be no internal assessment for practical.
- A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department/Institute to the effect that the candidate has completedthe practical course of that semester of S.Y.B.Sc. Chemistry as per the minimum requirement
- The practical examination will be conducted in **ONE SESSIONS** of three hours each.
- The learners will be evaluated based on the experiments performed during the examination.
- The questions on slips for the same should be framed in such a way that candidate will be able tocomplete the task and should be evaluated for the skill and understanding of Chemistry.

Examination Pattern Distribution of Marks in Practical Examination

Sr. No.	**Particulars**	**Marks**
1	Experiment	30
	Viva voce	10
2	Certified journal	10
	Total Marks	**50**

Dean,
Faculty of Science and Technology

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA SAWANTWADI

DIST: SINDHUDURG- 416 510, MAHARASHTRA

Syllabus for Approval
Programme:- S. Y. B. Sc. Chemistry
(Minor Course)
SEMESTER-III

w.e.f. Academic Year 2024-25

Choice Based Credit System S.Y.B.Sc. Chemistry Syllabus

University of Mumbai

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA SAWANTWADI

(An Autonomous College)

DIST: SINDHUDURG- 416 510,
MAHARASHTRA

DEPARTMENT OF CHEMISTRY

Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	S. Y. B. Sc. CHEMISTRY (MINOR COURSE)
2.	Eligibility for Admission	F. Y. B. Sc
3.	Passing Marks	40%
4.	Ordinance/Regulations (if any)	
5.	No. of Years/Semesters	Two Semesters
6	Level	UG
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic Year	From Academic Year 2024-2025

Date:

Signature
HoD,
Dept. of Chemistry

PREAMBLE:

S. P. K. Mahavidyalaya, Sawantwadi (Autonomous) believes in implementing several measures to bringequity, efficiency and excellence in higher education system in conformity to the guidelines laid down by the University Grants Commission (UGC). In order to achieve these goals, all efforts are made to ensure high standards of education by implementing several steps to enhance the teaching- learning process, examination and evaluation techniques and ensuring the all-round development oflearners.

The four-year course in B.Sc. Chemistry has been designed to have a progressive and innovative curriculum in order to equip our learners to face the future challenges in the field of higher education. In semesters I and II learners are introduced to the basic areas of Chemistry such as Thermodynamics, Periodic table, Chemical Kinetics, Reaction and Mechanism.

In semesters III and IV the course content is made more rigorous by introducing the details of each of the above area. In semesters V and VI, course are designed to help in specialization in the core areas of Chemistry such as Molecular spectroscopy, Nuclear Chemistry, Chemical thermodynamics, Chemical kinetics, Molecular Symmetry and Chemical Bonding, Solid state Chemistry, Electrochemistry polymers, Quantum chemistry with Renewable energy resources Chemistry of inner transition elements, Theories of the metal-ligand bond, Organometallic chemistry, Mechanism of organic reactions , Stereochemistry, Synthesis of organic compounds, Quality in Analytical Chemistry, Chemical Calculations, Optical Methods, Electro analytical techniques and Applied components dyes and drugs. The practical course has been designed to helpthe student have a firm grip on the theoretical concepts through relevant experiments in each course.

OBJECTIVES:

- To help learners in developing a scientific attitude through the Chemistry curriculum that involves basic and core areas of Chemistry along with the recent scientific and technological advancements in applied areas of Chemistry
- To enhance knowledge of Chemistry through problem solving, tutorials and seminars
- To develop practical skills in Chemistry using a range of a activities such as projects in experimental Chemistry, study tours, industrial and research institutes visit.
- To inculcate a research attitude by involving learners in simple research projects reviewof research articles/papers, participation in scientific events etc.
- To help learners in developing analytical abilities and skills so as to address real world problems
- To help learners to plan a progressive and successful career in Chemistry, education and industry

Program Outcome: After successful completion of this programme learners will be able to

- Develop the knowledge of basic concepts of different branches of science required for postgraduate studies.
- Inculcate the skills useful in science laboratories for pursuing jobs in Industries.
- Introduce learners to the concepts useful for environment protection.
- Follow interdisciplinary approach for developing scientific temperament.
- Identify, formulate and analyze scientific problems and reach concrete solutions forsocietal benefits.

Program Specific Outcome: After successful completion of this programme (Chemistry)learners are able to

- Develop the knowledge of basic concepts in chemistry.
- Inculcate the skills useful in chemistry laboratory.
- Introduce learners to the green chemistry needs and concepts.
- Identify, formulate and analyze scientific problems and reach concrete solutions forsocietal benefits using various principles of chemical sciences.
- Acquire & explore essential skills to succeed in various chemical industries.
- Get a hold on higher educational opportunities like post-graduation in chemistry.
- Pursue higher studies in interdisciplinary areas such as biochemistry, genetics, pathology etc.
- Explore research areas in chemistry and related fields.

DEPARTMENT OF CHEMISTRY

Syllabus

Proposed Syllabus for CBCS

S. Y. B. Sc.: Minor Chemistry

Structure of the Course:

The structure of minor courses (with codes) for Semester -III and IV for S. Y. B. Sc. (Chemistry)NEP-2020 is given below

MINOR SUBJECTS

Semester	Course Code	Course title	No. of Credits	No of Lectures In Hours
III	**S205 CHT (Minor)**	Physical and Analytical Chemistry-III	**2**	30
	S206 CHT (Minor)	Inorganic and Organic Chemistry -III	**2**	30
IV	**S211 CHT (Minor)**	Physical and Analytical Chemistry-IV	**2**	30
	S212 CHT (Minor)	Inorganic and Organic Chemistry -IV	**2**	30

SEMESTER-III

Course Code	Unit	Topics	Credits	L/Week
S205 CHT (Physical & Analytical Chemistry)	I	Chemical Thermodynamics-II, Chemical Kinetics-II	2	2
	II	Classical Methods of Analysis		
S206 CHT (Organic & Inorganic Chemistry)	I	Alcohols, phenols and epoxides, Carbonyl Compounds	2	2
	II	Directional, Non-Directional Bonding, Chemistry of Silicon		

SEMESTER-IV

Course Code	Unit	Topics	Credits	L/Week
S211 CHT (Physical & Analytical Chemistry)	I	Solid State, Catalyst	2	2
	II	Instruments based on the electrochemical properties of the analytes		
S212 CHT (Organic & Inorganic Chemistry)	I	Sulphonic acids, Diazonium Salt, Heterocyclic Chemistry	2	2
	II	Chemistry of Transition Elements, Co-ordination Chemistry		

Semester- III
Paper I: Physical & Analytical Chemistry [S205 CHT]: Minor
Credit: 02 **Theory: 30 Lectures**

Unit I: Physical Chemistry

1.1 Chemical Thermodynamics-II (8L)

1.1.1 Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy, Variation of Gibb's free energy with Pressure and Temperature.

1.1.2 Gibbs-Helmholtz equation, van't Hoff reaction isotherm and van't Hoff reaction isochore. (Numericals expected).

1.1.3 Thermodynamics of Open System: Partial Molal Properties, Chemical Potential and its variation with Pressure and Temperature, Gibb's Duhem equation.

1.2 Chemical Kinetics-II (7L)

1.2.1 Introduction to reaction mechanism (concept of elementary steps, intermediates, and the overall reaction mechanism with an example of Thermal chain reactions: H_2. and Br_2. reaction.

1.2.2 Types of Complex Chemical reactions: Reversible or opposing, consecutive and parallel reactions
(No derivations, only examples expected),

2. Classical Methods of Analysis. [15 L] 2.1. Titrimetric Methods [04 L]

2.1.1. Terms involved in Titrimetric methods of analysis. Comparing volumetry and Titrimetry

2.1.2. The Conditions suitable for titrimetry

2.1.3. Types of titrimetry
- i) Neutralisation (Acidimetry, alkalimetry)
- ii) Redox (Iodometry, Iodimetry,)
- iii) Precipitation
- iv) Complexometric titrations

2.1.4. Tools of Titrimetry: Graduated glassware and Calibration

2.2. Standard solutions[02L]

2.1.1 Primary and Secondary standards in Titrimetry

2.1.2 Calculations based on preparation of primary and secondary standards

2.2 Neutralization Titration [03 L]

2.2.1 Concept of pH and its importance in Neutralization Titrations

2.2.2 Endpoint and Equivalence point of Neutralization titrations

2.2.3 Determination of End point by using Indicators causing colour change

2.2.4 Selection of indicators – Ostwald's theory of indicators

2.3 Gravimetric analysis [06L]

2.3.1 Introduction and Principle of Gravimetric Analysis

2.3.2 Types of Gravimetric Methods

i) Volatilisation Gravimetry ii) Precipitation Gravimetry

2.3.3 Precipitation Gravimetry:

i) Steps involved in precipitation gravimetric analysis

ii) Factors affecting precipitation

iii) Concept of Nucleation (Homogenous and Heterogeneous) and crystal growth

iv) Impurities involved in precipitates

i) Simultaneous precipitation

ii) Post precipitation

iii) Co-precipitation

2.3.4 Digestion and its importance

2.3.5 Filtration, Washing, Drying and Ignition of Precipitate.

2.3.6 Applications of Gravimetric Analysis:

i) Determination of sulfur from organic compounds;

ii) Estimation of Nickel in Cu-Ni alloy using dimethyl glyoxime

Semester III

Paper II: Organic & Inorganic Chemistry [S206 CHT]

Credit: 02 **Theory: 30 Lectures**

Unit I: Organic Chemistry

1. Alcohols, phenols and epoxides: [9 L]

1.1. Alcohols: Nomenclature, Preparation: Hydration of alkenes, hydrolysis of alkyl halides, reduction of aldehydes and ketones, using Grignard reagent. Properties: Hydrogen bonding, types and effect of hydrogen bonding on different properties. Acidity of alcohols, Reactions of alcohols

1.2.Phenols: Preparation, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols.

1.3 .Epoxides: Nomenclature, methods of preparation and reactions of epoxides: reactivity, ring-opening reactions by nucleophiles (a) In acidic conditions: hydrolysis, reaction with halogen halide, alcohol, hydrogen cyanide. (b) In neutral or basic conditions: ammonia, amines, Grignard reagents, alkoxides

2. Carbonyl Compounds: [6 L]

2.1 Nomenclature of aliphatic, alicyclic and aromatic carbonyl compounds. Structure, reactivity of aldehydes and ketones and methods of preparation; Oxidation of primary and secondary alcohols using PCC, hydration of alkynes, Rosenmund reduction and Gattermann – Koch formylation

2.2 Keto-enol tautomerism: Mechanism of acid and base catalyzed enolization

2.3 Active methylene compounds: Acetylacetone, ethyl acetoacetate diethyl malonate, stabilized enols. Alkylation of Acetylacetone and ethyl acetoacetate

Unit II: Inorganic Chemistry [10L]

2.1 Non-Directional Bonding

2.1.1 Ionic Bond: Conditions for the Formation of Ionic Bond. Types of Ionic Crystals

2.1.3 Radius Ratio Rules

2.2. Directional Bonding: Orbital Approach.

2.2.1 Covalent Bonding, The Valence Bond Theory- Introduction and basic tenet

2.1 Chemistry of Silicon

2.1.1 Silicon compounds: Occurrence, Structure and Inertness of SiO_2

2.1.2 Preparation of structure of $SiCl_4$

2.1.3 Preparation of extra-pure Silicon

Semester IV

Paper I: Physical & Analytical Chemistry [S211 CHT]: Minor

Credit: 02 **Theory: 30 Lectures**

Unit I: Physical Chemistry
Solid State: (7L)

1.1.1 Laws of Crystallography and Types of Crystals
1.1.2 Characteristics of simple cubic, face-centered cubic and body-centered cubic systems, interplanar distance in a cubic lattice (only expression for ratio of interplanar distances are expected)
1.1.3 Use of X-rays in the study of crystal structure, Bragg's equation (derivation expected), X-rays diffraction method of studying crystal lattice structure, structure of NaCl and KCl. Determination of Avogadro's number (Numericals expected)

Catalysis: (8 L)

1.2.1 Types of catalysis, catalytic activity, specificity and selectivity, inhibitors, catalyst poisoning and deactivation, enzyme catalyst
1.2.2 Mechanisms and kinetics of acid-base catalyzed reactions, effect of pH.
1.2.3 Nanoparticles as catalyst – basic concepts, their importance in chemical reactions, properties. Challenges associated with nanoparticles as catalyst.

2. Instruments based on the electrochemical properties of the analytes

2.1. Potentiometry: [05 L]

2.1.1. Principle.
2.1.2. Role of Reference and indicator electrodes
2.1.3. Applications in Neutralization reactions with reference to the titration of
Strong acid against
Strong Base (using quinhydrone electrode)
2.1.4. Graphical methods for detection of endpoints
i) Graph of EMF against Volume of titrant added ii)First derivative graph

2.2. pHmetry: [04 L]

2.2.1. Principle
2.2.2. Construction, working and maintenance of Combined Glass electrode
2.2.3. Applications In Titrimetry (Strong acid-Strong Base)

2.3. Conductometry: [06 L]

2.3.1. Principle
2.3.2. Conductivity cell: Construction
2.3.3. Applications in Neutralization Titrimetry with respect to
i. Strong Acid-Strong Base
ii. Weak Acid- Weak Base.
2.3.4. Advantages and limitations of conductometric titrations.

Paper II: Organic & Inorganic Chemistry [S212 CHT]

Credit: 02 **Theory: 30 Lectures**

Unit I: Organic Chemistry [15L]

1 Sulphonic acids: [5L]

Nomenclature, preparation of aromatic sulphonic acids by sulphonation of benzene (with mechanism), toluene and naphthalene, Reactions: Acidity of arene sulfonic acid, Comparative acidity of carboxylic acid and sulfonic acids. Salt formation, desulphonation. Reaction with alcohol, phosphorous pentachloride, IPSO substitution

2 Diazonium Salts :(6L)

Preparation and their reactions/synthetic application - Sandmeyer reaction, Gattermann reaction, Gomberg reaction, Replacement of diazo group by -H,-OH. Azo coupling with phenols, naphthols and aromatic amines, reduction of diazonium salt to aryl hydrazine and hydroazobenzene

3. Heterocyclic Compounds: (4L)

3.1. Classification, nomenclature of 5- and 6-membered rings containing one heteroatom

3.2. Pyridine: Basicity. Comparison of basicity of pyridine, pyrrole and piperidine. Sulphonation of pyridine (with and without catalyst), reduction and action of sodamide (Chichibabin reaction)

Unit II: Inorganic Chemistry [15L]

2.1 Comparative Chemistry of the transition metals

2.1.1 Position in the periodic table; Natural occurrence principal ores and minerals;

2.1.2 Significance of special stability of d^0, d^5 and d^{10} leading to variable oxidation states; Unusual oxidation states and their stabilities in aqueous solutions (with special reference to vanadium, and chromium.)

2.1.3 Origin of color for transition metals and their compounds: such as reflectivity, surface coatings, particle size, packing density for metals and nature of d-orbitals, number of electrons in the d-orbitals, geometry, and ability for charge transfer).

2.1.4 Magnetic properties of transition metal compounds: Origin of magnetism-spin and orbital motion of electrons; equation for spin only and spin-orbital magnetism in terms of Bohr magnetons (No derivation of relevant equations expected); Reasons for quenching of orbital moments.

2.2.1 Introduction to Chemistry of Coordination Compounds

i. Historical perspectives : Early ideas on coordination compounds ii. Basic terms and nomenclature.

iii. Types of ligands

2.2.2 Application of coordination compounds.

EXAMINATION PATTERN FOR MINOR SUBJECTS

A) Continuous Internal Assessment (40 Marks):

Sr. No.	Particulars	Marks
1	One Assignment.	10
2	One offline class test.	20
3	Active participation in routine class/practical's.	05
4	Overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	05

B) Semester End Examination (60 Marks):

Question Paper Pattern

1. These examinations shall be of **Two Hours** duration. Maximum marks **60**.
2. There shall be four questions each of **15 marks**. **Question 1** will be based on entire syllabuswith **Six MCQs**, **Six questions** on match the column and **Six questions** basedon true/false. **Questions 2** and **3** will be based on **Unit- I and Unit- II respectively**.**Questions 4** will be based on **Unit-I and II**.
3. All questions shall be compulsory with internal choice within the questions. (Each questionwill be of **18 to 20 marks** with options.)
4. Question may be subdivided into sub-questions A, B, C, D & E the allocation of marks depends on the weight age of the topic.

Distribution of external 60 marls

Qn.	Sub-Qn	Particulars	Unit	Marks with options	Total Marks for qn
1	**A**	Choose the Correct answer and rewrite the statement**. (Attempt any five out of seven)**	**I, II**	07	15
	B	Match the Columns**. (Attempt any five out of seven)**		07	
	C	State whether the statement is true or false. **(Attempt any five out of six)**		06	
2	**A,B,C,D , E**	Answer the following (Attempt **any three out of five**)	**I**	20	15
3	**A,B,C, D,E**	Answer the following (Attempt **any three out of five**)	**II**	20	15
4	**A,B,C,D ,E**	Answer the following (Attempt **any three out of five**)	**I& II**	20	15
		Total		**80**	**60**

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA SAWANTWADI (AUTONOMOUS)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

Syllabus for Approval

Programme:- S. Y. B. Sc. Chemistry

VOCATIONAL SKILL COURSE

w.e.f. Academic Year 2024-25

Choice Based Credit System S. Y. B. Sc. Chemistry Syllabus

University of Mumbai

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA

SAWANTWADI

(An Autonomous College)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

DEPARTMENT OF CHEMISTRY

Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	S. Y. B. Sc.
2.	Eligibility for Admission	F. Y. B. Sc.
3.	Passing Marks	40%
4.	Ordinance/Regulations (if any)	
5.	No. of Years/Semesters	Two Semesters
6	Level	UG
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic Year	From Academic Year 2024-2025

Date:

Signature
HoD,
Dept. of Chemistry

Shri Pancham Khemraj Mahavidyalaya, Sawantwadi

Proposed First Year Curriculum as per NEP 2020

Department of Chemistry

Syllabus Structure for Vocational Skill Course

Semester	Paper Code	Paper Title	Type	Credits
III	**VSCHE-02**	Experimental Chemistry - II	**T**	**2**
IV	**VSCHE-03**	Experimental Chemistry - III	**T**	**2**

SEMESTER-III

VALUE EDUCATION COURSE

Experimental Chemistry – II: VSCHE -02

(Credit 02)

Semester-III: Chemistry Practicals

1. Tools of Analytical Chemistry-I:

a) Analytical glass wares like burettes, pipettes, Standard flasks, Separating funnels.
b) Weighing tools such as two pan balance and mono pan balance, digital balances:
c) Incineration devices: Burners, Electrical Incinerators, Muffle Furnace,
d) Drying Devices: Hot Air Oven, microwave oven, Desiccators, Vacuum desiccators
e) Monochromators, Filters, Sample holders, Prisms, Diffraction Gratings, Photo-emissive cells, Photomultiplier tubes

(The learner should draw diagrams and write-ups providing uses, care and maintenance of the items mentioned in (a)and principle, construction and uses of items(b)to (e)in his journal.)

2. **Gravimetric estimation of Nickel (II) as Ni-DMG and calculation of % error.** (The learner is expected to know the role of the various reagents/chemicals used in the estimation, the various steps involved. They should write the complete and Balanced chemical reaction for the formation of the $Ni(DMG)_2$ complex.
3. **Estimation of Fe Volumetrically**
4. **To determine solubility of sparingly soluble salts (any two) conductometrically**.
5. **Gravimetric estimation of Zinc as $ZnSO_4$ and calculation of % error.**

(The learner is expected to write a balanced chemical reaction, need for digestion of the precipitate and the skill required to carry out the incineration and to estimate the% error.)

(The learner is expected to write a balanced chemical reaction, need for digestion of the precipitate and the skill required to carry out the incineration and to estimate the % error.)

SEMESTER-IV

VALUE EDUCATION COURSE

Experimental Chemistry – III: VSCHE -03

(Credit 02)

1. **Tools of Analytical Chemistry-II**
    a. Filtration Flasks, Funnels, Separating Funnels, Distillation apparatus, Vacuum Distillation assembly, Centrifuge machine, Electrophoresis apparatus.
    b. Development chamber for chromatography
    c. Electrodes like Reference Electrodes and Indicator Electrodes (with respect to care and maintenance.)
    d. Conductivity cell (with respect to care and maintenance.)
    e. Combined Glass electrode (with respect to care and maintenance.)
    f. Types of Salt Bridges and preparation of anyone or use of a salt bridge, its effect on the potential of a given electrode/cell

    (The learner should draw diagrams and write-ups providing uses of the items mentioned in (a and b) and Principle, Construction care and Uses of items (c) to (f) in his journal.)
2. **Paper chromatography:** Separation of cations like Fe (III), Ni (II) and Cu (II) in a sample.
3. **Estimation of Amide Volumetrically**
4. **Estimation of Fe (II) in the given solution by titrating against $K_2Cr_2O_7$ potentiometrically and calculation of % error.**

    (The learner is expected to learn the handling of the potentiometer, use of Platinum electrode and reference electrode like SCE. They will learn to determine endpoint by plotting a graph. They are also expected to state the error estimate of their results).
5. **Estimation of Acetone Iodometrically.**

Reference:

1. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction, 7^{th} ed., Chapter 15, pp. 345-381.
2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961).
3. R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y.(1974).
4. Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi.

Examination Pattern

A) Semester End Practical Examination (50 marks):

Scheme of examination:

- There will be no internal assessment for practical.
- A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of that semester of S.Y.B.Sc. Chemistry as per the minimumrequirement
- The practical examination will be conducted in **ONE SESSIONS** of three hours each.
- The learners will be evaluated based on the experiments performed during theexamination.
- The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for theskill and understanding of Chemistry.

Distribution of Marks in Practical Examination

Sr. No.	Particulars	Marks
1	Experiment	30
	Viva voce	10
2	Certified journal	10
	Total Marks	**50**

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA SAWANTWADI (AUTONOMOUS)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

Syllabus for Approval

Programme:- S. Y. B. Sc. Chemistry

VALUE EDUCATION COURSE

w.e.f. Academic Year 2024-25

Choice Based Credit System S. Y. B. Sc. Chemistry Syllabus

University of Mumbai

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA

SAWANTWADI

(An Autonomous College)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

DEPARTMENT OF CHEMISTRY

Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	S. Y. B. Sc.
2.	Eligibility for Admission	F. Y. B. Sc.
3.	Passing Marks	40%
4.	Ordinance/Regulations (if any)	
5.	No. of Years/Semesters	Two Semesters
6	Level	UG
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic Year	From Academic Year 2024-2025

Date:

Signature
HoD,
Dept. of Chemistry

Shri Pancham Khemraj Mahavidyalaya, Sawantwadi

Proposed First Year Curriculum as per NEP 2020

Department of Chemistry

Syllabus Structure for Value Education Course

Semester	Paper Code	Paper Title	Type	Credits
III	**VECHE-01**	Environmental Impacts of Volatile Oxides	**T**	**2**
IV	**VECHE-02**	Green Chemistry	**T**	**2**

Program Outcomes:

Students will demonstrate an understand major concepts of Environment in association with multidisciplinary subjects such as physics, chemistry and mathematics etc. Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevance in the day-to-day life. Effective Communication- Development of various communication skills such as reading, listening, speaking, etc., which we will help in expressing ideas and views clearly and effectively. Social Interaction- Development of scientific outlook not only with respect to science subjects but also in all aspects related to life. Effective Citizenship- Imbibe moral and social values in personal and social life leading to highly cultured and civilized personality. Ethics- Follow the ethical principles and responsibilities to serve the society. Environment and Sustainability- Understand the issues of environmental contexts and sustainable development. Self-directed and Lifelong learning- Students will be capable of self- paced and self-directed learning aimed at personal development and for improving knowledge/skill development.

COURSE OBJECTIVES:

- To study about environment and ecosystems
- To study about different types of natural resource.
- Knowledge and concept of biodiversity and its conservation.
- Basic knowledge and concept of causes, effect and control of different type of environmental pollution.
- To study population growth and its impact on environment

COURSE OUTCOMES (CO): After completion of the course, a student will be able to COURSE OUTCOME :

CO1 - Gain knowledge about environment and ecosystem.

CO2 - Students will learn about natural resource, its importance and environmental impacts of human activities on natural resource.

CO3-Gain knowledge about the conservation of biodiversity and its importance.

CO4 Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.

CO5- Students will learn about increase in population growth and its impact on environment

SEMESTER-III

VALUE EDUCATION COURSE

Environmental Impacts of Volatile Oxides : VECHE-01

(Credit 02) [30 L]

VECHE-01	Introduction Environmental Impact of - 1) Oxides of Carbon 2) Oxides of Nitrogen 3) Oxides of Sulphur 4) Oxides of Phosphorous
	References: 1) Environmental Science, A. K. De, New Age International Publication . 2) E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK. 2) P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi. 3) Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

SEMESTER-IV

VALUE EDUCATION COURSE

Green Chemistry: VECHE-02

(Credit 02) [30 L]

VECHE-02	Introduction Twelve Principals of Green Chemistry Atom Economy Applications of Green Chemistry
	References: 3) Green Chemistry: A Textbook: V. K. Ahluwalia, New Age International Publication . 4) E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK. 2) P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi. 3) Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

Scheme of Examination

A) Internal Assessment of 20 Marks:

Sr. No.	Particulars	Marks
1	One Assignment/test	10
2	Class attendance	05
3	One subject based activity/viva based on the course	05
	Total Marks	**20**

External Assessment of 30 Marks:

Sr. No.	Particulars	Marks
1	External Exam	30
	Total Marks	**30**

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA SAWANTWADI (AUTONOMOUS)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

Syllabus for Approval

Programme:- S. Y. B. Sc. Chemistry

OPEN ELECTIVE

w.e.f. Academic Year 2024-25

Choice Based Credit System S. Y. B. Sc. Chemistry Syllabus

University of Mumbai

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA

SAWANTWADI

(An Autonomous College)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

DEPARTMENT OF CHEMISTRY

Syllabus for Approval

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3.	Passing Marks	40%
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5.	No. of Years/Semesters	Two Semesters
6	Level	UG
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic Year	From Academic Year 2024-2025

Date:

Signature
HoD,
Dept. of Chemistry

Shri Pancham Khemraj Mahavidyalaya, Sawantwadi

Proposed First Year Curriculum as per NEP 2020

Department of Chemistry

Syllabus Structure for Open Elective

Semester	Paper Code	Paper Title	Type	Credits
III	**OECHE-04 (GE/OE)**	Air Pollution: A Case Study	**T**	**2**
IV	**OECHE-05 (GE/OE)**	Water Pollution: A Case Study	**T**	**2**

Program Outcomes:

Students will demonstrate an understand major concepts of Environment in association with multidisciplinary subjects such as physics, chemistry and mathematics etc. Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevance in the day-to-day life. Effective Communication- Development of various communication skills such as reading, listening, speaking, etc., which we will help in expressing ideas and views clearly and effectively. Social Interaction- Development of scientific outlook not only with respect to science subjects but also in all aspects related to life. Effective Citizenship- Imbibe moral and social values in personal and social life leading to highly cultured and civilized personality. Ethics- Follow the ethical principles and responsibilities to serve the society. Environment and Sustainability- Understand the issues of environmental contexts and sustainable development. Self-directed and Lifelong learning- Students will be capable of self- paced and self-directed learning aimed at personal development and for improving knowledge/skill development.

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- To study about different types of natural resource.
- Knowledge and concept of biodiversity and its conservation.
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- To study population growth and its impact on environment

COURSE OUTCOMES (CO): After completion of the course, a student will be able to COURSE OUTCOME :

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CO5- Students will learn about increase in population growth and its impact on environment

SEMESTER-IV
OPEN ELECTIVE
AIR POLLUTION: A CASE STUDIES: OECHT 04 (Credit 02) [30 L]

OECH04	**AIR POLLUTION** a) A CASE STUDY: 1) Bhopal gas tragedy 2) London Smog 3) VIZAG gas tragedy 4) Endosulfan kerala tragedy
	References: 1) Environmental Science, A. K. De, New Age International Publication . 2) E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK. 2) P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi. 3) Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

SEMESTER-IV

OPEN ELECTIVE

WATER POLLUTION: A CASE STUDIES: OECHT 05

(Credit 02) [30 L]

OECH-05	**WATER POLLUTION** A CASE STUDY: 1) Meenamata Diseases 2) Ganga Pollution 3) Itai – Itai Disease 4) Kim Kim River Toxic Pollution
	References: 1) Environmental Science, A. K. De, New Age International Publication . 2) E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK. 3) P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi. 4) Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut(1996).

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S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA SAWANTWADI (AUTONOMOUS)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

Syllabus for Approval

Programme:- S. Y. B. Sc. Chemistry

SKILL ENHANCEMENT COURSE

w.e.f. Academic Year 2024-25

Choice Based Credit System S. Y. B. Sc. Chemistry Syllabus

University of Mumbai

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA

SAWANTWADI

(An Autonomous College)

DIST: SINDHUDURG- 416 510, MAHARASHTRA

DEPARTMENT OF CHEMISTRY

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Shri Pancham Khemraj Mahavidyalaya, Sawantwadi

Proposed First Year Curriculum as per NEP 2020

Department of Chemistry

Syllabus Structure for Skill Enhancement Course

Semester	Paper Code	Paper Title	Type	Credits
IV	**SECHE-03**	Experimental Chemistry - II	**T**	**2**

SEMESTER-IV

SKILL ENHANCEMENT COURSE

Experimental Chemistry – II: SECHE -03

(Credit 02)

Semester-IV: Chemistry Practicals

1) Preparations of Aspirin
2) Preparations of Benzimidazole
3) Preparations of Glucosazone from glucose or fructose
4) Preparations of Tribromoaniline from aniline.
5) Estimation of Calcium and Magnesium ions as calcium carbonate by complexometric titration.
6) Determination of dissolved oxygen (DO) in a given water sample.

Reference:

1. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction,7th ed., Chapter 15, pp. 345-381.
2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961).
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