



(For the candidates admitted from the academic year 2016-2017 onwards)

Semester	Part	Course	Title	Inst. Hours/Week	Credit	Exam Hours	Marks		Total	
							Int	Ext		
I	I	Language Course–I (LC) – Tamil*/Other Languages ** #		6	3	3	25	75	100	
	II	English Language Course - I (ELC)		6	3	3	25	75	100	
	III	Core Course – I (CC)		General Chemistry I	6	6	3	25	75	100
		Core Practical – I (CP)		Volumetric Analysis (P)	3	-	-	-	-	-
		First Allied Course–I (AC)		Mathematics I / Botany I / Computer Science / Zoology I	4	4	3	25	75	100
	First Allied Course – II (AP)		Mathematics II / Botany / Computer Science / Zoology	3	-	-	-	-	-	
	IV	Value Education		Value Education	2	2	3	25	75	100
Total				30	18				500	
II	I	Language Course–II (LC)– Tamil*/Other Languages ** #		6	3	3	25	75	100	
	II	English Language Course–II (ELC)		6	3	3	25	75	100	
	III	Core Course – II (CC)		General Chemistry – II	6	6	3	25	75	100
		Core Practical – I (CP)		Volumetric Analysis (P)	3	3	3	40	60	100
		First Allied Course – II (AP)		Mathematics II / Botany / Computer Science / Zoology	3	3	3	25 40	75 60	100
	First Allied Course – III (AC)		Mathematics III / Botany II / Computer Science / Zoology II	4	2	3	25	75	100	
	IV	Environmental Studies		Environmental Studies	2	2	3	25	75	100
Total				30	22				700	
III	I	Language Course – III (LC)– Tamil*/Other Languages ** #		6	3	3	25	75	100	
	II	English Language Course-III (ELC)		6	3	3	25	75	100	
	III	Core Course – III (CC)		General Chemistry - III	6	6	3	25	75	100
		Core Practical – II (CP)		Semimicro Analysis	3	-	-	-	-	-
		Second Allied Course – I (AC)		Physics I	4	4	3	25	75	100
	Second Allied Course-II/ (AP)		Physics (P)	3	-	-	-	-	-	
	IV	Non Major Elective I-for those who studied Tamil under Part-I a) Basic Tamil for other language students b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme		Chemistry in Every Day Life	2	2	3	25	75	100
Total				30	18				500	

IV	I	Language Course –IV (LC) - Tamil*/Other Languages ** #		6	3	3	25	75	100
	II	English Language Course – IV (ELC)		6	3	3	25	75	100
	III	Core Course – IV (CC)	General Chemistry - IV	5	5	3	25	75	100
		Core Practical – II (CP)	Semi Micro Analysis (P)	3	3	3	40	60	100
		Second Allied Course-II (AP)	Physics (P)	3	3	3	40	60	100
		Second Allied Course - III	Physics II	3	2	3	25	75	100
	IV	Non Major Elective II-for those who studied Tamil under Part I a) Basic Tamil for other language students b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme	Health Chemistry	2	2	3	25	75	100
		Skill Based Elective - I	Skill Based Elective - I	2	2	3	25	75	100
	Total			30	23				800
	V	III	Core Course – V (CC)	Inorganic Chemistry - I	5	5	3	25	75
Core Course – VI (CC)			Organic Chemistry - I	5	5	3	25	75	100
Core Course – VII (CC)			Physical Chemistry - I	6	5	3	25	75	100
Core Practical – III (CP)			Physical Chemistry (P)	3	3	3	40	60	100
Major Based Elective – I			Analytical Chemistry / Material & Nano Chemistry	5	5	3	25	75	100
IV		Skill Based Elective - II	Skill Based Elective - II	2	2	3	25	75	100
		Skill Based Elective – III	Skill Based Elective - III	2	2	3	25	75	100
		Soft Skills Development	Soft Skills Development	2	2	3	25	75	100
Total			30	29				800	
VI	III	Core Course – VIII (CC)	Organic Chemistry - II	6	6	3	25	75	100
		Core Course – IX (CC)	Physical Chemistry - II	6	6	3	25	75	100
		Core Practical – IV (CP)	Gravimetric & Organic Analysis (P)	6	5	3	40	60	100
		Major Based Elective II	Nuclear, Industrial Chemistry & Metallic State	6	6	3	25	75	100
		Major Based Elective III	Polymer Chemistry / Pharmaceutical Chemistry	5	5	3	25	75	100
	V	Extension Activities	Extension Activities	-	1	-	-	-	-
		Gender Studies	Gender Studies	1	1	3	25	75	100
		Total			30	30			
Grand Total			180	140				3900	

Language Part – I	-	4
English Part –II	-	4
Core Paper	-	9
Core Practical	-	4
Allied Paper	-	4
Allied Practical	-	2
Non-Major Elective	-	2

Skill Based Elective	-	3
Major Based Elective	-	3
Environmental Studies	-	1
Value Education	-	1
Soft Skill Development	-	1
Gender Studies	-	1
Extension Activities	-	1 (Credit only)

* for those who studied Tamil upto 10th +2 (Regular Stream)

+ Syllabus for other Languages should be on par with Tamil at degree level

those who studied Tamil upto 10th +2 but opt for other languages in degree level under Part I should study special Tamil in Part IV

** Extension Activities shall be out side instruction hours

Non Major Elective I & II – for those who studied Tamil under Part I

- a) Basic Tamil I & II for other language students
- b) Special Tamil I & II for those who studied Tamil upto 10th or +2 but opt for other languages in degree programme

Note:

	Internal Marks	External Marks
1. Theory	25	75
2. Practical	40	60
3. Separate passing minimum is prescribed for Internal and External marks		

FOR THEORY

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]
 The passing minimum for University Examinations shall be 40% out of 75 marks [i.e. 30 marks]

FOR PRACTICAL

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16 marks]
 The passing minimum for University Examinations shall be 40% out of 60 marks [i.e. 24 marks]

GENERAL CHEMISTRY I**OBJECTIVES**

1. To learn the periodic properties of elements and its classifications.
2. To understand the theoretical aspects of qualitative and quantitative analyses.
3. To understand the basics of alkanes, reactive intermediates and reaction mechanisms.
4. To learn about the chemistry of cycloalkanes, alkenes and alkynes.
5. To learn about the types, preparation and properties of sols, colloids and emulsions and the determination of molecular weight of macromolecules.

UNIT I PERIODIC TABLE AND PERIODIC PROPERTIES

- 1.1 Quantum Numbers, Filling up of atomic orbitals: Pauli's exclusion principle, Aufbau Principle, Hund's rule of maximum multiplicity – electronic configuration. Stability associated with half-filled and completely filled orbitals.
- 1.2 Periodic properties of elements – variation of atomic volume, atomic and ionic radii, ionization potential, electron affinity, electronegativity along periods and groups. Pauling scale of electronegativity.
- 1.3 Classification of elements into s, p, d and f block elements.

UNIT II ANALYTICAL METHODS

- 2.1 Qualitative Inorganic Analysis – Dry Test, flame test, cobalt nitrate test – wet confirmatory test for acid radicals, interfering acid radicals – elimination of interfering acid radicals.
- 2.2 Solubility product, common ion effect, complexation, oxidation-reduction reactions involved in identification of anions and cations – separation of cations into groups – Semi micro analysis of simple salts.
- 2.3 Volumetric analysis – preparation of standard solutions – normality, molarity and molality by titrimetric reactions – acid-base, redox, precipitation and complex metric titrations – indicators – effect of change in pH – selection of suitable indicators.

UNIT III ALKANES, REACTIVE INTERMEDIATES AND METHODS FOR REACTION MECHANISMS

- 3.1 Introduction: Inductive, mesomeric, electromeric effects and hyperconjugation – structure of organic molecules based on sp^3 , sp^2 and sp hybridization. Alkanes – sources of alkanes – general preparation – general properties – conformational analysis of ethane and n-butane.
- 3.2 Carbocations, Carbanions, Carbenes and Nitrenes: Generation and stability of reactive intermediates – Correlation of reactivity with structure of reactive intermediates. Free radicals: Generation, stability, identification methods – Free radical halogenation reactions and their mechanism.
- 3.3 Homolytic and Heterolytic cleavages of bonds, Characteristics of nucleophilic, electrophilic and free radical reactions. Thermodynamic and kinetic aspects, Hammond's postulates, isotope effects. Energy profile diagrams – Intermediate

versus transition state, Product analysis and its importance, crossover experiments, kinetic methods, Isotopic effects.

UNIT IV CHEMISTRY OF CYCLOALKANES, ALKENES, DIENES AND ALKYNES

- 4.1 Preparation of cycloalkanes – Chemical properties – Relative stability of cyclopropane to cyclooctane – Baeyer’s Strain theory – Limitations – Mono and disubstituted cyclohexanes.
- 4.2 Alkenes: Nomenclature – Petroleum source of alkenes and aromatics – General methods of preparation of alkenes – Chemical properties – Markovnikov’s rule and peroxide effect-Uses – Elimination reactions and its mechanisms (E_1, E_2).
- 4.3 Dienes: Structures and properties – conjugated dienes – stability and resonance – electrophilic addition – 1,2 addition and 1,4 addition. Alkynes: Nomenclature – General methods of preparation – Physical properties – Chemical properties – Uses.

UNIT V COLLOIDS AND MACROMOLECULES

- 5.1. Definition and types of Colloids- preparation, Purification (dialysis, electro dialysis and ultrafiltration) and stability of colloids, gold number.
- 5.2. Properties of colloids- kinetic, optical and electrical properties.
- 5.3. Emulsions – Types of emulsions, preparation, properties and applications, Donnan membrane equilibrium.
- 5.4 Osmosis – reverse osmosis and desalination. Macromolecules- Molecular weight of macromolecules- determination of molecular weight by osmotic pressure and light scattering methods.

REFERENCES

1. R.D. Madan, “Modern Inorganic Chemistry”, 2nd edition, S. Chand & Company Ltd., 2000.
2. P.L. Soni, “Text book of Inorganic Chemistry”, 20th revised edition, Sultan Chand & Sons, 2000.
3. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, Shoban Lal Nagin Chand & Co., (1993).
4. J.D. Lee, ‘Concise Inorganic Chemistry’, 20th revised edition, Sultan Chand & Sons, 2000.
5. R. Gopalan, P.S. Subramanian & K. Rengarajan, “Elements of Analytical Chemistry”, 2nd edition, Sultan Chand & Sons, 1000.
6. Morrison, R.T. and Boyd, R.N., Bhattacharjee, S. K. Organic Chemistry (7th edition), Pearson, India, (2011).
7. Bahl, B.S. and Bahl, A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
8. Jerry March, “Advanced Organic Chemistry, Reaction, Mechanism and Structure”, 7th Edition, Wiley Inter Science (2013).
9. Puri B.R., Sharma L.R. and Pathania M.S. Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin chand and Co. (2013)
10. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co Ltd.

VOLUMETRIC ANALYSIS (P)**OBJECTIVES**

1. To learn the techniques of titrimetric analyses.
2. To know the estimation of several cations and anions.
3. To know the estimation of total hardness of water.

Titrimetric Quantitative Analysis

1. Estimation of HCl Vs NaOH using a standard oxalic acid solution
2. Estimation of Na₂CO₃ Vs HCl using a standard Na₂CO₃ solution
3. Estimation of oxalic acid Vs KMnO₄ using a standard oxalic acid solution
4. Estimation of Iron (II) sulphate by KMnO₄ using a standard Mohr's salt solution.
5. Estimation of Ca (II) Vs KMnO₄ using a standard oxalic acid solution.
6. Estimation of KMnO₄ Vs thio using a standard K₂Cr₂O₇ solution.
7. Estimation of Fe (III) by using K₂Cr₂O₇ using a standard Mohr's salt solution using internal and external indicators.
8. Estimation of copper (II) sulphate by K₂Cr₂O₇ solution
9. Estimation of Mg (II) by EDTA solution
10. Estimation of Ca (II) by EDTA solution
11. Estimation of As₂O₃ using I₂ solution and standard Arsenious oxide solution.
12. Estimation of chloride (in neutral and acid media)

II. Applied Experiments

1. Estimation of Total Hardness of water
2. Estimation of Bleaching Powder
3. Estimation of saponification value of an oil
4. Estimation of copper in brass

Scheme of Valuation

Record

Procedure Writing

-

-

Max. marks

5 (marks)

10 marks

Results

- | | |
|-------|------------|
| < 1 % | - 45 marks |
| 1-2 % | -35 marks |
| 2-3 % | -25 marks |
| 3-4 % | -15 marks |
| > 4 % | - 10 marks |

GENERAL CHEMISTRY – II**OBJECTIVES**

1. To understand the principles of bonding and theories of chemical bonding.
2. To understand the chemistry of S-block elements and metallurgy of zero group elements.
3. To understand the aromatic character of benzene type molecules and to learn the reaction mechanisms involved in haloalkanes and halobenzenes.
4. To understand about the properties of atoms, characteristics, effect of radiations and the significance of wave functions.

UNIT I CHEMICAL BONDING

- 1.1 Ionic bond – formation, variable electrovalency – Lattice energy, Born – Haber Cycle. Covalent bond - formation, variable covalency, maximum covalency, covalent character in ionic bond – Fajans Rule. Polarisation – partial ionic character of a covalent bond.
- 1.2 VB theory, MO theory – Basic principles of bonding and antibonding orbitals, applications of MOT to H_2 , He_2 , N_2 & O_2 – molecular orbital sequence, comparison of VB & MO Theories.
- 1.3 Hybridisation – Formation of $BeCl_2$ & BCl_3 . VSEPR theory of simple inorganic molecules – $BeCl_2$, $SiCl_4$, PCl_5 , SF_6 , IF_7 , XeF_6 , BF_3 & H_2O .
- 1.4 Hydrogen bonding – Intermolecular & Intramolecular H_2 – bonding and consequences.

UNIT II CHEMISTRY OF s-BLOCK & ZERO GROUP ELEMENTS AND METALLURGY

- 2.1 General characteristics of s-block elements – comparative study of elements – alkali metals and their hydroxides, oxides and halides, alkaline earth metals and their oxides, carbonates and sulphates.
- 2.2 Diagonal relationship of Li & Mg, Be & Al, chemistry of NaOH, KI & $Mg(NH_4)PO_4$.
- 2.3 Metallurgy : Occurrence of metals – concentration of ores – froth floatation, magnetic separation, calcination, roasting, smelting, flux, aluminothermic process, purification of metals – electrolysis, zone refining, van Arkel de-Boer process.
- 2.4 Zero group elements – position in the periodic table, occurrence, isolation, applications, compounds of Xe – XeF_6 & $XeOF_4$.

UNIT III CHEMISTRY OF BENZENE AND BENZENOID COMPOUNDS

- 3.1 Aromaticity – Huckle's rule - structure of benzene – Benzene-preparation, chemical properties and uses. Aromatic electrophilic substitution reactions and mechanism – Orientation and reactivity in substituted benzenes.
- 3.2 Polynuclear aromatic hydrocarbons – Nomenclature, Naphthalene from coal tar and petroleum – Laboratory preparation, Structure of Naphthalene, Aromatic character, Physical properties, Chemical properties, Uses. Mechanism of Aromatic electrophilic substitution – Theory of orientation and reactivity.
- 3.3 Anthracene, Phenanthrene from coal tar and petroleum, Laboratory preparation, Molecular Orbital structures, Aromatic Characters, Physical Properties, Chemical

properties and uses. Preparation of biphenyls, Physical and Chemical properties and uses.

UNIT IV ALKYL AND ARYL HALOGENS

- 4.1 Nomenclature of haloalkanes – structure - general preparations of haloalkanes - physical and chemical properties and uses.
- 4.2 Nucleophilic aliphatic substitution reaction mechanisms (S_N1 and S_N2) – Stereochemical aspects.
- 4.3 Halobenzenes: Theory of orientation and reactivity - general preparation – properties - uses. Electrophilic and nucleophilic aromatic substitution reaction mechanisms.

UNIT V ATOMIC STRUCTURE AND BASIC QUANTUM MECHANICS

- 5.1. Rutherford's and Bohr's model an atom- Bohr's theory and origin of hydrogen spectrum. Sommerfield's extension of Bohr's theory.
- 5.2. Electromagnetic radiation- definitions for λ , ν and velocity.
- 5.3. Dualism of light -Particle nature of radiation- black body radiation and Planck's quantum theory, photoelectric effect and Compton effect of matter.
- 5.4. De Broglie hypothesis and Davisson and Germer experiment. Heisenberg's uncertainty principle. Schrodinger wave equation (Derivation not needed). Physical significance of Ψ and Ψ^2 .

REFERENCES

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. P.L. Soni, "Text book of Inorganic Chemistry", 20th revised edition, Sultan Chand & Sons, 2000.
3. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, Shoban Lal Nagin Chand & Co., (1993).
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5. R. Gopalan, P.S. Subramanian & K. Rengarajan, "Elements of Analytical Chemistry", 2nd edition, Sultan Chand & Sons, 1991.
6. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011).
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9. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin chand and Co.
10. Bahl B.S., Arun Bahl and Tuli G.D. (2012). Essentials of Physical Chemistry, New Delhi: Sultan Chand and Sons.

GENERAL CHEMISTRY – III**OBJECTIVES**

1. To learn the chemistry of p-block elements.
2. To study about the preparations and properties of interhalogen compounds.
3. To understand the arrangement of atoms in space, isomers and their nomenclature.
4. To learn about the gas laws, properties of real gases and types of molecular velocities.
5. To learn the types, structure and properties of solids and liquid crystals.

UNIT I CHEMISTRY OF p-BLOCK ELEMENTS

- 1.1 General characteristics of p-block elements. Comparative study of elements of III A & their compounds. Compounds of boron – boric acid, borax, borazole.
- 1.2 Extraction of Al and Pb - alums, alloys of Al. Chemistry of oxides of carbon – CO, CO₂. Allotropic forms of carbon.
- 1.3 Compounds of nitrogen and phosphorous – NH₂.NH₂, H₂NOH, hydrazoic acid, N₂-Cycle, fixation of N₂, PH₃ and P₂O₅.

Unit II INTERHALOGEN COMPOUNDS

- 2.1 Peroxides of sulphur, Thionic acids, sodium thiosulphate – preparation, properties, structure and uses.
- 2.2 Classification of oxides – acidic, amphoteric, neutral oxides, peroxides and superoxides.
- 2.3 Interhalogen compounds, Pseudohalogens, Oxyacids of halogens, Polyhalides and basic nature of iodine.

UNIT III STEREOCHEMISTRY

- 3.1 Principles of symmetry – symmetry elements (C_n, C_i and S_n) - asymmetry and dissymmetry – isomerism – constitutional isomers - stereoisomers – enantiomers – diastereomers - geometrical isomerism – meso and dl compounds - conventions used in stereochemistry: Newman, Sawhorse and Fischer notations and their interconversions.
- 3.2 Nomenclature, correlation of configuration – Cahn-Ingold-Prelog rules for simple molecules - R,S and D,L notations to express configurations - chirality - optical isomerism - optical activity – polarimeter – specific rotation - stereochemistry of allenes and spiranes
- 3.3 Atropisomerism - erythro and threo conventions – stereoselectivity, stereospecificity in organic reactions with examples. Resolution of racemic mixture – Walden Inversion – conformational analysis of cyclohexane - asymmetric induction.

UNIT IV GASEOUS STATE

- 4.1. Gases – Boyle’s law, Charle’s law and Avagadro’s law- ideal gas equation.
- 4.2. Real Gases- deviation from ideal behaviour – van der Waals equation of states- derivation – significance of critical constants- law of corresponding states- compressibility factor.
- 4.3. Inversion temperature and liquefaction of gases- Linde and Claude – demagnetization methods.
- 4.4. Maxwell’s distribution of molecular velocities (Derivation not needed).Types of molecular velocities- mean, most probable and root mean square velocities-Inter relationships. Collision diameter, mean free path and collision number.

UNIT V SOLID STATES AND LIQUID CRYSTALS

- 5.1. Classification of solids- Isotropic and anisotropic crystals- elements of symmetry- basic seven crystal systems- laws of crystallography- representation of planes- miller indices, space lattice and unit cell.
- 5.2. X-ray diffraction- derivation of Bragg’s equation- determination of structures of NaCl by Debye Scherrer (powder method) and rotating crystal methods.
- 5.3. Types of crystals, close packing of identical solid spheres, interstitial sites, limiting radius ratios (derivation not needed), radius ratio rule and shapes of ionic crystals, structures of NaCl, CsCl and ZnS.
- 5.4. Semiconductors- intrinsic and extrinsic semi conductors- n and p-type semiconductors.Liquid crystals- types and applications.

REFERENCES

1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, Shoban Lal Nagin Chand & Co., (1993).
2. R.D. Madan, “Modern Inorganic Chemistry”, 2nd edition, S. Chand & Company Ltd., 2000.
3. J.D. Lee, ‘Concise Inorganic Chemistry’, 20th revised edition, Sultan Chand & Sons, 2000.
4. Gurdeep Raj, ‘Advanced Inorganic Chemistry’, 20th revised edition, Sultan Chand & Sons, 2000.
5. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011).
6. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
7. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co Ltd.
8. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin Chand and Co.

SEMIMICRO ANALYSIS (P)**OBJECTIVES**

To learn the techniques of semimicro qualitative analysis of inorganic salt mixtures.

SEMIMICRO INORGANIC QUALITATIVE ANALYSIS

Analysis of a mixture containing two cations and two anions of which one will be an interfering acid radical. Semimicro methods using the conventional scheme with hydrogen sulphide may 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.

REFERENCE:

1. Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons (1997)

Note:

Internal Marks: 40 External marks : 60

Marks Distribution for external	:	Practical	-	55 marks
	:	Record	-	5 marks
	:	Total	-	60 marks

4 radicals correct with suitable tests :	55 marks
3 radicals correct with suitable tests ;	40 marks
2 radicals correct with suitable tests :	30 marks
1 radical correct with suitable tests :	15 marks
Spotting :	5 marks

NON MAJOR ELECTIVE I

Hours/Week: 2

Credits: 2

CHEMISTRY IN EVERY DAY LIFE

OBJECTIVES

To learn the scientific and chemical principles underlying in water chemistry, agricultural chemistry, food chemistry, cosmetic and other materials such as drugs, polymers, fibers and dyes.

UNIT-I WATER CHEMISTRY

- 1.1. Water – Characteristics of water, soft water and hard water.
- 1.2. Removal of hardness – Purification of water by ion exchange and reverse osmosis methods.
- 1.3. Water pollution: Sources and effects of water pollution (Domestic, Industrial, Agricultural) -Eutrophication.
- 1.4. Heavy metals such as Hg, Cr, Cd, Zn, Cu and metals like Pb, As, Ba, Temperature, Radio activity, synthetic detergents etc.,).

UNIT-II AGRICULTURAL CHEMISTRY

- 2.1 Plant nutrients –Requisites of good fertilizers - Effect of Nitrogen on plant growth, deficiency symptoms - examples for nitrogenous fertilizers: - Effect of Phosphorous on plant growth, deficiency symptoms – -examples for phosphatic fertilizers.
- 2.2 Effect of potassium on plant growth, deficiency symptoms - examples for potassium fertilizers – Functions of secondary and micro nutrients. Manures: Farm yard manure–Compost making – Green manuring - Concentrated organic manures: Oil cakes.
- 2.3 Difference between fertilizer and manure – Superiority of manure over fertilizer - Biofertilizers: Rhizobium, Azatobacter, Cyano bacteria. Pesticides: Classification on the basis of mode of action, types of pests and Chemical nature with examples – safety measures while using pesticides.
- 2.4 Fungicides, Herbicides, Acaricides, Rodenticides, Repellants, Fumigants, Defoliant (Definitions and Examples).

UNIT-III: FOOD CHEMISTRY

- 3.1. Food classification and functions- Digestion in mouth, stomach and intestine. Absorption- spoilages, preservation techniques (canning, dehydration, freeze–drying. salting, pickling, pasteurizing, fermenting and carbonating) .

- 3.2. Minerals and water as food–role of water in physiology –water balance – water sources, major and trace minerals –biological functions of Ca, P, Fe, Cu, I and Zn.
- 3.3. Food additives – colouring (Natural and synthetic colours)-List of permitted colours (Curcumin, Riboflavin, Betacarotene, Plain Caramel and amaranth)- description and uses.
- 3.4. Flavouring agents – Anti oxidants – Emulsifiers- Acidulants and beverages. Soft drinks aerated water (ingredients and side effects).

UNIT IV COSMETIC AND OTHER MATERIALS

- 4.1. Cosmetics – Face powder – constituents, uses, side effects. Nail polish, hair dye – composition and side effects.
- 4.2. Tooth powder – composition and manufacture. Lotions.
- 4.3. Preparation of phenyl, liquid blue and incense sticks.
- 4.4. Cleaning agents: Soaps- types and cleaning action – detergents – types – merits and demerits of soap and detergents –chemical definitions of shampoo, washing powder and bleaching powder.

UNIT V MATERIAL CHEMISTRY

- 5.1. Polymers: Explanations, uses and examples for thermo setting and thermo plastic polymers – Vulcanization of rubber.
- 5.2. Fibers: Natural fibers (cellulosic and proteinous) –Semi synthetic (Rayon) Synthetic fibers (Poly ester, Nylon and Acrylic) –Pretreatment of fibers (Sizing, Desizing, Bleaching).
- 5.3. Dyes and Dyeing process: Difference between dye and pigment -Witt's colour theory, classification of dyes based on application (Direct, Vat, Acid, Reactive, Mordant and Disperse)

REFERENCES

1. K. Kumarasamy, A. Alagappa Moses and M. Vasanthy, "Environmental studies", Bharathidasan University, Thiruchirappalli.
2. Alex Ramani, "Food Chemistry", MJP publishers (2009), Chennai.
3. Jayashree Gosh, "Text book of Pharmaceutical Chemistry" New Delhi, S. Chand & Company Ltd.,(2003).
4. K. Bagavathi Sundari , "Applied Chemistry" MJP Publishers, (2006) Chennai.
5. A Thankamma Jacob (1979), A Text Book of Applied Chemistry, 1st edition, Mc Millan India Ltd.
6. Hesse P.R, A text book of soil chemical analysis John Murray, New York, 1971.
7. Buchel K.H, Chemistry of Pesticides, John Wiley & Sons New York 1983.

GENERAL CHEMISTRY – IV**OBJECTIVES**

1. To learn the general characteristics of d and f block elements.
2. To understand the reactions of organometallic compounds, alcohols, phenols and ethers.
3. To learn about the fundamental concepts of first law of thermodynamics, to relate heat, work and energy and to calculate work from pressure – volume relationships.
4. To learn about the fundamental concepts of rate of the reaction, determination of order of the reaction and theories of reaction rates.

UNIT I d-BLOCK & f-BLOCK ELEMENTS

- 1.1 General characteristics of d-block elements, comparative study of zinc group elements, extraction of Mo & Pt - Alloys of copper, amalgams and galvanization. Evidences for the existence of Hg_2^{2+} ions.
- 1.2 General characteristics of f-block elements – Lanthanide contraction and its consequences. Extraction of Th.
- 1.3 Arrhenius, Lowry – Bronsted and Lewis concept of acids and bases.

UNIT II CHEMISTRY OF ORGANOMETALLIC COMPOUNDS

- 2.1 Introduction – preparation of organomagnesium compounds- physical and chemical properties- uses. Organozinc compounds – general preparation, properties and uses.
- 2.2 Organolithium, organocopper compounds – preparation, properties and uses.
- 2.3 Organolead, organophosphorous and organoboron compounds– preparation, properties and uses.

UNIT III CHEMISTRY OF ALCOHOLS, PHENOLS AND ETHERS

- 3.1 Nomenclature – industrial source of alcohols – preparation of alcohols: hydration of alkenes, oxymercuration, hydroboration, Grignard addition, reduction – physical properties – chemical properties - uses – glycols from dihydroxylation, reduction, substitution reactions and glycerols and their uses.
- 3.2 Preparation of phenols including di- and trihydroxy phenols – physical and chemical properties - uses – aromatic electrophilic substitution mechanism – theory of orientation and reactivity.
- 3.3 Preparation of ethers: dehydration of alcohols, Williamson's synthesis – silyl ether. epoxides from peracids - sharpless asymmetric epoxidation – reactions of epoxides – uses – introduction to crown ethers – structures – applications.

UNIT IV THERMODYNAMICS-I

- 4.1. Definitions- system and surrounding- isolated, closed and open system- state of the system- Intensive and extensive variables. Thermodynamic processes-

- reversible and irreversible, isothermal and adiabatic processes- state and path functions.
- 4.2. Work of expansion at constant pressure and at constant volume. First law of thermodynamics- statement- definition of internal energy (E), enthalpy (H) and heat capacity. Relationship between C_p and C_v .
 - 4.3. Calculation of w , q , dE and dH for expansion of ideal and real gases under isothermal and adiabatic conditions of reversible and irreversible processes.
 - 4.4. Thermochemistry- relationship between enthalpy of reaction at constant volume (q_v) and at constant pressure (q_p)- temperature dependence of heat of reaction- Kirchoff's equation- bond energy and its calculation from thermochemical data- integral and differential heats of solution and dilution.

UNIT V CHEMICAL KINETICS

- 5.1. Rate of reaction- rate equation, order and molecularity of reaction. Rate Laws- rate constants- derivation of first order rate constant and characteristics of zero order, first order and second order reactions- derivation of time for half change ($t_{1/2}$) with examples.
- 5.2. Methods of determination of order of reactions- experimental methods- determination of rate constant of a reaction by volumetry, colorimetry and polarimetry.
- 5.3. Effect of temperature on reaction rate- concept of activation energy, energy barrier, Arrhenius equation. Theories of reaction rates- collision theory- derivation of rate constant of bimolecular reaction- failure of collision theory- Lindemann's theory of unimolecular reaction.
- 5.4. Theory of absolute reaction rates – derivation of rate constant for a bimolecular reaction- significance of entropy and free energy of activation. Comparison of collision theory and absolute reaction rate theory (ARRT).

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1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, Shoban Lal Nagin Chand & Co., (1993).
2. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
3. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
4. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011).
5. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
6. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin Chand and Co.
7. Samuel Glasstone (1974), Thermodynamics for Chemists (3rd printing), East- West Edn.
8. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin Chand and Co.
9. Gurtu J.N. and Amit Gurtu (1979), Chemical Kinetics, 5th Edn, Mittal K.K.

NON MAJOR ELECTIVE II

Hours/Week: 2

Credits: 2

HEALTH CHEMISTRY

OBJECTIVES

1. To know the essentials of health and drugs.
2. To learn the functions of enzymes, hormones and body fluids
3. To know common diseases and their treatment

UNIT I HEALTH

Definition: Food, Food Pyramid - Health-Hygiene- mal, under and over nutrition, their causes and remedies, sanitation.

UNIT II DRUGS

Drugs - Types of drugs-depressant, anticonvulsant, narcotics, antipyretics, antibiotics, antiseptics, analgesics, muscle relaxants and cardiovascular and vasodepressants, steroids (Only Applications).

UNIT III BODY FLUIDS

Blood volume, groups, coagulation, blood pressure, anaemia, blood sugar, haemoglobin. Chemistry of urine.

UNIT IV ENZYMES AND HORMONES

Types of enzymes and enzyme action, Characters of hormones action, examples of essential hormones.

UNIT V COMMON DISEASES

Common diseases - Jaundice, vomiting, fever, night blindness, ulcer, and diabetes.

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1. Alex V Ramani, Food Chemistry, MJP Publishers, Chennai, 2009
2. Deb A C, Fundamentals of Biochemistry, New Central Book Agency, Calcutta, 1994.
3. Satake M and Mido Y, Chemistry for Health Science, Discovery Publishing House, New Delhi, 2003.
4. Jayashree Ghosh, A Text book of Pharmaceutical Chemistry, S. Chand and Co.Ltd, 1999.
5. Ashutosh Kar, Medicinal Chemistry, Wiley Easterns Limited, New Delhi, 1993.

INORGANIC CHEMISTRY - I**OBJECTIVES**

1. To understand the basics and theories of coordination compounds.
2. To study a few biologically important coordination compounds.
3. To understand the preparation and properties of nitrosyl compounds
4. To learn the basic principles and applications of magnetic properties.

UNIT I COORDINATION COMPOUNDS-I

- 1.1 Introduction - Types of ligands: unidentate, bidentate and polydentate ligands, chelating ligands and chelates- IUPAC nomenclature of coordination compounds.
- 1.2 Isomerism in coordination compounds: Structural isomerism, hydrate isomerism, coordination isomerism, ionisation isomerism, linkage isomerism, coordination position isomerism.
- 1.3 Stereoisomerism: Geometrical isomerism of four and six coordinate complexes, optical isomerism of four and six coordinate complexes, Werner and Sidgwick theories, methods of detecting complex formation.

UNIT II COORDINATION COMPOUNDS-II

- 2.1 Theories of coordination compounds : Valence bond theory, limitations of valence bond theory, crystal field theory – splitting of d orbitals in octahedral, tetrahedral and square planar fields, CFSE, factors affecting CFSE, colour, geometry and magnetic properties of coordination compounds, Jahn – Teller distortion (an elementary idea).
- 2.2 Molecular orbital theory: Molecular orbital diagram for $[\text{Co}(\text{NH}_3)_6]^{3+}$. Ligand field theory. (An elementary treatment only).

UNIT III COORDINATION COMPOUNDS-III

- 3.1 Labile and inert complexes, stability of coordination compounds – thermodynamic and kinetic stability, relationship between stepwise formation constant and overall formation constant, factors affecting the stability of complexes.
- 3.2 Unimolecular and bimolecular nucleophilic substitution reactions in octahedral and square planar complexes, trans effect – theories of trans effect and applications.
- 3.3 A few biologically important coordination compounds : Chlorophyll, haemoglobin and vitamin B₁₂.

UNIT IV CARBONYLS AND BINARY METALLIC COMPOUNDS

- 4.1 Metal carbonyls : Mono and binuclear carbonyls of Ni, Fe, Cr, Co and Mn – preparation, structure, reactions, bonding and uses.
- 4.2 Structure and bonding in π -metal alkenyl and π -metal alkynyl complexes of $[\text{PtCl}_3(\text{C}_2\text{H}_4)]^-$, $[\text{Co}(\text{CO})_6(\text{RC} \equiv \text{CR})]$ and ferrocene.
- 4.3 Binary metallic compounds : borides, carbides, hydrides and nitrides – classification, preparation, properties and uses.

UNIT V NITROSYL COMPOUNDS AND MAGNETIC PROPERTIES

- 5.1 Nitrosyl compounds: Classification-nitrosyl chloride and sodium nitroprusside - preparation, properties and structure.
- 5.2 Magnetic properties-meaning of the terms-magnetic susceptibility-magnetic moment-types of magnetism-Gouy balance-applications of magnetic properties.
- 5.3 Dipole moment-determination, application in the study of simple inorganic molecules.

REFERENCES

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. W.U. Malik, G.D. Tuli and R.D. Madan, S.Chand and Company Ltd., 'Selected topics in Inorganic Chemistry', 7th edition, 2001.
3. Gopalan R, Text Book of Inorganic Chemistry, 2nd Edition, Hyderabad, Universities Press, (India), 2012.
4. P.L. Soni, 'Text Book of Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. B.R. Puri, L.R. Sharma, K.C. Kalia, 'Principles of Inorganic Chemistry', 21st edition, Vallabh Publications, 2004-2005.
6. J.E. Huheey, 'Inorganic Chemistry', 4th edition, Pearson Education. Inc. 1993.
7. F.A. Cotton, 'Advanced Inorganic Chemistry', 6th edition, John Wiley & Sons, Pvt. Ltd., 2003 – 2004.
8. R. Gopalan, P.S. Subramanian and K. Rengarajan, 'Elements of Analytical Chemistry', 2nd edition, Sultan Chand & Sons, 1991.

ORGANIC CHEMISTRY I**OBJECTIVES**

1. To learn the reactions of carbonyl compounds, carboxylic acids, amines, heterocycles.
2. To know the requirement of the oxidation and reducing agents for synthesis.

UNIT I CHEMISTRY OF CARBONYL COMPOUNDS

- 1.1 Nomenclature - structure of carbonyl compounds - chemical properties - nucleophilic addition mechanism at carbonyl group (eg: HCN, ROH, RNH₂) - acidity of alpha hydrogen - keto-enol Tautomerism (proof for the two forms).
- 1.2 Reduction and oxidation reactions of carbonyl compounds - paraformaldehyde, metaformaldehyde - uses of aliphatic carbonyl compound - Claisen condensation - Aldol condensation - Robinson annulation.
- 1.3 General methods of preparation of aromatic carbonyl compounds - physical and chemical properties - uses - Effect of aryl group on the reactivity of carbonyl group.

UNIT II CHEMISTRY OF CARBOXYLIC ACIDS

- 2.1 Nomenclature - Acidity of carboxylic acids based on substituent effect - comparison of acid strengths of halogen substituted acetic acids - acid strengths of substituted benzoic acids - Acid derivatives - Nucleophilic substitution mechanism at acyl carbon.
- 2.2 Preparation, properties and uses of acid derivatives: acid chloride, anhydrides, esters, amides - chemistry of compounds containing active methylene group - synthesis and synthetic applications of acetoacetic ester and malonic ester.
- 2.3 Preparation of dicarboxylic acid - physical and chemical properties - uses. Introduction to oils and fats - fatty acids - manufacture of soap - mechanism of cleaning action of soap.

UNIT III CHEMISTRY OF NITROGEN COMPOUNDS

- 3.1 Nomenclature - nitro alkanes - alkyl nitrites - differences - aromatic nitro compounds - preparation and reduction of nitro benzene under different conditions, TNT.
- 3.2 Amines - effect of substituents on basicity of aliphatic and aromatic amines - Reactions of amino compounds (primary, secondary, tertiary and

quaternary amine compounds) - Mechanism of carbylamine reaction, diazotization and comparison of aliphatic and aromatic amines.

- 3.3 Diazonium compounds - preparation and synthetic applications of diazomethane, benzene diazonium chloride and diazo acetic ester.

UNIT IV CHEMISTRY OF HETEROCYCLIC COMPOUNDS AND DYES

- 4.1 Introduction - nomenclature of heterocyclic compounds having not more than two heteroatoms such as oxygen, nitrogen and sulphur - structure, synthesis and properties of furan, pyrrole, thiophene. Pyridine - structure, preparation - compare the basicity of pyridine with pyrrole and amines.
- 4.2 Quinoline - structure and Skraup synthesis. Isoquinoline - structure and Napieralski synthesis and Indole - structure and Fischer-indole syntheses.
- 4.3 Dyes - color and constitution - chromophore - auxochrome - classification according to application and structure - preparation and uses of - methyl orange, fluorescein, Alizarin, Indigo and malachite green dyes.

UNIT V OXIDATION AND REDUCTION

- 5.1 Oxidation: Osmium tetroxide - Chromyl chloride - Ozone - DDQ - Dioxiranes.
- 5.2 Lead tetraacetate - selenium dioxide - DMSO either with Ac_2O or oxalyl chloride - Dess-Martin reagent.
- 5.3 Reduction: Catalytic hydrogenation using Wilkinson Catalyst - Reduction with LAH, NaBH_4 , tert-butylaluminum hydride, NaCNBH_3 , hydrazines.

REFERENCES

1. Finar I.L., Organic Chemistry, Vol 1&2, (6th edition) England, Addison Wesley Longman Ltd. (1996).
2. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011)
3. Bahl, B.S. and Bahl, A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010)
5. Pine S.H., Organic Chemistry, (5th edition) New Delhi, McGraw - Hill International Book Company (1987)
6. Seyhan N. Ege, Organic Chemistry, (5th edition) New York, Houghton Mifflin Co., (2005)

PHYSICAL CHEMISTRY I**OBJECTIVES**

1. To know the various concepts of photochemistry and group theory.
2. To learn the second law of thermodynamics, carnot cycle, carnot theorem, entropy, free energy and Maxwell's relations.
3. To learn the third law of thermodynamics, Van't Hoff isotherm, Clausius – Clapeyron equation and Nernst heat theorem.
4. To understand the laws and properties of solutions.
5. To learn the fundamental concepts of phase rule and its applications to one, two and three component systems.

UNIT I PHOTOCHEMISTRY AND GROUP THEORY

- 1.1. Consequences of light absorption- Jablonski diagram- radiative and non-radiative transitions. Lambert's Beer law, quantum efficiency.
- 1.2. Photochemical reactions-Comparison between thermal and photochemical reactions. Photosensitization and quenching. Fluorescence, phosphorescence and chemiluminescence. Laser and uses of lasers.
- 1.3. Group theory – symmetry elements and symmetry operation- group postulates and types of groups- abelian and non abelian – symmetry operation of H₂O molecule.
- 1.4. Illustration of group postulates using symmetry operations of H₂O molecule - construction of multiplication table for the operation of H₂O molecule – point group- definition- elements (symmetry operations) of the following molecules- H₂O, BF₃ and NH₃.

UNIT II THERMODYNAMICS II

- 2.1. Second law of thermodynamics – need for the law- different statements of the law- Carnot's cycle and efficiency of heat engine- Carnot's theorem- thermodynamic scale of temperature.
- 2.2. Concept of entropy- definition and physical significance of entropy- entropy as a function of P, V and T – entropy changes during phase changes- entropy of mixing – entropy criterion for spontaneous and equilibrium processes in isolated system.
- 2.3. Gibb's free energy (G) and Helmholtz free energy(A) – variation of A and G with P, V and T- Gibb's – Helmholtz equation and its applications.
- 2.4. Thermodynamic equation of state, Maxwell's relations- ΔA and ΔG as criteria for spontaneity and equilibrium.

UNIT III THERMODYNAMICS III

- 3.1. Equilibrium constant and free energy change- thermodynamic derivation of law of mass action- equilibrium constants in terms of pressure and concentration – NH₃, PCl₅ and CaCO₃.
- 3.2. Thermodynamic interpretation of Lechatelier's principle (Concentration, temperature, pressure and addition of inert gases).
- 3.3. Systems variable composition- partial molar quantities- chemical potential – variation of chemical potential with T, P and X (mole fraction) – Gibb's Duhem

equation. Van't Hoff's reaction isotherm- van't Hoff's isochore. Clapeyron equation and Clausius – Clapeyron equation- applications.

- 3.4. Third law of thermodynamics- Nernst heat theorem. Statement of III law and concept of residual entropy – evaluation of absolute entropy from heat capacity data.

UNIT IV SOLUTIONS

- 4.1. Raoult's law, Henry's law, Ideal and non-ideal solutions, completely miscible liquid systems-benzene and toluene. Deviation from Raoult's law and Henry' law. Duhem-Margules equation. Theory of fractional distillation. Azeotropes- HCl – water and ethanol- water system.
- 4.2. Partially miscible liquids- phenol- water, triethylamine- water and nicotine- water systems. Lower and upper CSTs – effect of impurities on CST. Completely immiscible liquids- principle and applications of steam distillation. Nernst distribution law – derivation.
- 4.3. Dilute solutions- colligative properties, relative lowering of vapour pressure, osmosis, law of osmotic pressure, derivation of elevation of boiling point and depression in freezing point.
- 4.4. Determination of molecular masses using colligative properties. Abnormal molecular masses, molecular dissociation- degree of dissociation- molecular association.

UNIT V PHASE CHANGES

- 5.1. Definitions of terms in the phase rule- derivation and application to one component system – water and sulphur- super cooling, sublimation.
- 5.2. Two-component systems-solid liquid equilibria, simple eutectic (lead- silver, Bi-Cd), desilverisation of lead.
- 5.3. Compound formation with congruent melting point (Mg-Zn) and incongruent melting point (Na-K).
- 5.4. Solid Solutions-(Ag-Au)-fractional crystallization, freezing mixtures- $\text{FeCl}_3\text{-H}_2\text{O}$ systems, $\text{CuSO}_4\text{-H}_2\text{O}$ system.

REFERENCES

1. Gurdeep Chatwal R, Photochemistry, Good publishing House.
2. Raman, K. (1990), Group theory and its application to Chemistry, New Delhi: Tata McGraw-Hill.
3. Samuel Glasstone (1974), Thermodynamics for Chemists (3rd printing), East- West Edn.
4. Rajaram J. and Kuriacose, J.C. (1986) Thermodynamics for students of Chemistry, New Delhi: Lal Nagin Chand.
5. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin Chand and Co.
6. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co Ltd.
7. Atkins P.W. (1994), Physical chemistry, (5th edition), Oxford University press.
8. Sangaranarayanan, M.V., Mahadevan, V., Text Book of Physical Chemistry, 2nd Edition, Hyderabad, Universities Press, (India) 2011.

PHYSICAL CHEMISTRY (P)**OBJECTIVES**

1. To learn the fundamentals of conductometric and potentiometric titrations.
2. To understand the method of determination of molecular weight, CST, TT and rate constant.

LIST OF EXPERIMENTS:

1. Critical Solution Temperature
2. Effect of impurity on Critical Solution Temperature
3. Transition Temperature
4. Rast Method
5. Phase Diagram (Simple eutectic system)
6. Kinetics of Ester Hydrolysis
7. Partition Co-efficient of iodine between water and carbon tetrachloride.
8. Conductometric Acid-Base Titration
9. Potentiometric Redox Titration
10. Determination of cell constant

MARK DISTRIBUTION :

Internal : 40 Ext. Evaluation :60
Record :5
Procedure Writing with formula : 10
Practicals :45

ANALYTICAL CHEMISTRY**OBJECTIVES**

1. To know the storage and handling of various chemicals and first aid procedures.
2. To learn data analysis, various separation techniques.
3. To learn gravimetric analysis and various thermo analytical methods.
4. To learn visible spectrophotometry and colorimetry.
5. To know the various electroanalytical techniques.

UNIT I LABORATORY HYGIENE AND SAFETY

- 1.1. Storage and handling of chemicals-corrosion, flammable, explosive, toxic, carcinogenic and poisonous chemicals.
- 1.2. Simple first aid procedures for accidents involving acids, alkalies, bromine, burns and cut by glass.
- 1.3. Precautions to avoid poisoning-treatment for specific poisons, threshold vapour concentrations-safe limits-laboratory safety measures.
- 1.4. Waste disposal-fume disposal-precautions for avoiding accidents.

UNIT II DATA ANALYSIS

- 2.1. The Mean-significant numbers, the median-precision, accuracy-confidence limits, standard deviation.
- 2.2. Errors-method for improving accuracy-rejection of data-presentation of tabulated data-Scatter diagram –method of least squares- S.I. units.
- 2.3. Separation techniques: Precipitation-solvent extraction-chromatography – types, column chromatography-thin layer chromatography.
- 2.4. Paper chromatography – paper electrophoresis –Ion exchange chromatography –Gas liquid chromatography.

UNIT III GRAVIMETRIC ANALYSIS AND THERMO ANALYTICAL METHODS

- 3.1. Gravimetric analysis - principles-methods of gravimetric analysis - requirement of gravimetric analysis-precipitation-theories of precipitation.
- 3.2. Types of precipitation – co-precipitation, post precipitation - and precipitation from homogeneous solution-digestion, filtration and washing, drying and ignition. Inorganic and organic precipitating agents.
- 3.2. Thermo analytical techniques – types-TGA principle-Instrumentation - TGA analysis of CaC_2O_4 . H_2O .

- 3.3. Differential thermal analysis-principle-DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.-factors affecting TGA & DTA

UNIT IV VISIBLE SPECTROPHOTOMETRY AND COLORIMETRY

- 4.1. Theory of spectrophotometry and colorimetry, Beer-Lambert's law (statement only), Molar absorptivity and absorbance.
- 4.2. Visual comparators-multiple standard methods, duplication and dilution method, balance method, photoelectric colorimeter, spectrophotometer.
- 4.3. Criteria for satisfactory colorimetric estimation-advantages of colorimetric estimation, determination of composition of complexes, colorimetric estimation of iron.

UNIT V ELECTROANALYTICAL TECHNIQUES

- 5.1. Electro gravimetry –theory - electro gravimetric analysis of Fe and Cu.
- 5.2. Electrolytic separation of metals: principle –separation of copper and nickel, Electro deposition- principle –overvoltage.
- 5.3. Coulometry -Principle of coulometric analysis –coulometry at controlled potential- apparatus and technique-separation of nickel and cobalt. Amperometry titrations-principle –Instruments –types-applications.

REFERENCES

1. Gopalan R, Subramanian PS and Rengarajan K (1993) "Elements of analytical chemistry" second revised edition, Sultan Chand.
2. Gurdeep R Chatwal, Sham K. Anand (2005) "Instrumental methods of chemical analysis", Himalaya publishing house.
3. Vogel A.I. Text Book of Quantitative Inorganic analysis," The English Language Book Society, Fourth edition.
4. Douglas A. Skoog, Donald M. West and F. J. Holler, Fundamentals of Analytical chemistry, 7thedition, Harcourt College Publishers.
5. Mendham J., Denny R. C., Barnes J.D., Thomas M., Vogel's Test book of Quantitative Chemical analysis 6th edition, Pearson education.
6. Sharma, B. K., Instrumental methods of chemical analysis, Goel Publishing House, Merrut (1997).

MATERIAL & NANO CHEMISTRY**OBJECTIVES**

1. To study the types of ionic crystals and defects in solids.
2. To learn the different kinds magnetic properties.
3. To learn the basic concepts of nanomaterial's and their applications.

UNIT I IONIC CONDUCTIVITY AND SOLID ELECTROLYTES

Types of ionic crystals – alkali halides – silver chloride-alkali earth fluovider –simple stoichiometric oxides. Types of ionic conductors – halide ion conductors – oxide ion conductors – solid electrolytes – applications of solid electrolytes. Electrochemical cell – principles – batteries, sensors and fuel cells –Inorganic solids – colour, magnetic and optical properties.

UNIT II MAGNETIC MATERIALS

Ferrites : Preparation and their applications in microwave –floppy disk – magnetic bible memory and applications. Insulating Materials: Classification on the basis of temperature – Polymer insulating materials and ceramic insulating materials. Ferro electric materials: examples – applications of ferroelectrics.

UNIT III MODERN ENGINEERING MATERIALS

Metallic glasses – introduction –composition, properties and applications. Shape memory alloys: introduction – examples – application of SMA – advantages and disadvantages. Biomaterials : Introduction –metals and alloys in biomaterials –ceramic biomaterials, composite biomaterials-polymer biomaterials.

UNIT IV NANOPHASE MATERIALS

Introduction – techniques for synthesis of nanophase materials–sol-gel synthesis-electrodeposition –inert gas condensation-mechanical alloying and applications of nanophase materials-composite materials: Introduction –types.

UNIT V NANO TECHNOLOGY

Introduction –importance –various stages of nanotechnology –nanotube technology – nanoparticles –fullerenes-nano dendrimers –nano pore channels, fibres and scaffolds – CVD dismond technology –FCVA technology and its applications – nano imaging techniques.

REFERENCES

1. Aathony R. West, Solidstate chemistry and its applications, john wiley & Sons(1989).
2. Raghavan V.R.,Materials Science and Engineering, Printice Hall (India) Ltd., (2001).
3. Kenneth J. Klabunde, Nanoscale materials in chemistry, A. John Wiley and Sons Inc. Publication.

ORGANIC CHEMISTRY II**OBJECTIVES**

1. To learn the chemistry of carbohydrates, proteins, vitamins, alkaloids and terpenoids.
2. To understand the rearrangements and spectroscopy techniques for the elucidation of structures.

UNIT I CHEMISTRY OF CARBOHYDRATES

- 1.1 Carbohydrate - classification, properties of mono saccharides (glucose and fructose), structure and configuration of mono saccharides, interconversion.
- 1.2 Ascending and descending series, muta rotation, epimerization- cyclic structure - determination of size of sugar rings.
- 1.3 Disaccharides - sucrose, maltose - structure elucidation - polysaccharide - starch and cellulose (elementary treatment).

UNIT II CHEMISTRY OF PROTEINS AND VITAMINS

- 2.1 Amino acids – Zwitter ion – isoelectric point - general methods of preparation and reactions of amino acids. Peptides - Peptide linkages – proteins - classification of proteins.
- 2.2 Structure of proteins - primary structure - end group analysis - Edman method - secondary structure - tertiary structure - denaturation - colour reactions of proteins.
- 2.3 Nucleic acids - elementary treatment of DNA and RNA - Vitamins - classification, structure and biological importance of vitamins A, B₁, B₂, B₆, B₁₂ and C.

UNIT III CHEMISTRY OF ALKALOIDS AND TERPENOIDS

- 3.1 Chemistry of natural products - alkaloids – classification, isolation - methods for synthesis of coniine, piperine, nicotine and quinine.
- 3.2 Terpenoids - classification - isoprene, special isoprene rule, methods for synthesis of citral, limonene, menthol, camphor.

UNIT IV MOLECULAR REARRANGEMENTS

- 4.1 Molecular rearrangements - types of rearrangement (nucleophilic and electrophilic) – mechanism with evidence for the following re-arrangements: pinacol – pinacolone.
- 4.2 Benzil - benzilic acid, benzidine, Claisen, Fries, Hofmann. Curtius, Lossen, Beckmann and dienone – phenol rearrangements.

UNIT V ORGANIC SPECTROSCOPY

- 5.1 UV - VIS spectroscopy - types of electronic transitions – Instrumentation- solvent effects on λ max - Woodward - Fieser rules for calculation of λ max : dienes only – bathochromic shift and hypsochromic shift.
- 5.2 IR spectroscopy - number and types of fundamental vibrations – selection rules- modes of vibrations and their energies. Instrumentation - position of IR absorption frequencies for functional groups like aldehyde, ketone, alcohol, acid, amine and amide.
- 5.3 NMR spectroscopy - principle - chemical shift- factors affecting the chemical shift - inductive effect and hydrogen bonding - TMS, delta scales, splitting of signals - spin-spin coupling, NMR spectrum of EtOH, n -propyl bromide and isopropyl bromide.

REFERENCES

1. Finar I.L., Organic Chemistry, Vol 1&2, (6th edition) England, Addison Wesley Longman Ltd. (1996).
2. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson (India), (2011)
3. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010)
4. Pine S.H., Organic Chemistry, (5th edition) New Delhi, McGraw – Hill International Book Company (1987)
5. Seyhan N. Ege, Organic Chemistry, (5th edition) New York, Houghton Mifflin Co., (2005)
6. William Kemp, Organic Spectroscopy, 3rd edition, ELBS.
7. Introduction to Spectroscopy by Pavia, D. L. Lampman, G. M, Kriz, G. S, Vyvyan, J. A. 5th edition, Cengage Learning, (2015)
8. Spectroscopy identification of Organic compounds, Silverstein, R. M, Webster, F. M 7th edition, CRC Press, (2015)

PHYSICAL CHEMISTRY II**OBJECTIVES**

1. To learn the various concepts of electrochemistry.
2. To know the types and theories of catalysis.
3. To learn the adsorption isotherms.
4. To know the spectroscopic techniques such as IR, UV-visible, Raman and NMR.

UNIT I ELECTRICAL CONDUCTANCE

- 1.1. Conductance in metal and in electrolytic solution- specific conductance and equivalent conductance. Arrhenius theory of electrolytic dissociation and its limitation. Weak and strong electrolyte according to Arrhenius theory. Ostwald's dilution law- Derivation, applications and limitation.
- 1.2. Effect of dilution on equivalent conductance and specific conductance. Kohlrausch's law and its applications. The elementary treatment of the Debye-Huckel- Onsager equation for strong electrolytes-evidence for ionic atmosphere.
- 1.3. Transport number and Hittorf's rule. Determination of transport number by Hittorf's method and moving boundary method.
- 1.4. Application of conductance measurements- determination of degree of dissociation of weak electrolytes -determination of solubility product of a sparingly soluble salt. common ion effect, conductometric titrations.

UNIT II ELECTROCHEMICAL CELLS

- 2.1. Galvanic cells - reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement - computation of E.M. F. - calculation of thermodynamic quantities of cell reactions (ΔG , ΔH , ΔS and K).
- 2.2. Types of reversible electrodes- gas/metal ion- metal/metal ion, metal/ insoluble salt/anion and redox electrodes, electrode reactions.
- 2.3. Nernst equation - derivation of cell E. M. F and single electrode potential - standard hydrogen electrode- reference electrodes- standard electrode potentials- sign convention- electrochemical series and its significance.
- 2.4. Potentiometric titrations -Acid-Base titrations- Oxidation-reduction (Redox) titrations- Precipitation titrations. Corrosion- general and electrochemical theory - passivity-prevention of corrosion.

UNIT III CATALYSIS AND SURFACE PHENOMENA

- 3.1. Catalyst-Definition and Characteristics - Types of catalysis-Homogeneous and heterogeneous, induced, auto, positive and negative catalysis, catalytic poisons and catalytic promoters.
- 3.2. Enzyme catalysis - Michaelis-menten equation and Michaelis-menten law.
- 3.3. Adsorption-types-chemical and physical, characteristics of adsorption. Theories of catalysis- intermediate compound formation theory and adsorption theory.
- 3.4. Different types of isotherms- Freundlich and Langmuir adsorption isotherms.

UNIT IV SPECTROSCOPY I

- 4.1. Electromagnetic spectrum- the region of various types of spectra. Microwave spectroscopy- rotational spectra of diatomic molecules treated as rigid rotator, condition for a molecule to be active in microwave region.
- 4.2. Rotational constants (B) and selection rules for rotational transition. Frequency of spectral lines, calculation of inter-nuclear distance in diatomic molecules.
- 4.3. Infrared spectroscopy- vibrations of diatomic molecules- harmonic oscillators, zero point energy, dissociation energy and force constant, condition for molecule to be active in the IR region, selection rules for vibrational transition, fundamental bands, overtones and hot bands.
- 4.4. UV- Visible spectroscopy-conditions- Franck-Condon principle- pre dissociation- applications.

UNIT 5 SPECTROSCOPY II

- 5.1. Raman spectroscopy – Rayleigh scattering and Raman scattering. Stokes and anti-stokes lines in Raman spectra, Raman frequency, quantum theory of Raman effect, conditions for a molecule to be Raman active.
- 5.2. Comparison of Raman and IR spectra – structural determination from Raman and IR spectroscopy, rule of mutual exclusion.
- 5.3. NMR spectroscopy- nuclear spin and conditions for a molecule to give rise to NMR spectrum – theory of NMR spectra, number of NMR signals, equivalent and non-equivalent protons.

REFERENCES

1. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin chand and Co.
2. Bahl B.S., Arun Bahl and Tuli G.D. (2012). Essentials of Physical Chemistry, New Delhi: Sultan Chand and Sons.
3. Moore W. J. (1972), Physical chemistry, 5th Edition, Orient Longman Ltd.
4. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co Ltd.
5. Colin Bannwell N and Elaine Mc Cash M, Fundamentals of molecular spectroscopy, 4th edition, Mc Graw hill publishing company limited.
6. Russell S. Drago, (1978), Physical methods in Inorganic chemistry, East-west student edition.

GRAVIMETRIC & ORGANIC ANALYSIS (P)**OBJECTIVES**

1. To learn the techniques of gravimetric analysis.
2. To learn the methods of different organic compounds preparation and analysis.

GRAVIMETRIC ANALYSIS:

1. Estimation of Lead as lead chromate.
2. Estimation of Barium as barium chromate.
3. Estimation of Nickel as Nickel - DMG complex.
4. Estimation Calcium as calcium oxalate monohydrate
5. Estimation of Barium as barium sulphate.

ONLY FOR DEMONSTRATION:

1. Estimation of Copper as copper (I) thiocyanate
2. Estimation of Magnesium as magnesium oxinate
3. Estimation of Iron as Iron (III) oxide.

ORGANIC QUALITATIVE ANALYSIS AND ORGANIC PREPARATION:**Organic Analysis**

Analysis of Simple Organic compounds (a) characterization of functional groups (b) confirmation by preparation of solid derivatives / characteristic colour reactions.

Note: Mono -functional compounds are given for analysis. In case of bi-functional compounds, students are required to report any one of the functional groups.

ORGANIC PREPARATION: (ANY FOUR)

Preparation of Organic Compounds involving the following chemical conversions.

1. Oxidation
2. Reduction
3. Hydrolysis
4. Nitration
5. Bromination
6. Diazotization
7. Osazone formation

DETERMINATION OF PHYSICAL CONSTANTS

Determination of boiling /melting points by semimicro method.

MARK DISTRIBUTION:

Internal : 40 Ext. Evaluation : 60
Record : 5+5 = 10
Gravimetry : 25
org. preparation & org Analysis : 25
Org. preparation : 6
Phy Contant : 4
Org. analysis :15
Armatic/ Alphatic -2
Sat/Unsat - 2
Spl. Element -3
functinonal group -5
Derivatives - 3

REFERENCE

1. Venkateswaran V, Veeraswamy R., Kulandaively A.R., Basic principles of practical chemistry, 2nd edition, New Delhi, sultan chand & sons, (1997)

NUCLEAR, INDUSTRIAL CHEMISTRY & METALLIC STATE**OBJECTIVES**

1. To know the fundamentals of nuclear chemistry.
2. To understand the applications of nuclear chemistry.
3. To study the metallic bond, theories and applications.
4. To understand the applications of inorganic polymers.

UNIT I NUCLEAR CHEMISTRY I

- 1.1 Introduction, nuclear structure – composition of the nucleus, subatomic particles, nuclear forces, nuclear stability – mass defect and binding energy, whole number rule and packing fraction, n-p ratio, odd even rules, nuclear models – liquid drop and shell models, isobars, isotones and isomers.
- 1.2 Isotopes – detection, physical and chemical methods of separation, isotopic constitution of elements.
- 1.3 Radioactivity – introduction – radioactive emanations – characteristics of α , β and γ -rays, disintegration theory, modes of decay-group displacement law, rate of integration and half-life period, disintegration series, Geiger-Nuttal rule.

UNIT II NUCLEAR CHEMISTRY II

- 2.1 Detection and measurement of radioactivity – Wilson cloud chamber, Geiger – Muller counter.
- 2.2 Particle accelerators – linear accelerator and cyclotron.
- 2.3 Artificial radioactivity – nuclear transformation – classification of nuclear reactions, fission – atom bomb, fusion – hydrogen bomb, Stellar energy – nuclear reactor – atomic power projects in India.
- 2.4 Applications of radioisotopes as tracers in reaction mechanism, medicine, agriculture, industry and carbon dating. Hazards of radiations.

UNIT III METALLIC STATE

- 3.1 Metallic bond : Packing of atoms in metals (BCC, CCP, HCP) electron gas, Pauling and band theories, structure of alloys, substitutional and interstitial solid solutions, Hume-Rothery ratios, crystal defects – stoichiometric and non- stoichiometric defects.
- 3.2 Semi conductors - intrinsic and extrinsic – n-type and p-type. Composition, properties, structure and uses in electronic industry.

UNIT IV INORGANIC POLYMERS AND THERMO ANALYTICAL METHODS

- 4.1 Inorganic polymers – coordination polymers, metal alkyls, phosphonitrilic polymers.
- 4.2 Silicates – classification into discrete anions – one, two and three dimensional structures with typical examples.
- 4.3 Composition, properties and uses of beryl, asbestos, talc, mica, feldspar and zeolite.

UNIT V INDUSTRIAL CHEMISTRY

- 5.1 Gaseous fuels : Natural gas, gobar gas, water gas, semi water gas, carburetted water gas, producer gas and liquified petroleum gas (LPG) – composition, manufacture and applications.
- 5.2 Fertilizers : Manufacture of nitrogen, phosphorus, potassium and mixed fertilizers, micro nutrients and their role in plant life.
- 5.3 Safety matches : Introduction, raw materials and manufacturing method.
- 5.4 Paints and varnishes : Definition, types and composition.
- 5.5 Glass : Composition, manufacture, types and uses.
- 5.6 Cement : Manufacture – wet and dry processes, composition and setting of cement.

BOOKS FOR REFERENCE:

1. R.D. Madan, “Modern Inorganic Chemistry”, 2nd edition, S. Chand & Company Ltd., 2000.
2. Gilreath, ‘Fundamental concepts of Inorganic Chemistry’, 18th Printing, McGraw Hill International Book Company, 1985.
3. S. Glasstone, ‘Source book on Atomic Energy’, East-West Press, 1967.
4. R.Gopalan, P.S. Subramanian and K. Rengarajan, ‘Elements of Analytical Chemistry’, Sultan Chand & Sons, 2nd edition, 1991.
5. P.L.Soni, ‘Text Book of Inorganic Chemistry’, 20th revised edition, Sultan Chand & Sons, 2000.

POLYMER CHEMISTRY**OBJECTIVES**

1. To know the chemistry of polymers.
2. To study the importance of polymers.
3. To study the concepts of polymerization and techniques.

POLYMER CHEMISTRY**UNIT 1 INTRODUCTION TO POLYMERS AND RUBBERS**

Basics of polymers – monomers and polymers - definition .classification of polymers on the basis applications - thermosetting and thermoplastics - distinction among plastics. Functionality -. Copolymers. Degree of polymerization. Types of polymerization reactions – chain polymerization -free radical and ionic polymerization – coordination and step polymerization reactions- polyaddition and polycondensation – miscellaneous reactions: ring-opening and group transfer polymerization. Basics of rubbers: types - vulcanization of rubber- ebonite- uses of rubbers.

UNIT II PROPERTIES AND REACTIONS OF POLYMERS

Properties: Glass transition temperature (T_g) -definition – factors affecting T_g . Relationship between T_g and molecular weight. Importance of T_g . Molecular weight of polymers: number average (M_n), weight average (M_w), sedimentation and viscosity average molecular weights. Reactions: Hydrolysis – hydrogenation – addition – substitutions – cross linking and cyclisations reaction. Polymer degradation- thermal, photo and oxidation degradation of polymers (basics only)

UNIT III POLYMERIZATION TECHNIQUES AND MOULDING TECHNIQUE

Polymerization techniques: bulk, solution, emulsion, melt condensation and interfacial polycondensation polymerization. Moulding technique: Injection, compression, extrusion, rotational and calendaring.

UNIT IV CHEMISTRY OF COMMERCIAL POLYMERS

Preparation, properties and uses of the polymers: Polyethylene, polypropylene, polystyrene, PVC, teflon and polymethylmethacrylate, polycarbonate, polyurethanes, polyamides (Kevlar), phenol-formaldehyde, urea-formaldehyde resin, epoxy resins, rubber-styrene and neoprene rubbers.

UNIT V ADVANCES IN POLYMERS

Biopolymers – biomaterials. Polymers in medical field - High temperature and fire – resistant polymers. Silicones - conducting polymers- carbon fibers.(basic idea only) and polymer composites.

TEXT BOOK :

Billmeyer F.W., Text book of polymer science, Jr. John Wiley and Sons, 1984.

BOOKS FOR REFERENCE

1. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 1978.
2. Sharma, B.K., Polymer Chemistry, Goel Publishing House, Meerut, 1989.
3. Arora M.G., Singh M. and Yadav M.S., Polymer Chemistry, 2nd Revised edition, anmol Publications Private Ltd., New Delhi, 1989.

PHARMACEUTICAL CHEMISTRY

OBJECTIVES

1. To study the principles and functioning of drugs.
2. To know the importance and functioning of antibiotics.
3. To study the impact of poisons.

UNIT I DRUGS TERMINOLOGY

Terminology: Drugs, pharmacy, pharmacology, pharmacognosy, therapeutics, toxicology, chemotherapy, pharmacopoeia - first aid for bleeding for blood, maintain breathing, Cuts, Abrasions and Bruises, Fractures, Burns and Fainting. First aid box for accident, plaster of paris. Symptoms treatment for Anemia, Diabetics, T.B, Asthma, Jaundice, Piles, Leprosy, Typhoid, Malaria, Cholera, Filariasis. Medicinally important compound Aluminum, phosphorus, Arsenic, Mercury, Iron, Milk of magnesia, Aluminum Hydroxide gel.

UNIT II ANTIBIOTICS

Antibiotics: Introduction, classification – based on biological action, chemical structure- Biosynthesis and degradation of penicillin. an account of semi synthetic penicillin, different types of penicilium, SAR chloroamphenicol, synthesis, SAR and Assay – chloroamphenicol, Streptomycin – structure assay – structure Activity relationship.

UNIT III ANALGESIC AND ANTIPYRETICS

Analgesic and Antipyretics: Analgesic - Narcotic analgesics, synthetic analgesics pethidine and methadone, Narcotic antagonist, Nalorphine, Non-narcotic - antipyretic analgesics. Pyrazole, salicylic acid, P- amino phenol derivative aspirin and Ibuprofen, Ketoprofen, Naproxen.

UNIT IV ANESTHETICS, ANTISEPTICS AND DISINFECTANTS

Anesthetics : Definition, classification of anesthetics, Ethers, Halohydrocarbons, chloroform Halo ethane, Fentanyl principle- Intravenous anesthetics. Structure of thiopental sodium – Local anesthetics – cocaine- source and structure – preparation and uses of procaine. Amethocaine and Benzocaine. Antiseptics and Disinfectants – phenol coefficient. Phenolic component tranquilizers –definition and example. Psychotropic drugs. LSD and Marijuana, AIDS HIV, propagation prevention and treatment. Definition– cancer – and

antineoplastics drugs- antimetabolite – Natural substance, alkylation agent.
Definition Hyperglycemic drug type and causes for diabetics.

UNIT V POISONS

Poisons: Poison Investigation Definition kinds of poison – Accidental suicidal and homicidal death – action of poison – general condition that control action of poison – general condition that control action of poison Hints of Investigation. Industrial gases and volatile poison, synthetic gases – carbon di sulphide – petroleum distillate, aromatic compounds, chlorinated hydro carbons.

REFERENCES

1. Lakshmi S, pharmaceutical chemistry 2011.
2. Jaya shree Ghosh, A text book of pharmaceutical chemistry, 3rd ed., S.Chand & Company Ltd., New Delhi (2008)
