VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)

DEPARTMENT OF CHEMISTRY
Three/Four- Years UG Programme
Open Elective

Curriculum, Teaching and Evaluation Structure

for

B. Sc. – III Chemistry

Semester – V & VI

(Implemented from academic year 2023 - 24 onwards)

VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)
Department of Chemistry

Program Outcomes (POs):

PO1: Disciplinary Knowledge: Graduates will gain in-depth understanding in their specific major or discipline, mastering the foundational principles and theories, as well as advanced concepts.Execute strong theoretical and practical understanding developed from the specific programme in the area of work.

PO2: Problem-Solving Skills: Graduates will learn to use their knowledge to identify, analyze, and solve problems related to their field of study.

PO3: Analytical Skills: Graduates will gain the ability to collect, analyze, interpret, and apply data in a variety of contexts. They might also learn to use specialized software or equipment.

PO4: Research Skills and Scientific temper: Depending on the field, graduates might learn how to design and conduct experiments or studies, analyze results, and draw conclusions. They might also learn to review and understand academic literature.

PO5: Communication Skills: Many programs emphasize the ability to communicate effectively, both orally and in writing. Graduates may learn to present complex information clearly and succinctly, write detailed reports, and collaborate effectively with others.

PO6: Ethics and Professionalism: Graduates may learn about the ethical and professional standards in their field, and how to apply them in real-world situations.

B. Sc. In Chemistry

Program Specific Outcomes (PSOs):

After successful completion of degree program in Chemistry a student should be able to;

PSO1: Understand fundamental facts and concepts in Chemistry as well as its applications so as to develop interest in the study of chemistry as a discipline.

PSO2: To develop the ability to apply the principles of Chemistry in practical.

PSO3: Acquire skills of different analytical techniques used in chemistry.

PSO4: Develop Skills to evaluate, analyze and interpret the chemical reactions by using various techniques.

PSO5: Acquire knowledge and skills required to hire in any sector related to chemistry as well as to admit for higher education.

VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)
Department of Chemistry

Teaching and Evaluation scheme
Three/Four- Years UG Programme
Department/Subject Specific Core or Major (DSC)
Third Year Semester- V&VI

Class	Semester	Course Name	Name of the paper	Credits
B. Sc. III	V	Chemistry (DSC)	1002E1-Physical & Inorganic Chemistry	4
			1002E2-Organic Spectroscopic Techniques & Analytical Chemistry	4
			Chemistry Lab-V Practical	2
			Chemistry Lab-VI Practical	2
		Chemistry (SEC-SE)	Laboratory Safety Management	2
	VI	Chemistry (DSC)-III	1002F1-Physical & Inorganic Chemistry	4
			1002F2-Organic Chemistry & Industrial Chemistry	4
			Chemistry Lab-VII Practical	2
			Chemistry Lab-VIII Practical	2
		Chemistry (SEC)-SF	Project work & Industrial study tour	2
			Total Credits	32

Vivekanand College, Kolhapur (Empowered Autonomous)

B. Sc. Part III (Chemistry)

Syllabus CBCS Pattern

To be implemented from June-2023

INTRODUCTION

This syllabus is prepared to give sound knowledge and understanding of chemistry to undergraduate students in the last year of the B.Sc. degree course. The syllabus aims to make the study of chemistry as stimulating, interesting, and relevant as possible. The syllabus is prepared by keeping in mind the aim to make students capable of studying chemistry in academic and industrial courses and to expose the students, to develop interest in them in various fields of chemistry. The new and updated syllabus is based on a disciplinary approach with vigor and depth taking care the syllabus is not heavy at the same time it is comparable to the syllabi of other universities at the same level. The syllabus is prepared after discussions of a number of faculty members of the subject and by considering the existing syllabi of B.Sc. Part-I, II & III, new syllabi of XIth & XIIth standards, syllabi of NET and SET exams. U.G.C. model curriculum, syllabi of different entrance examinations and syllabi of other Universities. The units of the syllabus are well defined and the scope is given in detail. The periods required for units are given. The lists of reference books are given in detail.

List of Laboratory Equipments

- **Apparatus &Equipments**
  1. Digital balance with 1 mg accuracy
  2. Conductometer
  3. Potentiometer
  4. pH Meter
  5. Polarimeter
  6. Colorimeter
  7. Thermostat
  8. Electric Oven
  9. Suction Pump

10. Crucible Heater
11. IR Lamp
12. Magnetic stirrer
13. Buckner funnel
14. Water bath / Thermostat.
15. Platinum electrode
16. Glass electrode
17. Silver, Zinc, Copper electrodes
18. Conductivity cell
19. Distilled water plant.
20. Refractometer
21. Freeze
22. Deep Freeze
23. H_2S Apparatus
24. Muffle Furnace
25. Magnetic Stirrer

- **Glassware & Porcelain ware:**

1. Burette (25/50 ml)
2. Micro burette (10 ml)
3. Pipette (5 ml, 10 ml, 25 ml)
4. Graduated Pipette (1/2/5/10 ml)
5. Conical flask (100 ml, 250 ml)
6. Beakers (100 ml, 250 ml, 500 ml)
7. Volumetric flask (25ml, 50 ml,100 ml, 250 ml)
8. Gooch Crucible / Sintered glass Crucible
9. Silica Crucible
10. Watch glass
11. Glass tubing
12. Glass Funnel (3")
13. Gas jar
14. Glass rod

15. Test Tubes (12 x100, 5x5x8)
16. Evaporating dish
17. TLC Unit
18. Measuring cylinder
19. Thile's tubes
20. Fusion Tube
21. Capillary tube
22. Stopper bottle
23. Thermometer (1/10°, 360°)
24. Water condenser
25. Distillation flask (100 ml/ 250 ml)
26. Titration tiles.
27. Asbestos sheet.
28. Desiccators
29. Clay pipe triangle

- **Iron & Wooden ware:**
  1. Burners
  2. Tripod stand
  3. Iron stand
  4. Wire gauze
  5. Burette stand
  6. Test tube stand
  7. Pair of tongs
  8. Test tube holder
  9. Spatula
  10. Copper foil
- **Chemicals:** All the chemicals required for experiments are mentioned in the syllabus.
- **Others:**
  1. Filter papers (Kalpi)
  2. Whatman Filter paper No. 1, 40, 41

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Lab Safety Precautions / Measures in Chemistry Laboratory:

Part-I: Personal Precautions

1. All personnel must wear safety Goggles at all times.
2. Must wear the Lab. Aprons / Lab jacket and proper shoes.
3. Except in emergency, an over-hurried activity is forbidden.
4. Fume cupboard must be used whenever necessary.
5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

Part-II: Use of safety and Emergency Equipment's

1. First aid kits.
2. Sand Bucket.
3. Fire extinguishers (dry chemical and carbon dioxide extinguisher).
4. Chemical storage cabinet with proper ventilation.
5. Material safety data sheets
6. Management of local exhaust system and fume hoods.
7. Sign in register if using instruments.

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Vivekanand College, Kolhapur (Empowered Autonomous)
B. Sc. Part – III CBCS Syllabus with effect from June-2023,
Semester -V
Chemistry-DSE-1002E1 Physical and Inorganic Chemistry
Theory: 60 Hrs (75 Lectures) Credits-4
Section I: Physical Chemistry
Theory: (38 Hrs)

Course Outcomes: After the completion of the course the student will be able to:

CO1: Learn and understand quantum Chemistry, Heisenberg's uncertainty principle, concept of energy operators (Hamiltonian), learning of Schrodinger wave equation, physical interpretation of the ψ and ψ2 and particle in a one-dimensional box.

CO2: Acquire knowledge about spectroscopy, Electromagnetic spectrum, Energy level diagram, Study of rotational spectra of diatomic molecules: Rigid rotor model, Microwave oven, vibrational spectra of diatomic molecules, simple Harmonic oscillator model, Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, related knowledge will be gained by the students.

CO3: Learn and understand photochemical laws, reactions and various photochemical phenomena.

CO4: Learn and understand the knowledge of emf measurements, types of electrodes, different types of cells, various applications of emf measurements.

Section-I: Physical Chemistry (38 Periods)

Unit I Elementary quantum mechanics [09]

1.1 Introduction.

1.2 Limitations of classical mechanics, Black body radiation, Photoelectric effect, Duel nature of matter and energy: De Broglie hypothesis.

1.3 Heisenberg's uncertainty principle.

1.4 Concept of energy operators (Hamiltonian).

1.5 Derivation of Schrodinger wave equation, well-behaved function.

1.6 Physical interpretation of the ψ and ψ^2.

1.7 Particle in a one-dimensional box.

Unit II Molecular Spectroscopy **[10]**

2.1 Introduction.

2.2 Electromagnetic radiation.

2.3 Interaction of radiation with matter, Electromagnetic spectrum, Energy level diagram.

2.4 **Rotational spectra of diatomic molecules**: Rigid rotor model, moment of inertia, energy levels of rigid rotor, selection rules, Intensity of spectral lines, determination of bond length, isotope effect, Microwave oven

2.5 **Vibrational spectra of diatomic molecules:** Simple Harmonic oscillator model, Vibrational energies of diatomic molecules, Determination of force constant, overtones.

2.6 **Raman spectra:** Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, selection rules.

2.7 Comparative study of IR and Raman spectra, rule of mutual exclusion-CO_2 molecule.

2.8 Numerical problems.

Unit III Photochemistry **[07]**

3. Introduction, Difference between thermal and photochemical processes.

3.1 Laws of photochemistry: i) Grotthus-Draper law ii) Lambert law iii) Lambert– Beer's law (with derivation) iv) Stark-Einstein law.

3.2 Quantum yield, Reasons for high and low quantum yield.

3.3 Factors affecting Quantum yield.

3.4 Photo sensitized reactions – Dissociation of H_2, Photosynthesis.

3.5 Examples of photochemical reactions – Photo dimerisation of anthracene, decomposition of HI and HBr.

3.6 Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence.

3.7 Chemiluminescence, Electroluminescence and Bioluminescence.

3.8 Numerical problems.

Unit IV Electromotive force **[12]**

4.1 Introduction

4.2 Thermodynamics of electrode potentials, Nernst equation for electrode and cell potentials in terms of activities.

4.3 E. M. F. series.

4.4 Types of electrodes: Description in terms of construction, representation, half cell reaction and emf equation for

1) Metal – metal ion electrode.
2) Amalgam electrode.
3) Metal–insoluble salt electrode.
4) Gas–electrode.
5) Oxidation–Reduction electrode.

4.5 Reversible and Irreversible cells.

i. Chemical cells without transference.

ii. Concentration cells with and without transference.

iii. Liquid- Liquid junction potential: Origin, elimination and determination.

4.6 Equilibrium constant from cell emf.

4.7 Applications of emf measurements:

i. Determination of pH of solution using Hydrogen electrode.

ii. Solubility and solubility product of sparingly soluble salts (based on concentration cells).

4.8 Numerical problems.

Reference Books:

1. Physical Chemistry by G.M. Barrow, International student Edition, McGraw Hill.
2. University General Chemistry by C.N.R. Rao, Macmillan.
3. Physical Chemistry by, R.A. Alberty, Wiley Eastern Ltd.
4. The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5. Principles of Physical Chemistry by S. H. Maron, C.H. Prutton,4th Edition.
6. Nuclear and Radiochemistry byFried lander, Kennedy and Miller, John Wiley and Sons. Wiley International edition.
7. Essentials of Nuclear Chemistryb yH. J. Arnikar, 4th edition. Wiley Eastern.
8. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Nagin chand and Company, Jalandar.
9. Instrumental methods of chemical analysis by Chatwal and Anand, 5th Edition, Himalaya Publication.
10. Fundamentals of molecular spectroscopy by C.N. Banwell – Tata McGraw-Hill.
11. Quantum Chemistry including molecular spectroscopy by B.K. Sen, Tata McGraw-Hill.
12. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.
13. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36thEdition
14. Principles of Physical Chemistry by Maron and Lando (Amerind).
15. Electrochemistry by S.Glasstone.
16. Physical Chemistry by W.J. Moore.
17. Basic Chemical Thermodynamics by V.V. Rao (Macmillan).
18. Essential of Physical Chemistry, Bahl and Tuli (S.Chand).
19. Text Book of Physical Chemistry, Soni and Dharmarha.

Section II: Inorganic Chemistry
Theory: (37 Hrs)

Course Outcomes: After the completion of the course the student will be able to:

CO1: It is useful for the study of role of acids and bases, all chemical properties of solutes in Chemistry.

CO2: Students will gain an understanding of synthesis and applications of the semiconductors and superconductors in electrical and electronic devices. The students will get a basic understanding of nano chemistry, nanotechnology and its fascinating aspects.

CO3: Improve the level of understanding of structure, method of preparation and applications of organometallic compound in various fields are explained.

CO4: Impart essential knowledge in students regarding classification, types, mechanism and applications of catalyst in industrial fields is explained.

CO5: Understand geometry, stability, colour and nature of bonding between metal ion and ligand in complexes.

Unit-I: Acids, Bases and Non aqueous Solvents **[08]**

(A) Introduction to theories of Acids and Bases –Arrhenius concept, Bronsted-Lowry concept, Lewis Concept, Lux-Flood Concept (definition and examples), Hard and Soft Acids and Bases (HSAB Concept), Classification of acids and bases as hard, soft and borderline, Pearson's HSAB concept, Acid – Base strength and hardness-softness, Applications and limitations of HSAB principle.

(B) Chemistry of Non aqueous Solvents - Introduction, definition and characteristics of solvents, Classification of solvents, Physical properties and Acid-Base reactions in Liquid Ammonia (NH_3) and Liquid Sulphur Dioxide (SO_2).

Unit-II: Metals, Semiconductors, Superconductors and Nanomaterials **[14]**

(A) Metals, Semiconductors and Superconductors - Introduction, Properties of metallic solids, Theories of bonding in metal: i) Free electron theory ii) Molecular orbital theory (Band theory), Classification of solids as conductor, insulators and semiconductors

on the basis of band theory, Semiconductors, Types of semiconductors - intrinsic and extrinsic semiconductors, Applications of semiconductors, Superconductors: Superconductivity, Meissner effect, Ceramic superconductors- Preparation and structures of mixed oxide $YBa_2Cu_3O_{7-x}$, Applications of superconductors.

(B) Nanomaterials -Introduction and Importance of nanomaterials, Properties (Comparison between bulk and nanomaterials): i) Optical properties ii) Electrical conductivity and iii) Mechanical properties, Methods of preparation: Top-down, bottom-up fabrication a) Co-precipitation method b) Sol-gel method c) Chemical reduction method d) Hydrothermal method, Applications of Nanomaterials.

Unit-III: Organometallic Chemistry **[06]**

Definition, Nomenclature and EAN rule of organometallic compounds, Synthesis and structural study of alkyl and aryl compounds of Li, Be and Al, Zeiss salt and ferrocene, Preparation, structure, bonding and properties of mononuclear carbonyls: $[Ni(CO)_4]$, $[Fe(CO)_5]$, $[Cr(CO)_6]$.

Unit-IV: Catalysis **[05]**

Introduction, Classification of a catalytic reaction - Homogenous and Heterogeneous, Types of Catalysis, Characteristics of catalytic reactions, Mechanism of catalysis - Intermediate compound formation theory and Adsorption theory, Industrial applications of catalysis.

Unit-IV: Molecular orbital theory (MOT) **[04]**

Introduction, MOT of octahedral complexes with sigma bonding such as $[Ti(H_2O)_6]^{3+}$, $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, Merits and demerits of MOT.

Reference Books:

1. Concise Inorganic Chemistry by J.D. Lee - 5th Edition.
2. Inorganic Chemistry, - D.F. Shiver & P.W. Atkins - C.H. Longford ELBS - 2nd Edition.
3. Basic Inorganic Chemistry, - F.A. Cotton and G. Wilkinson, Wiely Eastern Ltd 1992.
4. Concept and Model of Inorganic Chemistry by Douglas - Mc Daniels – 3rd Edition John Wiley publication.
5. Co-ordination Compounds by Baselo and Pearson
6. Inorganic Chemistry by J.E. Huheey, 4th Edition, Pearson Education.
7. Inorganic Chemistry by A. G. Sharpe - 3rdEdition
8. Principles of Bioinorganic Chemistry by S.J. Lippard and J.M. Berg, 1st Edition.
9. Advanced Inorganic Chemistry (4th Edition) Cotton and Wilkinson
10. Theoretical Inorganic Chemistry by Day and Selbine.
11. Organometallic Chemistry by R.C. Malhrotra A.Sing, Wiley Eastern Ltd. New Delhi.
12. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
13. Textbook of Inorganic Chemistry by K.N. Upadhyaya Vikas Publishing House – New Delhi.
14. Inorganic Solids: An introduction to concepts in solid-state structural chemistry by Adam, D.M. John Wiley & Sons, 1974.

Vivekanand College, Kolhapur (Empowered Autonomous)
B. Sc. Part – III CBCS Syllabus with effect from June-2023,
Semester -V
Chemistry-DSE-1002E2 Organic and Analytical Chemistry
Theory: 60 Hrs (75 Lectures) Credits-4
Section I: Organic Chemistry
Theory: (37 Hrs)

Course Outcomes: After the completion of the course the student will be able to:

CO1: Understand basic concepts of spectroscopy.

CO2: Acquire knowledge of various spectroscopic techniques such as UV, IR, NMR and Mass Spectroscopy.

CO3: Interpret molecular structural formula by using spectroscopic techniques.

CO4: To make the solutions and find the structures of unknown organic compounds on the basis of IR, NMR, UV and Mass spectroscopic data.

Unit-I: Introduction to Spectroscopy **[03]**

Meaning of spectroscopy, Nature of electromagnetic radiation -wave length, frequency, energy, amplitude, wave number, and their relationship, different units of measurement of wavelength frequency, different regions of electromagnetic radiations, Interaction of radiation with matter-absorption, emission, florescence and scattering, Types of spectroscopy and advantages of spectroscopic methods. Energy types and energy levels of atoms and molecules.

Unit-II: Ultra-Violet (UV) Spectroscopy **[09]**

Introduction, Beer-Lamberts law, absorption of U.V. radiation by organic molecule leading to different excitation, Terms used in U.V. Spectroscopy-Chromophore, Auxochrome, Bathochromic shift, hypsochromic shift, hyperchromic and hypochromic effect, Modes of electromagnetic transitions. Effect of conjugation on position of U.V. band, Calculation of λ-max by Woodward and Fisher rules for dienes and enones systems, Colour and visible spectrum, Applications of U.V. Spectroscopy.

Unit-III: Infra-Red (IR) Spectroscopy **[08]**

Introduction, Principle of I.R. Spectroscopy, IR Instrumentation, schematic diagram, Fundamental modes of vibrations, Condition for absorption of IR radiations, Regions of I.R. Spectrum, fundamental group region, finger print region, Hooks Law for Calculation of vibrational frequency, IR Sampling, Factors affecting on IR absorption frequency, Characteristic of I.R. absorption of following functional groups Alkanes, alkenes, alkynes, Alcohol and phenols, Ethers, Carbonyl compounds, Amines, Nitro com, Aromatic Compounds.

Unit-IV: Nuclear Magnetic Resonance (NMR) Spectroscopy **[05]**

Introduction, Principles of PMR Spectroscopy, NMR-Instrumentation, Schematic diagram, Magnetic and nonmagnetic nuclei, Chemical shift - definition, measurement, calculation, Factors affecting Chemical shift, Shielding, & deshielding, Peak Integration, Merits of TMS as PMR reference compounds, Coupling Constant, Types of Coupling Constant, Spin-spin splitting (n+1 rule), Applications.

Unit-V: Mass spectroscopy **[08]**

Introduction, Principle of mass spectroscopy, Mass spectrometer – schematic diagram, Types of ions produced in mass spectrum, Fragmentation patterns of - alkanes, alkenes, aromatic hydrocarbons, alcohols, phenols, amines and carbonyl compounds, McLaffrety rearrangement, Applications.

Unit-VI: Combined Problems based on UV, IR, NMR and Mass Spectral data **[05]**

Reference Books:

1. Absorption Spectroscopy of Organic Molecules by V. M. Parikh.
2. Spectroscopy of Organic compounds by P. S. Kalsi.

3. Elementary Organic Absorption Spectroscopy by Y. R. Sharma.
4. Instrumental Methods of Analysis (7th edition) by Willard, Merritt, Dean, Settle.
5. Spectroscopy by G. R. Chatwal and S. K. Anand
6. Spectroscopy by Pavia, lampman, Kriz
7. Organic Spectroscopy (2nd edition) by Jag Mohan
8. Organic Spectroscopy (3rd edition) by William Kemp
9. Instrumental Methods of Chemical Analysis by H. Kaur.

Section II: Analytical Chemistry
Theory: (38 Hrs)

Course Outcomes: After the completion of the course the student will be able to:

CO1: Acquire knowledge of theoretical and practical aspects of Soil, water and fertilizers analysis.

CO2: Acquire skills of various analytical techniques such as Flame photometry, potentiometry, and colorimetry.

CO3: Acquire skills of various analytical techniques such as Flame photometry, potentiometry, and colorimetry.

CO4: Learn various aspects to apply analytical techniques to analyzed the samples.

Unit-I: Soil and Water Analysis **[08]**

Introduction, Importance of Soil Testing and Analysis, Sample Collection and Processing Purpose of Soil testing and analysis, selection of field, Method of Soil Sample collection Methods of soil sample processing, precautions during soil collection & processing, Soil parameters testing with the help of p^H Meter, Conductivity meter, spectrometer, UV-Spectrophotometer, soil testing kit and mobile soil testing van

Physical analysis of water – pH, Conductance, Colour, odour, Turbidity and taste, Chemical Analysis –Total Dissolved solids, Hardness, Salinity, Alkalinity, Acidity, Sulphates, Nitrates, Dissolved Oxygen, Chemical Oxygen Demand, Biological Oxygen Demand.

Unit-II: Analysis of Fertilizers: **[09]**

Introduction, Types of fertilizers, Necessity and requirements of good fertilizers, Sampling and sample preparation, Analysis of Nitrogen by Kjeldahl's method, Analysis of Phosphorus by phosphomolybdate method, Analysis of Potassium by sodium tetraphenyl borate method.

Unit-III: Flame Photometry **[08]**

Introduction, General principles of flame photometry, Instrumentation: Block diagram, Burners (Premix and Lunder graph burners), mirror,

slits, filters, detector (Photomultiplier tube), Effect of solvent in flame photometry, Experimental procedure of analysis (Standard addition and internal standard), Interferences and Factors that influence the intensity of emitted radiation in a flame photometer, Applications of flame photometry in real sample analysis, Limitations of flame photometry.

Unit-IV: Potentiometric titrations: **[05]**

General Introduction, Potentiometric titrations - Classical and analytical methods for locating end points, Types of Potentiometric Titration: Acid-base titration, Redox titration, Precipitation titration, Advantages of potentiometric titrations, Basic circuit of direct reading potentiometer.

Colorimetry: Introduction, Lambert-Beer's law, basic terms used- Transmittance, Optical Density, Opacity, Extinction coefficient, Deviation from Beer's law, Classification of methods of 'colour' measurement or comparison - i) Photoelectric Colorimeter method - Single beam photo-electric colorimeter, Determination of unknown concentration by using Concentration – Absorbance plot

Unit-V: Chromatography **[08]**

General Introduction, Basic principle of chromatography, Classification of Chromatography.

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.

Reference Books:

1. A. I. Vogel, Textbook of Quantitative Chemical Analysis, 6th ed, Pearson Education, 2002.
2. S. M. Khopkar,Analytical Chemistry Problems and Solutions, New AgeInternational Publishers, 2002.
3. S. M. Khopkar, Basic Concepts of Analytical Chemistry, 3rd ed, New Age International Publishers, 2008.
4. D. A. Skoog, D.M.West, F.J. Holler, Fundamantals of Analytical Chemistry, 8th ed. Philadelphia, Saunders College Publishing, 1996.
5. D. A. Skoog, F.J.Holler, T.A.Nieman, Principles of Instrumental Analysis, 6th ed. Philadelphia, Saunders College Publishing, 1996.
6. G. R. Chatwal and S. K. Anand: Instrumental methods of Chemical Analysis, Himalaya Publishing House.
7. H. H. Willard, L. L. Merritt and J. A. Dean; Instrumental methods of Analysis, 7th ed. CBS Publishers, 1986.
8. Instrumental methods of chemical analysis – H. Kaur
9. Instrumental methods of chemical analysis –Willard, Merit & Dean
10. Text Book of Quantitative inorganic analysis – A.I. Vogel
11. Analytical chemistry – Walton
12. Textbook of qualitative inorganic analysis – Kolthoff and Sandel

Semester V
SEC: 1002E Laboratory Safety Management

Course Outcomes: After the completion of the course the student will be able to:

CO1: Demonstrate a comprehensive understanding of laboratory safety principles and protocols, hazardous chemicals, and routes of entry for toxins.

CO2: Learn about MSDS and Laboratory safety symbols.

CO3: Acquire the knowledge of Prevention of Accidents and First Aid Measures in the laboratory.

CO4: Learn Safe Handling of Chemicals and waste management in the laboratory.

Unit-I: Introduction to Laboratory Chemicals & its Management **[09]**

- Introduction
- General Laboratory Protocols,
- Types of hazardous chemicals: Corrosives, Oxidisers, Flammables, Water Reactives, Pyrophorics, Peroxide forming chemicals; toxics: acute effect, chronic effect, prevention of toxic exposures, LD_{50}, LC_{50}, Threshold limit values
- Routes of Entry: Inhalation, Skin absorption, Gastrointestinal introduction of toxins
- Receipt of chemicals; Labeling of chemicals; Storage of chemicals.

Unit-II: MSDS & Laboratory Safety Pictograms (Symbols) **[09]**

- Introduction,
- MSDS, CASRN
- Safety symbols of various reactive chemicals.

Unit-III: Prevention of Accidents and First Aid Measures **[10]**

- Introduction
- First Aid measures for cuts/bleeding, burns, flammable liquid spill, Fire accidents: Fire on the cloth, Eye accidents, Chemical

spill on skin, Inhalation of chemical vapours, spilling of unknown and neutral compounds, poisons, inhalation of poisonous gases.

- Universal antidote for any poison
- Materials in First Aid Kit.

Unit-IV: General Safety & Safe Handling of Chemicals **[09]**

- General Safety and Operational Rules: Electrical Safety, Vacuum operations, Handling glassware, Fume Hood Safety and Ventilation
- Handling and transportation of chemicals, Chemical Spills on surface, Guidelines for handling of acids, alkalis, phenols and reactive chemicals, Compressed Gas Safety, Safe Handling of Cryogenic liquids, Handling of Dry Ice.
- Waste Management & Disposal
- Housekeeping

Reference Books:

1. Handbook for Laboratory Safety, Benjamin R. Svein bjornsson, Svein bjornGizurarson,
2. CRC Handbook of Laboratory Safety, A. Keith Furr
3. Laboratory safety manual, Environmental Health and Safety Department University of Washington

Vivekanand College, Kolhapur (Empowered Autonomous)
B. Sc. Part – III CBCS Syllabus with effect from June-2023,
Semester -VI
Chemistry-DSE-1002F1 Physical and Inorganic Chemistry
Theory: 60 Hrs (75 Lectures) Credits-4
Section I: Physical Chemistry
Theory: (37 Hrs)

Course Outcomes: After the completion of the course the student will be able to:

CO1: Acquire knowledge about basic concept of adsorption, types of adsorptions, Freundlich, Langmuir adsorption isotherm, BET equation

CO2: Acquire knowledge about basic concept of Thermodynamics, free energy, Gibbs-Helmholtz equation and its applications, problem related with it.

CO3: Learn and understanding Space lattice, lattice sites, Lattice planes, Unit cell, Laws of crystallography, Weiss indices and Miller indices, Cubic lattices and types of cubic lattice, planes or faces of a simple cubic system, Diffraction of X rays, Derivation of Bragg's equation. Determination of crystal structure by Bragg's method, crystal structure of NaCl and KCl on the basis of Bragg's equation

CO4: Learning of kinetics, Simultaneous reactions such as i) opposing reaction ii) side reaction iii) consecutive reactions iv) chain reaction v) explosive reaction

CO5: To understand the scintillation counter and Geiger Counter method, and range of α partials, Geiger Nuttal relation, Decay constant.

Unit-I: Adsorption **[07]**

Introduction, Adsorption as a surface phenomenon (mechanism), Definition of important basic terms: absorption, adsorption, adsorbant, adsorbate, interface etc., Distinction between adsorption and absorption, Characteristics of adsorption, Factors affecting adsorption, Types of adsorption, Distinction between physical adsorption and chemical adsorption, Adsorption isotherms: Freundlich, Langmuir adsorption isotherm, BET equation (derivation not expected), determination of surface area using Langmuir method and BET equations.

Unit-II: Thermodynamics **[09]**

2.1 Introduction.

2.2 Free energy: Gibbs function (G) and Helmholtz function (A), Criteria for thermodynamic equilibrium and spontaneity.

2.3 Relation between ΔG and ΔH: Gibbs-Helmholtz equation.

Phase equilibria: Clapeyron – Clausius equation and its applications.

2.5 Thermodynamic derivation of law of mass action, Van't–Hoff isotherm and isochore.

2.6 Fugacity and activity concepts.

2.7 Partial molar quantities, Partial molar volume, Concept of chemical potential, Gibbs Duhem equation.

2.8 Numerical problems.

Unit-III: The Solid State **[07]**

3.1 Introduction: Space lattice, lattice sites, lattice planes, unit cell.

3.2 Laws of crystallography:

i. Law of constancy of interfacial angles

ii. Law of rational indices

iii. Law of crystal symmetry.

3.3 Weiss indices and Miller indices.

3.4 Cubic lattice and types of cubic lattice, planes or faces of a simple cubic system, spacing of lattice planes.

3.5 Diffraction of X-rays, Derivation of Bragg's equation.

3.6 Determination of crystal structure by Bragg's method.

3.7 Determination of crystal structure of NaCl and KCl on the basis of Bragg's equation.

3.8 Numerical problems.

Unit-IV: Chemical Kinetics [07]

4.1 Introduction

4.2 Third Order Reaction –Derivation of rate constant, properties, examples

4.3 Steady state approximation (Statement, one example)

4.4 Simultaneous reactions such as

i. Opposing or reversible or counter reaction : (Derivation of rate equation for first order opposed by first order expected)

ii. Side reaction or parallel reactions (Derivation expected).

iii. Consecutive or successive reactions (Derivation not expected).

Unit-V: Radioactivity and its Detection [07]

Introduction, Detection and measurement of nuclear reactions by scintillation and Geiger Muller counter methods, Decay constant, half-life and average life of radioactive elements, Radioactive equilibrium and range of α-partials, Geiger Nuttal relation, determination of radioactive constant (Decay constant), Numerical problems.

Reference Books:

1. P.W. Atkins, The Elements of Physical Chemistry: 4th ed. Oxford University Press, 2005.
2. G.M. Barrow, Physical Chemistry: 6th Ed, Tata McGraw Hill Publishing Co. Ltd., 2008.
3. G.K. Vemulapalli, Physical Chemistry Prentice Hall of India Pvt. Ltd., 2009.
4. G.W. Castellan, Physical Chemistry: 3rd ed., Narosa Publishing House, 2004.
5. S. Glasstone, Text Book of Physical Chemistry, 2nd ed, Affiliated East-West press Pvt. Ltd., New Delhi.
6. K.J. Laidler and J.H. Meiser, Physical Chemistry: 2nd ed. CBS, First Indian ed.1999.
7. S. Glasstone, Thermodynamics for Chemist: Affiliated East-West Press Pvt. Ltd., New Delhi.
8. Ira N. Levine, Physical Chemistry: 6th ed., Tata McGraw Hill, Inc., 2011.
9. Reisman Arnold, Phase equilibria–Edited by Ernest M. Loebe, New York and London Academic Press.

10. F.D. Ferguson and P.K. Jones, Phase Rule: (Butter worth Publisher).
11. J.N. Murrell and E.A. Boucher, Properties of Liquids and Solution: Wiley, 1982.
12. D.K. Chakravarty, Adsorption and Catalysis, Oxford Publishers.1985
13. D.J. Shaw, Introduction to Colloid and Interface Science: Butterworth and Co., 1981.
14. D.H. Everett, Basic Principles of Colloid Science: Royal Society of Chemistry, 1988.
15. Thomas J.M. and Thomas W.J. Introduction to Principles of Heterogeneous Catalysis: VCH Publishers, New York, 2008.
16. Fried lander, Kennedy and Joseph W., Nuclear and Radiochemistry–John Wiley & Sons, NewYork, 1955.
17. Arnikar H.J., Essentials of Nuclear Chemistry: 4th ed, New Age International Ltd., Publishers, New Delhi.1955.
18. Principles of Adsorption and Adsorption Processes Douglas M. Ruthven John Wiley & Sons – 1984 - Technology & Engineering
19. Adsorption: Fundamental Processes and Applications Mehrorang Ghaedi Ghaedi Academic Press19 - Mar-2021-Science-728 pages
20. An Introduction to Radioactivity by Richard Laws on, Introduction to Radioactivity Page R.S. Laws on October 1999.

Section II: Inorganic Chemistry
Theory: (37 Hrs)

Course Outcomes: After the completion of the course the student will be able to:

CO1: Study the important aspects of the mechanism of the reactions involved in inorganic complexes of transition metals as well as thermodynamic and kinetic aspects of metal complexes.

CO2: Impart essential knowledge in students regarding the characteristics, properties and separation of lanthanides and Actinides are discussed. Also Synthesis and IUPAC Nomenclature of transuranic elements (TU) explained.

CO3: To impart essential knowledge in students regarding the characteristics, properties and separation of lanthanides and Actinides are discussed. Also Synthesis and IUPAC Nomenclature of transuranic elements (TU) explained.

CO4: To improve the level of understanding of the techniques involve in ore dressing and extraction of cast iron from its ore are discussed.

CO5: To give the students a thorough knowledge of role of various metals and nonmetals in our health are discussed.

Unit-I: Coordination Chemistry **[12]**

(A) Inorganic Reaction mechanism - Introduction, Classification of Mechanism: Association, dissociation, interchange and the rate-determining steps, SN^1 and SN^2 reactions for inert and labile complexes, Mechanism of substitution in cobalt (III) octahedral complexes, Trans effect and its theories, Applications of trans effect in synthesis of Pt (II) complexes.

(B) Thermodynamic and Kinetic aspects of metal complexes

Introduction, Thermodynamic stability and Kinetic Stability, Relation between thermodynamic and kinetic stability, Stepwise stability constant, Factor affecting the stability of complexes, Determination of Stability constant by Job variation, Mole ratio and Slope ratio method.

Unit-II: Nuclear Chemistry **[05]**

Nuclear reactions and energetic of nuclear reactions, Types of nuclear reactions: i) Artificial transmutation ii) Artificial radioactivity iii) Nuclear fission and its application in Heavy water nuclear reactor iv) Nuclear fusion, Applications of radio-isotopes as tracers: i) Chemical investigation-Esterification ii) Structural determination-Phosphorus pentachloride iii) Analytical Chemistry-Isotopic dilution method for determination of volume of blood iv) Age determination - Dating by C^{14}.

Unit-III: Chemistry of f-Block Elements **[09]**

(A) Lanthanides - Introduction, Occurrence, Electronic Configuration, Oxidation State, Lantahnide contraction, Separation of Lanthanides by Ion exchange method.

(B) Actinides - Position in periodic table, Electronic configuration, General methods of preparation of transuranic elements - i. Neutron capture - followed by β decay, ii. Accelerated projectile bombardment, iii. Heavy ion bombardment, IUPAC nomenclature of the super heavy elements with atomic number (Z) greater than 100.

Unit-IV: Iron and Steel **[07]**

Occurrence and ores of iron, Definition of the Terms - Ore, Mineral, Slag, Flux, Gangue, Matrix, Calcinations, Reduction, Roasting, Smelting and Leaching, Extraction of iron by Blast furnace.

Steel: Definition and types, Conversion of cast iron into steel by i. Bessemer process, ii L.D. process, Heat treatment on steel.

Unit-V: Bio-inorganic Chemistry **[05]**

Introduction, Essential and trace elements in biological process, Metalloporphyrins with special reference to hemoglobin and myoglobin, Role of metal ions present in biological systems with special reference to Na^+, K^+, Mg^{2+}

and Ca^{2+} ions, Na/K pump, Role of Mg^{2+} ions in energy production and chlorophyll, Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

Reference Books:

1. Concise Inorganic Chemistry (ELBS, 5th Edition) – J.D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D.F. Shriver, P.W. Atkins, C.H. LangFord, Oxford University Press, 2nd Edition.
3. Basic Inorganic Chemistry: Cotton and Wilkinson.
4. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson.
5. Concepts and Models of Inorganic Chemistry: Douglas and Mc. Daniel. 3rd Edition, John Wiley publication.
6. Structural principles in inorganic compounds. W.E. Addison.
7. Theoretical principles of Inorganic Chemistry – G.S. Manku.
8. Theoretical Inorganic Chemistry by Day and Selbine.
9. Co-ordination compounds. SFA Kettle.
10. Essentials of Nuclear Chemistry by H. J. Arnikar.
11. Nuclear Chemistry by M. N. Sastri
12. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd. New Delhi.
13. Inorganic Chemistry by A. G.Sharpe, Addision–Wisley Longman –Inc.
14. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
15. Text book of Inorganic Chemistry by K. N. Upadhyaya Vikas Publishing House – NewDelhi.
16. Inorganic Chemistry 3rd edn G. L. Miessler and D.A. Tarr, pearson publication
17. Co-ordination compounds by Baselo and Pearson.
18. UGC Inorganic chemistry by H.C. Khera, Pragati prakashan
19. UGC Advance Inorganic Chemistry by Agarwal and Keemtilal, Pragati Prakashan

Vivekanand College, Kolhapur (Empowered Autonomous)
B. Sc. Part – III CBCS Syllabus with effect from June-2023,
Semester -VI
Chemistry-DSE-1002F2 Organic and Industrial Chemistry
Theory: 60 Hrs (75 Lectures) Credits-4
Section I: Organic Chemistry
Theory: (38 Hrs)

Course Outcomes: After the completion of the course the student will be able to:

CO1: Learn the mechanism of different organic name reactions and to become confident to solve the problems based on the reactions.

CO2: Adopt the utility of reagents in organic synthesis.

CO3: Understand the fundamentals of terpenoids and alkaloids.

CO4: Illustrate the applications of nucleophilic substitution reactions of aromatic compounds.

CO5: Acquire knowledge of pharmaceuticals and its use.

Unit-I: Name Reactions **[08]**

Beckmann, Benzilicacid, Baeyer Villiger, Diels-Alder reaction, Mannich Reaction, Michael Reaction, Fries, Dienone-Phenol rearrangement, Problems based on reactions.

Unit-II: Synthetic Reagents **[08]**

DDQ, OsO_4, N-bromo succinamide, Zn-Hg, DCC, $LiAlH_4$, CAN, Raney Ni, Diazomethane,

Unit-III: Natural product **[07]**

Terpenoid: Introduction, Occurrence, Isolation, General Characteristics, Classification, General Methods for structure determinations, Isoprene rule, Analytical evidences and synthesis of Citral.

Alkaloids: Introduction, Occurrence, Isolation, Classification, Properties, General Methods for structure determinations, Analytical evidences and synthesis of Nicotine.

Unit-IV: Electrophilic addition to >C=C< and −C≡C− bonds [08]

A. Addition to Carbon-Carbon double (>C=CC=C< bond)

1. Introduction.
2. Examples of addition reactions.
3. Mechanism of electrophilic addition to >C=C< bond, orientation & reactivity, orientation & reactivity,

i. Hydrohalogenation.
ii. Anti-Markovnikoff's addition (peroxide effect).
iii. Rearrangements (support for formation of carbocation).
iv. Addition of halogens.
v. Addition of water.
vi. Addition of hypohalous acids (HO-X).
vii. Hydroxylation (formation of 1,A2-diols).
viii. Hydroboration-oxidation (formation of alcohol).
ix. Hydrogenation (formation of alkane).

B. Ozonolysis (formation of aldehydes & ketones).

C. Addition to Carbon-Carbon triple (−C≡C−) bond:

1. Introduction.
2. Examples of addition reactions.
3. Mechanism of electrophilic addition to−C≡C−bond.

i. Addition of halogens.
ii. Addition of halogen acids.
iii. Addition of hydrogen.
iv. Addition of water.
v. Formation of metal acetylides.

Unit-V: A) Pharmaceuticals [07]

Introduction, importance, qualities of good drug, Meaning of the terms: analgesic, antipyretic, anesthetics, antibiotics, anti-inflammatory, tranquilizer, antialargic and cardiovascular, anti hypertensive, anti-neoplastics sedative and hypnotics. Synthesis and Uses: Isoniazide, benzocaine, ethambutal,

B) Retrosynthesis

Introduction, Terms used-Target molecule (TM), Disconnection, Synthons, Synthetic equivalence, Functional group interconversion (FGI), one group disconnection (w. r. t. suitable examples), Retrosynthetic analysis and synthesis of Cinnamaldehyde, Cyclohexene, para methoxy acetophenone

Reference Books:

1. Advanced Organic Chemistry: Reactions, Mechanisms and structure by-Jerry March.
2. Reagents for Organic Synthesis by Louis F. Fieser , Mary Fieser -1967.
3. Mechanism and Structure in Organic Chemistry. April, 1963 By Edwin S.Gould.
4. A text book of Organic Chemistry by Arun Bahl, B.S.Bhal Eighteenth Revised edition 2006.
5. A guidebook to mechanism in Organic Chemistry sixth Edition by Peter Syke.
6. Organic Synthesis: The Disconnection Approach by Stuart Warren.
7. Organic Synthesis Through Disconnection Approach by P. S. Kalsi
8. Fundamentals of Organic Synthesis the Retrosynthetic Analysis by Ratan Kumar Kar
9. Organic Reactions and Their Mechanisms P. S. Kalsi 3rd Revised edition.
10. Advanced organic Chemistry by B.S. Bahl & Arun Bhal (Reprint in 1997)
11. Organic Chemistry by Morrison and Boyd 6th edition.
12. Organic Chemistry Vol II Stereochemistry and the Chemistry of Natural Products (5th ed) by I. Linear.
13. Organic Chemistry Natural Products Vol I, by O. P.Agrawal
14. Industrial Chemistry-B.K. Sharma, Goyal publishing house,Mirut
15. Shreeves chemical process industries 5th Edition, G.T. Oustin, McGrawHill
16. Riegel`s hand book of Industrial chemistry, 9th Edition, JemsA.Kent
17. Industrial chemistry –R.K. Das, 2nd Edition, 1976

Section II: Industrial Chemistry
Theory: (37 Hrs)

Course Outcomes: After the completion of the course the student will be able to:

CO1: Understand the basics of industrial chemistry.

CO2: Learn the manufacturing processes of heavy chemicals.

CO3: Acquire knowledge of sugar and jaggery industry.

CO4: Gain and understand fermentation processes involved in manufacturing of alcohol.

CO5: Illustrate overall information regarding manufacture of fertilizers.

Unit-I: **A) Introduction to Industrial Chemistry and Green Chemistry** **[08]**

Quality control, Quality assurance, process development, Research and Development, Analytical development, Environmental health and safety.

B) Industrial legislations: copy right act, patent act, trademarks; MSDS of hazardous chemicals and CASRN

Green Chemistry: Introduction, Principles and Significance of green chemistry, Green Chemicals - Green reagents, Green Catalysts and Green Solvents, Green organic Synthesis-Applications of microwaves and ionic liquids in chemical.

Unit-II: **Manufacturing of Heavy Chemicals** **[07]**

Manufacture of NH_3 by Haber–Bosch process, Physico-chemical principles and uses of NH_3. Manufacture of H_2SO_4 by contact process, Physicochemical principles, and uses of H_2SO_4. Manufacture of HNO_3 by Ostwald`s process, Physicochemical principles involved and uses of HNO_3.

Unit-III: **Manufacturing of Sugar and Jaggery** **[07]**

Sugar: Introduction, importance of sugar industry, Manufacture of cane sugar: raw material, Extraction, Clarification and Concentration of cane juice, Crystallization of sucrose, Centrifugation, Refining of cane sugar, Utilization of by-products of sugar industries.

Jaggery: Composition of Jaggery, forms of jaggery, Production process of jaggery, analysis of Jaggery - Moisture content, pH, reducing and non-reducing sugar, color.

Unit-IV: Fermentation Industry [08]

Introduction, importance, Basic requirement of fermentation process, Factors favoring fermentation, fermentation operations. Manufacture of Industrial alcohol (Ethyl alcohol) from a) Molasses b) Food grains, c) manufacture of alcohol from fruits (wine). Grades of alcohols: Silence spirit, rectified spirit, absolute alcohol, proof spirit, denatured spirit, duty and duty free alcohol. Importance of power alcohol as fuel.

Unit-V: Fertilizers [07]

General introduction, Classification of fertilizers, Necessity and requirements of good fertilizers, Manufacture of the following fertilizers: Urea, calcium ammonium nitrate, ammonium phosphates, polyphosphate, triple superphosphate, compound and mixed fertilizers. Introduction to biofertilizers.

Reference Books:

1. Industrial Chemistry - B.K.Sharma
2. Chemical process industries – Shrieve & Brink
3. Industrial chemistry – Kent
4. Industrial chemistry – Rogers
5. Industrial chemistry – R.K. Das
6. Mechanical chemistry – Burger
7. Nanotechnology: Principles and Practices –Sulbha Kulkarni
8. The Petroleum chemicals industry by R.F. Goldstine, & FnLondon
9. Fundamentals of petroleum chemical technology by P Below.
10. PetroChemicals Volume 1 and 2; A Chauvel and Lefevrev; Gulf Publishing company

SEC: 1002F Field Project & Industrial Study Tour

B. Sc. III

Syllabus for Practical Chemistry DSC-1002E and DSC-1002F

Physical Chemistry Practical's

I. Non instrumental Experiments:

i) Partition Law

To determine the partition coefficient of CH_3COOH between H_2O and CCl_4.

ii) Viscosity

To determine the viscosity average molecular weight of a polymer.

iii) Adsorption

To investigate the adsorption of oxalic acid by activated charcoal and test the validity of Freundlich& Langmuir isotherms.

iv) Solubility.

To study the effect of addition of electrolyte (NaCl or KCl) on the solubility of Benzoic acid at room temperature.

B. Chemical Kinetics. (Any four)

1. The study of energy of activation of first order reaction i.e. hydrolysis of methyl acetate in presence of 0.5 N HCl / 0.5 N H_2SO_4.
2. The study of energy of activation of second order reaction i.e. reaction between $K_2S_2O_8$ and KI (Equal concentrations).
3. The study of energy of activation of second order reaction i.e. reaction between $K_2S_2O_8$ and KI (Unequal concentrations).
4. To study the hydrolysis of methyl acetate by using its two concentrations in presence of 0.5 N HCl and hence find velocity constant of the reaction.
5. To study the effect of addition of electrolyte (KCl) on the reaction between $K_2S_2O_8$ and KI (Equal concentrations).

C. Partial molar volume.

1. To determine the partial molar volume of ethyl alcohol in a mixture of ethyl alcohol and water (Any seven mixtures be given).

II. Instrumental experiments

A. Potentiometery (Any four)

1. Titration of strong acid with strong alkali.

N.B. i) 8 to 10 ml of 1N acid solution to be given by examiner in 100 ml volumetric flask & student should dilute it to 100 ml and 10ml of this solution is taken for titration.

ii) Experiment is carried out by taking pilot run from 1 to 10 ml and then final run taking 0.2 ml reading in the range of end point.

2. Preparation of buffer solution and determination of their pH (Any five buffer solutions), Theoretical calculation of pH values by using Henderson's equation.
3. Determination of standard electrode potential of Zn/Zn^{++}, Cu/Cu^{++}, Ag/Ag^{+} (Any two).
4. Estimate the amount of Cl^-, Br^- and I^- in given unknown halide mixture by titrating it against standard $AgNO_3$ solution.
5. Titration of ferrous ammonium sulphate using $K_2Cr_2O_7$ solution and to calculate redox potential of Fe^{++}, Fe^{+++} system.

B. Conductometry (Any three).

N.B. i) 8 to 10 ml of 1N acid solution to be given by examiner in 100 ml volumetric flask & student should dilute it to 100 ml and 10ml of this solution is taken for titration.

1. Titration of a mixture of weak acid and strong acid with strong alkali
2. To study the effect of substituent on dissociation constant of weak acid with respect to acetic acid and monochloroacetic acid (cell constant to be given).

N.B. Calculate K by using formula $K= \alpha 2.C/1- \alpha$

3. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conduct metric method.
4. To determine the normality of citric acid in lemon by titrating it against standard 0.2 N NaOHsolution by conductometric method.
5. To determine λ_∞ of strong electrolyte (NaCl or KCl) and to verify Onsager equation.

C. Refractometry (Any One)

1. To determine the percentage composition of unknown mixture by (i) graphical methodand (ii) by composition law (Densities of pure liquids A & B be given).
2. To determine the molar refractivity of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the refraction equivalents of C, H and Cl atoms.

D. Colorimetry (Any Two).

1. To verify Lambert – Beer's law using CuSO4 solution.
2. To estimate of Fe^{+++} ions by thiocynate method.
3. To estimate Fe^{+++} ions using salicylic acid by colorimetric titration.
4. To determine the order of reaction for the oxidation of alcohol by potassium dichromate and potassium permanganate in acidic medium colorimetrically.

E. pHmetry (Any One).

1. To determine the dissociation constant of monobasic acid (Acetic acid).
2. To determine the dissociation constant of dibasic acid (Malonic acid).
3. To determine hydrolysis constant of aniline hydrochloride.

Inorganic Chemistry Practical's

Gravimetric Estimation: (G). N. B.: Any two experiments from G1 to G3 and any one experiment from G4 & G5.

1. G1: Gravimetric estimation of iron as ferric oxide from the given solution containing ferrous ammonium sulphate, copper sulphate and free sulphuric acid.
2. G2: Gravimetric estimation of aluminium as aluminium oxide from the given solution containing potash alum, coppersulphate and free sulphuric acid.
3. G3: Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride, ferric chloride and free hydrochloric acid.
4. G4: Gravimetric estimation of manganese as ammonium manganese phosphate from the given solution containing manganese sulphate, copper sulphate and free sulphuric acid.

5. G5: Gravimetric estimation of nickel as bis (dimethylglyoximato) nickel (II) from the given solution containing nickel sulphate, ferrous ammonium sulphate and free Sulphuric acid.

Inorganic Preparations (P) (Any six):

P1. Preparation of sodium cuprous thiosulphate

P2. Preparation of potassium trioxalato aluminate (III).

P3. Preparation of tris (ethylene diamine) nickel (II) thiosulphate.

P4. Preparation of tetra aminecopper(II) sulphate.

P5. Preparation of ammonium diamminetetrathiocynatochromate (III)

P6. Preparation of tris(thiourea) cuprous sulphate.

P7. Synthesis of CuO nanoparticles.

P8. Preparation of pigment (Zinc Oxide).

P9. Preparation of Urea formaldehyde resin.

P10. Preparation of Phenol formaldehyde resin.

Titrimetric Estimations:

A) Percentage Purity (Any two):

V1. Determination of percentage purity of tetrammine copper (II) sulphate.

V2. Determination of percentage purity of ferrous ammonium sulphate.

V3. Determination of percentage purity of potassium trioxalato aluminate.

B) Analysis of Commercial Sample. (Any five):

V4. Determination of percentage of magnesium in the given sample of talcum powder.

V5. Determination of amount of aluminum in the given solution of potash alum.

V6. Determination of titrable acidity in the given sample of milk or lassi.

V7. Determination of Fe in cement.

V8. Determination of chlorine in bleaching powder.

V9. Determination of Free acidity in ammonium sulphate fertilizer.

V10. Determination of percentage of $CaCO_3$ in chalk.

V11. Determination of COD.

C) Ion exchange method (Any two):

V11. Determination of amount of sodium present in the given solution of common salt using cation exchange resin (By Acid Base titration)

V12. Determination of amount of magnesium in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA.

V13. Determination of amount of zinc in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA.

Organic Chemistry Practical's

1. Separation and identification of Binary Organic Mixtures:

2. Organic Estimations (Any four):

1. Estimation of Sucrose. /Glucose
2. Estimation of Nitro group
3. Estimation of acid and ester present in given mixture of acid and ester.
4. Estimation of Unsaturation
5. Estimation of glycine (amino acid).
6. Saponification value of Oil.
7. Determination of number of –OCH3 group (Ziesels method).
8. Estimation of drug (Isoniazide/Ibuprofen).
9. Determination of molecular weight of acid

3. Organic Preparations (Any four):

Preparation of,

1. Dihydropyrimidone.
2. Dibenzalpropanone.
3. Benzilic acid.
4. 1,1-Bis 2 naphthol.
5. Hippuric acid from glycine.
6. Ethylbenzene from acetophenone.
7. Adipic acid from cyclohexene.

4. Preparation of Derivatives(Any five):

1. Picrate derivative of β – Naphthol and anthracene.
2. Oxalate derivative of Urea.
3. Nitrate derivative of Urea.
4. Iodoform derivative of Acetone.
5. 2:4 DNP derivative of Acetaldehyde.
6. m-Dinitrobenzene from Nitrobenzene.
7. Phenylhydrazone derivative of Aldehyde and Ketone.

Nature of Theory and Practical Examinations

N. B. The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective units.

Nature of Discipline-Specific Elective (DSE) Question Paper

Total Marks: 70 Theory + 30 Internal Marks (Section-1: 35+15, Section-II: 35+15)

Que. No.	Particulars	Marks	Marks of options
1a	Multiple choice questions (One mark for each question)	05	00
1b	Fill in the blanks	02	00
2	Long answer type questions (2 out of 3)	16	08
3	Short answer type questions (3 out of 5)	12	08
Total		**35**	**16**

- The duration of each theory paper for the examination will be of 2 hours.
- Internal examination (Oral/Seminar/Test/ Assignment) will be conducted for 15 marks for each paper.

Nature of Skill Enhancement Course (SEC) Question Paper

The nature of the SEC exam for

Sem-V will be multiple choice questions for 50 marks

Sem-VI project work and industrial study tour for 50 marks.

Nature of Practical Examination

The practical examination will be 200 marks. The distribution of marks will be as follows:

1. Physical Section: 65 marks
2. Inorganic Section: 70 marks
3. Organic Section: 65 marks

Total: 200 marks

The duration of practical examination will be of three days- six and half hours per day.

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

HEAD
DEPARTMENT OF CHEMISTRY
VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)