Shivaji University, Kolhapur

B.O.S. in Chemistry

B.Sc. Part – III

Semester Syllabus

[To be implemented from June – 2015]

INTRODUCTION

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

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

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

OBJECTIVES

To enable the students-

1. To promote understanding of basic facts and concepts in Chemistry while retaining the excitement of Chemistry.
2. To make students capable of studying Chemistry in academic and Industrial courses.
3. To expose the students to various emerging new areas of Chemistry and apprise them with there prevalent in their future studies and their applications in various spheres of chemical sciences.
4. To develop problem solving skills in students.
5. To expose the students to different processes used in Industries and their applications.
6. To develop ability and to acquire the knowledge of terms, facts, concepts, processes, techniques and principles of subjects,
7. To develop ability to apply the knowledge of contents of principles of Chemistry.
8. To acquire of new knowledge of chemistry and developments therein.
9. To expose and to develop interest in the fields of chemistry
10. To develop proper aptitude towards the subjects.

11. To develop the power of appreciations, the achievements in Chemistry and role in nature and society.
12. To develop skills required in chemistry such as the proper handling of apparatus and chemicals

Equivalence

Equivalence in accordance with titles and contents of papers (for revised syllabus)

Sr. No.	Title of old paper	Title of new paper
1	Paper – IX & XIII : Physical Chemistry	Paper – IX &XIII : Physical Chemistry
2	Paper - X &XIV: Inorganic Chemistry	Paper – X &XIV: Inorganic Chemistry
3	Paper - XI & XV: Organic Chemistry	Paper-XI & XV: Organic Chemistry
4	Paper – XII : Industrial Chemistry	Paper-XVI: Analytical Chemistry

A repeater candidate, if any, will be allowed to appear for examination as per old course up to March / April 2017 examination.

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. I.R.Lamp
11. Magnetic stirrer
12. Buckner funnel
13. Water bath
14. Platinum electrode
15. Glass electrode
16. Silver, Zink, Copper electrodes
17. Conductivity cell
18. Distilled water plant.
19. Refractometer
20. Freeze
21. Deep Freeze
22. H_2S Apparatus

Glassware & Porcelain ware:-

1. Burette (50ml)
2. Pipette (5ml,10ml,25ml)
3. Conical flask(100ml, 250ml)
4. Beakers (100ml, 250ml, 500ml)
5. Volumetric flask (100ml, 250ml)
6. Gooch Crucible
7. Watch glass
8. Glass tubing
9. Funnel (3")
10. Gas jar
11. Glass rod
12. Test Tubes (12x100, 5x5x8)
13. Evaporating dish
14. Crucible
15. T.L.C.Unit
16. Measuring cylinder

17. Thiele's tubes
18. Capillary tube
19. Stopper bottle
20. Thermometer (360^{o} C)
21. Water condenser
22. Distillation flask (100ml)
23. Titration tiles.

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

2. Whatman Filter paper No. 1, 40, 41, 42.

Lab safety Precautions / Measures in Chemistry Laboratory

Part-I: Personal Precautions-

1 All personnel must wear safety Goggles at all times.

2 Must were 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 Equipments -

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 date sheets

6 Management of Local exhaust system and fume hoods.

7 Sign. in register if using instruments.

Nature of theory question papers

Common Nature of Question Paper mentioned Separetly

General Structure

Theory examination: **There will be four theory papers of 40 marks each. Their titles and distribution of marks are as follows.**

Paper – **IX &XIII**	:	Physical Chemistry – 40 marks
Paper – **X &XIV**	**:**	Inorganic Chemistry – 40 marks
Paper – **XI & XV**	**:**	Organic Chemistry – 40 marks
Paper – **XII &XVI**	**:**	Industrial Chemistry– 40 marks
Paper – **XII &XVI**	**:**	Analytical Chemistry– 40 marks

The duration of each theory paper will be of 2 hours.

Practical examination:

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

Physical Section	:	60
Inorganic Section	:	65
Organic Section	:	60
Project	:	15
Total	:	200

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

Sub-committee, Board of Studies,
Shivaji University, Kolhapur.

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Semester Syllabus for B.Sc.-III

Theory

N. B. (i) Figures shown in bracket indicate the total lectures required for the respective topics.

(ii) The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective topics.

(iii) Industrial tour is prescribed.

(iv) Use of recent editions of reference books is essential.

(v) Use of scientific calculator is allowed.

(vi) **Values required for spectral problems should be provided in the question paper.**

SEMESTER V
Paper IX
(Physical Chemistry) 38 Lectures

Unit-1. Quantum Theory. [08]

1.1 Introduction
1.2 Duel nature of matter and energy:- De Broglie hypothesis.
1.3 The Heisenberg's uncertainty principle.
1.4 Concept of energy operators (Hamiltonian).
1.5 Derivation of Schrodinger wave equation.
1.6 Physical interpretation of the ψ and ψ^2.
1.7 Particle in a one dimensional box.
1.8 Schrodinger wave equation for hydrogen atom.
1.9 Concept of Quantum numbers.

Unit – 2. Spectroscopy. [08]

2.1 Introduction
2.2 Electromagnetic radiation.
2.3 Electromagnetic spectrum, Energy level diagram.
2.4 Rotational spectra of diatomic molecules: Rigid rotor model; moment of inertia (derivation expected); energy levels of rigid rotor, selection rules; spectral intensity; distribution using population distribution (Maxwell – Boltzman distribution), determination of bond length; isotope effect(Numerical problems not expected). Interaction of radiation with rotating molecule.
2.5 Vibrational spectra of diatomic molecules : Simple Harmonic oscillator model, Vibrational energies of diatomic molecules, Determination of force constant, overtones. Interaction of radiation with vibrating molecules.
2.6 Raman spectra : Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, selection rules.

2.7 Numerical problems.

Unit – 3 Photochemistry. [07]

3.1 Introduction
Difference between thermal and photochemical processes.
3.2 Laws of photochemistry :
i) Grotthus - Draper law,
ii) Lambert law,
iii) Lambert – Beer's law (with derivation),
iv) Stark - Einstein law.
3.3 Quantum yield, Reasons for high and low quantum yield.
3.4 Factors affecting Quantum yield.
3.5 Photosensitized reactions – Dissociation of H_2, Photosynthesis.
3.6 Photodimerisation of anthracene, decomposition of HI and HBr.
3.7Photophysical and photochemical processes.
3.8 Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence.
3.9 Chemiluminescence, Electroluminescence.
3.10 Numerical problems.

Unit – 4 Solutions. [05]

4.1 Introduction
4.2 Ideal solutions, Raoult's law, vapour pressure of ideal and non ideal solutions of miscible liquids.
4.3 Composition of liquid and vapour, vapour pressure and boiling point diagrams of miscible liquids.
Type I : Systems with intermediate total vapour pressure. (i.e. System in which b.p. increases regularly – Zeotropic)
Type II : Systems with a maximum in the total vapour pressure. (i.e. System with a b.p. minimum – Azeotropic)
Type III : Systems with a minimum in the total vapour pressure. (i.e. System with a b.p. Maximum – Azeotropic)
Distillation of miscible liquid pairs.
4.4 Solubility of partially miscible liquids.
(i) Maximum solution temperature type : Phenol – water system.
(ii) Minimum solution temperature type : Triethyl amine – water system.
(iii) Maximum and minimum solution temperature type : Nicotine – water system.
Distillation of partially miscible liquid pairs.
4.5 Vapour pressure and distillation of immiscible liquids, steam distillation.

Unit – 5. Electromotive force. [10]

(Convention : Reduction potentials to be used)
5.1 Introduction

5.2 Thermodynamics of electrode potentials, Nernst equation for electrode and cell potentials in terms of activities.
5.3 E.M.F. series.
5.4 Types of electrodes : Description in terms of construction, representation, half cell reaction and emf equation for
i) Metal – metal ion electrode.
ii) Amalgam electrode.
iii) Metal – insoluble salt electrode.
iv) Gas – electrode.
v) Oxidation – Reduction electrode.
5.5 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.
5.6 Equilibrium constant from cell emf, Determination of the thermodynamic parameters such as ΔG, ΔH and ΔS.
5.7 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 cell).
5.8 Numerical problems.

Semester V
Paper -X
(Inorganic Chemistry) 37 Lectures

Unit 1. Hard and Soft Acids and Bases (HSAB). [05]

1.1 Classification of acids and bases as hard and soft.
1.2 Theoretical bases of hardness and softness
1.3 Pearson's HSAB concept.
1.4 Acid – Base strength and hardness and softness.
1.5 Application and limitations of HSAB principle.

Unit 2. Metal ligand bonding in Transition metal complexes [08]

2.1 Isomerism in complexes with C.N.-4 and 6
2.1.1 Geometrical Isomerism
2.1.2 Optical Isomerism
2.1.3 Structural Isomerism-Ionisation Isomerism,Hydrate Isomerism, Coordination Isomerism,Linkage Isomerism and Co-ordination position Isomerism
2.2 Molecular orbital theory (MOT).
2.2.1 Introduction.
2.2.2 MOT of octahedral complexes with sigma bonding such as $[Ti(H2O)6]^{3+}$, $[Ni(NH3)6]^{2+}$, $[CoF6]^{3-}$, $[Co(NH3)6]^{3+}$.
2.2.3 Merits and demerits of MOT.

Unit 3. Inorganic Polymers. [07]

3.1 Introduction.
3.2 Basic concept and definition.
3.3 Classification of polymers - Organic and Inorganic polymers.
3.4 Comparison between organic and inorganic polymers.
3.5 Polymer back bone.
3.6 Homoatomic polymer containing – (i) Phosphorus. (ii) Fluorocarbons.
3.7 Heteroatomic polymers -
(i) Silicones (ii) Phosphonitrilic compounds.

Unit 4. Metals, Semiconductors and Superconductors. [10]

4.1 Introduction.
4.2 Properties of metallic solids.
4,3 Theories of bonding in metal.
i) Free electron theory.
ii) Molecular orbital theory (Band theory).
4.4 Classification of solids as conductor, insulators and semiconductors on the basis of band theory.
4.5 Semiconductors. Types of semiconductors - intrinsic and extrinsic semiconductors. Applications of semiconductors.
4.6 Superconductors: Ceramic superconductors - Preparation and structures of mixed oxide $YBa2Cu3O7 - x$
4.7 Applications of superconductors.

Unit 5. Organometallic Chemistry. [07]

5.1 Definition, Nomenclature of organometallic compounds.
5.2 Synthesis and structural study of alkyl and aryl compounds of Li, Be and Al.
5.3 Mononuclear carbonyl and nature of bonding in simple metal carbonyls.

Semester V
Paper No. XI
(Organic Chemistry) 38 Lectures

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

Regions of electromagnetic radiation.

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.

Ref. No. 1-9

Unit II. UV Spectroscopy [05]

1. Introduction,

2. Beer-Lamberts law, absorption of U.V. radiation by organic molecule leading to different excitation.

3. Terms used in U.V. Spectroscopy- Chromophore, Auxochrome, Bathochromic shift, hypsochromic shift, hyperchromic and hypochromic effect.

4. Modes of electromagnetic transitions.

5. Effect of conjugation on position of U.V. band.

6. Calculation of λ-max by Woodward and Fisher rules for dienes and enones systems.

7. Colour and visible spectrum.

8. Applications of U.V. Spectroscopy-

Ref-5. Section 2.1, 2.3, 2.7 to 2.15 pages 13-15, 18-38,

Unit III. IR Spectroscopy [06]

1. Introduction,

2. Principle of I.R. Spectroscopy,

3. IR Instrumentation, schematic diagram- (Rf No. 6, P. No. 33))

4. Fundamental modes of vibrations types and calculation –

(3N-6,3N-5; Rf 7, P. No. 19-22)

5. Condition for absorption of IR radiations

6. Regions of I.R. Spectrum, fundamental group region, finger print region.

7. Hooks Law for Calculation of vibrational frequency (Rf 8, P. No. 26; Rf 6, P. No. 29-32).

8. Factors affecting on IR absorption frequency (Rf. No. 2,137-144: Rf.No.6,47-49, 61-63; Rf. 7, P No.43-48, Rf. 8, P No.29-38).

9. Characteristic of I.R. absorption of following functional groups (RF No. 6) a) Alkanes (RF No. 6, P.No.40-41), alkenes (RF No. 6, P.No.40-42), alkynes (RF No. 6, P.No.43-44), b) Alcohol and phenols (RF No. 6, P.No.54-57), c)Ethers (RF No. 6, P.No.58-59), d) Carbonyl

compounds (RF No. 6, P.No.60-80), e) Amines (RF No. 6, P.No.80-82), f) Nitro compounds (RF No. 6, P.No.84-85), g) Aromatic Compounds (RF No. 6, P.No.51-54).

Unit IV. NMR Spectroscopy [09]

1. Introduction,
2. Principles of PMR Spectroscopy
3. NMR- Instrumentation, Schematic diagram (Rf. No. 2 P. No. 201).
4. Magnetic and nonmagnetic nuclei (Rf. No.1, P.No. 95-96).
5. Chemical shift- definition, measurement, calculation, Factors affecting Chemical shift (Rf No. 5, 2.192-2.196; Rf. No. 1, P. No. 103-110; Rf. 9, P. No. 372-383).
6. Shielding, & deshielding (Rf. 9, P.No. 376-381).
7. Peak Integration (Rf. 6, P.No. 123-124).
8. Merits of TMS as PMR reference compounds
9. Coupling Constant (Rf. 6, P.No. 138-141)
10. Types of Coupling Constant (Rf.6, P. No. 125-138; Rf. 9, P. No. 395-405).
11. Spin-spin splitting (n+1 rule).(Rf. 2, P.No. 245-257; Rf. 6, P.No. 131-137)
12. Applications

Unit V. Mass spectroscopy. [08]

1. Introduction
2. Principle of mass spectroscopy (Rf. No. 1, P. No. 142--143).
3. Mass spectrometer - schematic diagram (Rf. No. 2, P. No. 424).
4. Types of ions produced in mass spectrum (Rf. 5, P. No 2.285-2.2870, Rf. No. 1, P. No. 149-153).
5. Fragmentation patterns of- alkanes, alkenes, aromatic hydrocarbons, alcohols, phenols, amines and carbonyl compounds (Rf. No. 1, P. No. 161-174: Rf. No. 2, P. No. 453-512).
6. McLaffrety rearrangement (Rf. No.2, P. No. 479-493).
7. Applications-

Unit VI. Combined Problems based on UV, IR, NMR and Mass Spectral data **[08]**

Reference Books: (Use recent editions)

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

Semester-V
Paper-XII
(Industrial Chemistry) 38 lectures

1. Manufactue of Heavy Chemicals (8)

1.1 Introduction

1.2 Manufacture of Ammonia (NH_3)

i. Physico-chemical principles

ii. Manufacture by Haber's process

1.3 Manufacture of Sulphuric acid (H_2SO_4)

i. Physico-chemical principles

ii. Manufacture by Contact process

1.4 Manufacture of Nitric acid (HNO_3)

i. Physico-chemical principles

ii. Manufacture by Ostwald's (Ammonia oxidation process)

1.5 Manufacture of Sodium carbonate (Washing soda) (Na_2CO_3)

i. Physico-chemical principles

ii. Manufacture by Solvay process

2. Corrosion and Passivity (8)

2.1 Introduction of corrosion

2.2 Electrochemical theory of corrosion

2.3 Factors affecting on corrosion,

i. Position of metals in the electrochemical series on the basis of standard reduction potential

ii. Purity of metal

iii. Effect of moisture

iv. Effect of oxygen (differential aeration principle)

v. Hydrogen overvoltage

2.4 Methods of protections of metals from corrosion

2.5 Passivity

i. Definition

ii. Types of passivity

iii. Oxide film theory and evidences

iv. Applications of passivity

3. Sugar Industry **(7)**

3.1 Introduction

3.2 Manufacture of cane sugar, extraction, decolourisation, crystallization and other details of industrial process

3.3 Refining of raw sugar

3.4 Manufacturing of white sugar in India

3.5 Byproducts of sugar industry

4. Soaps and Detergents **(7)**

4.1 Introduction

4.2 Soaps

i. Raw materials,

ii. Types of soaps

iii. Cleaning action of soap

4.3 Manufacture of soap

i. Cold Process

ii. Semi-boiled Process

iii. Boiled or Hot Process

4.3 Detergents

i. Raw Materials

ii. Types of Detergents: Anionic, cationic and amphoteric

4.4 Comparisons between soaps and detergents.

5. Nanomaterials **(8)**

5.1 Terminology and history

5.2. Optical properties of nanomaterials

i. Semiconducting nanoparticle

ii. Metallic nanoparticle

5.3 Characterization and fabrication

i. Characterization methods

a) Scanning electron microscopy

b) Transmission electron microscopy

ii. Top-down, bottom-up fabrication

a) Colloidal route

b) Sol-gel method

c) Chemical reduction method

d) Electrochemical method.

5.4 Applications of Nanomaterials

Reference:

1. Text Book of Quantitative inorganic analysis – A.I.Vogel
2. Instrumental methods of chemical analysis –Willard, Merit & Dean
3. Principles of electroplating & electroforming – Blum &Hogaboom
4. Instrumentals methods of chemical analysis – Chatwal&Anand
5. Vogel's textbook of qualitative inorganic analysis – Bassett, Denny etc
6. Textbook of qualitative inorganic analysis – Kolthoff and sandel
7. Fundamentals of analytical chemistry – Skoog and West
8. Basic concepts of analytical chemistry – Khopkar
9. Analytical chemistry – Walton
10. Chemical process industries – Shrieve& Brink
11. Industrial chemistry – Kent
12. Industrial chemistry – Rogers
13. Industrial chemistry – R.K.Das
14. Text book of qualitative organic analysis - Vogel
15. Qualitative organic chemistry – Vogel
16. Hand book of organic analysis – H.T.Clarke
17. Chemistry of pesticides – K.H.Buchel
18. Mechanical chemistry – Burger
19. Biotechnology & applied microbiology – Alani& Moo- Young
20. Immobilized Biocatalysts – Joy Wleser
21. Inorganic Chemistry 5th edition Shriver and Aitkin's
22. Instrumental methods of chemical analysis – H.Kaur
23. Nanotechnology: Principles and Practices – Sulbha Kulkarni

SEMESTER VI
Paper XIII
(Physical Chemistry) 37 Lectures

Unit – 1. Phase Equilibria. [05]

1.1 Introduction

1.2 Gibbs phase rule : Phase rule equation and explanation of terms involved in the equation.

1.3 Phase diagram, true and metastable equilibria.

1.4 One component systems: (i) Water system (ii) Sulphur system with explanation for polymorphism.

1.5 Two component systems:
(i) Eutectic system: (Ag – Pb system); Desilverisation of lead,
(ii) Freezing mixture: (KI –H_2O system),
(iii) Formation of compound with congruent melting point ($FeCl_3$ – H_2O)

1.5 Three component solid-liquid system:
Development of triangular phase diagram: (Acetic acid – Chloroform –water system).

Unit – 2 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 _G and _H : Gibbs Helmholtz equation.

2.4 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 –3 The solid state. [08]

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 – 4 Radioactivity [04]

4.1 Introduction.
4.2 Detection and measurement of nuclear radiation by Scintillation and Geiger Muller counter methods.
4.3 Radioactive equilibrium and range of α - particles.
4.4Geiger – Nuttal relation, Determination of radioactive constant (decay constant).

Unit – 5 Chemical Kinetics. [04]

5.1 Introduction
5.2 Simultaneous reactions such as
i)opposing reaction: (Derivation of rate equation for first order opposed by first order expected, Numerical problems expected),
ii)side reaction:,
iii)consecutive reactions: (Derivation of rate equation and Numerical problems are not expected).

Unit –6 Surface Chemistry. [07]

6.1 Introduction: Adsorption, Mechanism of adsorption, Factors affecting adsorption.
6.2 Types of adsorption: Physical and chemical
6.3 Types of adsorption isotherms.
6.4 Adsorption isotherm.
i) Freundlich adsorption isotherm
i) Langmuir adsorption isotherm with derivation.
6.5 BET equation and determination of surface area of adsorbent by BET equation.
6.6 Applications of adsorption.

Recommended (Reference) Books:

(Use recent editions)

1. Physical Chemistry by G. M. Barrow, International student Edition, Mc Graw 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 by Friedlander, Kennedy and Miller, John Wiley and Sons. Wiley International edition.
7. Essentials of Nuclear Chemistry by H. J. Arnikar, 4th edition. Wiley Eastern.
8. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Naginchand 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 Mc Graw-Hill.
11. Quantum Chemistry including molecular spectroscopy by B. K. Sen, Tata Mc Graw - Hill.

12. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.
13. Elements of Physical Chemistry by D. Lewis and S. Glasstone (Macmillan).
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.
20. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition

SEMESTER -VI
Paper XIV
(Inorganic Chemistry) 38 Lecture

Unit 1 Inorganic Reaction mechanism [6]

1.1 Introduction
1.2 Classification of Mechanism
Association, dissociation, interchange and the rate determining steps
1.3 SN^1 and SN^2 reaction for inert and labile complexes
1.4 Mechanism of substitution in cobalt (III) octahedral complexes
1.5 Trans effect and its theories
1.6 Applications of trans effect in synthesis of Pt (II) complexes.

Unit 2 Thermodynamic and Kinetic aspects of metal complexes. [7]

2.1 Introduction
2,2 Thermodynamic stability
2.3 Kinetic Stability
2.4. Relation between thermodynamic and kinetic stability
2.5 Step wise stability constant
2.6 Factor affecting the stability of complexes

Unit 3. A. Nuclear Chemistry. [12]

3..1 Nuclear reactions and energetic of nuclear reactions.
3.2 Types of nuclear reactions-
i) Artificial transmutation.
ii) Artificial radioactivity.
iii) Nuclear fission and its application in Heavy water nuclear reactor.
vi) Nuclear fusion.
3.3 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}.

B. Actinides

3.4 Position in periodic table.
3.5 Electronic configuration.
3.6 General methods of preparation of Transuranic elements.
i) Neutron capture – followed by β decay.
ii) Accelerated projectile bombardment.
iii) Heavy ion bombardment.
3.7 IUPAC nomenclature of the super heavy elements with atomic number (Z) greater than 100.

Unit 4. Iron and Steel. [07]

4.1 Occurrence.
4.2 Extraction of iron by Blast furnace.
4.3 Steel: Definition and types.
4.4 Conversion of cast iron into steel by
i) Bessemer process.
ii) L.D. process.
4.5 Heat treatment on steel.

Unit 5. Bio-inorganic Chemistry. [06]

5.1 Introduction.
5.2 Essential and trace elements in biological process.
5.3 Metalloporphyrins with special reference to hemoglobin and myoglobin.
5.4 Biological role of alkali and alkaline earth metal ions with special reference to Na^+, K^+ and Ca^{2+}

Reference Books: (Use recent editions)

1. Concise Inorganic Chemistry (ELBS, 5th Edition) – J. D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, 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 – New Delhi.
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

Semester VI
Paper No. XV
(Organic Chemistry) 38 Lectures

Unit I. Name reactions. [08]

Statement, General Reaction, Mechanism and Synthetic applications

1. Diels -Alder reaction (Rf.1,P.No.536; Rf.2,P No 248; Rf.3, P No 197, 340, 349 Rf.4, P No No 626-636)
2. Oppenauer Oxidation (Rf. No.1, P.N.545; Rf.2, P No 391; Rf.3, P No 216; Rf.4, P No. 863,865)
3. Meerwein –Pondorff-Verley reduction (Rf. No.1, P.N.545)
4. Schmidt rearrangement (Rf. No.1, P.N.624; Rf.3, P No 122; Rf.4, P No 783,819)
5. Hofmann rearrangement (Rf. No.1, P.N.621; Rf.2,P No 732.551; Rf.3, P No 122; Rf.4, P No 783.816).
6. Wittig reaction (Rf.2,P No 409; Rf.3, P No 233; Rf.4, P No 693,702,709)
7. Wagner- Meerwein rearrangement (Rf. No.1, P.N. 584; Rf.3, P No 111; Rf.4, P No 794-798).
8. Favorskii rearrangement (Rf No. 1, P.N.157, 642; Rf.3, P No 294; Rf.4, P No 804-809).
9. Michael reaction (Rf No. 1, P.N.392; Rf.3, P No 200; Rf.4, P No 604
10. Dieckmann's reaction or condensation (Rf. No. 1, P.N. 334; Rf.2, P No 586; Rf.4, P No 367)
11. Problem based on above reactions.

References:

1. Mechanism and Structure in Organic Chemistry. April,1963 By Edwin S.Gould
2. A text book of Organic Chemistry by Arun Bahl , B.S.Bhal Eighteenth Revised edition 2006 .
3. A guidebook to mechanism in Organic Chemistry sixth Edition by Peter Sykes.

4. Advanced Organic Chemistry : Reactions, Mechanisms and structure by Jerry March.

Unit II. Reagents in Organic Synthesis. [06]

Preparation and Applications of following reagents.

1. Lithium aluminium hydride $LiAlH_4$ (Rf No.1 P.No. 350; Rf No.2 P.No. 581-595; Rf No.3 P.No. 877-881)
2. Osmium tetraoxide (Rf No.1 P.No. 616; Rf No.2 P.No. 759-764; Rf No.3 P.No. 894-895)
3. Dicyclohexyl Carbodiimide (DCC) (Rf No.2 P.No. 231-236)
4. Raney Nickel (Rf No.1 P.No. 439, 556; Rf No.2 P.No. 143, 440, 441, 956; Rf No.3 P.No. 870)
5. 2,3-Dichloro -5,6-dicyano – 1,4-benzoquinone (DDQ) (Rf No.2 P.No. 215-219)
6. Polyphosphoric acid (PPA) (Rf No.2 P.No. 894-905).
7. Diazomethane (Rf No.2 P.No. 191-195; Rf No.3 P.No. 969-972)
8. Cerric ammonium nitrate (CAN) (Rf No.2 P.No. 120-121)
9. N-Bromosuccinamide (NBS) (Rf No.2 P.No. 78-80; Rf No.3 P.No. 926-927)
10. Selenium dioxide (SeO_2) (Rf No.2 P.No. 992-1000; Rf No.3 P.No. 200)

References :

1. Advanced Organic Chemistry : Reactions, Mechanisms and structure by – Jerry March
2. Reagents for Organic Synthesis by Louis F. Fieser , Mary Fieser - 1967
3. A Text book of Practical Organic Chemistry including Qualitative Organic Analysis by Arthur I Vogel.

Unit III. Electrophilic addition to >C=C< bond and —C≡C— bond [08]

A. Addition to Carbon-Carbon double bond (>C=C<) : Introduction, Examples of addition reactions, Mechanism of electrophilic addition to >C=C< bond, Hydrohalogenation:-orientation & reactivity, Anti-Markovnikoff's addition (peroxide effect), Rearrangements (support for formation of carbocation), Addition of halogens, Addition of water, Addition of hypohalous acids (HO-X), Hydroxylation (formation of 1,2-diols),

Hydroboration-oxidation (formation of alcohol), Hydrogenation (formation of alkane), Ozonolysis (formation of aldehydes & ketones).

B. Addition to Carbon-Carbon triple bond (—C≡C—) : Introduction, Examples of addition reactions, Mechanism of electrophilic addition to —C≡C— bond. Addition of halogens, Addition of halogen acids, Addition of hydrogen, Addition of water, Formation of metal acetylides.

Reference books:

1. Organic Reactions and Their Mechanisms P. S. Kalsi 3rd Revised edition.
   Sections- 7.6, 11.1, 11.2, 11.3.11.6.11.7, 11.8, 11.9, 13.3 to 13.5 .
   pages – 304 to 310, 421 to 425, 427 to 431. 481 to 486.
2. Advanced organic Chemistry by B.S. Bahl & Arun Bhal (Reprint in 1997)
   pages – 241 to 258,
3. Organic Chemistry by Morrison and Boyd 6th edition.
   Sections-9.1,9.2,9.5,9.14,9.17,9.21,9.25,9.26

pages -317 to 323,327 to 343,346 to 355,357 to 360,431 to 433

Unit IV. Natural Products [08]

A] Terpenoids:

1. Introduction, Occurrence, Isolation, General Characteristic, Classification.
   (Rf. 1, P No. 368-370; Rf. 2, P No. 312-315)
2. General Methods for structure determinations
   (Rf. 1, P No. 370-372; Rf. 2, P No. 317-323)
3. Isoprene rule. (Rf. 2, P No. 317)
4. Analytical evidences and synthesis of Citral (Rf. 1 P No. 357-377) and alpha-terpineol.(Rf. 1, P No. 383-385)

B] Alkaloid:

1. Introduction, Occurrence, Isolation, Classification, Properties. (Rf. 1, P No. 710-711; Rf. 2, P No. 193-195)
2. General Methods for structure determinations (Rf. 1, P No. 711-715; Rf. 2, P No. 196-203)
3. Analytical evidences and synthesis of Ephedrine (Rf. 2 P No. 204-205) and Nicotine

Reference Books:

1. Organic Chemistry Vol 2, Stereochemistry and the Chemistry of Natural Products (5th ed) by I L Finar
2. Organic Chemistry Natural Products Vol I, by O P Agrawal

Unit V. Pharmaceuticals [06]

1. Introduction, Classification, Qualities of ideal drug.
2. Synthesis and uses: ethambutal, phenobarbitone, isoniazide, benzocaine, Chloramphenicol, paludrine.
3. Drug action of sulpha drugs.

(Ref.1: *P. No.*762-775; Ref.2: *P. No.*803-804, 818-822; Ref.3: *P. No.*987-1011)

References :

1. Industrial Chemistry-B.K. Sharma, Goyal publishing house, Mirut
2. Shreeves chemical process industries 5th Edition, G.T. Oustin, Mc Graw Hill
3. Riegel`s hand book of Industrial chemistry, 9th Edition, Jems A. Kent
4. Industrial chemistry –R.K. Das, 2nd Edition, 1976.
5.Synthetic drugs by M.S.Yadav ,Campus book international , page no. 284,285,212,213

Semester-VI
Paper-XVI
(Analytical Chemistry) 38 lectures

1. Theory of Titrimetric Analysis (8)

1.1 Introduction
1.2 Neutralization Indicators (Acid-Base Indicators)
1.3 Theory of indicators w.r.t. Ostwald's colour change interval and Ostwald's Quinoid theory
1.4 Neutralization curves and choice of indicators for the following titration,
i. Strong acid-strong base
ii. Strong acid-weak base
iii. Strong base - weak acid
1.5 Complexometric titration
i. General account
ii.Types of EDTA titration
iii. Metallochromic indicators w.r.t. Eriochrom Black-T indicator

2. Potentiometric Titrations **(8)**

2.1 Introduction
2.2 Determination of pH
2.3 Study of Quinhydrone and Glass electrodes and their use in determination of pH
2.4 Potentiometric titrations: Classical and analytical methods for locating end points
2.5 Acid base titration
2.6 Redox titration
2.7Advantages of potentiometric titrations
2.8 Precipitation titration
2.9 Basic circuit of direct reading potentiometer

3. Colorimetry and Spectrophotometry **[06]**

3.1 Theory of Colorimetry and Spectrophotometry
i. Lambert Beer's law
ii. Terms used in Colorimetry and Spectrophotometry
iii. Deviation from Beer's law.
3.2 Classification of methods of 'colour' measurement or comparison
i. Photoelectric Colorimeter method – Single beam photo-electric colorimeter.
ii. Spectrophotometer method – Single beam direct reading spectrophotometer
3.3 Determination of unknown concentration by using Concentration-Absorbance plot.

4. Flame Photometry **(8)**

4.1 Introduction
4.2 General principles of flame photometry
4.3 Instrumentation
4.4Effect of solvent in flame photometry
4.5 Instruments
4.6 Application of flame photometry
4.7 Interference in flame photometry
4.8 Factors that influence the intensity of emitted radiation in a flame photometer
4.9 Limitations of flame photometry
4.10 Conclusions

5. Chromatography **(8)**

7.1 Introduction
7.2 Developments in chromatography
7.3 Advantages of chromatography
7.4 Types of chromatography on the basis of mechanism of interaction of solute with Stationary phase
i) Adsorption ii) Partition iii) Ion Exchange iv) Size exclusion v) Affinity
7.5 Classification of chromatography on the basis of mobile phase and stationary phase
i) Gas Chromatography ii) Liquid Chromatography iii) Supercritical-fluid Chromatography
7.5 Paper Chromatography and its applications
7.6 Thin layer chromatography and its applications
7.7 Adsorption column chromatography and its applications
7.8 Gas chromatography and its applications.

References

1.Text Book of Quantitative inorganic analysis – A.I.Vogel
2. Instrumental methods of chemical analysis –Willard, Merit & Dean
3. Principles of electroplating & electroforming – Blum &Hogaboom
4. Instrumentals methods of chemical analysis – Chatwal & Anand
5. Vogel's textbook of qualitative inorganic analysis – Bassett, Denny etc
6. Textbook of qualitative inorganic analysis – Kolthoff and sandel
7. Fundamentals of analytical chemistry – Skoog and West
8. Basic concepts of analytical chemistry – S.M. Khopkar
9. Analytical chemistry – Walton
10. Chemical process industries – Shrieve& Brink
11. Industrial chemistry – Kent
12. Industrial chemistry – Rogers
13. Industrial chemistry – R.K.Das
14. Text book of qualitative organic analysis - Vogel
15. Qualitative organic chemistry – Vogel
16. Hand book of organic analysis – H.T.Clarke
17. Chemistry of pesticides – K.H.Buchel
18. Mechanical chemistry – Burger
19. Biotechnology & applied microbiology – Alani& Moo- Young
20. Immobilized Biocatalysts – Joy Wleser
21. Instrumental methods of chemical analysis – H.Kaur
22. A text book of Quantitative chemical analysis Vogel's by J.Mendham, R. C. Denney
23. Quantitative Chemical Analysis – Daniel C. Harris

LABORATORY COURSE

1.Use of Digital/Analytical/Chainometric/Single pan balance is allowed.

2. Use of Scientific calculator is allowed.

3. Use of Chart/Text book/Hand book of practical is allowed.

4. There will be a project having weightage of 15 marks.

Project should be focused on experimental application of Chemistry, society /industrial oriented

The project will be assessed by all the three examiners with equal weightage at the time of practical examinations. The project may be completed individually or by a group of students not exceeding number three. One copy of the project should be submitted at the time of examination. After assessment this copy will remain in the department.

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PHYSICAL CHEMISTRY

I. Non instrumental Experiments:

A. Any one of the following

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. Potentiometry (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 four).

1. Titration of weak 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.

2. Titration of a mixture of weak acid and strong acid with strong alkali.

3. 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 $K= \alpha^2.C/1- \alpha$
4. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conductometric method.
5. To determine the normality of citric acid in lemon by titrating it against standard 0.2 N NaOH solution by conductometric method.
6. To determine λ_∞ of strong electrolyte (NaCl or KCl) and to verify Onsager equation.

C. Refractometry.

1. To determine the percentage composition of unknown mixture by (i) graphical method and (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 $CuSO_4$ solution.
2. To estimate of Fe+++ ions by thiocynate method.
3. To estimate Fe+++ ions using salicylic acid by colorimetric titration.

E. pH – metry (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.

Reference Books:

1. Findlay's Practical Physical Chemistry (Longman)
2. Advanced Practical Physical Chemistry by J. B. Yadav, Goel publishing house.
3. Practical Physical Chemistry by B. D. Khosla, V. C. Garg (R. Chand and Co.)
4. Systematic experimental Physical Chemistry by Rajbhoj, Chandekar (Anjali Publicaiton) Aurangabad.
5. Practical Physical Chemistry: Nandkumari, Kothari and Lavande.
6. Practical Physical Chemistry by Gurtu (S. Chand).
7. Text Book of Qualitative Inorganic Analysis by A. I. Vogel (ELBS Longman).

INORGANIC CHEMISTRY

I Gravimetric Estimations (G).

N. B. : Any **two** experiments from G1 to G3 and any **one** experiment from G4 & G5.

G1. Gravimetric estimation of iron as ferric oxide from the given solution containing ferrous ammonium sulphate, copper sulphate and free sulphuric acid.

G2. Gravimetric estimation of zinc as zinc pyrophosphate from the given solution containing zinc sulphate, ferrous ammonium sulphate and free sulphuric acid.

G3. Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride, ferric chloride and free hydrochloric acid.

G4. Gravimetric estimation of barium as barium chromate from the given solution containing barium chloride, ferric chloride and free hydrochloride acid.

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

[For the gravimetric experiments, stock solution should be given in the range of 10 to 15 cm3 and asked to dilute to 100 cm3 (or the stock solution should be given in the range of 20 to 30 cm3 and asked to dilute to 250 cm3). Use 50 cm3 of this diluted solution for estimation.]

II. Inorganic Preparations (P).

N. B. At least **six** preparations from the following with **percentage yield**:

P1. Preparation of sodium cuprous thiosulphate.
P2. Preparation of potassium trioxalato ferrate (III).
P3. Preparation of potassium trioxalato aluminate (III).
P4. Preparation of tris (ethylene diamine) nickel (II) thiosulphate.
P5. Preparation of ammonium diamminetetrathiocynatochromate (III) (Reineck's salt).
P6. Preparation of chlropenta-ammine cobalt (III) chloride.
P7. Preparation of hexammine nickel (II) chloride.
P8. Preparation of tris(thiourea) cuprous sulphate.

III) Titrimetric Estimations :

A) Percentage Purity

N. B. : Any **three** from the following.

V1. Determination of percentage purity of ferrous ammonium sulpahte.
V2. Determination of percentage purity of tetrammine copper (II) sulphate.
V3. Determination of percentage purity of potassium trioxalato-aluminate(III).
V4. Determination of percentage purity of potassium trioxalato ferrate (III).

B) Analysis of Commercial Sample.

N. B. Any **four** from the following :

V5. Determination of percentage of magnesium in the given sample of talcum powder.
V6. Determination of amount of aluminum in the given solution of potash alum.
V7. Determination of titrable acidity in the given sample of milk or lassi.
V8. Determination of percentage purity of boric acid using supplied sodium hydroxide.
(Standard succinic or oxalic acid solution to be prepared to standardise the given sodium hydroxide solution.)
V9. Determination of Thorium by complexometric titration using xylenol orange indicator (Use 0.001 M EDTA)

C) Ion exchange method.

N. B. Any **two** from the following.

V10. Determination of amount of sodium present in the given solution of common salt using cation exchange resin (By Acid Base titration).
V11. Determination of amount of magnesium in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA.
V12. Determination of amount of zinc in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA.

Reference Books:

1. A text book of quantitative Inorganic Analysis - A. I. Vogel.
2. Text book of Quantitative Inorganic Analysis - Kolthoff and Sandell.
3. Experimental Inorganic Chemistry - Palmer W. G.
4. Advanced Practical Inorganic Chemistry - Adams and Raynor.
5. Manual in Dairy Chemistry - I.C.A.R. Sub-Committee on Diary Education.
6. Chemical methods for environmental analysis - R. Ramesh and M. Anbu.

ORGANIC CHEMISTRY

I) Qualitative analysis

Separation of binary mixture and Identification of its components. At least 08 mixtures are to be separated & identified.

Nature 1) Solid – Solid : 4 mixtures

2) Solid – Liquid : 2 mixtures

3) Liquid – Liquid : 2 mixtures

1) Solid – Solid Mixtures:

One mixture from each the following types should be given:

i) Acid + Phenol ii) Acid + Base

iii) Acid + Neutral iv) Phenol + Base

v) Phenol + Neutral vi) Base + Neutral

2) Solid – Liquid Mixtures

Mixture of type Neutral + Neutral or Acid + Neutral should be given.

3) Liquid – Liquid Mixtures

Mixture of type Neutral + Neutral or Base + Neutral should be given.

Following compounds should be used for preparation of mixtures

Acids: Benzoic acid, Phthalic acid, Salicylic acid, Cinnamic acid, Aspirin, Oxalic acid.

Phenols: α-naphthol, β-naphthol

Bases: o-nitroaniline, m-nitroaniline, p-nitroaniline, aniline, o-toluidine and N, N-dimethyl aniline.

Neutrals: Anthracene, acetanilide, m-dintrobenzene, chloroform, carbon tetrachloride, acetone, nitrobenzene, ethyl acetate, ethyl benzoate, bromobenzene, urea and thiourea.

NB :

1. For Solid-Liquid and Liquid-Liquid mixtures avoid detection of type of mixture. Instead the weightage is given to detection of nature and separation of mixture.
2. Separation and qualitative analysis of the binary Mixtures should be carried out on microscale using microscale kits.

II) Quantitative analysis: Organic estimations:

1. Estimation of sucrose
2. Saponification value of oil.
3. To determine the amount of acid and ester present in the given mixture of acid and ester.
4. Determination of Molecular weight of monobasic/dibasic acid by volumetric method.
5. Estimation of unsaturation –to estimate the percentage purity of given olefinic compound by bromination method.

Note: Double burette method should be used for titration.

III) Organic Preparations: (Any four)

1. Multicomponent reaction - Preparation of Dihydropyrimidone.
2. Radical coupling reaction - Preparation of 1,1,2 bis-2 naphthol.
3. Base catalyzed Aldol condensation- Preparation of Dibenzalpropanone.
4. Diels Alder reaction- Reaction between Furan and Maleic acid
5. Benzil-Benzilic acid rearrangement reaction.
6. Electrophilic aromatic substitution reaction- Bromination of Acetanilide by KBr and Cerric Ammonium Nitrate.

IV) Preparation of Derivatives:

1. Benzoyl derivative (β-naphthol and aniline).
2. Picrate derivative (anthracene and β-naphthol).
3. Iodoform (Acetone).
4. Osazone of Carbohydrates (Glucose).
5. Oxalate derivative (of Urea).
6. 2,4-Dinitro phenyl hydrazone (carbonyl compounds)
7. Oxime derivatives (carbonyl compounds)

NB :

1. All preparations should be carried out by considering green Chemistry approach
2. Preparation of derivative should be carried out on small scale. The starting compound should not be given more than one gram.

3. Calculation of percentage practical yield in preparation is must.
4. Recrystallization of crude product and its melting point.
5. The product **should be** confirmed by **TLC**.
6. Assign reactions with mechanism.

V) Reference Books

1. Practical Organic Chemistry by – A.I. Vogel.
2. Practical Organic Chemistry by – O. P. Agarwal

VI) Nature of Practical Examination

1. The practical examination will be of 200 marks.
2. The duration of practical examination will be of three days - six and half hour per day.
3. Questions related to the practical exercise carried out by the student should be asked in viva.
4. Use of scientific calculator is allowed.
5. S.I. units should be used wherever possible.
6. Use of Chart / Hand book / Text book of practical is allowed.
7. A student is expected to submit a journal certified by the Head of the Department.
8. A student not be permitted to appear at the practical examination unless he/she produces a certified journal. If the journal is lost, the student should produce a certificate from the Head of the Department stating that he/she has satisfactory completed the practical work but his / her journal is lost.
9. Use of Digital / Analytical / Chainometric / Single pan balance is allowed.
10. A student should submit one copy of project at the time of examination. Each examiner should asses the project work for five marks and sign the same.

VII) Distribution of marks for practical examination

A) Physical Chemistry	**60 marks**
i) Non-instrumental experiment	25 marks
ii) Instrumental experiment	25 marks
iii) Viva	05 marks
iv) Journal	05 marks

B) Inorganic Chemistry	**65 marks**
i) Gravimetric analysis	25 marks
ii) Preparation	15 marks
iii) Volumetric estimation	15 marks
iv) Viva	05 marks
v) Journal	05 marks
C) Organic Chemistry	**60 marks**
i) Binary Mixture separation	25 marks
ii) Estimation/Preparation	20 marks
iii) Derivative/Interpretation of spectra	05 marks
iv) Viva	05 marks
v) Journal	05 marks
D) Project	**15 marks**
Total:	**200 marks**