

ANNAMALAI UNIVERSITY
BACHELOR OF SCIENCE
B.Sc. INDUSTRIAL CHEMISTRY DEGREE COURSE
(With effect from 2021 - 2022)

The Course of Study and the Scheme of Examinations

S. No.	Part	Study Components		Ins. Hrs / week	Credit	Title of the Paper	Maximum Marks		
		Course Title					CIA	Uni. Exam	Total
SEMESTER I									
1.	I	Language	Paper-1	6	4	Tamil/Other Languages	25	75	100
2.	II	English (CE)	Paper-1	6	4	Communicative English I	25	75	100
3.	III	Core Theory	Paper-1	6	4	General Chemistry - I	25	75	100
	III	Core Practical	Practical-1	3	0	Volumetric Analysis	0	0	0
4.	III	Allied -1	Paper-1	4	3	Industrial Chemistry I	25	75	100
	III	Allied - 1	Practical-1	3	0	Industrial Chemistry Practical	0	0	0
5.	III	PE	Paper 1	6	3	Professional English I	25	75	100
6.	IV	Environmental Studies		2	2	Environmental studies	25	75	100
		Sem. Total		36	20		150	450	600
SEMESTER II									
7.	I	Language	Paper-2	6	4	Tamil/Other Languages	25	75	100
8.	II	English (CE)	Paper-2	6	4	Communicative English II	25	75	100
9.	III	Core Theory	Paper-2	5	4	General Chemistry - II	25	75	100
10.	III	Core Practical	Practical-1	3	2	Volumetric Analysis	25	75	100
11.	III	Allied-1	Paper-2	4	3	Industrial Chemistry II	25	75	100
12.	III	Allied Practical - 1	Practical-1	2	2		25	75	100
13.	III	PE	Paper 1	6	3	Professional English II	25	75	100
14.	IV	Value Education		2	2		25	75	100
15.	IV	Soft Skill		2	1		25	75	100
		Sem. Total		36	25		225	675	900

S.NO.	Part	Study Components		Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
		Course Title					CIA	Uni. Exam	Total
SEMESTER III									
16.	I	Language	Paper-3	6	4	Tamil / Other Languages	25	75	100
17.	II	English	Paper-3	6	4	English	25	75	100
18.	III	Core Theory	Paper-3	4	4	General Chemistry - III	25	75	100
	III	Core Practical	Practical-2	3	0	Inorganic Qualitative Analysis & Preparations	0	0	0
19.	III	ALLIED-2	Paper-3	4	3	Industrial Chemistry –III	25	75	100
						Industrial Chemistry practical-II			
20.	IV	Skill Based Subject	Paper-1	2	2	Water Treatment and Analysis	25	75	100
21.	IV	Non-Major Elective	Paper-1	2	2	Medicinal Chemistry	25	75	100
				30	19		150	450	600
SEMESTER IV									
22.	I	Language	Paper-4	6	4	Tamil/Other Languages	25	75	100
23.	II	English	Paper-4	6	4	English	25	75	100
24.	III	Core Theory	Paper-4	4	4	General Chemistry - IV	25	75	100
25.	III	Core Practical	Practical-2	3	3	Inorganic Qualitative Analysis & Preparations	25	75	100
26.	III	Allied-2	Paper-4	4	3	Industrial Chemistry -IV	25	75	100
						Industrial Chemistry Practical-II			
27.	III	Allied Practical	Practical-2	3	2	Industrial Chemistry Practical-II	25	75	100
28.	IV	Skill Based Subject	Paper-2	2	2	Food Chemistry	25	75	100
29.	IV	Non-Major Elective	Paper-2	2	2	Chemistry in Every Day Life	25	75	100
				30	24		200	600	800

S.NO.	Part	Study Components		Ins. hrs	Credit	Title of the Paper	Maximum Marks		
		Course Title		/week			CIA	Uni. Exam	Total
SEMESTER V									
30.	III	Core Theory	Paper-5	6	5	Inorganic Chemistry - I	25	75	100
	III	Core Practical	Practical-3	3	0	Gravimetric Estimation	0	0	0
31.	III	Core Theory	Paper-6	6	5	Organic Chemistry - I	25	75	100
	III	Core Practical	Practical-4	3	0	Organic Analysis and Preparations	0	0	0
32.	III	Core Theory	Paper-7	6	4	Physical Chemistry - I	25	75	100
33.	III	Internal Elective	Paper-1	3	3	Any one from A. Analytical chemistry - I B. Basis of computer programming in C and its applications in Chemistry c. Organic Synthesis	25	75	100
34.	IV	Skill Based Subject	Paper-3	3	2	Applied Chemistry	25	75	100
				30	19		125	375	500
SEMESTER VI									
35.	III	Core Theory	Paper-8	5	4	Inorganic Chemistry - II	25	75	100
36.	III	Core Theory	Paper-9	5	4	Organic Chemistry - II	25	75	100
37.	III	Core Theory	Paper-10	4	4	Physical Chemistry - II	25	75	100
38.		Compulsory Project		5	5	Group/Individual Project	25	75	100
39.	III	Core Practical-3	Practical-3	0	2	Gravimetric Estimation	25	75	100
40.	III	Core Practical-4	Practical-4	0	2	Organic Analysis and Preparations	25	75	100
41.	III	Core Practical-5	Practical-5	3	3	Physical Chemistry Experiments	25	75	100
42.	III	Internal Elective	Paper-2	3	3	Any one from A. Analytical Chemistry-II B. Textile Chemistry C. Nano Chemistry	25	75	100

43.	III	Internal Elective	Paper-3	3	3	Any one from A. Pharmaceutical Chemistry B. Polymer Chemistry C. Green Chemistry	25	75	100
44.	III	Skill based Subject	Paper-4	2	2	Agriculture and Leather Chemistry	25	75	100
45.	IV	Extension Activities		0	1		100	0	100
		TOTAL		30	33		350	750	1100

Part	Subject	Papers	Credit	Total Credits	Marks	Total Marks
Part I	Languages	4	4	16	100	400
Part II	Communicative English & English	4	4	16	100	400
Part III	Allied (Odd Semester)	2	3	6	100	200
	Allied (Even Semester)	2	3	6	100	200
	Allied Practical	2	2	4	100	200
	Electives	3	3	9	100	300
	Core	10	(3-5)	42	100	1000
	Core practical	5	(2-3)	12	100	500
	Professional English	2	3	6	100	200
	Compulsory Project (Group/Individual Project)	1	5	5	100	100
Part IV	Environmental Science	1	2	2	100	100
	Soft skill	1	1	1	100	100
	Value Education	1	2	2	100	100
	Lang. & Others /NME	2	2	4	100	200
	Skill Based	4	2	8	100	400
Part V	Extension Activities	1	1	1	100	100
	Total	43		140		4500

ANNAMALAI UNIVERSITY
B.Sc., INDUSTRIAL CHEMISTRY SYLLABUS UNDER CBCS
(With effect from 2020 - 2021)

SEMESTER I
PAPER – 1 GENERAL CHEMISTRY – I

Objective:

Basic concepts regarding Atomic Structure, Periodic Properties, Bonding Concepts, Ionic Bond, VSEPR and MO Theories, Nomenclature of Organic Compounds, Hybridisation, Reaction Intermediates, States of Matter, Principle of Volumetric Analysis, Related Problems and Applications wherever necessary are to be taught for I- Semester.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Recollect the Chemistry of Quantum Numbers.
- 2) Review and apply periodicity of properties.
- 3) Discuss various types of bonding through VB & MO theories.
- 4) Name simple Aliphatic and Aromatic Compounds.
- 5) Illustrate and apply electron displacement effects and reaction mechanisms.
- 6) Elaborate the basic concepts of solid, liquid and gaseous states.
- 7) Apply the principles of Volumetric Analysis.

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7) Apply the principles of Volumetric Analysis.

UNIT-I ATOMIC STRUCTURE

1.1 Quantum numbers n , l , m and s – Pauli's exclusion principle – Energy distribution and orbitals - Hund's rule of maximum multiplicity - Aufbau's principle – Electronic Configuration of elements - Stability of Half-filled and completely filled orbitals. Shapes of s , p , d and f orbitals.

1.2 Classification of elements – General characteristics of s , p , d and f - Block elements – Periodicity of properties- Definition and Periodicity of the following properties – Atomic radii and Ionic radii - Factors affecting the Atomic radii and Ionic radii.

1.3 Ionisation potential, Electron affinity and Electronegativity - Factors affecting the Ionisation potential, Electron affinity and Electronegativity – Pauling scale – Mulliken electronegativity scale – Applications of Electronegativity regarding the Bonding nature. Trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT- II CHEMICAL BONDING

2.1 Ionic bond - Conditions for the formation of ionic bond - General properties – Energetics of formation of NaCl from Na^+ and Cl^- - Hydration energy, Lattice energy and their applications – Born-Haber cycle - Polarisation of ions- Fajan's rule - Transition from ionic to covalent character.

2.2 Covalent bond - Conditions for the formation of covalent bond - General properties - Polarity of bonds - Orbital overlap - Bond lengths and Bond energies - Hybridisation - Sigma and Pi bonds - VSEPR theory - Geometries of BeCl_2 , BF_3 , NH_3 , CH_4 , SF_4 , ICl_2^- , H_2O , PCl_5 , ClF_3 , XeF_6 , SF_6 and IF_7 molecules - Partial ionic character of covalent bond - Percentage of ionic character from dipole moment and electronegativity difference.

2.3 Molecular Orbital theory – Bonding and Anti-bonding orbitals - Relative order of

Energies of molecular orbitals - MO diagram of H_2 , He_2 , O_2 , O_2^+ , O_2^- , N_2 , F_2 , HF and CO - Bond Order - Stability and Magnetic properties of the molecules - Comparison of VB and MO theories. Hydrogen bonding-types, examples and effect on properties.

UNIT- III BASIC CONCEPTS OF ORGANIC CHEMISTRY

3.1 Classification of Organic Compounds – Nomenclature of Organic Compounds –

Functional Groups - Homologous Series - IUPAC Recommendations for Naming Simple Aliphatic and Alicyclic Compounds.

3.2 Basic concepts of bonding in organic chemistry - Hybridisation – Definition – Geometry of Molecules - Methane, Ethane, Ethylene, Acetylene and Benzene - Electron displacement effects - Inductive - Inductomeric - Electromeric – Mesomeric Effect - Resonance - Hyperconjugation and Steric Effects.

3.3 Cleavage of bonds - Homolytic and Heterolytic fission of carbon-carbon bond – Methods to determine the Reaction Mechanism - Reaction intermediates - Structure and Stability of Carbocations, Carbanions

and Free radicals.

UNIT-IV STATES OF MATTER

4.1 Gaseous state - Kinetic gas equation - Postulates and Derivation - Gas laws from the kinetic gas equation - Kinds of velocities - Mean, RMS, Most Probable Velocities - Calculation of molecular velocities - Maxwell's distribution of Molecular Velocities (No derivation) - Effect of Temperature on velocity distribution - Equipartition of energy - Heat capacity on molecular basis - Virial equation of state - Boyle temperature - Coefficient of Compressibility and Thermal expansion.

4.2 Liquid state - Density – Diffusion - Viscosity – Evaporation - Surface tension Determination using Stalagmometer - Effect of temperature on surface tension - Parachor - Definition and Applications only - Coefficient of Viscosity- determination using Oswald's Viscometer- Effect of Temperature and Pressure - Liquid crystals - Classification and Applications.

4.3 Solid State - Crystal lattices - Symmetry elements in crystals - Unit cell- Seven crystal systems - Space lattice - Bravais lattices - Laws of Crystallography-law of constancy of inter facial angles and Rational Indices- Miller indices, X-ray diffraction by crystals.

UNIT-V PRINCIPLES OF VOLUMETRIC ANALYSIS

5.1 Definitions of Molarity, Molality, Normality and Mole Fraction – Their Calculations - Definition and Examples for Primary and Secondary standards - Calculation of Equivalent Weight of Acid, Base, Oxidising Agent, Reducing Agent and Salts.

5.2 Principles of Volumetric Analysis - Theories of Acid- Base, Redox, precipitation titrations, Complexometric Iodometric and Iodimetric titrations.

5.3 Theories of indicators- Choice of indicators - Acid-base indicators - Redox, Metal ion and Adsorption indicators.

ALLIED – 1

PAPER – 1

INDUSTRIAL CHEMISTRY – I

Objectives:

Cements, Ceramics, Refractories, Adhesives, abrasives, Pulp and Paper - Introduction - classification - preparation - Manufacture - properties - Requirements - Composition - Mechanism - applications.

UNIT-I

1.1 INORGANIC CEMENTING MATERIALS - Introduction - Lime and its manufacture - Gypsum Plaster - Cement - Types of cement. - Chemical Composition

1.2 Manufacture of Portland cement - Chemical Composition of Portland Cement - Setting and Hardening of Portland Cement. Heat of Hydration of Cement - Special Cement – Concrete and RCC - Decay of Concrete.

UNIT-II

2.1 GLASS AND CERAMICS - Introduction - Manufacture of Glass - Varieties of Glasses.

2.2 Plasticity of Clay - White wares - Glazing - applications - Earthenware's and stoneware's – Optical Fibers.

UNIT-III

3.1 REFRACTORIES - Introduction - Classification - Manufacture of Refractories - Cermets - Insulating refractories - Requirements of a refractory.

3.2 Non-petroleum Fuels - Combustion - Mass analysis from volume analysis and vice-versa Flue gas-analysis - Efficiency of combustion.

UNIT-IV

4.1 ADHESIVES - Introduction - Classification of adhesives - Adhesive Action - Development of Adhesive Strength. Solvent Responsive Adhesives - Uses of Solvent Responsive Adhesives. Chemically reactive adhesives.

4.2 Preparation of adhesives - Synthetic resin adhesives – Rubber based adhesives - Cellulose and silicate adhesives - Uses of adhesives.

UNIT-V

5.1 Abrasives - introduction - Natural Abrasives - Artificial Abrasives – Grinding Wheels.

5.2 Pulp and paper - Introduction - Manufacture of pulp - Sulphate pulp - Soda pulp - Rag pulp - Beating, refining, filling, sizing and coloring - manufacture of paper.

SEMESTER II
PAPER – 2
GENERAL CHEMISTRY - II

OBJECTIVES:

- Basic knowledge on s- and p- Block Elements, Group Study, Hydrocarbons, Cycloalkanes, Dienes, Quantum Chemistry, Thermochemistry, First Law of Thermodynamics, Derivation of Equations, Related Problems, Reaction Mechanism and Applications wherever necessary are to be taught for II- Semester.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Compare the basic properties of elements and their Compounds of s & p – block elements.
- 2) Explain the reaction mechanisms of alkanes, alkenes and alkynes and predict the products.
- 3) Classify dienes and analyze the stability of alkanes, alkenes and cycloalkanes.
- 4) Recollect the basic concepts of Quantum Theory and Thermodynamics.
- 5) Calculate the thermodynamic parameters using thermo chemical equations and data.

UNIT-I s- and p- Block Elements

1.1 Alkali metals - Li, Na, K, Rb and Cs - Occurrence - Comparative study of Elements with respect to Oxides, Halides, Hydroxides and Carbonates - Exceptional property of Lithium - Diagonal Relationship of Li with Mg.

1.2 Alkaline earth metals - Be, Mg, Ca, Sr and Ba - Occurrence - Comparative study of the elements with respect to Oxides, Hydroxides, Halides, Sulphates and Carbonates - Exceptional property of Beryllium - Diagonal relationship of Be with Al - Comparison of Alkaline Earth Metals with Alkali Metals - Magnesium acting as bridge element between II A and II B groups - Magnesium resembles Zinc.

1.3 p- Block elements - Boron family - Group discussion - Anomalous behaviour of Boron - Diagonal Relationship between Boron and Silicon - Electron deficiency and Electron acceptor behaviour of Boron trihalides - Bonding in Diborane (Hydrogen-bridge structure) - Preparation, Properties, structure and Uses of Borazine, NaBH_4 , LiAlH_4 and boron nitride.

UNIT-II HYDROCARBONS

2.1 Alkanes - Methods of preparation of alkanes - Wurtz method, Kolbe's method and Reduction of alkyl halides - Physical and Chemical Properties of alkanes - Mechanism of Free Radical Substitution in alkanes – Halogenation and Reactivity.

2.2 Alkenes - Properties of alkenes – Electrophilic and Free radical addition - Addition reactions of Alkenes with mechanism - Addition of Hydrogen, Halogens, Hydrogen Halide (Markownikoff's rule) - Hydrogen bromide (Peroxide effect) - Sulphuric Acid, Water, BH_3 , Ozonolysis, Hydroxylation with KMnO_4 - Allylic substitution by NBS.

2.3 Alkynes - Acidity of alkynes - Addition of hydrogen - Hydroboration - Hydrohalogenation - Addition of hypohalous acid, Hydration - Addition of water with HgSO_4 catalyst - Oxidation with KMnO_4 – Ozonolysis - Formation of Acetylides.

UNIT-III DIENES AND CYCLOALKANES

3.1 Dienes – Classification - Conjugated, Isolated and Cumulative Dienes - Stability of

Dienes - 1, 2- and 1, 4- Addition reactions of H_2 and HX with mechanisms – Synthesis of dienes – 1, 3 - Butadiene, Isoprene and Chloroprene - Diels-Alder reaction.

3.2 Cycloalkanes - Preparation using Wurtz's reaction, Dieckmann's ring closure and Reduction of aromatic hydrocarbons - Substitution and Ring opening reactions.

3.3 Stability of Alkanes, Alkenes and Cycloalkanes - Bayer's strain theory - Theory of Strainless rings.

UNIT-IV QUANTUM CHEMISTRY AND THERMOCHEMISTRY

4.1 Planck's Quantum theory of radiation - Photoelectric Effect - Compton Effect - Wave mechanical concept of the atom - de Broglie's relationship – Davisson and Germer experiment - Wave nature of electron - Heisenberg's Uncertainty Principle.

4.2 Schrodinger wave equation (Without derivation) - Significance of wave functions ψ and ψ^2 - Shapes of s, p and d- orbitals.

4.3 Thermodynamics - Definition and Explanation of terms - System, Boundary, Surroundings - Homogeneous and Heterogeneous systems – Open, Closed and Isolated systems -Intensive and Extensive properties - State of a system - Independent state variables - Dependent state variables - Thermodynamic functions - State and Path functions.

UNIT-V THERMODYNAMICS

5.1 Thermodynamic processes - Types of processes - Cyclic - Reversible – Irreversible - Isothermal –

Adiabatic Process - Exact and Inexact Differentials - Concept of Heat and Work - Zeroth Law of Thermodynamics.

5.2 First law of Thermodynamics - Statement and Equation – C_p and C_v Relationship - Calculation of w , q , ΔE and ΔH for the Expansion of Ideal Gases under Reversible, Isothermal and Adiabatic Conditions.

1.3 Thermochemistry - Heat of a reaction - Exothermic and Endothermic reactions - Calculation of ΔH from ΔE and vice versa - Thermochemical equations - Bond dissociation energy - Calculation from thermochemical data - Variation of Heat of a reaction with temperature - Kirchoff's Equation and Its significance.

CORE PRACTICAL
Paper – 1
VOLUMETRIC ANALYSIS

Acidimetry

1. Estimation of Borax - Standard Sodium Carbonate
2. Estimation of Sodium Hydroxide - Standard Sodium Carbonate
3. Estimation of HCl – Standard Oxalic Acid.

Iodometry

4. Estimation of Copper - Standard Copper Sulphate
5. Estimation of Potassium Dichromate - Standard Potassium Dichromate

Complexometry

6. Estimation of Magnesium using EDTA.
7. Estimation of Zinc using EDTA

Dichrometry

8. Estimation of Ferrous Iron using Diphenyl amine / N- pPhenylanthranillic acid as indicator.

Precipitation titration

9. Estimation of Chloride in neutral medium (Demonstration experiment).

Permanganometry

10. Estimation of Ferrous Sulphate – Standard FAS.
11. Estimation of Oxalic Acid – Standard Oxalic Acid.

- Students must write Short Procedure for the given estimation in Ten Minutes during the examination and submit the Paper for Evaluation.

ALLIED – 1
PAPER – 2
INDUSTRIAL CHEMISTRY – II

Objectives:

Elaborate study of Fuels Introduction - classification - preparation - properties - their sources of energy - storage - alternate fuels - applications

UNIT-I

1.1 FUELS AND COMBUSTION - Introduction - Classification of Fuels - Calorific Value – Theoretical Calculation of Calorific Value of a Fuel Gross calorific value and net calorific value – Characteristics of a Good Fuel - Solid fuels - Wood.

1.2 Coal - Classification of Coal by Rank - Selection of Coal - Analysis of Coal and its significance

UNIT-II

2.1 Types of coking - Types of Carbonization of Coal - Role of Sulphur in Coal - Role of Ash in Coal

2.2 Gaseous fuels - Producer Gas - Water Gas - Natural Gas – Oil Gas - Biogas - Components - composition - preparation – advantages - disadvantages and applications of Coal gas - Gobar gas - LPG

UNIT-III

3.1 Liquid fuels - Petroleum - Cracking - Advantages of catalytic cracking over thermal cracking - Synthetic Petrol.

3.2 Refining of Gasoline – Reforming - Knocking - Octane number of Gasoline - Diesel Engine Fuels - Diesel - Octane number of Diesel Oil - Diesel index.

UNIT-IV

4.1 Residual fuel oils - Asphalt - Aviation fuel - advantages - Kerosene as a fuel.

4.2 Analysis and testing of liquid and gaseous fuels - Utilization of fuels - Solar power.

UNIT-V

5.1 Other sources of energy – Electricity Power - Modern Concept of Fuel - Fuels for Metallurgy.

5.2 Power Alcohol - Recent Advances In Fuel Technology. Alternative Fuels – Alcohols – Promising Biofuel : An Alternative Source to Diesel and Gasoline - Control of Pollution in Refineries.

**ALLIED PRACTICAL
PAPER 1 & 2
INDUSTRIAL CHEMISTRY**

WATER TESTING

1. Estimation of total dissolved solids in the given water sample (TDS) (Only for demonstration)
2. Estimation of total suspended solids in the given water sample (TSS) (Only for demonstration)

3. Determination of total permanent and temporary hardness of water using EDTA.
4. Determination of acetic acid in commercial vinegar using NaOH.

5. Determination of alkali content in antacid tablet using HCl.
6. Estimation of calcium in chalk - Permanganometry.

7. Limit test for Sulphate

8. Limit test for Chloride

9. Limit test for Iron

10. Limit test for Lead

SEMESTER - III
CORE PAPER - 3
GENERAL CHEMISTRY - III

OBJECTIVE:

Basic concepts regarding the Principles of Inorganic Analysis and Applications of Qualitative Analysis, Types of Solvents, p- Block Elements, Group Study, Aromaticity, Electrophilic and Nucleophilic Substitution Reactions, Elimination Reactions, Reaction Mechanism, Second Law of Thermodynamics, Derivation of Equations, Related Problems and Applications wherever necessary are to be taught for III semester.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Explain the basic principles of Inorganic Qualitative Analysis.
- 2) Compare the properties of Carbon, Nitrogen and Oxygen elements and their compounds.
- 3) Apply Huckel's rule and predict the Aromaticity of compounds.
- 4) Discuss the mechanism of substitution and elimination reactions of Aliphatic and Aromatic compounds.
- 5) Explain the Thermodynamic second law and predict the spontaneity of a process.

UNIT - I

Semimicro Techniques - Principles of Acid-Base Equilibria - Common ion effect - Solubility Product and its Applications in Qualitative Analysis - Principles of Inorganic Analysis - Reactions involved in the Separation and Identification of Cations and Anions in Qualitative analysis - Spot test reagents - Aluminon, Cupferon, DMG, Thiourea, Magneson, Alizarin and Nessler's reagent - Types of solvents - Protic and Aprotic solvents - Amphiprotic / Amphoteric solvents - Aqueous and Non-aqueous solvents- Reactions in non-aqueous solvents with reference to - Liquid Ammonia and liquid SO₂. Acids and bases-Arrhenius, Bronsted-Lowry, Lewis and Lux-Flood concept.

UNIT - II

Carbon family - Group study - Comparative study of Elements with respect to Valency, Oxides, Halides, Hydrides and Oxyacids - Catenation - Comparison of Properties of Carbon and Silicon - Silicates - Classification and Structure - Silicones- Preparation, Properties and Uses - Nitrogen family - Group study - Comparative study of N, P, As, Sb and Bi with respect to Oxides, Oxyacids, Halides and Hydrides - Hydrazine and Hydroxylamine - Hydrazoic acid - Preparation and uses of NaBiO₃ - Oxygen family - Group study - Comparative study of O, S, Se and Te with respect to Catenation, Oxides, Halides, Hydrides and Oxyacids - Anomalous Behaviour of Oxygen - Oxyacids of Sulphur (Structure only) - Peracids of Sulphur - Preparation, Properties and Structure - Differences Between Permonosulphuric Acid and Perdisulphuric Acid.

UNIT - III

Aromaticity - Modern Theory of Aromaticity - Huckel's (4n +2) Rule and Its Simple

Applications to Benzenoid and Non- benzenoid Compounds - Electrophilic substitution reactions in Aromatic Compounds - Mechanisms of Nitration, Halogenations, Sulphonation, Friedel-Crafts Acylation and Alkylation - Directive influence - Orientation - Ortho/Para ratio - Nuclear and Side chain Halogenation.

UNIT - IV

Aliphatic Nucleophilic Substitutions - Mechanisms of S_N1 , S_N2 and S_Ni Reactions - Effect of Structure of Substrate, Solvent, Nucleophile and Leaving Group Elimination reactions - Mechanism of E1 and E2 reactions - Hoffmann and Saytzeff's rules - Cis and Trans Eliminations - Aromatic Nucleophilic Substitutions - Unimolecular Nucleophilic Substitution, Bimolecular Nucleophilic Substitution and their Mechanism.

UNIT - V

Second Law of Thermodynamics - Need for the II Law of Thermodynamics - Spontaneous Process - Criteria of Spontaneity - Different Forms of Statements of the Second Law - Cyclic Process - Definition - Heat Engines - Carnot's cycle - Efficiency - Carnot's theorem (Statement only) - Concept of Entropy - Definition and Mathematical Statement - Randomness and Entropy - Standard Entropy -Derivation of Entropy from Carnot Cycle - Entropy change of an Ideal Gas during Isothermal Process - Entropy changes in Cyclic, Reversible and Irreversible Processes - Entropy Changes in Physical Transformations - Calculation of Entropy Changes with Changes in T, V and P - Entropy of Mixing of Ideal Gases - Physical Significance of Entropy.

ALLIED - 2

PAPER - 3

INDUSTRIAL CHEMISTRY - III

High Polymers, Rubber, Plastics and Resins - Introduction - classification - preparation - properties - Mechanism - applications.

UNIT - I

HIGH POLYMERS - Introduction - Nomenclature - Classification of Polymers - Homo and hetero chain polymers - Addition polymerization - Condensation polymerization - Mechanism of Addition Polymerization - Cationic - Anionic polymerization - Free radical and Coordination or Ziegler-Natta polymerization.

UNIT - II

Physical and Mechanical Properties of Polymers - Crystallinity in Polymer - Polymer Reaction - Polymer structure and properties - Strength, plastic deformation - chemical resistance - Physical state of polymer - Glass Transition Temperature

UNIT - III

Introduction to Rubber - Latex - Processing Latex - Compounding of Rubber - Vulcanizations of Rubber - Degradation stability - Synthetic rubbers - Preparation and applications of SBR - Butyl rubber - Nitrile rubber - Neoprene and Silicone rubber.

UNIT - IV

Plastic Materials - Classification of Plastics (or Resins) - Moulding Constituents of a Plastic - Fabrication techniques used for thermoplastic resin (Moulding process) - Important Thermoplastic Resins - Natural resins - Polyethylene - PVC

UNIT - V

Important thermosetting resins - Phenol Formaldehyde Resin or Phenolic Resin - Amino Resins and Plastics - Epoxy Resins - Acrylic Resins and Plastics - Polyester resins - Silicone Resins - Silicone fluids - Silicone greases - Polyurethane's - Foamed or cellular plastics.

SKILL BASED SUBJECT

PAPER - 1

WATER TREATMENT AND ANALYSIS

Objective:

To impart knowledge about the various methods of Water Analysis and Treatment of Water.

UNIT - I

Introduction - Characteristics of water - Alkalinity - Hardness - Unit of hardness - Total solids - Oxidation - Transparency - Silica content - Purification of Water for drinking purpose - Potability of water - Clarification - Coagulation - Contact and Electrochemical Coagulation. Sterilisation and Disinfection of water - Precipitation - Aeration - Ozonisation - Chlorination.

UNIT - II

Water Softening Methods - Clark's process - Lime soda process - Modified lime soda process - Permutit or Zeolite process - Ion exchange process - Demineralisation of water - Determination of Hardness of water - Titration method - Complexometric method using EDTA - Expressing Hardness - Equivalents of Calcium Carbonate - Problems to determine Temporary and Permanent Hardness.

UNIT - III

Hard water and Industries - Industrial water treatment - Boiler feed water method of Softening - Prevention of plumbo solvency - Scales in boilers - Consequences - Internal conditioning methods - Desalination of Brackish water - Electrolysis - Reverse osmosis - Removal of Fe, Mn and Silicic acid - Effluent Treatment of Water from Paper Industry, Petrochemicals, Fertilizer industry and Power station.

UNIT - IV

Water analysis - Sampling of Water for analysis - Chemical Substances affecting Potability - Colour, Turbidity, Odour, Taste, Temperature, pH and Electrical Conductivity - Analysis of Solids present in water - Suspended Solids - Dissolved Solids - Total Acidity - Alkalinity - Free CO₂ - Free Chlorine - Ca, Mg, Fe, Mn, Ag and Zn - Water in Industry - Pollution of Water by Fertilisers, Detergents, Pesticides and Industrial wastes.

UNIT - V

Analysis of Chemical Substances Affecting Health - NH₃, Nitrate, Nitrite, Cyanide, Sulphate, Sulphide, Chloride and Fluoride - Measurement of Toxic Chemical Substances - Analysis of Chemical Substances indicative of Pollution - Dissolved oxygen - Biochemical Oxygen Demand (BOD) - Chemical Oxygen Demand (COD) - Bacteriological Examination of Water - Total Count Test - E. coli test - E. coli index - Most Probable Number method - Biological Examination of Water - Physical Examination of Water - Radioactivity of Water - Methods of removing Radioactivity from Water.

Outcome:**The Students will be able to**

- 1) Classify water based on the presence of dissolved salts in it.
- 2) Explain the various methods to make the water potable.
- 3) Discuss the softening methods of hardwater and determine hardness of water.
- 4) Understand electro dialysis and RO methods to desalinate Brackish water.
- 5) Analyse the presence of Chemical substances in water indicative of pollution by measuring BOD and COD.
- 6) Illustrate the methods used for biological examination of water.

Reference Books

1. Industrial Chemistry (Including Chemical - Engineering) - B. K. Sharma - Goel Publishing House, Meerut (1987).
2. Pollution Control in Process Industries - S. P. Mahajan - Tata McGraw Hill Publishing Company Ltd., New Delhi (1991).
3. Water Pollution and Management - C. K. Varshney - Wiley Eastern Ltd., Chennai -20 (1991).

**NON-MAJOR ELECTIVE
PAPER - 1
MEDICINAL CHEMISTRY**

Objectives:

To learn the basic idea of Drugs and Names of Common Drugs, Blood, Blood Pressure, Diabetes, AIDS, Vitamins, Indian Medicinal Plants and First Aid.

UNIT - I

Clinical Health and Biochemical Analysis - Definition of Health - WHO standard - Sterilisation of Surgical Instruments - Biochemical Analysis of Urine and Serum - Blood - Composition of Blood - Blood grouping and Rh factor.

UNIT - II

Common Drugs - Antibiotics, Antipyretics and Analgesics - Examples, Uses and Side effects Anti-inflammatory agents, Sedatives, Antiseptics and Antihistamines - Examples, Uses and Side effects - Tranquilizers, Hypnotics and Antidepressant drugs - Definition, Examples, Uses and Side effects

UNIT - III

Vital Ailments and Treatment - Blood pressure - Hypertension and Hypotension - Diabetes, Cancer, AIDS - Causes, Symptoms and Treatment - Vitamins - Classification of Vitamins - Sources and Deficiency diseases caused by Vitamins.

UNIT - IV

Indian Medicinal Plants - Palak, Vallarai, Kizhanelli and Thumbai - Chemical Constituents and Medicinal Uses - Hibiscus, Adadodai, Thoothuvalai - Chemical Constituents and Medicinal Uses - Nochi, Thulasi, Aloe Vera - Chemical Constituents and Medicinal Uses.

UNIT - V

First Aid and Safety - Treatment of Shock, Haemorrhage, Cuts and Wounds - Burns - Classification - First Aid - Asbestos, Silica, Lead Paints, Cement, Welding fumes and Gases - Hazard alert and Precautions for Safety.

Reference Books

1. Applied Chemistry, Jayashree Ghosh - S. Chand and Company Ltd., 2006
2. Biochemistry, S. C. Rastogi - Tata McGraw Hill Publishing Co., 1993.
3. Medicinal Plants of India, Rasheeduz Zafar - CBS Publishers and Distributors, 2000.
4. Hawk's Physiological Chemistry, B. L. Oser - Tata-McGraw Hill Publishing Co. Ltd.
5. Practical Pharmaceutical Chemistry, A. H. Beckett and J. B. Stenlake - Vol. I - CBS Publishers and Distributors, 2000.

Outcome:**The Students will be able to**

- 1) Understand the composition of blood and biochemical analysis of Urine and Serum
- 2) Gain knowledge about uses and side effects of Antibiotics, Antipyretics, Analgesics and tranquilizers.
- 3) Explain the causes, symptoms and treatment of Blood pressure, Diabetes, Cancer and AIDS.
- 4) Classify and understand the sources and diseases caused by deficiency of Vitamins.
- 5) Analyse the therapeutic importances of Indian Medicinal plants
- 6) Describe the first Aid and Safety treatment of Shock, Haemorrhage, Cuts and wounds and Burns.

SEMESTER - IV
CORE PAPER - 4
GENERAL CHEMISTRY - IV

OBJECTIVE:

Noble gases, Carboxylic Acids, Amines, Alcohols, Phenols, Naphthols, Important Name Reactions, Mechanism, Thermodynamics, Derivation of Equations, Partial Molar Properties, Chemical Potential, Related Problems and Applications are to be taught for IV semester.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Classify water based on the presence of dissolved salts in it.
- 2) Explain the various methods to make the water potable.
- 3) Determine the hardness of water and discuss the softening methods of hard water.
- 4) Discuss electro dialysis and RO methods to desalinate brackish water.
- 5) Analyze the presence of chemical substances in water indicative of pollution by measuring BOD and COD.
- 6) Illustrate the methods used for biological examination of water.

UNIT - I

Noble gases - Electronic Configurations - Position of Noble Gases in the Periodic Table - Chemical inertness of Noble gases - Reason - Compounds of Xenon - Hybridization and Geometry of XeF_2 , XeF_4 , XeF_6 , XeOF_2 , XeO_3 and XeOF_4 (Preparation, Properties - Not necessary) - Clathrates - Definition and Applications - Uses of Noble gases.

UNIT - II

Monocarboxylic acids - Acetic acid and Benzoic acid - Preparation by Grignard method - Conversion of Acids to their derivatives - Amide, Ester, Anhydride and Acid Chloride - Strength of Carboxylic Acids - Effect of Substituents on the Strength of Acids - Dicarboxylic acids - Oxalic acid, Malonic acid, Succinic acid, Glutaric acid and Adipic acid - Preparation - Properties - Action of Heat on Dicarboxylic acids - Amines - Ethylamine and Aniline - Preparation - Basicity of Amines - Effect of Substituents on Basicity - Reactivity of Amines - Distinction between Primary, Secondary and Tertiary Amines.

UNIT - III

Alcohols - Preparation by Grignard method - Oxidation of alcohols - Difference between Primary, Secondary and Tertiary alcohols - Preparation and Properties of Allyl alcohol - Phenols - Acidic character of phenols - Kolbe's reaction, Reimer-Tiemann reaction, Gattermann, Lederer-Manasse, Houben-Hoesh, Friedel-Crafts, Schotten-Baumann and Liebermann's Nitroso Reaction - Preparation, Properties and Uses of Alpha- and Beta- Naphthols.

UNIT - IV

Free energy and Work function - Gibbs free energy - Helmholtz free energy -Relationship between Gibbs free energy and Helmholtz free energy -Their variations with Temperature, Pressure and Volume - Free energy change as criteria for Equilibrium and Spontaneity. Difference between Free Energy and standard Free Energy - Maxwell's Relations - Thermodynamic Equation of State - Gibbs-Helmholtz equation - Derivation and Applications - Clausius-Clapeyron equation - Derivation and Applications.

UNIT-V

Third Law of Thermodynamics - Entropy at Absolute Zero - Nernst Heat Theorem - Statement of III law of thermodynamics - Planck's formulation of III law of thermodynamics - Evaluation of Absolute Entropy from Heat Capacity Measurements - Exceptions to III law - Applications of III law - Partial molar properties - Chemical Potential - Definition - Effect of Temperature and Pressure on Chemical Potential - Gibbs - Duhem equation. Fugacity-Variation with Temperature and Pressure.

CORE PRACTICAL

PAPER - 2

INORGANIC QUALITATIVE ANALYSIS AND PREPARATION

Analysis of mixture containing two cations and two anions (One will be an interfering anion). Semimicro methods using the conventional scheme are to be adopted.

Cations to be studied

Lead, Copper, Bismuth, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Barium, Calcium, Strontium, Magnesium and Ammonium.

Anions to be studied

Carbonate, Sulphide, Sulphate, Nitrate, Chloride, Bromide, Fluoride, Borate, Oxalate and Phosphate.

Preparation of Inorganic compounds

- Tetraamminecopper(II) Sulphate
- Tris(thiourea)copper(I) Chloride
- Potassium trioxalatoferrate(II)
- Ferrous Ammonium Sulphate
- Microcosmic Salt
- Manganese(II) Sulphate

References

- Vogel's Text Book of Quantitative Chemical Analysis, 5th Edition, ELBS/ Longman, England, 1989.
- Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam.

ALLIED - 2

PAPER - 4

INDUSTRIAL CHEMISTRY - IV

Objective:

Corrosion, control of corrosion, surface coating, paints and pigments, varnishes
semiconductors - Introduction - cause of corrosion - classification - preparation -
properties - Need - Composition - Mechanism - applications.

UNIT - I

CORROSION AND ITS CONTROL - Introduction - Economic aspects of corrosion - Dry or
Chemical Corrosion - Wet or electrochemical corrosion - Mechanism of Electrochemical
Corrosion - Galvanic Corrosion - Concentration Cell Corrosion - Differential aeration
corrosion - Pitting Corrosion - Underground or soil corrosion - Passivity.

UNIT - II

Factors Influencing Corrosion - Microbiological Corrosion Atmospheric corrosion -
Corrosion Control - Proper designing - Using pure metal - Using metal alloys - Chemical
conversion - Coating - Phosphating - Chromising - Treatment of metal surfaces hot dipping -
Use of inhibitors.

UNIT - III

PROTECTIVE COATINGS - Introduction - Metallic Coatings - Various methods of cleaning
articles before electrode position - Electroplate and - Electroplating methods - Pretreatment
of the surface - Metallic Coatings - Hot Dipping -Cementation or Impregnated Coatings -
Sprayed Metal Coatings - Cladding - Vapour Deposition.

UNIT - IV

Paints - ingredients and their functions Required Properties of a Paint Paint Constituents and
Their Functions - Manufacture of Paint - Types of Pigments - Characteristics of pigment -
Oils - Uses in Paint Emulsion Paints - Special Paints - Paint Remover Varnishes.

UNIT - V

Electrical Insulating Materials - Dielectric properties - Requirements of an Electrical
Insulating Material - Classification of insulating material - Electrical Rigid Insulations -
Semiconductors - Introduction - Classification - Degenerate semiconductors - super
conductors

SKILL BASED SUBJECT

PAPER - 2

FOOD CHEMISTRY

Objective:

To impart knowledge about Different Foods, Their Nutritive Values and Food Preservation.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Describe the structures and nutritive values of cereals, Pulses and sugar and their medicinal values.
- 2) Illustrate the composition and nutritive values of Vegetables, Fruits, Milk, Egg and soya beans.
- 3) Define and classify Beverages and functions of appetizers.
- 4) Explain the methods of preservation of foods.
- 5) Discuss about Food Additives and their functions.

UNIT - I

Cereals - Definition - Classification - Processing - Structure of Cereals - Composition and Nutritive value - Pulses - Definition - Classification - Processing - Structure of Pulses - Composition and Nutritive Value - Toxic Constituents in Pulses - Medicinal value of Cereals and Pulses - Sugar - Structure and Properties - Nutritive value - Sugar composition in different food items - Sugar related products - Classification and Nutritive value - Artificial sweeteners - Examples - Saccharin and Cyclamate - Advantages and Disadvantages.

UNIT - II

Vegetables and Fruits - Classification - Composition and Nutritive values - Fungi and Algae as food - Enzymatic Browning and Non- enzymatic Browning - Nutritive value of some common foods - Milk, Egg and Soyabeans.

UNIT - III

Beverages - Definition - Examples - Classification - Fruit Beverages - Milk Based Beverages - Malted Beverages - Examples - Alcoholic and Non-Alcoholic Beverages - Examples - Appetizers - Definition - Classification - Examples - Water - Functions and Deficiency.

UNIT - IV

Food Preservatives - Definition - Classification - Food Spoilage - Definition - Prevention - Methods of Preservation - Classification - Low and High temperature - Preservatives – Examples - Dehydration - Osmotic pressure - Food irradiation.

UNIT - V

Food Additives - Definition - Artificial sweeteners - Saccharin and Cyclamate - Classification - Their functions - Chemical substances - Packaging of Foods - Classification - Materials used for Packaging - Food Colours - Restricted use - Spurious Colours - Taste Enhancers - MSG - Vinegar.

Reference Books

- Food Science - B. Srilakshmi, III Edition, New Age International Publishers, 2005.
- Food Chemistry - Lilian Hoagland Meyer, CBS Publishers & Distributors, 2004.
- Food Science, Nutrition and Health - Brian A. Fox, Allan G. Cameron, Edward Arnold, London.
- Fundamentals of Foods and Nutrition - Mudambi R. Sumathi, and Rajagopal, M. V., - Wiley Eastern Ltd., Madras.
- Handbook of Food and Nutrition - M. Swaminathan - Bangalore Printing and Publishing Co. Ltd., Bangalore.

NON - MAJOR ELECTIVE

PAPER - 2

CHEMISTRY IN EVERY DAY LIFE

Objectives:

To know the basics of Chemistry in our life

To know about the Food Colours, Plastics, Drugs etc.,

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Explain the preparations of cosmetics, soaps and detergents and the Hazards of Cosmetics used in everyday life.
- 2) Identify Adulterants in various food items.
- 3) Define and classify Vitamins and understand their physiological importance.
- 4) Describe Food preservative methods.
- 5) Define Antipyretics, Analgesics, Anesthetics and Sedatives.
- 6) Discuss the preparation and applications of plastics, Resins, Rubbers.
- 7) Classify fertilizers and describe their uses and Hazards.
- 8) Explain advantages and disadvantages of natural and artificial sweetening agents.

UNIT - I

General Survey of Chemicals used in everyday life - Cosmetics - Talcum Powder, Tooth pastes, Shampoos, Nail Polish and Perfumes - General formulation - Preparation - Hazards of Cosmetic use - Soaps and Detergents - Types - Preparation and Uses.

UNIT - II

Food and Nutrition - Carbohydrates, Proteins, Fats and Minerals - Examples - Vitamins - Definitions - Classification - Sources and their Physiological importance - Balanced diet - Adulterants in Milk, Ghee, Oil, Coffee Powder, Tea, Asafoetida, Chilli Powder, Pulses and Turmeric Powder - Identification.

UNIT - III

Food colours used in food - Soft drinks and its Health hazards - Food Preservatives - Definition - Examples - Methods of preservation - Low and High temperature - Dehydration - Osmotic pressure - Food irradiation.

UNIT - IV

Plastics, Polythene, PVC, Bakelite, Polyesters, Resins and their Applications - Natural Rubber - Synthetic rubbers - Vulcanisation - Preparation and its Applications - Antipyretics, Analgesics, Anaesthetics, Sedatives - Definition - Examples and Uses.

UNIT - V

Gobar gas - Production - Feasibility and Importance of Biogas with special reference to Rural India - Fertilizers - Definition - Classification - Urea, NPK and Super phosphates - Need - Uses and Hazards - Sweetening agents - Sucrose and Glucose - Artificial Sweetening agents - Saccharin - Cyclamate - Advantages and Disadvantages.

Reference Books

1. Chemical Process Industries - Norris Shreve Joseph A. Brine .Jr.
2. Perfumes, Cosmetics and Soaps - W. A. Poucher (Vol 3).
3. Environmental Chemistry - A. K. DE.
4. Industrial Chemistry, B. K. Sharma- Goel publishing house Meerut.
5. Food Science - B. Srilakshmi - III Edition - New Age International Publishers, 2005.
6. Food Chemistry, Lillian Hoagland Meyer - CBS publishers & distributors, 2004.
7. Fundamental Concepts of Applied Chemistry - Jayashree Ghosh, S. Chand & Co Ltd., New Delhi - 2010.
8. Applied chemistry - K. Bagavathi Sundari - MJP Publishers (2006).

SEMESTER - V
CORE PAPER - 5
INORGANIC CHEMISTRY - I

Objectives:

To study about the Halogens and Related compounds.

To give students a firm grounding in Co-ordination chemistry and Solid state Chemistry.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Compare the properties of Halogens and their Compounds.
- 2) Recollect the basic concepts and nomenclature of Co-ordination Compounds.
- 3) Explain the theories of Co-ordination Compounds.
- 4) Compare VBT with MOT and apply Complexes in qualitative and quantitative analyses.
- 5) Calculate the CFSE Values of Octahedral and Tetrahedral Complexes.
- 6) Analyze the bonding and structure of metallic carbonyls.
- 7) Draw the structures of ionic crystals and explain the defects in solids.

UNIT - I

Halogens - Group discussion - Comparative study of F, Cl, Br, I and At - Reactivities, hydracids, and oxides- Oxyacids of Halogens (Structure only) - Classification of Halides - Comparison of Fluorine with Oxygen-Fluorides of oxygen-Exceptional properties of Fluorine - Interhalogen compounds - Preparation, Properties and Geometry of AX, AX₃, AX₅ and AX₇ type of Compounds - Pseudohalogens and pseudohalides - Cyanogen and Thiocyanogen - Comparison of Pseudohalogens and Halogens - Basic Properties of Iodine - Evidences.

UNIT - II

Coordination compounds - Definition of terms used - Classification of Ligands - Chelation and Effect of Chelation - Applications of Complexes - Coordination Number and Stereochemistry of Complexes - IUPAC Nomenclature of Complexes - Isomerism in Complexes - Ionisation isomerism, Hydrate Isomerism, Linkage Isomerism, Ligand Isomerism, Coordination Isomerism, Coordination position Isomerism and Polymerisation Isomerism - Geometrical and Optical Isomerism in 4- and 6- Coordinated Complexes.

UNIT - III

Werner's theory of Coordination Compounds-Sidgwick's Theory - EAN rule - Theory of Bonding - Valence Bond Theory - Postulates of VBT - Hybridisation, Geometry and Magnetic properties - Failure of VBT - Crystal field theory - Spectrochemical series - Splitting of d - orbitals in Octahedral, Tetrahedral and Square Planar Complexes - Factors affecting crystal field splitting energy-Crystal Field Stabilisation Energy - Calculation of

CFSE In Octahedral and Tetrahedral Complexes - Low Spin and High Spin Complexes - Explanation of Magnetic Properties, Colour and Geometry Using CFT.

UNIT - IV

Comparison of VBT and CFT - Applications of Coordination Compounds in Qualitative and Quantitative Analysis - Estimation of Nickel using DMG and Aluminium using Oxine - Detection of Potassium ion, S^{2-} ion, Fe^{2+} ion and Fe^{3+} ion - Separation of Copper and Cadmium ions in the second group - Separation of Pb^{2+} and Ag^+ ions in the first group - Bonding, Hybridization and Structure of Carbonyls of Ni, Cr, Fe, Co, Mn, W and V.

UNIT - V

The nature of the Solid State - Amorphous and Crystalline - Differences - Close Packing in Crystals - Examples for Cubic, BCC and FCC Lattices - Bragg's law - Application of XRD to Crystal studies - Structure of NaCl, CsCl, CaF_2 and ZnS - Metallic bond - Free electron, Valence bond and Band theory of Solids, Metals, Semiconductors and Insulators - Defects in solids - Schottky Defect and Frenkel Defect - Metal Excess and Metal Deficiency Defects - Conductors in Ionic Solids - Electrical and Magnetic properties.

CORE PAPER - 6

ORGANIC CHEMISTRY - I

Objectives:

To effectively impart knowledge about Carbohydrates, Stereochemistry, Conformational Analysis, Nitroalkanes and Heterocyclic chemistry.

To make the students more inquisitive in learning the Mechanistic details in Organic Chemistry through the teaching of the named reactions.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Elucidate the structures of saccharides.
- 2) Assign the stereo configuration of Organic Compounds.
- 3) Compare the Conformation and Configuration of cyclohexanes and substituted cyclohexanes.
- 4) Explain the preparation, properties and uses of Nitro alkanes.
- 5) Apply different reagents in studying various Organic reactions.
- 6) Explain the mechanism of Organic named reactions.
- 7) Explain the synthesis and properties of five and six membered heterocyclic compounds and condensed heterocyclic compounds.
- 8) Compare the basicity of heterocyclic Compounds.

UNIT - I

Carbohydrates - Classification - Aldoses and Ketoses, Reducing and Non-reducing Sugars - Reactions of Glucose and Fructose - Osazone formation, Mutarotation and their Mechanism - Structural elucidation of Glucose and Fructose - Pyranose and Furanose forms - Haworth's method - Determination of Ring Size- Haworth Projection Formula - Configuration of Glucose and Fructose - Epimerization - Chain lengthening and chain shortening of Aldoses - Inter conversion of Aldoses and Ketoses - Uses of Glucose - Disaccharides and Polysaccharides - Reactions and Structural elucidation of Sucrose and Maltose - Properties, Structure and Uses of Starch and Cellulose.

UNIT - II

Stereoisomerism - Definition - Classification into Optical and Geometrical isomerism. Conditions for Optical Activity - Asymmetric centre - Chirality - Achiral molecules - Meaning of (+) and (-) and D- and L- notations - Elements of symmetry - Projection formulae - Fischer, Flying Wedge, Sawhorse and Newmann projection formulae - Notation of optical isomers - Cahn - Ingold - Prelog rules - R, S notation of Optical isomers with one Asymmetric carbon atoms - Erythro and Threo representations - Optical activities in Compounds not containing Asymmetric Carbon Atoms - Biphenyl, Allenes and Spiranes - Racemisation - Methods of Racemisation (By substitution and Tautomerism) - Resolution - Methods of Resolution (Mechanical, Biochemical and Conversion To Diastereomers) -

Asymmetric Synthesis (Partial and Absolute Synthesis) - Walden inversion - Geometrical isomerism - Cis - Trans, Syn - Anti and E-Z Notations - Geometrical Isomerism In Maleic and Fumaric Acids and Unsymmetrical Ketoximes - Methods of Distinguishing Geometrical Isomers using Melting Points, Dipole Moment, Dehydration, Cyclisation, Heat of Hydrogenation and Combustion.

UNIT - III

Conformational analysis - Introduction of terms - Conformations, Configuration, Dihedral Angle, Torsional Strain - Differences between Conformational isomers and Configurational isomers - Conformational analysis of Ethane and n-Butane including energy diagrams - Conformations of Cyclohexane (Chair, Boat and Twist-Boat forms) - Axial and Equatorial bonds - Ring flipping showing Axial and Equatorial bonds Interconversions - Conformations of Methyl Cyclohexane, Dimethyl Cyclohexane and their stability - 1,2 and 1,3 - Interactions.

UNIT - IV

Nitroalkanes - Preparation - Properties - Structure - Nitro-Acinitro Tautomerism - Uses of Nitroalkanes - Differences between Primary, Secondary and Tertiary Nitroalkanes. Diazomethane, Diazoacetate, alkylazides - Preparation and synthetic uses - Reagents and their Applications in Organic Chemistry - Anhydrous AlCl_3 , P_2O_5 , H_2/Pd - BaSO_4 , Zn/Hg - HCl and Ag_2O - Mechanism of Aldol, Perkin and Benzoin condensations - Knoevenagel, Claisen, Wittig, Cannizzaro, Reformatsky and Michael addition reactions.

UNIT - V

Heterocyclic compounds - Huckel's rule - Aromaticity of Heterocyclic compounds - Preparation, Properties, Structure and Uses of Furan, Pyrrole and Thiophene - Preparation and properties of Pyridine and Piperidine - Comparative study of Basicity of Pyrrole, Pyridine and Piperidine with Amines - Nucleophilic and Electrophilic substitution reactions of Pyridine - Condensed Five and Six Membered Heterocyclic Compounds - Preparation of Indole, Quinoline and Isoquinoline - Fischer-Indole synthesis, Skraup Quinoline synthesis and Bischler-Napieralski synthesis - Electrophilic substitution reactions.

CORE PAPER - 7
PHYSICAL CHEMISTRY - I

Objectives:

To impart knowledge about the Solutions, Phase Rule and its Applications, Colligative properties, Chemical Equilibrium, Phase Rule and its Applications, Electrochemistry and its Applications.

Course Outcomes:

Upon completion of this course, the students will be able to

- Explain the Thermodynamics of ideal and Non-ideal solutions, Nernst distribution law and its applications.
- Draw and explain phase diagrams of one Component and two Component systems having congruent and incongruent melting points.
- Derive law of Chemical equilibrium and Van't Hoff isotherm.
- Determine molar mass from the colligative properties.
- Explain variation of conductivity with dilution, measurement of conductivity and concept of Transport Number and its determination.
- Explain Debye-Huckel Theory of strong electrolytes.
- Apply conductivity measurements and explain conductometric titrations.
- Explain buffer action and derive Henderson equation and pH of aqueous salt solutions.

UNIT - I

SOLUTIONS

Solutions of liquids in liquids -Ideal Solution and Raoult's law - Vapour pressure of ideal solutions. Vapour Pressure-Composition and Temperature-Composition Curves of Ideal and Non-ideal Solutions. Thermodynamics of Solutions. Gibbs-Duhem-Margules equation - Vapour pressure of Non-ideal solutions - Fractional distillation of Binary liquid solutions - Lever rule- Azeotropic mixtures - Partially miscible liquids. CST and effect of impurity on CST. Phenol - Water, Triethylamine - Water and Nicotine - Water systems - Immiscible Liquids- Steam Distillation. Nernst distribution law - Definition - Thermodynamic derivation - Applications.

UNIT - II

PHASE RULE

Definition of the terms - Phase, Components and Degrees of freedom - Derivation of Gibbs phase rule - Applications of phase rule - One component system - Water and Sulphur system - Thermal Analysis and Cooling Curves- Reduced phase rule - Two components system - Simple eutectic system - Lead-silver system - Compound formation with congruent and incongruent melting points. Zn-Mg,Na-k,FeCl₃-H₂O,KI-H₂O systems - Freezing Mixtures.

UNIT - III

COLLIGATIVE PROPERTIES AND CHEMICAL EQUILIBRIUM

Colligative properties - Lowering of vapour pressure - Osmosis and osmotic pressure - Thermodynamic Derivation of Elevation of boiling point and Depression of freezing point - Determination of molar mass - Van't Hoff factor - Chemical Equilibrium - Law of Chemical Equilibrium - Thermodynamic derivation of Law of Chemical Equilibrium. Relationship between K_p, K_c and K_x for reactions involving Ideal Gases - Van't Hoff Reaction Isotherm - Temperature Dependence of Equilibrium Constant - Van't Hoff Isochore - Le Chatelier's Principle and Its Applications.

UNIT - IV

ELECTROCHEMISTRY - I

Metallic and Electrolytic Conductors-Faraday's Laws-Electro plating Specific conductance and Equivalent conductance - Measurement of equivalent conductance - Variation of Equivalent Conductance and Specific Conductance with Dilution Kohlrausch Law and its applications - Ostwald's Dilution Law and its Limitations - Debye-Huckel's theory of Strong Electrolytes - Onsagar equation (No derivation) -Verification and Limitations Wien effect, Falkenhagen effect. Ionic Strength - Migration of ions - Ionic Mobility - Ionic Conductance - Transport Number and its determination - Hittorff's method and Moving Boundary method.Effect of Temperature and Concentration on Conductance.

UNIT - V

ELECTROCHEMISTRY - II

Applications of Conductometric Measurements - Determination of Degree of Dissociation of Weak Electrolytes, Ionic Product of water - Solubility Product of sparingly soluble salt - Conductometric Titrations - Concept of pH - Buffer solutions, Buffer action - Henderson equation - Applications of Buffer Solutions - Hydrolysis of Salts - Expressions for Hydrolysis Constant, Degree of Hydrolysis and pH of aqueous salt solutions.

INTERNAL ELECTIVE

PAPER - 1

(to choose one out of 3)

A. ANALYTICAL CHEMISTRY - 1

Objective:

To impart knowledge about Data Analysis, Purification of organic compounds, Different Spectroscopic Techniques and their Application.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Analyze Data and explain the methods of purification of solids.
- 2) Purify solid and liquid Organic Compounds.
- 3) Explain the concept of Gravimetric Analysis.
- 4) Describe the principles, Instrumentation and applications of UV, Visible, Microwave, IR and Raman Spectroscopy.
- 5) Determine the structure of Organic Compounds using various spectral techniques.

UNIT - I

Data analysis - Types of errors - Correction of determinate errors - Idea of Significant Figures and their Importance with examples - Precision and Accuracy - Methods of expressing Accuracy - Error analysis - Minimising errors - Methods of expressing Precision - Average deviation - Standard Deviation and Confidence Limit - Purification of Solid Organic Compounds - Solvent extraction - Recrystallisation - Use of immiscible solvents - Soxhlet extraction - Crystallisation - Use of miscible solvents - Fractional Crystallisation and Sublimation.

UNIT - II

Purification of liquids - Experimental Techniques of Distillation - Fractional Distillation - Vacuum Distillation - Steam Distillation - Tests of Purity - Gravimetric Analysis - Characteristics of Precipitating Agents - Condition of Precipitation - Types of Precipitants - Purity of Precipitate - Co-precipitation and Post precipitation - Precipitation from Homogeneous Solution - Digestion and Washing of precipitate - Ignition of precipitate - Uses of Sequestering Agents - Definition of spectrum - Electromagnetic radiation - Quantization of different forms of energies in molecules (Translational, Rotational, Vibrational and Electronic) - Born- Oppenheimer approximation - Condition of energy of absorption of various types of spectra.

UNIT - III

Microwave Spectroscopy - Theory of Microwave Spectroscopy - Selection Rule - Calculation of Moment of Inertia and Bond Lengths of Diatomic molecules - Effect of Isotopic Substitution - UV - Visible Spectroscopy - Absorption laws - Calculations involving Beer- Lambert's law - Instrumentation - Photocalorimeter and Spectrophotometer - Block diagrams with description of components - Theory of Electronic Spectroscopy - Types of Electronic Transitions - Chromophore and Auxochromes - Absorption bands and Intensity - Factors influencing Position and Intensity of Absorption Bands - Frank- Condon Principle - Applications.

UNIT - IV

IR Spectroscopy - Principle - Theory of IR spectra - Vibrational Degrees of Freedom - Modes of Vibration of Diatomic Molecules -Triatomic linear (CO_2) and Non-linear Molecules (H_2O) - Stretching and Bending vibrations - Symmetric and Asymmetric Stretching vibrations - Selection rules - Expression for Vibrational Frequency (Derivation not needed) - Calculation of Force constant - Factors influencing Vibrational Frequencies - IR Spectrophotometer - Instrumentation - Source, Monochromator, Cell, Detectors, Recorders and Sampling Techniques - Applications of IR Spectroscopy - Identification of Functional Groups - Interpretation of the spectra of Alcohols, Aldehydes, Ketones and Esters (Aliphatic and Aromatic) - Hydrogen bonding.

UNIT - V

Raman Spectroscopy - Rayleigh and Raman scattering - Selection rule - Raman shift - Stokes and Anti-stokes lines - Differences between Raman and IR Spectroscopy - Raman Spectrophotometer - Instrumentation - Block diagram - Components and their Functions - Advantages of using Laser in Raman Spectroscopy - Applications - Structural elucidation in the study of Inorganic and Organic Compounds - Rotational-Raman spectra of Non - Centrosymmetric molecules - Mutual exclusion principle (CO_2 and N_2O) - Applications - Structural diagnosis.

Reference Books

- Elements of Analytical Chemistry - R. Gopalan, P. S. Subramanian, K. Rengarajan - S. Chand and sons (1997).
- Fundamentals of Analytical Chemistry - D. A. Skoog and D. M. West, Holt Reinhard and Winstor Publications - IV Edition (1982).
- Principles of Instrumental Methods of Analysis - D. A. Skoog and Saunders, College Publications, III Edition (1985).
- Analytical Chemistry - S. M. Khopkar - New age International Publishers.
- Instrumental Methods of Chemical Analysis - Chatwal - Anand, Himalaya Publishing House (2000).

- Analytical Chemistry - R. Gopalan, Sultan Chand.
- Analytical Chemistry - S. Usharani, Macmillan.
- Instrumental Methods of Analysis - 7th Edition - H. H. Willard, L. L. Merit. J. Dean and F. A. Settle -Wadsworth Publishing Company Limited, Belmont, California, USA, 1988.
- Physico- Chemical Techniques of Analysis - P. B. Janarthanan - Vol. I & II - Asian Publishing.
- Instrumental Methods of Chemical Analysis - B. K. Sharma - Goel Publications.
- Applications of Absorption Spectroscopy of Organic Compounds - Prentice Hall, John R. Dyer.
- Spectroscopic Identification of Organic Compounds - R. M. Silverstein, G. C. Bassler and T. C. Morill - John Wiley and Sons.

INTERNAL ELECTIVE

PAPER - 1

B. BASICS OF COMPUTER PROGRAMMING IN C AND ITS APPLICATIONS IN CHEMISTRY

Objective:

- To introduce the basics of computers.
- To learn C language and its applications in solving problems in Chemistry.

UNIT - I

Basic Computer Organisation, Processor and Memory - Main Memory, Secondary Storage Devices and Storage Hierarchy - Software - Relationship between Hardware and Software - Types of Software - Planning the Computer Program - Algorithm and Flowcharts - Basics of Operating Systems.

UNIT - II

Computer Languages - Machine Language, Assembly Language, Assembler, Compiler, Interpreter and Programming Languages - C language - Introduction - C Compiler - Operating Systems and Preprocessor Directives - Variables, Constants, Operators, Input and Output Functions.

UNIT - III

Control Structures - Conditional, Looping, Goto, Break, Switch and Continue Statements, Functions, Arrays And Pointers.

UNIT - IV

Applications in Chemistry - Calculation of the Radius of the first Bohr orbit for an Electron - Calculation of Half-life Time for an integral order reaction - Calculation of Molarity, Molality and Normality of a solution - Calculation of Pressure of Ideal Gases and Van der Waal's gases - Calculation of Electronegativity of an Element using Pauling's relation.

UNIT - V

Applications in Chemistry - Calculation of Empirical Formulae of Hydrocarbons - Calculation of Reduced Mass of a few Diatomic Molecules - Determination of the Wave Numbers of Spectral lines of Hydrogen atom - Calculation of Work of Expansion in Adiabatic Process - Calculation of pH, Solubility Product and Bond Energy using Born-Landé equation - Calculation of Standard Deviation and Correlation Coefficient.

Reference Books

- Computers in Chemistry, K. V. Raman, 8th Edition, Tata McGraw Hill Publishers, 2005.
- Programming with C, Venugopal and Prasad, 11th Edition, 1971. .
- Programming in C, E. Balaguruswamy, 2nd Edition, 1989.

INTERNAL ELECTIVE
PAPER - 1
C. ORGANIC SYNTHESIS

Objectives

- To know the Basics of Retrosynthesis.
- To impart knowledge about the Ring Synthesis.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Analyze the importance of Organic synthesis.
- 2) Explain various disconnection approaches in Organic synthesis.
- 3) Explain the role of protecting groups in Organic synthesis.
- 4) Apply Ring synthesis in the synthesis of Camphor, Longifolene, Cortisone and Reserpine.

UNIT - I

DISCONNECTION APPROACH

An introduction to Synthons and Synthetic Equivalent - Disconnection Approach - Functional Group Interconversions - The importance of the Order of Events in Organic Synthesis - One group C-X and Two group C-X disconnections - Chemoselectivity - Reversal of Polarity.

UNIT - II

PROTECTING GROUPS

Principle of Protection of Alcoholic group and Amino group - Principle of Protection of Carbonyl group and Carboxyl group - Activation of Functional Groups.

UNIT - III

ONE GROUP C-C DISCONNECTIONS

Alcohols and Carbonyl Compounds - Regioselectivity and Alkene Synthesis - Uses of Acetylenes and Aliphatic Nitro Compounds in Organic Synthesis.

UNIT - IV

TWO GROUP C-C DISCONNECTIONS

Diels-Alder Reaction - 1, 3 - Difunctionalised Compounds - α , β - Unsaturated Carbonyl Compounds - Control in Carbonyl Condensations - 1,5-Difunctionalised Compounds - Michael Addition and Robinson Annulation reactions.

UNIT-V

RING SYNTHESIS

Saturated Heterocyclic Compounds - Synthesis of 3-, 4- and 6- Membered Rings Aromatic Heterocycles in Organic Synthesis - Application of the above in the Synthesis of Camphor, Longifoline, Cortisone and Reserpine.

Reference Books

- Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge University Press, UK.
- Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Part- B, Plenum Press.
- Modern Synthetic Reactions. H. O. House and W. A. Benjamin,

SKILL BASED SUBJECT

PAPER - 3

APPLIED CHEMISTRY

Objective:

To impart Knowledge about Petrochemicals, Paper Technology, Sugar Industry, Explosives, Photography and Dairy Chemistry,

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Explain the refining process of petroleum and differentiate between Thermal and Catalytic Cracking.
- 2) Explain the various processes involved in paper technology.
- 3) Recover glucose from molasses and estimate sugar.
- 4) Prepare alcohol from molasses.
- 5) Explain the Proximate and Ultimate analysis of Coal.
- 6) Describe Chemical changes occurring in Milk during processing.
- 7) Define the principle involved in photography.
- 8) Explain the need for making milk powder and principle involved in drying process.

UNIT - I

Petroleum - Origin - Composition of Petroleum - Inorganic, Engler and Modern theories - Classification - Refining (Simple Refinery) - Cracking - Thermal and Catalytic - Knocking - Octane Rating - Antiknock Compounds - Cetane Rating - Synthetic Petrol - LPG - Gobar Gas - Production - Feasibility and Importance of Biogas with special reference to Rural India - Petrochemicals - Elementary study - Definition - Chemicals from Natural Gas, Petroleum, Light naphtha and Kerosene - Origin - Composition - Synthetic Gasoline.

UNIT - II

Paper technology - Introduction - Manufacture of pulp - Various raw materials used for the preparation of pulp - Preparation of Sulphite pulp, Soda pulp and Rag pulp - Various processes - Beating, Refining, Filling, Sizing and Colouring - Manufacture of Paper - Calendering - Uses.

UNIT - III

Sugar industry - Sugar industries in India - Sugarcane and sugar beet - Manufacture of cane sugar - Extraction of juice - Concentration - Separation of crystals - Recovery of Glucose from Molasses - Defection - Sulphitation - Carbonation - Testing and Estimation of Sugar - Double Sulphitation Process - Preparation of Bagasse - Use of Bagasse for Manufacture of Paper and Electricity - Preparation of Alcohol from Molasses - Preparation of Absolute Alcohol - Manufacture of Wine, Beer, Methylated Spirit and Power Alcohol.

UNIT - IV

Explosives - Primary, Low and High Explosives - Single compound explosives - Binary explosives - Plastic explosives - Dynamites - Blasting explosives - Preparation and Uses of Lead Azide, Nitroglycerine, Nitrocellulose, TNT, Cordite, Picric Acid and Gun Powder - Introduction to Rocket Propellants - Photography - Chemical Principle - Preparation of Sensitive Emulsion - Exposure - Developing - Fixing and Printing - Colour photography - Xerographic copying - Coal - Classification by rank - Proximate and Ultimate analysis - Low and High Temperature Carbonisation - Otto-Hoffmann's by-product - Distillation of Coal Tar.

UNIT - V

Milk - Definition - Physico-Chemical properties of milk - Constituents of milk and Their Physico-chemical Properties - Chemical change taking place in Milk due to Processing Parameters - Boiling, Pasteurisation, Sterilisation and Homogenisation - Definition and Composition of Creams, Butter, Ghee and Ice Creams - Milk Powder -Definition, Need for making powder - Principles involved in Drying process - Spray drying and Drum drying.

Reference Books

1. Fundamental Concepts of Applied Chemistry - Jayashree Ghosh - 1st Edition, S. Chand & Co. Ltd, New Delhi, 2006.
2. Milk and Milk Products - Clarence Henry Eckles, Willes Barnes Combs, Harold Macy - 4th Edition, Tata McGraw Hill Publishing Company Ltd, Reprint 2002.
3. Industrial Chemistry - B. K. Sharma - 13th Edition, Goel Publishing House, 2008.

SEMESTER - VI
CORE PAPER - 8
INORGANIC CHEMISTRY - II

Objectives:

To impart knowledge about Nuclear chemistry, Radioactivity, Metallurgy, Chemistry of f-Block Elements, Organometallic Compounds and Bio-inorganic Chemistry.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Explain the stability of nuclides in terms of N/P ratio, mass defect, binding energy and packing fraction.
- 2) Describe natural and artificial radioactivity and compare high energy nuclear reactions.
- 3) Describe the various processes involved in Metallurgy.
- 4) Compare the properties of d-block elements.
- 5) Compare the properties of lanthanides and actinides.
- 6) Classify Organometallic Compounds and discuss the biological importance of Fe, Cu and Zn.

UNIT - I

NUCLEAR CHEMISTRY

Introduction - Composition of Nucleus - Fundamental Particles of Nucleus - Nuclear Forces operating between the Nucleons - N/P ratio - Nuclear Stability - The whole number rule and Packing fraction - Isotopes, Isobars, Isotones, mirror nuclei and Nuclear isomers - Detection and Separation of isotopes - Nuclear Binding Energy - Mass defect - Simple calculations involving Mass Defect and Binding Energy per Nucleon - Magic Numbers - Liquid drop model - Shell model.

UNIT - II

RADIOACTIVITY

Natural Radioactivity - Properties of Alpha, Beta and Gamma rays - Detection and measurement of Radioactivity - Radioactive series including Neptunium series - Soddy's Group Displacement Law - Rate of disintegration and Half - Life period - Derivation - Average life period - Artificial Radioactivity - Induced Radioactivity -Q-value of nuclear reactions- Uses of Radioisotopes-Hazards of radiations - Nuclear fission - Nuclear energy - Nuclear reactors, Breeder reactors - Nuclear fusion -Thermonuclear reactions - Energy source of the Sun and Stars -Atom bomb and Hydrogen bomb- Comparison of Nuclear Fission and Nuclear Fusion.

UNIT - III

METALLURGY

General metallurgy and Metallurgical processes - Methods of Concentration - Gravity separation, Froth floatation process, Magnetic separation, Roasting - Reduction methods - Smelting, Calcination, Goldschmidt Aluminothermic process, Reduction by active metals, Electrolytic reduction - Purification methods - Liquation, Zone refining, Van Arkel method, Carbonyl process and Electrolytic refining - Characteristic properties of d-block elements- Comparative study of Ti, V, Cr, Mn and Fe group elements with special reference to Occurrence, Oxidation States, Magnetic Properties, complexes, coordination number and Colour - Occurrence and Extraction of Ti, Mo, W and Co - Preparation and Uses of Ammonium Molybdate and V_2O_5 .

UNIT - IV

INNER TRANSITION ELEMENTS

General Characteristics of f- Block elements - Position of Lanthanides in the periodic table - Separation of Lanthanides (Ion exchange method) - Comparative study of Lanthanides and Actinides - Occurrence, Oxidation states, Magnetic properties, Colour and Spectra and complex formation - Lanthanide Contraction - Causes and Consequences - Comparison between Lanthanides and Actinides - Position of Actinides in the periodic table - Extraction of Thorium and Uranium

UNIT - V

ORGANOMETALLIC COMPOUNDS AND BIOINORGANIC CHEMISTRY

Organometallic Compounds - Definition - Nomenclature - Classification - Organo-Lithium and Organo-Boron Compounds - Preparation, Properties, Structure and Uses - Biological Functions of Iron, Copper and Zinc - Biologically Important Compounds - Myoglobin, Cytochrome, Haemoglobin and Ferritin - Binary Metallic Compounds - Hydrides, Borides, Carbides and Nitrides - Classification - Preparation, Properties, Structure and Uses.

CORE PRACTICAL
PAPER - 3
GRAVIMETRIC ESTIMATION

1. Estimation of Sulphate as Barium Sulphate.
2. Estimation of Barium as Barium Sulphate.
3. Estimation of Barium as Barium Chromate.
4. Estimation of Lead as Lead Chromate.
5. Estimation of Calcium as Calcium Oxalate Monohydrate.

References

- Qualitative Inorganic Analysis, A.I. Vogel - 7th Edition, Prentice Hall.
- Quantitative Chemical Analysis, A.I. Vogel - 6th Edition, Prentice Hall.

CORE PAPER - 9
ORGANIC CHEMISTRY - II

Objectives:

- To kindle interest in students in learning Bio-organic chemistry through the introduction of topics such as Proteins, Nucleic acids, Terpenes, Alkaloids etc.
- To generate Keen Interest and Thinking in Understanding the Mechanisms of Molecular Rearrangements and Synthetic Applications of Acetoacetic Ester, Benzene Diazonium Chloride, Grignard Reagents and Diazomethane.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Explain the mechanisms of inter and intra molecular rearrangements.
- 2) Classify amino acids and explain their preparation and properties and synthesis of Peptides.
- 3) Differentiate between DNA and RNA.
- 4) Explain primary and secondary structures of proteins.
- 5) Elucidate the structures of Antibiotics, Alkaloids and Terpenoids.

UNIT - I

MOLECULAR REARRANGEMENTS

Rearrangements - Classification - Anionotropic, Cationotropic and Free Radical Rearrangements - Intermolecular and Intramolecular Rearrangements - Examples - Cross over experiment - Differences between Intermolecular and Intramolecular rearrangements - Mechanisms, Evidences, Migratory Aptitude, Intermolecular or Intramolecular nature of the following rearrangements - Pinacol-Pinacolone, Benzil-Benzilic acid and Beckmann rearrangement - Mechanism of Hoffmann, Curtius, Baeyer-Villiger, Claisen (Sigmatropic), Fries rearrangement, Cope and Oxy-Cope rearrangements.

UNIT - II

AMINO ACIDS AND POLYPEPTIDES

Amino acids - Classification - Essential and Non-Essential amino acids - Acidic, Basic and Neutral Amino Acids - Alpha, Beta and Gamma- Amino acids - Preparation of alpha amino acids - Gabriel's Phthalimide synthesis, Strecker synthesis and Erlenmeyer Azlactone synthesis - Glycine, Alanine and Tryptophan - General properties of Amino acids - Reactions of Amino acids due to Amino group and Carboxyl group - Zwitterions - Isoelectric point - Peptides - Synthesis - Bergmann Method - Structural Determination of Polypeptides - End Group Analysis - N-Terminal and C-Terminal Amino Acids Determination.

UNIT - III

PROTEINS AND NUCLEIC ACIDS

Proteins - Definition - Classification based on Physical Properties, Chemical Properties and Physiological Functions - Primary and Secondary Structure of Proteins - Helical and Beta

Sheet Structures (Elementary Treatment Only) - Denaturation of Proteins - Nucleic acids - Nucleoproteins - Definition - Types of Nucleic Acids - RNA and DNA - Nucleoside, Nucleotide, Degradation of Nucleotide Chain - Components of RNA and DNA - Differences between DNA and RNA - Structures of Ribose and 2- Deoxyribose - Double Helical Structure of DNA - Biological functions of Nucleic Acids - Elementary ideas on Replication and Protein Synthesis.

UNIT - IV

CHEMISTRY OF NATURAL PRODUCTS

Antibiotics - Definition - Structural elucidation of Penicillin and Chloramphenicol - Uses of Penicillin and Chloramphenicol - Alkaloids - Classification - Isolation of alkaloids - General methods of Determination of structure of Alkaloids - Synthesis and Structural Elucidation of Piperine, Coniine and Nicotine - Terpenoids - Definition - Classification - Isoprene rule - Synthesis and Structural elucidation of Citral, Menthol and Alpha- pinene.

UNIT - V

ORGANOSULPHUR COMPOUNDS AND AROMATIC SULPHANIC ACIDS.

Thioalcohols-Structure-Nomenclature-methods of preparation-Physical and Chemical properties - Thioethers-Structure-Nomenclature-Physical and Chemical properties - dimethyl sulphoxide - uses.Mustard gas-Preparation-Properties and uses - Aromatic sulphanic acid - stucture-Nomenclature-benzene sulphanic acid,benzene sulphanyl chloride, benzene disulphanic acids,Toluene sulphanic acids,Chloramine-T,Saccharin and sulphanilic acid-Chemical properties and uses.

CORE PRACTICAL

PAPER - 4

ORGANIC QUALITATIVE ANALYSIS AND PREPARATIONS

Analysis of organic compounds containing one functional group and characterisation with a derivative.

Reactions of the following Functional Groups:

Aldehyde, Ketone, Carboxylic Acid (Mono and Di), Ester, Carbohydrate (Reducing and Non-Reducing), Phenol, Aromatic Primary Amine, Amide, Nitro Compounds, Diamide and Anilide.

Organic Preparations

Acylation

1. Acetylation of Salicylic acid or Aniline.
2. Benzoylation of Aniline or Phenol.

Nitration

3. Preparation of m- Dinitrobenzene
4. Preparation of p- Nitroacetanilide

Halogenation

5. Preparation of p- Bromoacetanilide
6. Preparation of 2,4,6-Tribromophenol

Diazotisation /Coupling

7. Preparation of Methyl Orange

Oxidation

8. Preparation of Benzoic Acid from Toluene or Benzaldehyde.

Hydrolysis

9. Hydrolysis of Ethyl Benzoate (Or) Methyl Salicylate (Or) Benzamide.

Reference Books

- ❖ Vogel's Text Book of Chemical Analysis
- ❖ Practical Chemistry - A. O. Thomas - Scientific Book Center, Cannanore.
- ❖ Practical Chemistry - 3 Volumes - S. Sundaram and others.
- ❖ Text Book of Practical Organic Chemistry - A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hannaford and P.W. G. Smith - 5th Edition - 1996.
- ❖ Comprehensive Practical Organic Chemistry - Preparation and Quantitative Analysis - V. K. Ahluwalia, Renu Agarwal - Universities Press - 2013.

CORE PAPER - 10
PHYSICAL CHEMISTRY - II

Objectives:

To impart Knowledge about Electrochemistry, Surface Chemistry, Photochemistry, Chemical Kinetics and Theories of reaction rates.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Derive Nernst equation and explain Cell reactions.
- 2) Explain Concentration Cells and polarization.
- 3) Derive rate constant expressions for zero, first, second and third order reactions and determine the order of a reaction.
- 4) Compare Collision theory and ARRT.
- 5) Explain Lindemann's theory of unimolecular reactions.
- 6) Explain Langmuir Theory of Adsorption.
- 7) Derive Michaelis-Menten equation for enzyme catalyzed reactions.
- 8) State laws of photochemistry and explain the kinetics of photo chemical reactions.
- 9) Explain various Photo physical processes and Photosensitized reactions.

UNIT - I

ELECTROCHEMISTRY - III

Galvanic cells - Daniel cell - Reversible and Irreversible Cells - EMF of a Cell and its Measurement - Standard Weston Cadmium Cell - Evaluation of Thermodynamic Quantities- ΔG , ΔH and ΔS from emf data - Derivation of Nernst equation for Electrode Potential and Cell emf -Types of reversible electrodes - Electrode reactions - Electrode potentials - Reference electrodes - Standard Hydrogen Electrode - Standard Electrode Potential - Sign conventions - Electrochemical Series and its Applications.

UNIT - II

ELECTROCHEMISTRY - IV

Liquid Junction Potential - Concentration cells With Transference and Without Transference Applications of Concentration cells - Valency of ions, Solubility and Solubility Product - Activity Coefficient of electrolytes - Determination of pH using Hydrogen, Quinhydrone and Glass electrodes - Potentiometric titrations - Polarisation - Overvoltage - Decomposition potential - Storage Cells- Lead Storage Battery- Mechanism of Charging and Discharging- Fuel Cells (H_2-O_2 Cell).

UNIT - III

CHEMICAL KINETICS

Definitions of the terms - Order and Molecularity - Rate of the reaction - Derivations of expressions for Zero, First, Second (for equal and unequal concentrations of reactants) and Third order rate equations - Study of kinetics - Methods of Determination of Order of a reaction - Effect of Temperature on reaction rate - Arrhenius equation - Theories of reaction rates - Bimolecular Collision Theory - Lindmann's theory of Unimolecular Reactions - ARRT - Thermodynamic treatment of ARRT - Eyring equation - Comparison of Collision Theory and ARRT.

UNIT - IV

SURFACE CHEMISTRY

Adsorption - Characteristics of adsorption - Physisorption and Chemisorption - Differences between Physical and Chemical Adsorption - Applications of Adsorption - Adsorption of Gases by Solids - Different Types of Isotherms - Freundlich adsorption isotherm - Langmuir theory of adsorption - Derivation. BET Theory (no derivation) - Catalysis - Definition - General Characteristics of Catalytic Reactions - Acid-Base catalysis - Enzyme catalysis - Michaelis-Menten Equation - Effect of Temperature and pH on Enzyme Catalysis. Enzyme Inhibition - Homogeneous catalysis - Function of a catalyst in terms of Gibbs's free energy of activation - Heterogeneous catalysis - Kinetics of Unicellular Surface Reactions.

UNIT - V

PHOTOCHEMISTRY

Difference between Thermal and Photo chemical reactions - Laws of photochemistry - Grothus-Draper law, Stark-Einstein's law - Primary and Secondary processes - Quantum yield and its determination - Qualitative description of Fluorescence, Phosphorescence-Jablonski diagram - Photosensitized Reactions. Luminescence, Chemiluminescence and Bioluminescence - Kinetics of Photochemical Reactions - H_2-Cl_2 and H_2-Br_2 reactions - Photodimerisation of Anthracene.

REFERENCE BOOKS

INORGANIC CHEMISTRY

1. Inorganic Chemistry - P. L. Soni - Sultan Chand (2006).
2. Principles of Inorganic Chemistry - B. R. Puri, L. R. Sharma and K. C. Kallia - Milestone Publications (2013).
3. Selected Topics in Inorganic Chemistry - W. U. Malik, G. D. Tuli and R. D. Madan - S. Chand Publications (2008).
4. Inorganic Chemistry: Principles of Structure and Reactivity - J. E. Huheey, E. A. Keiter, R. I. Keiter and O. K. Medhi - 2006.
5. Concise Inorganic Chemistry - J. D. Lee - III edition - Von Nostrand.
6. Industrial Chemistry - B. K. Sharma - Goel Publications (1983).
7. Industrial Chemistry R. K. Das - Kalyani Publications, New Delhi (1982).

8. Coordination Chemistry - S. F. A. Kettle - ELBS (1973).
9. Coordination Chemistry - K. Burger - Butterworthy (1973).
10. Vogel's Handbook of Quantitative Inorganic Analysis - Longman.
11. Text Book of Qualitative Inorganic Analysis - A. I. Vogel - III edition (1976).
12. Source Book on Atomic Energy - S. Glasstone- East-West Press Pvt. Ltd. (1967).
13. Nuclear and Radiochemistry - John Wiley and Sons (1964).
14. Nuclear Chemistry - H. J. Arnikar - Wiley Eastern Co., - II edition (1987).
15. Advanced Inorganic Chemistry - Cotton and Wilkinson - V Edition - Wiley and Sons (1988)
16. Text Book of Inorganic Chemistry - R. Gopalan - Universities Press - 2012.
17. Modern Inorganic Chemistry - R. D. Madan - S. Chand Publications, Reprint, 2014.

ORGANIC CHEMISTRY

1. Organic Chemistry - R. T. Morrison and Boyd - Pearson - 2010.
2. Organic Chemistry - I. L. Finar - Volume I and II - Pearson Education.
3. Text Book of Organic Chemistry - P. L. Soni - Sultan Chand & Sons - 2007.
4. Advanced Organic Chemistry - Bahl and Arun Bahl - S. Chand and Co. Ltd. - 2012.
5. Stereochemistry, Conformations and Mechanisms - Kalsi - 2nd Edition, Wiley Eastern Ltd., Chennai - 1993.
6. Organic Chemistry of Natural Products - Volume I and II - O. P. Agarwal - Goel Publishing House
7. A Guide Book to Mechanisms in Organic Chemistry - Peter Sykes - Pearson Education - 2006.
8. Stereochemistry of Organic Compounds - D. Nasipuri - New Age International Publishers..
9. Chemistry of Natural Products - Gurdeep Chatwal- Himalaya Publishing House.
10. Reactions and Reagents - O. P. Agarwal- Goel Publishing House.
11. Organic Reaction Mechanisms - Gurdeep Chatwal- Himalaya Publishing House.
12. A Text Book of Organic Chemistry, K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra - Vikas Publishing House - 2011.
13. Modern Organic Chemistry- M. K. Jain and S. C. Sharma- Vishnoi Publications, 2014.
14. Reaction, Mechanism and Structure - Jerry March - John Wiley and Sons, NY -1992.
15. Organic Chemistry - Bruice - Pearson Education.
16. Text Book of Organic Chemistry - C. N. Pillai - Universities Press - 2009.
17. Organic Reaction Mechanisms - Parmar and Chawla - S. Chand & Co.
18. Organic Chemistry - I. L. Finar - 6th Edition, Pearson Education, 2008.
19. A Guide Book to Mechanisms in Organic Chemistry - Peter Sykes - Pearson Education, 2006
20. Stereochemistry of Carbon Compounds- E. I. Eliel - Tata Mcgrow Hill Education - 2000.
21. Organic Chemistry - T. W. Graham Solomon, C. B. Fryhle - S. A. Dnyder - John Wiley & Sons - 2014.
22. Advanced Organic Reaction Mechanism (Problems and Solutions) - N. Tewari - Books and Allied (P) Ltd - 2005.
23. Advanced Organic Stereochemistry (Problems and Solutions) - N Tewari - Books and Allied (P) Ltd - 2010.

PHYSICAL CHEMISTRY

1. Principles of Physical Chemistry - B. R. Puri, Sharma and Madan S. Pathania, Vishnal Publishing Co., - 2013.
2. Text Book of Physical Chemistry - P. L. Soni, O. P. Dharmarha and U. N Dash - Sultan Chand & Co., - 2006.
3. Physical Chemistry - Negi and Anand - Eastern Wiley Pvt.Ltd..
4. Physical Chemistry - Kundu and Jain - S. Chand & Co.
5. Physical Chemistry - K. L. Kapoor - Macmillan - 4 volumes.
6. Elements of Physical Chemistry - Glasstone and Lewis - Macmillan.
7. Text book of Physical Chemistry - S. Glasstone - Macmillan (India) Ltd.
8. Fundamentals of Physical Chemistry - Maron and Landor - Colier - Macmillan.
9. Physical Chemistry - G. W. Castellan - Narosa publishing house - 2004.
10. Physical Chemistry - Walter J. Moore - Orient Longman - 1972.
11. Numerical Problems on Physical Chemistry, Gashal - Books and Allied (P) Ltd.,
12. Universal General Chemistry, C.N.R. Rao, Macmillan.
13. Group Theory and its Chemical Applications - P. K. Bhattacharya - Himalaya Publishing House.
14. Text book of Physical Chemistry - M. V. Sangaranarayanan, V. Mahadevan, Universities Press - 2011.
15. General and Physical Chemistry - Dr. A. Arunabhasan, Books of Allied (P) Ltd., - Ghosal - 2009.

CORE PRACTICAL
PAPER - 5
PHYSICAL CHEMISTRY EXPERIMENTS

1. Kinetics

Determination of the Order of the following reactions

- a) Acid catalysed Hydrolysis of an Ester (Methyl or Ethyl acetate)
- b) Saponification of an Ester (Methyl or Ethyl Acetate)
- c) Iodination of Acetone.

2. Molecular weight of a solute - Rast's method using Naphthalene or Diphenyl as Solvents.

3. Heterogeneous equilibria

- a) *Phenol-Water system - CST
- b) Effect of impurity - 2 % NaCl or Succinic acid solutions on Phenol -Water system - Determination of the Concentration of the given solution

4. Determination of the Transition Temperature of the given salt hydrate.
 $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$, $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$, $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$, $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$

5. Electrochemistry

Conductivity

- a) Determination of Cell Constant and Equivalent Conductivities of the solutions of two different concentrations.
 - b) Conductometric titration of a Strong Acid against a Strong Base.
- 6. Potentiometric titration** of a Strong Acid against a Strong Base.

7. Colorimetry- Determination of unknown concentration using Photoelectric colorimeter.

8. Determination of pKa of acetic acid using pH Meter.

***Need not be given in examination.**

Students must write Short Procedure / Formula with explanation in Ten Minutes for evaluation during the university practical examination.

INTERNAL ELECTIVE

PAPER - 3

(to choose one out of 3)

A. ANALYTICAL CHEMISTRY - II

Objective:

To impart knowledge about Different Chromatographic and Spectroscopic Techniques.

UNIT - I

Chromatography - Principles and Techniques of Column, Paper and Thin Layer Chromatography - Column Chromatography - Preparation of Column - Adsorption - Adsorbents - Elution - Recovery of Substances - TLC - Choice of Adsorbent and Solvents - Preparation of Chromatogram and Applications - R_f value - Paper Chromatography - Solvents used - Factors affecting R_f value - Separation of Amino Acid Mixtures - Radial Paper Chromatography - Applications - ion exchange chromatography - Principle - Experimental Techniques - Types of Resins - Requirement of a Good Resin - Action of Ion Exchange Resins - Experimental Techniques and Applications - Separation of Zinc- Magnesium, Cobalt - Nickel and Cadmium - Zinc ions.

UNIT - II

High Pressure Liquid Chromatography and Gas Chromatography - Principle and Applications - Gas Chromatography - Mass Spectrophotometer (GC-MS) - Liquid Chromatography - Mass Spectrophotometer (LC-MS) - Principle and Applications - Polarography - Principle - DME - Advantages and Disadvantages - Ilkovic equation and its significance (No Derivation) - Polarography as an Analytical tool in Quantitative and Qualitative Analysis - Amperometric Titrations.

UNIT - III

NMR Spectroscopy - Principle of Nuclear Magnetic Resonance - Basic Instrumentation - Number of Signals - Chemical Shift - Shielding and Deshielding - Factors influencing Chemical Shift - Spin-Spin Coupling and Coupling constants - TMS as NMR standard - Splitting of Signals - NMR Spectra of simple Organic Molecules - Applications in Structural Elucidation.

UNIT - IV

Mass Spectroscopy - Basic principles of Mass Spectrum - Instrumentation - Molecular ion peak- Base peak - Metastable peak - Isotopic peak and their Uses - Fragmentation - Factors affecting Cleavage Patterns - Nitrogen rule - Ring rule - McLafferty

rearrangement - Determination of Molecular Formulae with examples - Mass spectrum of simple organic compounds - Identification - Alcohols, Aldehydes and Aromatic hydrocarbons.

UNIT - V

ESR Spectroscopy - Condition - Selection Rule for Transition - Theory of ESR Spectra - Basic Instrumentation - ESR Spectrometer - Components and their Functions - Hyperfine splitting - ESR Spectra of simple radicals - CH_3 , CD_3 , Naphthalene radical ions only - Applications in structural elucidation - Thermoanalytical methods - Principle involved in Thermogravimetric analysis (TGA) and Differential Thermal Analysis (DTA) - Instrumentation- Discussion of Various Components with Block Diagram - Characteristics of TGA ($\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) and DTA curves - Factors Affecting TGA and DTA Curves - Thermometric Titrations - Principle and Applications.

Outcome:

The Students will be able to

- 1) Explain the principles and techniques of column, paper and thin layer chromatography, ion-exchange, high - pressure liquid and gas chromatography
- 2) Elucidate the structure of organic compounds using NMR, Mass and ESR spectroscopy .
- 3) Discuss the principle and applications of TGA, DTA and thermometric titrations.
- 4) Explain the principle of polarography and amperometric titrations .

Reference Books

1. Analytical Chemistry - S. M. Khopkar - New Age International Publishers - 1998.
2. Analytical Chemistry - R. Gopalan - Sultan Chand & Sons - 2002.
3. Chemical Analysis: An Instrumental Approach - A. K. Srivastava and P. C. Jain.
4. Spectroscopic Identification of Organic Compounds - R. M. Silverstein, G. C. Basseler & T. C. Morill.
5. Organic Spectroscopy - W. Kemp.
6. Spectroscopic Methods in Organic Chemistry - D. Williams & I. Fleming.
7. Fundamentals of Molecular Spectroscopy - 4th Edition, C. N. Banwell and E. M. McCash - Tata McGraw Hill Publishers, New Delhi - 2006.
8. Applications of Absorption Spectroscopy of Organic Compounds - John R. Dyer.
9. Introduction to Molecular Spectroscopy - Barrow.
10. Spectroscopy of Organic Compounds - P. S. Kalsi.
11. Instrumental Methods of Chemical Analysis - B. K. Sharma - Goel Publications - 2000.
12. Fundamentals of Analytical Chemistry: An introduction - D. A. Skoog, D. M. West - Thomson - 2004.
13. Analytical Chemistry: Theory and Practice - U. N. Dash.
14. Vibrational Spectroscopy - D. N. Sathyanarayanan - New Age International Publishers - 2000.
15. Fundamentals of Spectroscopy - Y. R. Sharma - S. Chand - 2008.

16. Fundamentals of Molecular Spectroscopy - 4th Edition - C. N. Banwell and E. M. McCash - Tata McGraw Hill, New Delhi - 2006.
17. Elementary Organic Spectroscopy - Principles and Chemical Applications - Y. R. Sharma, S. Chand & Company Private Limited, V Revised Edition - 2013.

INTERNAL ELECTIVE PAPER - 2

B. TEXTILE CHEMISTRY

Objective:

To impart knowledge about the Production, Properties and Applications of Natural and Synthetic Fibres, Colour and Constitution, Classification of Dyes and Concept of Dyeing in Textile Industry.

UNIT - I

General Classification of Fibres - Chemical structure - Production - Properties - Count, Denier, Tex, Staple Length, Spinning Properties, Strength, Elasticity and Creep - Applications of the following Natural Cellulose Fibres (Cotton and Jute) - Natural Protein Fibres (Wool and Silk) - General characteristics.

UNIT - II

Chemical Structure, Production and properties of the following Synthetic Fibres - Man-made Cellulose Fibres (Rayon and Modified cellulose fibres) - Polyamide Fibres (Different types of Nylons) - Preparation - Nylon degradation - Polyester Fibres - Preparation - Degradation - Polyacrylonitrile fibre - Preparation and Properties - Viscose fibre - Preparation and Properties - Identification tests for Cellulose, Cotton, Wool, Silk, Rayon, Acrylic, Viscose, Polyamide and Polyester Fibres.

UNIT - III

Impurities in Raw Cotton and Grey Cloth, Wool and Silk - General principles of the Removal, Scouring - Purpose, Alkali Scouring and Acid Scouring - Bleaching (Methods - Hypochlorite, Peroxide and Bleaching Powder) - Desizing (Hydrolytic and Enzymatic), Kier Boiling and Chemicking - Dyeing of Polyester and Blends - Functions of Dispersing agents - Fibre swelling - Carrier dyeing - High temperature dyeing - Selection of dyestuff.

UNIT - IV

Colour and Constitution - A general treatment - Chromophores - Auxochromes - Bathochromes and Hypsochromes - Classification of dyes - Acidic, Basic, Direct, Mordant, Azoic, Ingrain, Vat and Reactive Dyes - Classification as per Chemical

constitution - Azo dyes - Triphenyl Methane Dyes, Phthalein Dyes, Indigo and Anthraquinone Dyes - Structure, Preparation and Uses - Methyl Orange, Phenolphthalein and Malachite Green.

UNIT - V

Dyeing - Dyeing of Wool and Silk - Fastness properties of dyed materials - Dyeing of Nylon, Terylene and other Synthetic Fibres - Finishing - Finishes given to Fabrics - Mechanical finishes on Cotton, Wool and Silk - Method used in process of Mercerizing - Anticrease and Antishrink finishes - Water Proofing.

Outcome:

The Students will be able to

- 1) Understand the chemical structure of fibres.
- 2) Identify natural and synthetic fibres through identification tests.
- 3) Explain Scouring and Bleaching methods used in textile industries.
- 4) Classify dye and explain the concept of dyeing in textile industries.
- 5) Explain the methods used in the process of mercerizing in textile industries.

References

- Chemical Technology of Fibrous Materials - F. Sadov, M. Horchagin and A. Matetshy, Mir Publishers.
- The Identification of Textile Fibres - Bruno Nuntak.
- Introduction to Textile Science - 3rd edition, Maryory L. Joseph.
- Textile Chemistry - Vol. II, R. H. Peters, Elsevier, Amsterdam.
- Dyeing and Chemical Technology of Textile Fibres - 5th Edition, E. R. Trotman, Charles Griffin & Co Ltd.
- Chemistry of dyes & Principles of Dyeing - V. A. Shenai, Sevak Publications.
- Scouring and Bleaching, E. R. Trotman, Charles Griffin & Co Ltd.
- Text Book of Applied Chemistry - K. Kapur.
- A Students Text Book of Textile Science - A. J. Hall.

INTERNAL ELECTIVE

PAPER - 3

C. NANO CHEMISTRY

Objectives:

- To introduce the Basics of Nanotechnology.
- To learn the Instrumental Techniques used in Characterisation of Nanomaterials.

UNIT - I

BASICS OF NANOCHEMISTRY

Introduction - Definition - Length scales - Importance of Nanoscale and its Technology - Self Assembly of Materials - Self Assembly of Molecules - Porous solids, Nanowires, Nanomachines and Quantum Dots.

UNIT - II

NANOPARTICLES

Introduction - Types of Nanoparticles - Preparation, Properties and Uses of Gold, Silicon, Silver, Zinc Oxide, Iron Oxide, Alumina and Titania Nanoparticles.

UNIT - III

SYNTHETIC TECHNIQUES

Techniques to Synthesise Nanoparticles - Top down and Bottom up Approaches - Common Growth Methods - Characterisation of Nanoparticles - Applications and Toxic effects of Nanomaterials.

UNIT - IV

NANOMATERIALS

Preparation, Properties and Applications of Carbon Nanotubes, Nanorods, Nanofibres and Nanoclays.

UNIT - V

INSTRUMENTAL TECHNIQUES

Electron Microscopes - Scanning Electron Microscopes (SEM) - Transmission Electron Microscopes (TEM) - Scanning Probe Microscopy - Atomic Force Microscopy (AFM) - Scanning Tunneling Electron Microscope (STEM) - Basic Principles only.

Books for Study

- Nanotechnology, S. Shanmugam, MJP Publishers, Chennai (2010).
- A Handbook on Nanochemistry, Patrick Salomon, Dominant Publishers

and Distributers, New Delhi.

- Nanobiotechnology, S. Balaji, MJP Publishers, Chennai (2010).

Outcome:

The Students will be able to

- 1) Understand the basics of Nanotechnology .
- 2) Explain the preparation ,properties and uses of Nano particles.
- 3) Discuss the techniques used to synthesise Nano particles.
- 4) Understand the role of Electron microscopes- SEM ,TEM,SPM,AFN, and STEN in Nano technology.

Books for Reference

- The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Vol. I and II, CNR Rao, Springer (2006).
- Nanotechnology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press (2005).
- Nanochemistry, G. B. Segreev, Elsevier, Science, New York, (2006).
- Nano: The Essentials, T. Pradeep, Tata Mc-Graw Hil Publishers, New Delhi (2007).
- Text Book of Nanoscience and NanoTechnology, P. Shankar Baldev Raj, B. B. Rath and James Murday - 2014.

INTERNAL ELECTIVE

PAPER - 3

A. PHARMACEUTICAL CHEMISTRY

Objective:

- To effectively impart knowledge about Various Diseases and Their Treatment, Importance of Indian Medicinal Plants and Different Types of Drugs. Preparation, Synthesis and Structural Determination are not required for the Compounds mentioned.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Define the terms involved in pharmaceutical chemistry.
- 2) Explain the causes, symptoms and treatment of common diseases.
- 3) Explain the composition of blood.
- 4) Explain the role of antibacterial, antiseptics, vitamins, analgesics and anesthetics.
- 5) Apply the therapeutic importance of Indian medicinal plants.
- 6) Classify hormones and explain their functions.

UNIT - I

Definition of the following terms - Drug, Pharmacophore, Pharmacology, Pharmacopoeia, Bacteria, Virus, Chemotherapy and Vaccine - Causes, Symptoms and Treatment for Jaundice, Cholera, Malaria and Filariasis - First Aid for Accidents - Antidotes for Poisoning - Organic Pharmaceutical Aids - Their Role as Preservatives, Antioxidants, Colouring, Flavouring and Sweetening agents - Examples.

UNIT - II

Causes, Detection and Control of Anaemia and Diabetes - Diagnostic tests for Sugar, Salt and Cholesterol in Serum and Urine - Blood - Composition of Blood and Blood Plasma - RBC - Structure and Functions - Functions of Haemoglobin - WBC - Structure and Functions - Rh Factor - Blood Coagulation - Identification and Estimation of Cholesterol in Blood - Blood Pressure - Hypertension and Hypotension - Normal, High and Low to Control - Indian Medicinal Plants and Their Uses - Tulasi, Neem, Kizhanelli, Mango, Semparuthi, Adadodai and Thoothuvelai.

UNIT - III

Antibacterials - Sulpha drugs - Sulphanilamide Derivatives - Mode of action of Sulpha drugs - Examples - Prontosil, Sulphathiazole and Sulphafurazole - Uses - Antibiotics - Definition - Gram positive and Gram negative bacteria - Uses of Ampicillin, Streptomycin and Tetracyclines - Antiseptics and Disinfectants -

Definition and Distinction - Phenolic compounds, Chloro compounds and Cationic surfactants - Vitamins - Definition - Classification of Vitamins - Sources and Uses - Deficiency Diseases caused by Vitamins.

UNIT - IV

Analgesics - Definition - Classification - Narcotic and Non- narcotic - Antipyretic analgesics - Mechanism of action - Morphine and its derivatives - Pethedine and Methadone - Salicylic acid derivatives - Antipyretics and Antiinflammatory Agents - Definition and Actions - Aspirin, Paracetamol, Ibuprofen - Disadvantages and Uses - Anaesthetics - Definition - Classification - Local and General - Volatile - Uses of volatile liquids as Inhalation Anaesthetics - Chloroform - Gaseous Anaesthetics - Nitrous Oxide, Ether and Cyclopropane - Uses and Disadvantages - Intravenous Anaesthetic Agents - Thiopental sodium, Methohexitol and Propanidid - Drugs affecting CNS - Definition, Distinction and Examples for Tranquilizers, Sedatives (Phenobarbital, Diazepam) - Hypnotics, Psychedelic Drugs - LSD, Hashish- Their effects.

UNIT - V

Antineoplastic Drugs - Causes and Types of Cancer - Treatment of Cancer - Antineoplastic Agents - Antimetabolites - AIDS - AZT, DDC - Hormones - Definition - Classification - Physiological Functions of Insulin, Adrenaline, Thyroxin and Oxytocin - Sex hormones - Androsterone, Testosterone, Progesterone and Estrogen - Biological functions - Disorders of Hyposecretion and Hypersecretion of Hormones.

Reference Books

1. A Text Book of Pharmaceutical Chemistry - Jayashree Ghosh - S. Chand Company Ltd, 2015.
2. Pharmaceutical Chemistry - S. Lakshmi - Sultan Chand, 2011.
3. Pharmacology and Pharmatherapeutics - R. S. Satoskar - Popular Prakashan - Vol.I and Vol. II.
4. Medicinal Chemistry - Asuthosh Kar - New Age International Publishers, 2007.
5. A Text Book of Synthetic Drugs - O. D. Tyagi - Ammol Publications.
6. Introduction to Biological Chemistry - J. Awapara, Prentice Hall.
7. A Text Book of Biochemistry - Ambika.S.
8. Biochemistry - A. L. Leninger, II Edition, Kalyani Publishers, Ludhiana, 1998.
9. Essentials of Biological Chemistry - James Fanley - East West Press.
10. Medicinal Chemistry - Gurdeep Chatwal - Himalaya Publishers House, 2012.
11. Medicinal Chemistry - Ahluwalia - Ane Books, 2008.
12. A Text Book of Pharmaceutical Chemistry - Viva Books Private Ltd., New Delhi, 2009.
13. Medicinal Plants of India - Rasheeduz Zafar - CBS Publishers and Distributors, 2000.

**INTERNAL ELECTIVE
PAPER - 3**

B. POLYMER CHEMISTRY

Objective:

To impart Knowledge about the Types of Polymers, Polymerization Techniques, Commercial Polymers and their Applications.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Classify polymers and explain the various types of polymerization techniques.
- 2) Explain various methods of determining molecular weights of polymers.
- 3) Describe the chemistry of plastics and resins.
- 4) Explain the preparation of commercial, natural and synthetic polymers.
- 5) Enumerate the importance of Biopolymers, Conducting polymers and Acrylic polymers.

UNIT - I

Introduction to Polymers - Monomers, Oligomers, Polymers and their Characteristics - Classification of Polymers - Addition and Condensation Polymers - Natural and synthetic - Linear, Branched, Cross-Linked and Network - Plastics - Elastomers - Fibres - Homopolymers and Copolymers - Bonding in Polymers - Primary and Secondary bond forces in Polymers - Cohesive energy and Decomposition of Polymers - Chain Growth Polymerisation - Cationic, Anionic and Free radical polymerisation - Stereoregular polymers - Ziegler Natta polymers - Step Growth Polymers.

UNIT - II

Polymerization Techniques - Bulk, Solution, Suspension and Emulsion Polymerisation - Melt Polycondensation - Polymer Processing - Calendering - Die Casting and Rotational Casting - Molecular weight of polymers - Number average - Weight average - Sedimentation and Viscosity - Average molecular weight - Molecular weight and Degree of Polymerisation - Methods of determination of Molecular Weight - Gel permeation chromatography – Ultracentrifugation - Reactions - Hydrolysis - Hydrogenation - Addition - Substitution - Cross linking - Vulcanisation - Cyclisation.

UNIT - III

Plastics and Resins - Definitions - Thermoplastic and Thermosetting Resins - Constituents of Plastic Fibres - Dyes, Pigments, Plasticisers, Lubricants and Catalysts - Important Thermoplastic Resins - Acrylics, Polyvinyl and Cellulose Derivatives - Important Thermosetting Resins - Phenolic resins - Epoxy resins - Adhesives - Shellac resins - Vegetable glues and Animal glues.

UNIT - IV

Chemistry of Commercial Polymers - General methods of Preparation and Uses of the following - Teflon, Polyethylene, PTFE, Polystyrene, Polycarbonates and PVC - Textile fibres - Definition and Polymer requirement for fibres - Polyamides - Nylon 66 - Nylon 6 - Polyesters - Terylene - Cellulose acetate - Viscose rayon - Natural and Synthetic Rubber - Constitution of Natural rubber - Natural Rubber - Isoprene - Synthetic Rubber - Butyl, Buna, Buna- S, SBR, Thiocol, Neoprene, Polyurethane and Silicone Rubber - Ebonite.

UNIT - V

Advances in Polymers - Biopolymers, Biomaterials, Polymers in Medical Field, High temperature and Fire Resistant Polymers - Applications of Silicones - Conducting Polymers - Elementary idea - Examples - Polysulphur Nitriles, Polyparaphenylene, Polypyrrole, Polythiophene, Polyaniline and Polyacetylene - Acrylic polymers - Polymers of Acrylic Acid, Methacrylic Acid and Polyacrylates.

Reference Books

1. Text Book of Polymer Science, F. W. Bill Meyer, Jr. John, Wiley & Sons - 1984.
2. Polymer Science - V, R. Gowarikar, N. V. Viswanathan, Jayadev Sreedhar - Wiley Eastern Ltd., New Delhi - 2005
3. Polymer Chemistry, B. K. Sharma - Goel Publishing House, Meerut - 1989.
5. Polymer Chemistry - M. G. Arora, M. S. Vadar - Anmol Publications (p) Ltd., New Delhi - 1998.
6. Polymer Chemistry - An introduction - M. P. Stevens, Oxford - 2002.

INTERNAL ELECTIVE

PAPER - 3

C. GREEN CHEMISTRY

Objective:

To impart knowledge about Green Solvents, Green Techniques, Green Catalysts and Green Reactions.

Course Outcomes:

Upon completion of this course, the students will be able to

- 1) Summarize the importance of green chemistry.
- 2) Select green solvents for various synthetic processes.
- 3) Describe the various techniques to prepare nanoparticles.
- 4) Explain the importance of green catalysis.
- 5) Explain the rearrangement and aromatic substitution reactions with the help of green chemistry.

UNIT - I

GREEN CHEMISTRY - INTRODUCTION

Need for Green Chemistry - Principles of Green Chemistry - Atom economy - Definition with example (Ibuprofen synthesis) - Green oxidants - Hydrogen peroxide - Green synthesis - Evaluation of the type of the reaction - Rearrangements (100 % Atom economic) - Addition reaction (100 % Atom economic) - Organic reactions by Sonication method - Apparatus required - Examples of Sonochemical Reactions (Heck, Hunsdiecker and Wittig reactions).

UNIT - II

GREEN SOLVENTS

Selection of Solvents - Aqueous Phase Reactions - Diels-Alder reaction in water - Catalysis in water (Aerobic Oxidation of Alcohols catalysed by Pd (II) / Bathophenanthroline) - Reactions in ionic liquids - Simple preparation - Types - Properties and Applications - Ionic liquids in Organic Reactions (Heck reaction, Suzuki reactions, Epoxidation), Industrial (Battery) and Analytical Chemistry (Matrices for MALDI-TOF MS, Gas Chromatography Stationary Phases) - Advantages and Disadvantages - Solid Supported Synthesis - Supercritical CO₂ - Preparation, Properties and Applications (Decaffeination, Dry cleaning) - Environmental impact.

UNIT - III

GREEN TECHNIQUES

Microwave and Ultrasound Assisted Green Synthesis - Apparatus required - Examples of MAOS (Synthesis of Fused Anthroquinones, Leukart reductive Amination of

Ketones) - Advantages and Disadvantages of MAOS - Aldol condensation - Cannizzaro condensation - Diel's-Alder reaction - Strecker's synthesis - Photochemical reactions using Sunlight - Photoreduction of Benzophenone to Benzopinacol using Sunlight - Photochemical alternative to Friedel- Crafts reaction - Nanoparticles - Introduction - Types of Nanoparticles - Techniques to prepare Nanoparticles - Top down and Bottom up approaches - Common growth methods.

UNIT - IV

GREEN CATALYSIS

Green Catalysis - Heterogeneous catalysis - Uses of Zeolites, Silica, Alumina, Clay supported catalysis - Biocatalysis - Enzymes and Microbes - Phase Transfer Catalysis (PTC) - Principles, Catalysts and Lipophilicity of ions - Two phase systems - Solid-Liquid, Liquid-Liquid, Gas-Liquid - Triphase systems - Inverted PTC - Applications in Synthesis - Micellar Catalysis, Surfactants and Synthesis in water - Principles, Materials and Synthetic Applications.

UNIT - V

GREEN REACTIONS

Acetylation of Primary Amine, Base catalysed Aldol condensation (Synthesis of Dibenzalpropanone), Halogen addition to C = C bond (Bromination of Trans-Stilbene), [4+2] Cycloaddition reaction (Diels-Alder reaction between Furan and Maleic acid) - Rearrangement reaction (Benzil- Benzilic acid rearrangement), Coenzyme catalyzed Benzoin condensation (Thiamine hydrochloride catalysed synthesis of Benzoin), Pechmann condensation for Coumarin synthesis (Clay catalysed Solid State Synthesis of 7- Hydroxy- 4- methylcoumarin) - Electrophilic Aromatic Substitution Reactions (Nitration of phenol, Bromination of Acetanilide) - Green oxidation reactions (Synthesis of adipic acid, Preparation of Manganese (III) acetylacetonate) - Zeolite catalyzed Friedel-Crafts acylation.

Books for Study

- Green Chemistry: Environmental Friendly Alternatives, Rs. Sanghi and M. M. Srinivatava, Narosa Publishing House, New Delhi.
- Green Chemistry, V. Ahluwalia, Narosa, New Delhi (2011).
- Nanotechnology, S. Shanmugam, MJP Publishers, Chennai. (2010).
- A Handbook on Nanochemistry, Patrick Salomon, Dominant Publishers and Distributers, New Delhi.
- Nanobiotechnology, S. Balaji, MJP Publishers, Chennai (2010).
- Nano: The Essentials, T. Pradeep, Tata Mc-Graw Hill, New Delhi (2007).

Books for Reference

- Methods and Reagents for Green Chemistry, P. Tundo, A. Perosa and F. Zechini, John Wiley & Sons Inc., New Jercey, (2007).

- The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Vol. I and II, CNR Rao, Springer (2006).
- Nanotechnology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press (2005).
- Nanochemistry, G. B. Segreev, Elsevier, Science, New York, (2006)

SKILL BASED SUBJECT

PAPER - 4

AGRICULTURE AND LEATHER CHEMISTRY

OBJECTIVE:

To learn about Soil fertility and Productivity, Soil Chemistry, Insecticides, Leather Industry and Treatment of Tannery Effluents.

UNIT - I

SOIL CHEMISTRY

Soil - Introduction - Classification - Properties of Soil - Physical properties - Components - Structure and Texture - Soil-Water, Soil-Air and Soil-Temperature - Chemical properties - Soil Minerals, Soil Colloids, Soil Reaction and Buffering - Analysis of Soil - Soil pH - Determination of Soil pH - Effect of pH on Plants - Buffering of soil - Soil acidity, Soil salinity and Soil alkalinity - Soil Fertility - Carbon and Nitrogen cycle - Acid, Alkaline and Saline soils - Their Formation - Reclamation - Liming agents.

UNIT - II

FERTILISERS AND MANURES

Fertilisers - Definition - Classification - Requirements of a Good fertiliser - Nitrogen fertiliser - Urea - Preparation and Uses - Potash fertiliser - KCl, K₂SO₄ and KNO₂ - Preparation and Uses - Phosphorus fertiliser - Phosphatic slag, Superphosphate of lime and Triple Superphosphate - Preparation and Uses- NPK fertiliser - Advantages- Role of Micronutrients - Manures - Compost - Composting - Methods of Composting - Farmyard Manure, Vermicompost, Composted Coconut Coir Pith, Press mud and Poultry manure –Applications - Types of pollutions caused by Fertilisers - Ill effects of Fertilisers and their Control.

UNIT - III

INSECTICIDES AND FUNGICIDES

Insecticides - Definition - Classification of Insecticides - Stomach poisons - Contact poisons and Fumigants - Insecticides - Organic Insecticides - DDT - Gammexane - Malathion - Parathion - Fungicides - Inorganic Fungicides - Sulphur compounds - Copper compounds - Mercuric compounds - Organic Fungicides - Dithiocarbamates - Dithane M - Bordeaux mixture - Herbicides - Rodenticides - Pesticides in India - Adverse Environmental Effects of Pesticides.

UNIT - IV

LEATHER CHEMISTRY

Introduction - Constituents of Animal Skin - Preparing Skins and Hides – Leather processing - Process before Tannage - Flaying, Curing, Drying, Pickling, Cleaning and Soaking - Liming and Degreasing - Manufacture of Leather - Leather Tanning methods - Vegetable Tanning - Chemistry of Chrome Tanning and Mineral Tanning - Deliming - Dyeing of Leather and Fat Liquoring - Leather Finishing - Oil Tanning - By products.

UNIT - V

TANNERY EFFLUENTS

Tannery effluents - Pollution and its control - Water pollution and Air pollution - Waste Management - Treatment of Tannery Effluents - Primary, Secondary and Tertiary treatment - Pollution Prevention - Effect of Tannery Effluents on Agriculture - Organic Amendments - Reclamation of Tannery Effluents Affected Soil.

Outcome:

The Students will be able to

- 1) Explain the structure Texture and Chemical properties of soil
- 2) Define and classify fertilizers and illustrate the requirements of a good fertilizer.
- 3) Control the pollution caused by fertilizers.
- 4) Define and classify insecticides.
- 5) Discuss leather tanning methods.
- 6) Control pollution caused by tannery effluents.

Reference Books

- Industrial Chemistry by B. K. Sharma - Goel Publishing House, Meerut.
- Applied Chemistry by K. Bagavathi Sundari, MJP Publishers, 2006.
- Fundamental Concept of Applied Chemistry by Jayashree Ghosh, S. Chand & Company Ltd.,
- The Nature and Properties of Soils - IX Edition - Nyle. C. Bready - S. Chand.
- Soils and Soil Fertility - Louis M. Thompson - and Frederick. R. Troch - Tata Mc Graw Hill Publishing Co.
- Text Book of Soil Science - T. D. Biswas and S. K. Mukerjee - II Edition.
- Soil Science - A. Sankara.
- Fundamentals of Leather Science - Wood roffe Publications of CLRI - Chennai.
- Nature and Properties of Soils - Harry, O. Buckman.

SCHEME OF VALUATION FOR PRACTICAL EXAMINATIONS

PRACTICAL - I

VOLUMETRIC ANALYSIS

Internal assessment: 25 Marks

External assessment: 75 Marks

Total: 100 marks

Record: 15 Marks

Procedure: 10 Marks

Error upto 2 % : 50

 2.1 - 3 % : 40

 3.1 - 4 % : 30

 4.1 - 5 % : 20

 >5 % : 10

For incomplete or wrong calculation deduct 20 % of total marks scored.

For no calculation deduct 40 % of total marks scored.

For each arithmetic error deduct 1 mark.

CORE PRACTICAL - II

INORGANIC QUALITATIVE ANALYSIS AND PREPARATION

Internal assessment: 25 Marks

External assessment: 75 Marks

Total: 100 marks

Record: 15 Marks

Preparation: 20 (Quantity- 15 Marks; Quality- 5 marks)

Analysis: 40 Marks.

Each radical with procedure: 10 Marks

(Spotting for each radical - 5 Marks; Fixing the group - 5 Marks)

PRACTICAL - III
GRAVIMETRIC ANALYSIS

Internal assessment: 25 Marks

External assessment: 75 Marks

Total: 100 marks

Record: 15 Marks

Procedure: 10 Marks

Error upto 2 % : 50

 2.1 - 3 % : 40

 3.1 - 4 % : 30

 4.1 - 5 % : 20

 >5 % : 10

- a. Among the duplicate results, the value more favorable to the candidate must be taken.
- b. When no duplicate result is given deduct 5 marks.
- c. If the two results differ by more than 2 % deduct 5 marks.
- d. For each independent arithmetical error deduct 1 mark.
- e. For incomplete or wrong calculation deduct 20 %.
- f. For no calculation deduct 40 %.
- g. If the experiment is not completed due to an accident, award 5 marks.

PRACTICAL - IV

ORGANIC ANALYSIS

Internal assessment: 25 Marks

External assessment: 75 marks

Total: 100 marks

Record: 15 Marks

Preparation: 15 (quantity: 10 & quality: 5)

Analysis: 45

Preliminary reaction: 4

Aliphatic/ Aromatic: 4

Saturated/ Unsaturated: 4

Tests for elements: 9

Functional groups: 10

Confirmatory tests: 10

Derivative/Coloured reaction: 4

PHYSICAL CHEMISTRY PRACTICALS

Internal assessment: 25 Marks

External assessment: 75 Marks

Total: 100 Marks

Record: 15 Marks

Experiment: 45 Marks

Manipulation, Tabulation and Calculation: 15 Marks

1) Kinetics

Graph : 10 Marks

Below a factor of 10 : 35

By a factor of 10 : 25

More than a factor of 10 : 15

2) Molecular weight

Error upto 10 %: 45

20 %: 35

30 %: 25

> 30 %: 15

3) Effect of electrolyte on CST

Graph: 10

Error upto 10 %: 35

20 %: 25

30 %: 15

> 30: 10

4) Transition temperature

Graph: 10

Error upto 2°C difference: 35

7°C difference: 25

> 7°C difference: 15

5) Conductance

Equivalent conductance: 25 marks

Error upto 10 % : 25

Upto 15 % : 15

>15 % : 10

Cell constant : 20 marks

Error upto 10 % : 20

Upto 15 % : 15

>15 % : 10

6) Conductometric titration

Graph: 10

Upto 2 % : 35

2.1 to 3 % : 30

3.1 to 4 % : 25

4.1 to 5 % : 20

> 5% : 15
