

## General Chemistry - I

### Unit - I Atomic Structure and Introduction to Quantum Mechanics

( 15 hrs)

Rutherford's Atomic model, Plank's quantum theory of radiation, Photoelectric effect, Bohr's theory of hydrogen atom – postulates, Bohr's radius, energy of electron origin of hydrogen spectrum. Particle and wave nature of electron – de Broglie's equation, Heisenberg's uncertainty principle and Compton effect.

Postulates of quantum mechanics – operators – addition and subtraction of operators, multiplication of operators, linear operators. Commutator, vector operator. Laplacian and Hamiltonian operators ( Only definition ). Schrodinger wave equation ( no derivation ) – Significance of  $\Psi$  and  $\Psi^2$  - Wave mechanical concept of atomic orbitals, - Shapes of orbitals – Quantum numbers – Zeeman effect, Pauli's exclusion principle, Aufbau principle – Effective nuclear charge, screening effect, Slater's rule – applications and limitations. Electronic configuration of first 20 elements – extra stability of half- filled and completely filled orbitals. Hund's rule – its basis and applications.

### Unit - II Classification of Elements and Periodicity of Properties

Classification of elements – noble gases and s, p, d, and f – block elements. Modern periodic table. Position of hydrogen in the periodic table – Variation of atomic volume, atomic and ionic radii, ionization potential, electron affinity, electronegativity along periods and groups – variation of metallic characters – factors influencing the above periodic properties.

### Unit – III

#### 3.1 Chemical bonding

Ionic bond – factors influencing the formation of ionic compounds – ionization energy, electron affinity and lattice energy; inert pair effect, Fajan's rules.

Covalent bond – polarity of covalent bond, percentage ionic character of covalent bond, dipole moment and molecular structures of  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ ,  $\text{NH}_3$  and  $\text{CH}_4$  , bond characteristics – bond length, bond angle and bond energy.

Classification of solids, isotropic crystals, representation of planes, Miller indices, space lattice, unit cell, crystal systems, packing of ions in crystals ( CCP and HCP ). X-rays diffraction – derivation of Bragg's equation, discussion of structures of  $\text{NaCl}$ ,  $\text{CsCl}$  and  $\text{ZnS}$ , determination of Avogadro's number. Liquid crystals – introduction to liquid crystals – smectic, nematic, and Cholesteric type crystals with examples.

## **Unit – IV Principles of Inorganic Qualitative and Quantitative Analysis ( 15hrs )**

Common ion effect, solubility product, application of the solubility product principle in qualitative analysis. Principle of elimination of interfering anions. Complexation reactions in qualitative analysis. Reactions of cations and anions in the analysis. Spot test reagents and tests with them – Cupferon, DMG, thiourea, magneson, molarity, molality, and mole fraction, primary and secondary standards, theories of acid – base, redox, complexometric, iodometric and iodometric titrations, calculations of equivalent weights, theories of acid – base, redox, metal ion adsorption indicators and choice of indicators

## **Unit V Basic Concepts of Organic Chemistry**

Hybridisation and shapes of molecules – methane, ethane, ethylene, acetylene and benzene. Electron displacement effects – inductive, electromeric, mesomeric ( resonance ) and hyperconjugation. Steric effect. Cleavage of bonds – homolytic and heterolytic fissions. Reactive intermediates – carbocations, carbanions and free radicals – their formation and stability.

Nomenclature of organic compounds: IUPAC system of nomenclature of compounds containing upto 8 carbon atoms – mono and bifunctional compounds.

### **Textbooks:**

1. B. R. Puri, L.R. Sharma, M.S. Pathania, Principles of physical Chemistry, 44<sup>th</sup> ed., New Delhi, Vishal Publishing Company, 2010
2. Puri, , B.R., L.R. Sharma and K.C. Kalia. Principles of Inorganic Chemistry, 30th ed., New Delhi, Mile stone publishers and distributors, 2009.
3. B.S. Bahl and Arun Bahl, Text book of Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
4. Soni, P.L., and H.M. Chawla-Text book of Organic Chemistry, 29th ed., New Delhi, 29<sup>th</sup> ed., Sultan Chand & Sons, 2007.

### **Reference Books:**

1. Glasstone Samuel. Text book of Physical Chemistry. 2<sup>nd</sup> ed., New Delhi: Macmillan India Ltd., 1990.
2. Gilbert W. Castellan, University of Maryland, Physical Chemistry, 3<sup>rd</sup> ed., Narosa Publishing House, New Delhi.
3. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London, 2010.
4. Brown, G.I. A New Guide to Modern Valency Theory. 3<sup>rd</sup> ed., Longman.
5. Soni, P.L. and Mohan Katyal. Text book of Inorganic Chemistry. 20th ed., New Delhi: Sultan Chand & sons 2006

## I SEMESTER – Non Major electives

### 1. CHEMISTRY IN EVERY DAY LIFE ( 30 hours ) 2 Credits

#### Unit – I

1.1 General survey of chemicals used in everyday life.

1.2 Air-Components and their importance; photosynthetic reaction, air pollution, green house effect and their impact on our life style.

1.3 Water – sources of water, qualities of potable water, soft and hard water, methods of removal of hardness-water pollution.

#### Unit – II

2.1 Building material – cement, ceramics, glass and refractories – definition, composition and application only.

2.2 Plastics polythene, PVC, bakelite, polyesters, melanine formaldehyde resins – preparation and uses only.

#### Unit III

3.1 Food and Nutrition – Carbohydrates, Proteins, Fats – definition and their importance as food constituents – balanced diet – Calorie – minerals and vitamins ( sources and their physiological importance ).

3.2 Cosmetics – Tooth pastes, face powder, soaps, and detergents, shampoos, nail polish, perfumes – general formulation and preparations – possible hazards of cosmetics use.

#### Unit IV

4.1 Chemicals in food production – fertilizers – need, natural sources; urea, NPK fertilizers and super phosphate

4.2 Fuel – classification – solid, liquid and gaseous; nuclear fuel – examples and uses

#### Unit V

5.1 Pharmaceuticals drugs – analgesics and antipyretics – paracetamol and aspirin

5.2 colour chemicals – pigments and dyes – examples and applications.

5.3 Explosives – classification and examples.

### REFERENCES

1. Chemical process Industries ( 4<sup>th</sup> Editions ) R. Norris Shreve, Joseph A. Brink Jr

2. Perfumes, cosmetics and soaps VV.A Poucher ( Vol.3 )

3. Environmental chemistry A.K.DE

## **2. COTTAGE INDUSTRY PRODUCTS**

**( 30 Hours ) 2 Credits**

### **Unit I : Household materials**

Manufacturing process – composition and uses of safety matches, agarbathis, naphthalene balls, wax candles, writing/fountain pen ink, chalk crayons and gum paste.

### **Unit II: Soaps**

Soaps – introduction – types – hot process – batch process – continuous process – manufactures of soap by continuous process, toilet and transparent soaps, laundry soaps – oils to be used in soaps - cleaning action of soaps

### **Unit III: Paints and varnishes**

Paints – introduction – manufactures – setting of the paint, pigments – definition – classification, varnishes – introduction – types – manufacture – solvents and thinner

Unit IV: Detergents – introduction – principal groups of synthetic detergents – classification of surface active agents – biodegradability of surfactants – anionic detergents – oxo process – Alfol process – Welsh process – cationic detergents

### **Unit V: Shave lotion shampoo**

Shave lotion – introduction – factors for growth of shave lotion industries – uses – formulation with process, hair shampoo – introduction, properties, uses and applications – raw materials – types of shampoo protein and egg shampoo, herbal shampoo, vitamin shampoo, antidandruff shampoo – manufacturing process

### **References**

1. Sharma B.K., Industrial Chemistry, Goel Publishing House, 6<sup>th</sup> ed., 1994
2. Chattopadhyay P.K., Modern Technology of Soaps, Detergents and Toiletries 2<sup>nd</sup> ed.,2015

### **3. FOOD CHEMISTRY**

**( 30 hours ) 2 Credits**

#### **Unit I: FOOD ADULTERATION**

Sources of food, types, advantages and disadvantages. Food adulteration – contamination of Wheat, Rice, Alia, Milk, Butter etc. with clay stones, water and toxic chemicals – Common adulterants. Common adulterants Ghee adulterants and their detection. Detection of adulterated Foods by simple analytical techniques.

#### **Unit II: FOOD POISON**

Food poisons – natural poisons (alkaloids – nephrotoxin) – pesticides, (DDT, BHC, Malathion)- Chemical poisons – First aid for poison consumed victims.

#### **Unit III: FOOD ADDITIVES**

Food Additives – artificial sweeteners – Saccharine – Cyclamate and aspartate. Food flavours – esters, aldehydes and heterocyclic compound. Food colors – Emulsifying agents – preservatives – leavening agents. Baking powder – yeast – taste makers – MSG vinegar.

#### **Unit IV: BEVERAGES**

Beverages – soft drinks – soda- fruits juices – alcoholic beverages examples. Carbonation – addiction to alcohol – diseases of liver and social problems.

#### **Unit V: EDIBLE OILS**

Fats, Oils – Sources of oils – Production of refined vegetable oils – Preservation. Saturated and unsaturated fats – iodine value – role of MUFA and PUFA in preventing heart diseases – determination of iodine value, RM value saponification values and their significance.

#### **BOOKS FOR REFERENCE**

1. Swaminathan M., Food Science and Experimental Foods, Ganesh and company
2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S Chand & Co. Publishers.
3. Thanamma Jacob Text Books of applied chemistry for Home Science and allied Sciences, Macmillan.

## **2. DAIRY CHEMISTRY (30 hours) 2 Credits**

### **Unit I: COMPOSITION OF MILK**

Milk – definition – general composition of milk – constituents of milk – lipids, proteins, carbohydrates, vitamins and minerals – physical properties of milk – colour, odour, acidity, specific gravity, conductivity – Reconstituted effect – factors affecting the composition of milk – adulterants, preservatives with neutralizer – examples and their detection – estimation of fat, acidity and total solids in milk.

### **Unit II: PROCESSING OF MILK**

Microbiology milk – destruction of micro-organisms in milk – physical – chemical changes taking place in milk due to processing – boiling, pasteurization – types of pasteurization – Bottle, Batch and HTST ( High Temperature Short Time ) – Vacuum pasteurization – Ultra High Temperature pasteurization.

### **Unit III: MAJOR MILK PRODUCTS**

Cream – definition – composition – chemistry of creaming process – gravitational and centrifugal methods of separation of cream – estimation of fat in cream.

Butter - definition – composition- theory of churning – desi butter – salted butter estimation of acidity and moisture content in water.

Ghee – major constituents- common adulterants added to ghee and their detection – rancidity – definition – prevention – antioxidants and synergists – natural and synthetic.

### **Unit IV: SPECIAL MILK**

Standardised milk – definition – merits – reconstituted milk – definition – flow diagram of manufacture – Homogenised milk – flavoured milk – vitaminised milk – toned milk – Incubation milk – vegetables toned milk – humanized milk – condensed milk – definition, composition and nutritive value.

### **Unit V: FERMENTED AND OTHER MILK PRODUCTS**

Fermented milk products – fermentation of milk – definition, conditions, cultured milk – definition of culture – example, conditions – cultured cream butter milk – Bulgarian milk – acidophilous milk – yoheer Indigeneous products – khoa and chhana definition – Ice cream – definition – percentage composition – types – ingredients – manufacture of ice-cream stabilizers – emulsifiers and their role milk powder – definition – need for making milk powder – drying process – types of drying

## BOOKS FOR REFERENCE

1. Robert Jenness and patom S., Wiley, Principles of Dairy Chemistry, New York.
2. Rangappa K.S an Acharya K.T., Indian Dairy Products.
3. Wond F.P., Fundamentals of Dairy Chemistry, Springer.
4. Bagavathi Sundari . k, Applied Chemistry, MJP Publishers
5. Sukumar De, Outline of Dairy technology.

## GENERAL CHEMISTRY-II

### UNIT-I Chemistry of s-Block elements [group IA and IIA]

Hydrogen: Hydrides-Classification as ionic, molecular and metallic, hydrides; one method of preparation, important and uses of  $\text{LiAlH}_4$  and  $\text{CaH}_2$

Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonate and bicarbonates. Diagonal relationship of Li with Mg. Extraction of Li from its silicate-ores

Preparation, properties and uses of  $\text{NaOH}$ ,  $\text{Na}_2\text{CO}_3$ , KBr,  $\text{KClO}_3$ , alkaline earth metals; comparative study of the elements with the respect to oxides, hydroxides, sulphates, halides and carbonates. Extraction and anomalous behavior of Be. Biological importance of Group I and Group II metals.

### UNIT-II: Chemistry of p-Block Elements

2.1 Boron family[Group IIIA]: Preparation and structure of diborane, boron nitride and borazine, Chemistry of borax. Extraction of Al and its uses. Alloys of Al.

2.2 Carbon family[Group-IVA]; comparison of carbon with silicon, manufacture and uses of CO and  $\text{CO}_2$ (includes dry ice), carbides types, preparation and industrial applications. Silicates-classification and structure, silicones-preparation and properties and uses.

Tin-Allotropic forms of Tin, Alloys of Tin, Tinning and Tin plating

Lead-lead accumulator(discharging and recharging), Lead pigments.

### UNIT-III: Gaseous state

Postulates of kinetic theory of gases, derivation of gas laws from the kinetic gas equation. Kinetic energy and temperature-average translational kinetic energy and its calculation. Maxwell's distribution of molecular velocities(no derivation)-mean, root, mean square and most probable velocity, collision diameter, collision number, collision frequency, mean free path. Transport properties of viscosity, thermal conductivity, diffusion. Principles of equipartition of energy. Real gases-van der waals equation of state-derivation. Boyle temperature. Significance of critical constants. Laws of corresponding states, coefficient of compressibility, coefficient of thermal expansion, Joule Thompson effect.

### UNIT-IV: Liquid state

Some properties of Liquids( Molecular basis)-Equilibrium vapour pressure of a liquid, boiling point, heat of evaporation, heat of condensation, freezing point. Surface tension-definition, measurement of surface tension, effect of temperature on surface tension, surface tension on everyday life, Parachoe-definition, calculation and applications. Viscosity or fluidity-definition, measurement and calculation, factors affecting viscosity in everyday life.

#### 4.2 Colloids

Definiton, types, preparation and purification of colloids, properties-kinetic, optical and electrical stability of colloids, gold number, associated colloids. Emulsion-types, preparation, properties and application. Gel types, preparation, properties and applications. Donnane membrane equilibrium. Osmosis, reverse osmosis, dialysis and desalination. Macromolecules-determination of molecular weight by osmotic pressure method and light scattering methods.

#### 4.3 Nanomaterials

Elementary concepts of nanomaterials: Nanoparticle of Au, Ag and  $\text{TiO}_2$ -preparation, properties and uses.

### UNIT-V

5.1 Chemistry of alkanes and cycloalkanes: General methods of preparation and properties of alkanes and cycloalkanes Conformational analysis of ethane and nu-butane. Bayer's strain theory.

5.2 Alkenes, Alkynes and Dienes: Preparation of Alkenes( Dehydrogenation, dehydrohalogenation, dehydration), Prepatation of alkynes(dehydrohalogenation, dehalogenation) Addition( with mechanisms) of  $\text{H}_2\text{X}_2$ ,  $\text{HX}$ ,  $\text{HOX}$ ,  $\text{B}_2\text{H}_6$  and  $\text{O}_3$  to alkenes and alkynes. Addition of  $\text{HBr}$ ( peroxide effect, free radical reaction mechanism) to alkenes and alkynes. Allylic substitution of alkenes by  $\text{NBS}$ . Dienes types, stability; preparation of -1,3 butadiene, isoprene and chloroprene. Reactivity:1,2-and 1,4-addition to butadiene, Diels alder reaction. Introduction to Polymers: Polymerisation-types, natural rubber.

#### Textbooks:

1. B. R. Puri, L.R. Sharma, M.S. Pathania, Principles of physical Chemistry, 44<sup>th</sup> ed., New Delhi, Vishal Publishing Company, 2010
2. Puri, , B.R., L.R. Sharma and K.C. Kalia. Principles of Inorganic Chemistry, 30th ed., New Delhi, Mile stone publishers and distributers, 2009.
3. B.S. Bahl and Arun Bahl, Text book of Organic Chemistry, S. Chand and Sons, New Delhi, 2005.

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2. Soni, P.L., and H.M. Chawla-Text book of Organic Chemistry, 29th ed., New Delhi, 29<sup>th</sup> ed., Sultan Chand & Sons, 2007

## **II SEMESTER-NON MAJOR ELECTIVE PAPERS**

### **1. SOIL AND AGRICULTURAL CHEMISTRY (30 Hours) 2 credits**

#### **Unit I: Origin and Physical properties of soil**

Definition of soil-origin-igneous-metamorphic and sedimentary rocks-rock systems-main components of soil-minerals of importance with respect to agriculture. Physical properties of soil - soil texture and textural classification-soil structure and soil air, soil temperature, their importance in plant growth.

#### **Unit II: Chemical properties of soil and analysis**

Origin of problems in soils, their properties-acid, alkali and saline soils – diagnosis - remediation of acid and salt affected soils. Soil testing-concept, objectives and basis-soil sampling, collection processing - Bio - conversation of agricultural wastes.

#### **Unit III: Plant nutrients**

Plant nutrients - macro and micro nutrients - their role in plant growth – sources - forms of nutrients absorbed by plants - factors affecting nutrient absorption - deficiency symptoms in plants.

#### **Unit IV: Fertilizers**

Fertilizers –classification of NPK fertilizers-sources-natural and synthetic - their properties, uses-micro nutrients fertilizers, bio-fertilizers with examples.

#### **Unit V: Pesticides, Fungicides and Herbicides**

Pesticides: Definition –Classification – organic and inorganic pesticides with examples.

Fungicides: Definition – classification and each classification with examples

Herbicides: Definition-classification and each classification with examples

Acaricides – rodenticides – attractants - repellants - fumigants, defoliant

#### **References:**

1. Biswas, T.D. and Mukeherjee, S.K Textbook of Soil Science,1987
2. Daji, A.J. A Textbook of soil science, Asia Publishing House,Madras,1970

3. Tisdale, S.L.Nelson,W.L. and Beaton, J. D. Soil fertility and fertilizers, Macmillian publishing Company, New York,1990.
4. Hesse, P.R. A Textbook of soil chemical analysis, John Murray, New York,1971.
5. Sree Ramula, U.S chemistry of insecticides and fungicides, Oxford and IBH Publishing Co., New Delhi,1979.

### **CORE PAPER-III MAJOR PRACTICALS-I**

**(90 HOURS: I & II SEMESTERS 2 CREDITS)**

The following volumetric analyses are prescribed.

1. Estimation of HCl by NaOH using a standard oxalic acid solution
2. Estimation of  $\text{Na}_2\text{CO}_3$  by HCl using a standard  $\text{Na}_2\text{CO}_3$  solution
3. Estimation of oxalic acid by  $\text{KMnO}_4$  using a standard oxalic acid.
4. Estimation of Fe(II)sulphate by  $\text{KMnO}_4$  using a standard Mohr's salt solution.
5. Estimation of  $\text{KMnO}_4$  by thio using a standard  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.
6. Estimation of Fe(II) by  $\text{K}_2\text{Cr}_2\text{O}_7$  solution using a standard Fe(II) solution
7. Estimation of Cu(II) sulphate using a standard  $\text{K}_2\text{Cr}_2\text{O}_7$ .
8. Estimation of Mg(II) by EDTA solution using standard Zn(II) solution.
9. Estimation of Zn(II) by EDTA solution using standard Mg(II) solution.
10. Estimation of chloride using silver nitrate solution
11. Estimation of total hardness of water.

The following inorganic preparations are prescribed

1. Preparation of Ferrous ammonium sulphate or Mohr's salt from scrap iron
2. Preparation of potash alum or potassium aluminium sulphate from scrap Aluminium
3. Preparation of copper silicate from sand
4. Preparation of tetrammine copper(II) sulphate from scrap copper.

## **ALLIED CHEMISTRY-I (60 HOURS)4 Credits**

**(For Maths and Physics Students)**

### **Unit I : NUCLEAR CHEMISTRY**

Fundamental particles of nucleus, isobars isotones and isomers-Differences between chemical reaction: fusion and fission –Radio active series, group displacement law - Mass defect, derivation of  $1\text{amu} = 931\text{ MeV}$ - nuclear binding energy and calculation - Applications of radio isotopes-carbon dating and in medicine.

### **Unit II: INDUSTRIAL CHEMISTRY**

Fuels – Classification - gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, compressed natural gas-Fertilizers-Classification-urea, Ammonium sulphate, superphosphate, Triple super phosphate, potassium nitrate-manufacture and uses-Silicones-Preparation, properties and application.

Hardness of water: temporary and permanent hardness, disadvantages of hard water - softening of hard water-Zeolite process, demineralization process and reverse osmosis-Purification of water for domestic use: use of chlorine, ozone and UV light-definition and determinations of BOD and COD.

Polymers: General method of preparation and properties of the following: PVC, Polyethylene, Teflon, Bakelite, Nylon 6 and Nylon 6, 6.

### **Unit III: FUNDAMENTALS OF ORGANIC CHEMISTRY**

Classification of organic compounds-Hybridization in methane, ethane, acetylene, benzene-classification of reagents-electrophiles, nucleophiles and free radicals-Classification of reactions-addition, substitution, elimination and polymerisation-Polar Effects-Inductive effect, resonance, hyper-conjugation, steric effect- Keto-enol tautomerism-electrophilic substitution mechanism in benzene (nitration and sulphonation) - Aromaticity- Huckel's rule and application to Benzene, Naphthalene, Anthracene and Phenanthrene.

### **Unit IV : THERMODYNAMICS**

Definition of certain terms-system, surrounding, reversible and irreversible processes- limitations of I law, Need for II law-Different Statements of II. Law-Carnot cycle-Efficiency-Carnot Theorem-Thermodynamic Scale of Temperature-Entropy-Definition, Unit and change of entropy for phase transformation, Free energy-nature of process in terms of free energy and entropy-Statement of third law.

## **Unit V : CHEMICAL KINETICS AND PHOTOCHEMISTRY**

Rate of chemical reaction-differential rate expression-order and molecularity-Integrated rate expression for first, second, and zero order reactions-Half-Life period-Effect of temperature on rate-Activation energy .Arrhenius equation –Arrhenius reaction rate theory-Homogeneous and heterogeneous catalysis. Photochemistry. Statement of Grotthus - Draper Law, Stark-Einstein's Law, Quantum Yield. Hydrogen chloride reaction (elementary idea only) Photosynthesis, Photosensitisation, Phosphorescence Fluorescence, Chemiluminiscence - Definition with examples.

### **BOOKS FOR REFERENCE**

1. Gopalan R. and Sundaram s., Allied Chemistry, Sultan Chand & Sons Publishers, New Delhi 2<sup>nd</sup> ed.
2. Soni P.L. and Mohan Katyal, Text Book of Inorganic Chemistry, Sultan Chand and Company Pvt. Ltd, New Delhi,20<sup>th</sup> ed.
3. Bahl B.S. and Aun Bahl, A text book of Organic Chemistry 21<sup>st</sup> ed., S.Chand and Company Pvt. Ltd.
4. Puri B.R., Sharma L.R and Pathania M.s,Text Book of Physical Chemistry, Vishal Publishing Co., New Delhi,2010.
5. Jainuden M.D,Text book of Chemical Kinetics and Photochemistry.
6. Dara S.S.,Text book of Environmental chemistry and Pollution control, S.Chand and Co., New Delhi,2006.
7. Billmayer F.W, Text Book of Polimer Science,Wiley India Pvt, Ltd., 3<sup>rd</sup> Edition,2007.
8. Gowrikar V.R, Viswanathan N.V and Sreedhar J, Polimer science ,New age, International publication, New Delphi, Reprint ed.2005.

## ALLIED CHEMISTRY – II ( 60 Hours ) 4 Credits

### ( FOR MATHS AND PHYSICS STUDENTS )

#### Unit I : COORDINATION CHEMISTRY

Definition of terms – Classification of Ligands – Nomenclature – Chelation – EDTA and its application – werner's Theory – Effective Atomic Number – Pauling's theory – Postulates – Hybridisation, Geometry and magnetic properties of  $[\text{Ni}(\text{CN})_4]^{-2}$ ,  $[\text{NiCl}_4]^{-2}$ ,  $[\text{Fe}(\text{CN})_6]^{-4}$ ,  $[\text{Co}(\text{NH}_3)_6]^{+3}$  and  $[\text{CoF}_6]^{-3}$  – Biological Role of haemoglobin and Chlorophyl ( elementary idea only ) – Applications of coordination compounds in qualitative analysis like separation of copper and cadmium ions; Nickel and cobalt ion; Identification of metal ions like Cu, Fe and Ni.

#### Unit II: BIOMOLECULES

Classification, preparation and reaction of glucose and fructose. Discussion of open chain structure. Interconversion of glucose to fructose and vice versa – Preparation and properties of sucrose. Structure of starch, cellulose and derivatives of cellulose – Diabetes – causes and control; measures RNA and DNA (elementary idea only) – Amino acids; Classification, preparation and properties of alanine – preparation of dipeptide using Bergman method.

#### Unit III: PHASE DIAGRAM

Phase rule: Definition of terms, application of phase rule to water system – reduced phase rule and its application to Pb-Ag system. Freezing mixture – Completely miscible liquid systems – upper and lower critical solution temperature.

#### Unit IV: ELECTROCHEMISTRY

Galvanic cells – emf – standards electrode potential – reference electrodes ( hydrogen and calomel electrode only) – electrochemical series and its applications – Electroplating process – Nickel and Chrome plating – Different type of cells – primary cell, Secondary cell and fuel cells- elementary idea only, Corrosion and methods of prevention, Conductometric titrations – hydrolysis of salts. Derivation of  $K_h$  – Definition of pH and its determination by using glass electrodes. Buffer solution – Henderson's equation. Application of pH and buffer in biological process and industries.

#### Unit V: ANALYTICAL CHEMISTRY

Introduction to Qualitative and Quantitative Analysis – Principle of volumetric analysis – Separation techniques – extraction – distillation – crystallization – Chromatographic separations – Principles and applications of column, paper, thin layer, gas – liquid and ion-exchange.

## **BOOKS FOR REFERENCE**

1. Gopalan R. and Sundaram S., Allied Chemistry, Sultan Chand & Sons Publishers, New Delhi 2<sup>nd</sup> ed.
2. Soni P.L and Mohan Katyal, Text book of Inorganic Chemistry, Sultan Chand & Sons Publishers, New Delhi 20<sup>nd</sup> ed.
3. Bahl B.S and Arun Bhal, A Text Book of Organic Chemistry 21<sup>st</sup> ed., S. Chand and Company Pvt. Ltd
4. B. R. Puri, L.R. Sharma, M.S. Pathania, Principles of physical Chemistry, 44<sup>th</sup> ed., New Delhi, Vishal Publishing Company, 2010
5. Jainudeen M.D, Text book of Chemical Kinetics and Photochemistry
6. Dara S.S., Text Book of Environmental Chemistry and Pollution control, S. Chand and Co., New Delhi, 2006
7. Gopalan R., Subramanian P.S. and Rangarajan K, Elements of analytical chemistry, Sultan Chand & Sons Publishers, New Delhi, 1991.

## **ALLIED CHEMISTRY PRACTICAL COMMON FOR MATHEMATICS AND NON MATHEMATICS STUDENTS**

### **VOLUMETRIC ANALYSIS**

1. Estimation of Sodium hydroxide using standard Sodium Carbonate.
2. Estimation of Hydrochloric acid using standard Oxalic acid.
3. Estimation of Ferrous sulphate using standard Mohr's salt.
4. Estimation of Oxalic acid using standard Ferrous sulphate.
5. Estimation of Potassium permanganate using standard Sodium hydroxide.
6. Estimation of iron from iron tablets using standard potassium permanganate.
7. Estimation of magnesium using EDTA.
8. Estimation of calcium from calcium tablets using EDTA.
9. Estimation of Ferrous ion using diphenylamine as internal indicator.

Detection of adulterants in the following food stuffs

1. Coffe powder
2. Tea
3. Milk
4. Edible oil.
5. Ghee/butter
6. Turmeric powder
7. Chilli powder
8. Jaggery

9. Asafoetida

10. Honey

### **REFERENCES**

1. Basic Principles of practical Chemistry, Venkateswaran, Veerasamy & Kulandaivel, S. Chand & Co.
2. Laboratory chemical methods in food analysis, Dr. Geetha Swaminathan and Dr. Mary George, Margham Publishers.

## **ALLIED CHEMISTRY – I ( 60 Hours ) – 4 Credits**

### **( BRANCHES OTHER THAN MATHS AND PHYSICS)**

#### **Unit I: NUCLEAR CHEMISTRY**

Fundamental particles of Nuclear Isotopes, Isobars, Isotones and Isomers – Differences between chemical reactions and nuclear reactions: Fusion and fission – Radioactive series, group displacement law – mass defect – Application of radio isotopes – Carbon dating, rock dating in medicine.

#### **Unit II: INDUSTRIAL CHEMISTRY**

Fuels – Classification – gaseous fuels like water gas, producer gas, Liquefied petroleum gas, gobar gas, compressed natural gas – Fertilizers – Classification – Urea, ammonium sulphate, superphosphate, Triple super phosphate, potassium nitrate – manufacture and uses – Silicones – Preparation, Properties and applications. Hardness of water: temporary and permanent hardness, disadvantages of hard water – Softening of hard water – Definition and determinations of BOD and COD.

#### **Unit III: FUNDAMENTALS OF ORGANIC CHEMISTRY**

Classification of organic compounds – Hybridization in methane, ethane, acetylene, benzene – Classification of reagents – electrophiles, nucleophiles and free radicals – Classification of reactions – addition, substitution, elimination, condensation and polymerization – Polar Effects – Inductive effect, resonance, hyper conjugation, steric effect – Keto-enol tautomerism – electrophilic substitution mechanism in benzene( nitration and sulphonation )

#### **Unit IV: CHEMISTRY OF SOME USEFUL ORGANIC AND INORGANIC COMPOUNDS**

Preparation and uses of  $\text{CH}_2\text{Cl}_2$ ,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{CF}_2\text{Cl}_2$ . BHC, DDT, Teflon PVC, Nylon-6,6 and Terylene,

Inter halogen compounds –  $\text{AX}$ ,  $\text{AX}_3$ ,  $\text{AX}_5$  type – Preparation and Structure.

#### **Unit V: PHOTOCHEMISTRY**

Introduction to Photochemistry – statement of Grotthus – Draper Law, Stark – Einstein's Law, Quantum yield. Hydrogen-Chloride reaction ( Elementary idea only ) Photosynthesis, Photosensitization, phosphorescence, Fluorescence, Chemiluminescence – Definition with example.

#### **BOOKS FOR REFERANCE**

1. Gopalan R. and Sundaram s., Allied Chemistry, Sultan Chand & Sons Publishers, New Delhi 2<sup>nd</sup> ed.

2. . Soni P.L. and Mohan Katyal, Text Book of Inorganic Chemistry, Sultan Chand and Company Pvt. Ltd, New Delhi, 20<sup>th</sup> ed.
3. Bahl B.S. and Aun Bahl, A text book of Organic Chemistry 21<sup>st</sup> ed., S. Chand and Company Pvt. Ltd.
4. Puri B.R., Sharma L.R and Pathania M.s, Text Book of Physical Chemistry, Vishal Publishing Co., New Delhi, 2010.
5. Jainudeen M.D, Text book of Chemical Kinetics and Photochemistry.
6. Dara S.S., Text book of Environmental chemistry and Pollution control, S. Chand and Co., New Delhi, 2006.

**ALLIED CHEMISTRY – II ( 60 Hours ) – 4 Credits**  
**( BRANCHES OTHER THAN MATHS AND PHYSICS)**

**Unit I : COORDINATION CHEMISTRY**

Definition of terms – Classification of Ligands – Nomenclature – Chelation – EDTA and its application – werner's Theory – Effective Atomic Number – Pauling's theory – Postulates – , – Biological Role of haemoglobin and Chlorophyl ( elementary idea only ) – Applications of coordination compounds in qualitative and quantitative analysis like separation of copper and cadmium ions; Nickel and cobalt ions.

**Unit II: CARBOHYDRATES**

**Classification, preparation and reactions of glucose and fructose.** Inter conversion of glucose to fructose and vice versa – preparation and properties of sucrose. structure of starch. Cellulose and derivatives of cellulose – Diabetes – causes and control measures

**Unit III: PROTEINS**

Amino acids – Classification, Preparation and properties of alanine – Preparation of dipeptide using Berman method – Proteins – Classification according to composition, biological functions and shape – Denaturation and colour reactions of proteins – Primary and secondary structure of Proteins – Nucleic acids: DNA and RNA – Their components and biological functions.

## **Unit IV: ELECTROCHEMISTRY**

**4.1** Galvanic cells – emf – standard electrode potential – reference electrodes (hydrogen and calomel electrode only) – electrochemical series and its applications – Different type of cells – primary cell, Secondary cell and fuel cells- Corrosion and methods of prevention, Corrosion and methods of prevention – Definition of pH. Buffer solution – Henderson's equation. Application of pH and buffer in biological process and industries.

## **4.2 CATALYSIS**

Characteristics of Catalytic reaction – Types of Catalysis – Each with example

## **Unit V: ANALYTICAL CHEMISTRY**

Introduction to Qualitative and Quantitative Analysis – Principle of volumetric analysis – Separation techniques – extraction – distillation – crystallization – Chromatographic separations – Principles and applications of column, paper, thin layer.

## **BOOKS FOR REFERENCE**

1. Gopalan R. and Sundaram s., Allied Chemistry, Sultan Chand & Sons Publishers, New Delhi 2<sup>nd</sup> ed.
2. . Soni P.L. and Mohan Katyal, Text Book of Inorganic Chemistry, Sultan Chand and Company Pvt. Ltd, New Delhi, 20<sup>th</sup> ed.
3. Bahl B.S. and Aun Bahl, A text book of Organic Chemistry 21<sup>st</sup> ed., S. Chand and Company Pvt. Ltd.
4. Puri B.R., Sharma L.R and Pathania M.s, Text Book of Physical Chemistry, Vishal Publishing Co., New Delhi, 2010.
5. Jainudeen M.D, Text book of Chemical Kinetics and Photochemistry.
6. Dara S.S., Text book of Environmental chemistry and Pollution control, S. Chand and Co., New Delhi, 2006.

**ALLIED CHEMISTRY PRACTICALS**  
**COMMON FOR MATHEMATICS AND NON MATHEMATICS STUDENTS**  
**MATHEMATICS STUDENTS**

**VOLUMETRIC ANALYSIS**

1. Estimation of sodium hydroxide using standard Sodium carbonate.
2. Estimation of hydrochloric acid using standard Oxalic acid.
3. Estimation of ferrous sulphate using standard Mohr's salt.
4. Estimation of oxalic acid using standard Ferrous sulphate.
5. Estimation of Potassium permanganate using standard sodium hydroxide.
6. Estimation of iron from iron tablets using standard potassium permanganate.
7. Estimation of magnesium using EDTA.
8. Estimation of calcium from calcium tablets using EDTA.
9. Estimation of Ferrous ion using diphenylamine as internal indicator.

**Detection of adulterants in the following food stuffs**

11. Coffee powder
12. Tea
13. Milk
14. Edible oil
15. Ghee/Butter
16. Turmeric powder
17. Chilli powder
18. Jaggery
19. Asafoetida
20. Honey

**REFERENCES**

1. Basic Principles of practical chemistry, Venkateswaren , Veerasamy & Kulandaivel, S.Chand& CO.
2. Laboratory chemical methods in food analysis, Dr. Geetha Swaminathan and Dr.Mary George, Margham Publishers.

## GENERAL CHEMISTRY – III

### Unit I: CHEMISTRY OF NITROGEN AND OXYGEN FAMILIES ( 15 hrs )

1.1 Group VA elements: General characteristics of Group VA elements; chemistry of  $\text{H}_2\text{N-NH}_2$ ,  $\text{NH}_2\text{OH}$ ,  $\text{HN}_3$  and  $\text{HNO}_3$ . Chemistry of  $\text{PH}_3$ ,  $\text{PCl}_3$ ,  $\text{PCl}_5$ ,  $\text{POCl}_3$ ,  $\text{P}_2\text{O}_5$  and oxyacids of phosphorous.

1.2 Group VIA elements: General characteristics of group VIA elements – Structures and allotropy of elements – chemistry of ozone – classification and properties of oxides – oxides of sulphur, selenium and tellurium – Oxyacids of sulphur, selenium and tellurium – halides and oxohalides of group VIA elements.

### Unit II: CHEMISTRY OF HALOGENS AND NOBLE GASES ( 15hrs )

2.1 Chemistry of Halogens: General characteristics of halogen with reference to electro negativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Halogen acids, oxides and oxyacids. Inter halogen compounds, pseudo halogens and basic nature of Iodine.

2.2 Noble gases: Position in the periodic table. Preparation, Properties and structure of  $\text{XeF}_2$ ,  $\text{XeF}_4$ ,  $\text{XeF}_6$ , and  $\text{XeOF}_4$ ; uses of noble gases.

### Unit III: NUCLEOPHILIC SUBSTITUTION AND ELIMINATION REACTIONS (10hrs)

3.1 Nucleophilic substitution:  $\text{S}_{\text{N}}1$ ,  $\text{S}_{\text{N}}2$  and  $\text{S}_{\text{N}}\text{i}$  reactions-mechanisms, effect of solvent, structure of substrate, nucleophilicity of the reagent [ nucleophile ] and nature of the leaving group.

3.2 Elimination reactions:  $\text{E}1$ ,  $\text{E}2$ , and  $\text{E}1\text{CB}$  reactions and mechanisms: Hofmann and Saytzeff's rules. Elimination vs Substitution.

### Unit IV: BENZENE AND POLYNUCLEAR AROMATIC HYDROCARBONS ( 15 hrs )

Aromaticity – Huckels rule with respect to benzene, naphthalene, anthracene, phenanthrene, and heterocyclic compounds ( 5- & 6-membered rings); electrophilic substitution in benzene-general mechanism; nitration, sulphonation, halogenations, Friedel-Crafts alkylation and acylation. Orientation [directive influence] and reactivity in mono substituted benzenes. Polynuclear hydrocarbons-naphthalene, anthracene and phenanthrene-preparation, properties and uses.

### Unit V: THERMODYNAMICS – I ( 20 hrs )

5.1 Terminology of thermodynamics – Thermodynamic equilibrium – nature of work and heat – first law of Thermodynamics – statement – definition of internal Energy (E) , Enthalpy (H) and Heat capacity. Relation between  $C_p$  and  $C_v$ . Calculation of W, q, dE and dH for expansion of ideal and real gases under isothermal and adiabatic condition of reversible and irreversible processes. Joule-Thompson effect and Coefficient ( $\mu_{\text{JT}}$ ) – Calculation of  $\mu_{\text{JT}}$  for ideal and real gases – Inversion temperature.

5.2 Thermochemistry – Relation between enthalpy of reaction at constant volume ( $q_v$ ) and at constant pressure ( $q_p$ ) – Temperature dependence of heat of reaction – Kirchoff's equation – Derivation and application – Enthalpy of formation combustion – Bond energy and its calculation from thermochemical data – integral and differential heats of solution and dilution.

**Textbooks:**

1. Puri B.R., Sharma L.R and Pathania M.S, Principles of Physical Chemistry, Vishal Publishing Co., 47<sup>th</sup> ed., New Delhi, Vishal publishing Co., 2016.
2. Puri B.R., Sharma L.R and Kalia K.C , Principles of Inorganic Chemistry, Vishal Publishing Co., 33<sup>th</sup> ed., New Delhi, Milestone Publishers and Distributors., 2016.
3. Soni P.L and Chawla H.M, Text book of Organic Chemistry, Sultan Chand & Sons Publishers, New Delhi 20<sup>nd</sup> ed.

**Reference Books**

1. Lee J.D Concise Inorganic Chemistry, 5<sup>th</sup> ed., Blackwell science, 2005.
2. Soni P.L and Mohan Katyal, Text book of Inorganic Chemistry, Sultan Chand & Sons Publishers, New Delhi 20<sup>nd</sup> ed.
3. Soni P.L and Dharmarsha O.P and Dash U.N , Text book of Physical Chemistry, Sultan Chand & Sons Publishers, 23<sup>rd</sup> ed. New Delhi 2011
4. Glasstone Samuel, Textbook Physical Chemistry 2<sup>nd</sup> ed., Macmillar india ltd., 1990.
5. Graham solomons T.W. Organic chemistry, 3<sup>rd</sup> ed., John wiley & sons.
6. Morrison R.T and Boyd R.N., Organic Chemistry, 6<sup>th</sup> ed., Pearson Education, Asia 2002.

## GENERAL CHEMISTRY – IV

### UNIT I: OXIDATION AND REDUCTION REACTIONS ( 10 hrs )

Covalency – oxidation number – oxidation state – difference between oxidation number and valency – rules for calculating oxidation number – definition of oxidation and reduction – redox reaction and half reactions oxidizing agents and reducing agents – equivalent weights of oxidising and reducing agents – auto oxidation and induced oxidation- balancing of redox equations by oxidation number method and ion-electron method.

### UNIT II: CHEMISTRY OF d-BLOCK ELEMENTS ( 15 hrs )

Transition Elements – Electronic configuration – General periodic trend – Atomic and ionic radii, metallic character, melting and boiling points, ionization energy, oxidation state reactivity, colour and tendency to form complexes – Group study of Scandium, Titanium, Vanadium, Chromium, Manganese, Iron, cobalt, Nickel, copper and Zinc groups – Galvanization, Evidences for the existence of mercurous ion as  $\text{Hg}_2^{2+}$ .

### UNIT III: HETEROCYCLIC COMPOUNDS AND DYES (15 hrs )

#### 3.1 Hetero cyclic compounds (10 hrs)

Nomenclature, Preparation and properties of Furan, Pyrrole, Thiophene and Pyridine. Comparative study of basicity of pyrrole and pyridine with aliphatic amines. Synthesis and reactions of Indole, Quinone and Isoquinoline.

#### 3.2 Dyes ( 5 hrs )

Theory of colour and constitution. Preparation and uses of: Azo dye – Bismark brown, Triphenyl methane dye – malachite green, phthalein dye – fluorescein, anthraquinone dye – alizarin and vat dye-indigo.

### UNIT IV:

#### 4.1 Alcohols and thiols (10 hrs)

Monohydric, dihydric and trihydric alcohols: Nomenclature, preparation of alcohols from alkenes, alkyl halides, Grignard reagent and carbonyl compounds. Reactions of alcohols- dehydration, oxidation, action of Grignard reagent, dehydration using copper and esterification.

Thiols: Nomenclature, structure, preparation and properties.

#### 4.2 Ethers and thioethers (5hrs)

Ethers: Nomenclature, structure, preparation and properties, uses.

Thioethers: Nomenclature, structure, preparation and properties, uses.

## UNIT V: Thermodynamics-II (20hrs)

Second law of thermodynamics – Limitations of first law & Need for the second law – Different statement of the law – Carnot's cycle and efficiency of heat engine – Carnot's theorem – Thermodynamic scale of temperature – 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 systems – 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 – Thermodynamic equation of state – Maxwell's reactions.

### Text Books

- 1 Puri B.R., Sharma L.R and Pathania M.S, Principles of Physical Chemistry, Vishal Publishing Co., 44<sup>th</sup> ed., New Delhi, Vishal publishing Co., 2016.
- 2 Puri B.R., Sharma L.R and Kalia K.C , Principles of Inorganic Chemistry, Vishal Publishing Co., 33<sup>th</sup> ed., New Delhi, Milestone Publishers and Distributors., 2016.
- 3 Soni P.L and Chawla H.M, Text book of Organic Chemistry, Sultan Chand & Sons Publishers, New Delhi 20<sup>nd</sup> ed.

### Books for References

1. Glasstone Samuel, S. And Lewis D., Elements of Physical Chemistry 2<sup>nd</sup> ed., Macmillan & Co. Ltd., London
2. Morrison R.T. and Boyd R.N., Organic Chemistry, 6<sup>th</sup> ed. Pearson Education, Asia, 2002
3. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, 12<sup>th</sup> ed., Sultan chand & Co., New Delhi, 1997.
4. Madan R.D. Sathya Prakash's Modern Inorganic Chemistry, 2<sup>nd</sup> ed., Sultan chand & Co., New Delhi, 1990

## SEMIMICRO INORGANIC QUALITATIVE ANALYSIS ( MAJOR CHEMISTRY PRACTICAL )

### Semi-Micro Qualitative Analysis

1. Analysis of simple acid radicals: Carbonate, sulphide, sulphate, thiosulfate, chloride, bromide, iodide, nitrate
2. Analysis of interfering acid radicals: Fluoride, oxalate, borate, phosphate, arsenate, arsenite
3. Elimination of interfering acid radicals and identifying the groups of basic radicals
4. Analysis of basic radicals (group-wise): Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminium, arsenic, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium
5. Analysis of mixtures containing two cations and two anions.

Each student is expected to do the analysis of atleast 10 mixtures.

**Book for reference**

Venkateswaran V, Veeraswamy R., Kulanivelu A.R., Basic principles of practical Chemistry, 2<sup>nd</sup> edition, New delhi, Sultan chand & Sons

**PAPER VII**  
**INORGANIC CHEMISTRY**

**UNIT I: CHEMISTRY OF f-BLOCK ELEMENTS (15 hrs )**

General characteristics of f-block elements – Comparative account of lanthanides and actinides – Occurrence, Oxidation states, Magnetic properties, Colour and spectra – Lanthanides and Actinides Separation by ion-Exchange and Solvent extraction methods – Lanthanide contraction – Chemistry thorium and Uranium – Occurrence, Ores, Extraction, properties and uses – Preparation, Properties and uses of ceric ammonium sulphate, thorium dioxide and uranyl acetate.

**UNIT II: COORDINATION CHEMISTRY (15hrs)**

Types of ligands, IUPAC Nomenclature, Isomerism – Ionisation, hydrate, linkage, ligand and coordination isomerism. Stereoisomerism – geometrical and optical isomerism in 4 & 6 coordinated complexes. Theories of coordination compounds – Werner's and Sidwick's EAN concept, Valence Bond theory – hybridization, geometry and magnetic properties of  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{NiCl}_4]^{2-}$ ,  $[\text{Fe}(\text{CN})_6]^{4-}$ ,  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{CoF}_6]^{3-}$ . Crystal field theory – spectrochemical series, splitting of orbitals in octahedral and tetrahedral complexes, low spin & high spin complexes. Explanation of colour and magnetic properties using CFT, comparison of VBT and CFT.

**UNIT III: APPLICATION OF COORDINATION COMPOUNDS (12hrs)**

Application of coordination compounds – Estimation of nickel using DMG and aluminium using oxine. Estimation of hardness of water using EDTA. Biologically important coordination compounds – Chlorophyll, haemoglobin vitamin – B<sub>12</sub>. ( their structure and applications). Metal Carbonyls : Mono and Poly nuclear Carbonyls of Ni, Fe, cr, Co and Mn – Synthesis, structures and bonding.

**UNIT IV: CHEMISTRY OF BINARY COMPOUNDS (10hrs)**

Classification, preparation, properties and uses of hydrides, borides, carbides and nitrides.

**UNIT V : CONCEPTS OF ACIDS AND BASES (8hrs)**

Theories of acids and bases – Arrhenius theory, Bronsted – Lowry theory – basicity of an acid and acidity of a base – relative strengths of acids and bases, Cady – Esley concept – general theory of solvent system, Lux – Flood concept, Lewis concept – Lewis acids – bases

concept in coordination chemistry – classification of Lewis acids, Usanovich concept. Concept of Hard and Soft Acids and Bases (HSAB).

### **TEXT BOOK**

- 1 Puri B.R., Sharma L.R and Kalia K.C , Principles of Inorganic Chemistry, Vishal Publishing Co., 33<sup>th</sup> ed., New Delhi, Milestone Publishers and Distributors., 2016.

### **BOOKS FOR REFERENCE**

1. Lee J.D Concise Inorganic Chemistry, 5<sup>th</sup> ed., Blackwell science, 2005.
2. Sharpe Alan G. Inorganic Chemistry, ELBS and Longman, 1981
3. Soni P.L., and Mohan kalyal, Text book of inorganic chemistry, 20<sup>th</sup> ed., S. Chand & Co., New Delhi, 2006
4. Malik wahid U., Tuli G.D. and Madan R.D., Selected Topics in Inorganic Chemistry, 7<sup>th</sup> ed., S.Chand & Company Ltd
5. James E.Huheey, Ellen A. Keiter, Richard L. Keiter and Ojhil K. Medhi, inorganic chemistry: Principles of Structure and Reactivity, 4<sup>th</sup> ed., Pearson India, 2011
6. Gurdeep Raj Chatwal and Harish Mehre, Advanced Inorganic Chemistry, 7<sup>th</sup> ed., Goel Publishing House, Meerut

## **PAPER- VIII ORGANIC CHEMISTRY – I**

### **UNIT-I: CHEMISTRY OF PHENOLS AND AROMATIC ALCOHOLS (12hrs)**

Phenols: Nomenclature, synthesis of phenol from benzene sulphonic acid, chlorobenzene and cumene - Properties – Acidity of phenols ( explanation on the basis of resonance stabilization). Reactions similar to those of alcohols, ring substitution in phenol – orientation of phenolic group towards electrophiles, halogenation, nitration and sulphonation, Libermann’s nitroso reaction, Riemeier – Tiemann reaction, Kolbe-Schmidt reaction and coupling with diazonium salts and condensation reactions.

Dihydric phenols and benzyl alcohols-preparation, properties and uses.

### **UNIT II: CHEMISTRY OF CARBONYL COMPOUNDS(15hrs)**

Nomenclature, structure of carbonyl compounds, acidity of alpha – hydrogen atom, keto-enol Tautomerism ( proof for the two forms). Mechanism of nucleophilic addition with HCN, ROH, NaHSO<sub>3</sub>, ammonia and its derivatives. Mechanism of Meerwein – Pinner Verley reduction, Clemmenson reduction, haloform reaction, Perkin and Benzoin condensation reaction.

### **UNIT III: CHEMISTRY OF CARBOXYLIC ACIDS AND THEIR DERIVATIVES (12hrs)**

Acidity of carboxylic acids, Effect of substituents on acidity, comparison of acid strengths of halogen substituted acetic acid and substituted benzoic acid.

Dicarboxylic acids: Preparation – form alkyl cyanides, cyclic ketones and halo esters.

Reactions – action of heat, action of  $\text{PCl}_5$  and  $\text{NH}_3$

Acid derivatives (Aliphatic): Synthesis and important properties of acid derivatives (acid chlorides, acid anhydrides, esters and amides). Acetoacetic and malonic esters – Preparation and synthetic applications.

#### **UNIT IV: CHEMISTRY OF NITROGEN COMPOUNDS (12hrs)**

Nitrobenzene – preparation, reduction in different media, conversion of nitrobenzene to m-dinitrobenzene and TNT. Amines: Nomenclature, Basicity of amines, effect of substituents on basicity of aliphatic and aromatic amines. Preparation – primary amines (Gabriel synthesis and reduction of nitriles), Secondary and tertiary amines- by the reduction of N-alkyl substituted amides.

Reaction of amines – primary aliphatic and aromatic amines with nitrous acid.

#### **UNIT V: AROMATIC HALIDES AND SULPHONIC ACIDS (9hrs)**

Aryl halides-Nomenclature, preparation, physical and chemical properties. Benzoyl chloride-Preparation, Physical and chemical properties.

Nomenclature of aromatic sulphonic acids-preparation and properties of aromatic sulphonic acids-benzene sulphonyl chloride, saccharin chloramine-T, sulphonilic acid and sulfanilamide

#### **TEXT BOOKS**

1. B.S. Bahl and Arun Bahl, Text book of Organic Chemistry, S. Chand and Sons, New Delhi, 2005
2. Soni, P.L., and H.M. Chawla-Text book of Organic Chemistry, 29th ed., New Delhi, 29th ed., Sultan Chand & Sons, 2007
- 3.

#### **REFERENCE BOOKS**

1. Morrison R.T and Boyd R.N., Organic Chemistry, 6<sup>th</sup> ed., Pearson Education, Asia 2002.
2. Graham solomons T.W. Organic chemistry, 3<sup>rd</sup> ed., John wiley & sons
3. Carey Francis A., Organic Chemistry, 7<sup>th</sup> ed., New Delhi, Tata MacGraw Hill Education pvt Ltd., 2009
4. Final I.L., Organic Chemistry, 6<sup>th</sup>, Vol (1&2) England, Wesley Longman Ltd. 1996.
5. John McMurry, Organic Chemistry, 9<sup>th</sup> ed., Cengage Learning, 2015.
6. Agarwal O.P., Organic Chemistry Reactions & Reagents, 49<sup>th</sup> ed., Goel Publishing House 2014.

## **PAPER IX**

### **PHYSICAL CHEMISTRY-I**

#### **UNIT-I: THERMODYNAMICS III(12 hrs)**

Equilibrium constant and free energy change-Thermodynamic derivation of law of mass action-Equilibrium constants in terms of pressure and concentration ( $K_p$  and  $K_c$ ) and their relation, - Thermodynamic interpretation of Lechatelier's principle ( Concentration, temperature, pressure and addition of inert gases). Systems of 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-  
Third law of Thermodynamics: Nernst heat theorem-Statement of third law and concept of residual entropy-Evaluation of absolute entropy from heat capacity data.

#### **UNIT II: SOLUTIONS(12hrs)**

Ideal and Non-ideal solutions. Concept of activity and activity coefficients-Completely miscible liquid systems-benzene and toluene. Raoult's law and Henry's law. Deviation from Raoult's law and Henry's law. Duhem- Margules equation. Azeotropes - HCL-water and Ethanol-water system-Partially miscible liquid systems- Phenol-water, triethylamine-water and Nicotine-water systems. Completely immiscible liquids-principle and application of steam distillation-Nernst Distribution Law-thermodynamic derivation, application to solvent extraction, limitations of distribution law.

#### **UNIT III: THERMODYNAMICS OF PHASE CHANGES(10hrs)**

Definition of terms in the phase rule-Derivation and application to one component system water and sulphur-super cooling, sublimation. Two components systems-solid-liquid equilibria, simple eutectic ( lead-silver), desilverisation of lead-Compound formation with congruent melting point. (Mg-Zn) and incongruent melting point(Na-K). Solid solutions-(Ag-Au)-freezing mixtures-KI-H<sub>2</sub>O systems.

#### **UNIT IV: DILUTE SOLUTIONS AND COLLIGATIVE PROPERTIES(10hrs)**

Colligative properties-relative lowering of vapour pressure, osmosis-Law and osmotic pressure-isotonic solutions, effect of concentration and temperature on osmotic pressure-thermodynamic derivation of elevation of boiling point and depression in freezing point-determination molecular masses using the above properties-abnormal molecular masses and Van't Hoff factor-degree of association and degree of dissociation.

#### **UNIT V: ELECTROCHEMICAL CONDUCTANCE(16 hrs)**

Electrical transport and conductance in metal and in electrolytic solution. Specific conductance and equivalent conductance. Measurement of equivalent conductance. Using Kohlrausch's bridge.

Arrhenius theory of electrolytic dissociation and its limitation. Weak and strong electrolyte according to Arrhenius theory Ostwald's dilution laws-application and limitations. Variation of equivalent conductance with concentration. Migration of ion-ionic mobility. Kohlraush's law and its application. The elementary treatment of the Debye - huckel onsager equation for strong electrolytes. Evidence for ionic atmosphere. The conductance at high fields (Wein effect) and high frequencies (Debye-Falkenhagen effect). Transport number and Hittorf's rule. Determination by moving boundary method. Application of conductance measurement's – determination of  $\Lambda_0$  of strong electrolytes. Determination of  $K_a$  of weak acids. Determination of solubility product of a sparingly soluble salt. Conductometric titrations.

### **TEXT BOOK**

Puri B.R., sharma L.R., Pathania M.S., principles of physical chemistry, 47<sup>th</sup> ed., vishal publishing co., 2016.

### **REFERENCE BOOKS**

1. Atkins P.W., physical chemistry, 5<sup>th</sup> ed., oxford university press, 1994.
2. Castellan G.V., physical chemistry, New Delhi, orient Longmans.
3. Levine I.N., physical chemistry 6<sup>th</sup> ed., 2009.
4. Rajaram J. and kuriacose J.C., thermodynamics for students of chemistry 3<sup>rd</sup> ed., Shoban Lal and co., 2013.
5. Bajpai D.N., advanced physical chemistry, S. Chand publishing, 2001.
6. Negi A.S. and Anand S.C., A text book of physical chemistry, John Wiley & sons Pvt. Ltd. 1986.

### **Paper X – Inorganic quantitative analysis - gravimetric analysis.**

The student are expected to write the procedure during examination for which marks should be awarded as per the scheme of examination

1. Estimation of lead as lead chromate
2. Estimation of barium and barium chromate
3. Estimation of nickel as nickel-DMG complex
4. Estimation of calcium as calcium oxalate
5. Estimation of barium as barium sulfate
6. Estimation of sulfate as barium sulfate
7. Estimation of aluminium as aluminium oxinate(for demonstration)
8. Estimation of silver as silver chloride(for demonstration)

## Books for References

1. Venkateswaran, V.Veerawamy R.Kulandaivelu A.R.,Basic Principles of Practical Chemistry, 2<sup>nd</sup> Edition, New Delhi, Sultan Chand & Sons,(1997).
2. Jeffery G.H ., Bassett J., Mendham J.And Denney R.C, Vogel's Text Book of Quantitative Chemical Analysis,5<sup>th</sup> ed., John Wiley & Sons Inc., New York,1989.

## PAPER XI - ORGANIC ANALYSIS AND PREPARATION

### ORGANIC ANALYSIS

Analysis of simple organic compounds (a) characterization functional groups(b)confirmation by preparation of solids derivatives /Characteristics colour reaction.

Note: 1. Mono-functional compounds are given for analysis. In case of bi-functional compounds, students are required to report any one of the functional groups.

2. Each student is expected to do the analysis of at least 15 different organic substances.

Recommended to adopt micro scale technique of organic analysis

### ORGANIC PREPARATIONS

Preparation of organic compounds involving the following chemical conversions

- 1.Oxidation
- 2.Reduction
- 3.Esterification
- 4.Acetylation
- 5.Hydrolysis
- 6.Nitration
- 7.Bromination
- 8.Diazotization
- 9.Osazone formation

### Books for reference

1. Venkateswaran,V.Veerawamy R.Kulandaivelu A.R.,Basic Principles of Practical Chemistry,2<sup>nd</sup> Edition, New Delhi, Sultan Chand & Sons,(1997).
2. Furnis,B.S., et al .Vogel's Textbook of Practical Organic Chemistry,5<sup>th</sup> ed., Prentice Hall,1989.

## PAPER –XII -PHYSICAL CHEMISTRY PRACTICAL

### Physical Chemistry Experiments

1. Critical solution temperature
2. Effect of temperature on critical solution temperature
3. Rast method
4. Transition temperature
5. Heat of neutralization
6. Phase diagram(Simple Eutectic)
7. Kinetics of iodination of acetone
8. Kinetics of ester hydrolysis

9. Kinetics of Persulphate-iodide reaction
10. Viscosity
11. Partition coefficient and equilibrium constant of  $KI + I \rightarrow KI_3$
12. Determination of cell constant, specific conductance and equivalent conductance of strong electrolyte.
13. Conductometric acid-Base titration
14. Conductometric Precipitation titration
15. Potentiometric acid-Base titration
16. Potentiometric redox titration

### **Books for Reference**

1. Venkateswaran, V. Veeraswamy R. Kulandaivelu A.R., Basic Principles of Practical Chemistry, 2<sup>nd</sup> Edition, New Delhi, Sultan Chand & Sons, (1997).
2. Daniels et al., Experimental Physical Chemistry, 7<sup>th</sup> ed., McGraw Hill, 1970.
3. Findlay, A., Practical Physical Chemistry, 7<sup>th</sup> ed., Longman, 1989.
4. Ahluwalia, V.K., Dingra, S. and Gulati, A. College Practical Chemistry, Orient Longman Pvt. Ltd., Hyderabad 2005.
5. Sharma, K.K. and Sharma, D.S. Introduction to Practical Chemistry, Vikas Publishing House, New Delhi, 2005.

## **PAPER – XIII**

### **INORGANIC CHEMISTRY – III**

#### **UNIT I: METALLIC BONDING (15hrs)**

Metallic state – Packing of atoms in metal ( BCC, FCC, HCP and simple cube) – Theories of metallic bonding – Electron gas, Pauling and band theories – semi conductors – n-type and p-type, transistors – Uses – structures of alloys – substitutional and interstitial solid solid solutions – Hume Rother ratio.

#### **UNIT II: CHEMISTRY OF ORGANOMETALLIC COMPOUNDS (15hrs)**

Introduction – Preparation of OrganoMagnesium compounds – Physical and Chemical Properties – Uses, Preparation of Organozinc compounds – Physical and Chemical Properties – Uses, Preparation of OrganoLithium compounds – Physical and Chemical Properties – Uses, Preparation of Organocopper, OrganoLeads, OrganoPhosphorus and OrganoBoron compounds.

Organometallic compounds of alkenes, alkynes and cyclopentadiene.

### **UNIT III: NUCLEAR CHEMISTRY (15hrs)**

Introduction – composition of nucleus – nuclear binding energies – structure of nucleus – nuclear shell model – magic numbers nuclear stability – theories of nuclear stability – i) nuclear binding energy theory ii) meson theory of nuclear forces iii) nuclear fluid theory – isotopes, isobars, isotones and nuclear isomers – detection of isotopes – Aston’s mass spectrograph separation of isotopes – electromagnetic method – the whole number rule and packing fraction – atomic weights.

### **UNIT IV: RADIOACTIVITY (15hrs)**

Radioactive Emanations, Alpha rays, Beta rays and Gamma rays. The Disintegration theory. Group Displacement Law. Rate of disintegration and Half-life period. Radioactive disintegration series. The Geiger-Nuttall rule – Artificial radioactivity. Induced radioactivity. Nuclear fission – Atom bomb, Nuclear fusion – hydrogen bomb. Hazards of radiation. Applications of Radioisotopes.

### **UNIT V: SOME SPECIAL TYPE OF COMPOUNDS (15hrs)**

Clathrates – examples and structures, interstitial and non-stoichiometric compounds – silicones – composition, manufacture, structure, properties and uses – silanes, phosphazenes – their synthesis, structure and uses – silicates and their polymers – classification into discrete anions – one, two, and three dimensional structures with examples – composition and uses of beryl, asbestos, talc, mica, zeolites and ultramarines. Types of solvents: Protic and aprotic solvents-aqueous and non aqueous solvents – liquid ammonia and liquid HF as solvents.

### **TEXT BOOK**

- 1 Puri B.R., Sharma L.R and Kalia K.C , Principles of Inorganic Chemistry, Vishal Publishing Co., 33<sup>th</sup> ed., New Delhi, Milestone Publishers and Distributors., 2016.

### **BOOKS FOR REFERENCE**

1. Lee J.d., Concise Inorganic chemistry.5<sup>th</sup> ., Blackwell Science,2005
2. Sharpe Alan G. Inorganic Chemistry. ELBS and Longman,1981.
3. Miessler G.L. and Donald, A. Tarr, Inorganic Chemistry 4<sup>th</sup> ed., Pearson 2010.
4. Malik, Wahid U., Tuli G.D. and Madan R.D., Selected Topics in Inorganic Chemistry, 7<sup>th</sup> ed., S.Chand & Company Ltd., 2007
5. Gurdeep Raj Chatwal and Harish Mehre, Advanced Inorganic Chemistry, 7<sup>th</sup> ed., Goel Publishing House, Meerut

## PAPER – XIV

### ORGANIC CHEMISTRY – II

#### UNIT 1: CHEMISTRY OF CARBOHYDRATES (15hrs)

Carbohydrates – Definition and classification of carbohydrates with examples. Mono saccharides. Explanation of enantiomers.

Diastereomers, epimers and anomers with examples. Mechanism mutarotation, osazone formation. Absolute configurations of glucose and fructose. Structural elucidation of glucose and fructose ( includes cyclic and Haworth structure). Inter conversions, ascending and descending the sugar series. Disaccharide – sucrose, Maltose – structural elucidation. Polysaccharide – starch and cellulose (Elementary treatment)

#### UNIT 2: CHEMISTRY OF PROTEINS AND VITAMINS(15hrs)

Amino acids-classification, General methods of preparation and reactions, zwitter ion, isoelectric point. Peptides and proteins – Peptide linkage, Classification of proteins, primary structure, End group analysis – Sanger's method and Edman method, secondary structure, tertiary structure, denaturation.

Vitamins – Classification, biological importance of Vitamins, Structural elucidation of Vitamin C. Structures of Vitamin A and Vitamin D.

#### UNIT 3: CHEMISTRY OF ALKALOIDS AND TERPENOIDS (15hrs)

Chemistry of natural products – Alkaloids – Isolation, classification, general methods of elucidating structure. Structural elucidation of nicotine and piperine. Terpenes – classification, isoprene rule, isolation and structural elucidation of citral,  $\alpha$ - terpeniol and menthol

#### UNIT 4: MOLECULAR REARRANGEMENTS 10hrs)

Molecular rearrangements – Types of rearrangements, Mechanism for the following rearrangements : pinacol – pinacolone, benzyl - benzilic acid, benzidine, Favorskii, Claisen, Fries, Hofmann, Curtius, Schmidt and Beckmann.

#### UNIT 5: STEREOCHEMISTRY OF ORGANIC COMPOUNDS (20hrs)

Stereoisomerism – definition, classification into geometric and optical isomerism. Optical isomerism – Optical activity, asymmetric centre (chirality), Symmetry elements ( $\sigma_n$ ,  $S_n$  and  $i$ ) meaning of (+) or d and (-) or l and D and L notations, concept of enantiomerism and diastereoisomerism; Racemisation – methods of Racemisation (by substitution and

tautomerism), Resolution – methods of resolution ( by mechanical, seeding and biochemical), Walden inversion. Projection formulae – Fischer, flying wedge, Sawhorse and Newmann projections, notation of optical isomerism:- cahn-Ingold and Prelog rules, R and S notations for one and two chirality (stereogenic) centres, erythro and threo representations. Geometrical isomerism: cis – trans; syn – anti; E – Z descriptors. [ 3D visualization through computers]

### **TEXT BOOK**

Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, 12<sup>th</sup> ed., Sultan Chand and Co., New Delhi, 1997.

### **BOOKS FOR REFERENCE**

1. Finar I.L., organic chemistry, vol.1 & 2 , 6<sup>th</sup> ed., Addison Wesley longman ltd., London., 1996.
2. Marrison R.T., Boyd R.N., organic chemistry 4<sup>th</sup> ed., Allyn and Bacon ltd., New York, 1976.
3. Pine S.H., organic chemistry 4<sup>th</sup> ed., McGraw-Hill international book company,(1986).
4. Peter Sykes, A guide book to mechanism in organic chemistry, 6<sup>th</sup> ed., pearson education,2003.
5. Kalsi, P.S., stereo chemistry of organic compounds: principles and application, new age international, 2011.
6. Sujatha V Bhat, nagasampagi B.A., and Meenakshi sivakumar, Chemistry of Natural Products, Springer, 2006.
7. Agarwal O.P., organic chemistry reactions and reagents, 49<sup>th</sup> ed., goel publishing house, 2014.

## **Paper – XV**

### **Physical chemistry II**

#### **Unit I : Chemical Kinetics (20 hrs)**

Rate of reaction – average and instantaneous rates , factors influencing rate of reaction- molecularity of a reaction – rate equation – order of a reaction . order an molecularity of simple and compound reactions, rate laws – rate constants – derivation of rate constants and characteristics for zero, first order , second and third order (equal initial concentration ) – derivation of time for half change with examples. Methods of determination of order of reactions – experimental methods of determination of rate constant of a reaction – volumetry, manometry and polarimetry.

Effect of temperature on reaction rate – temperature coefficient – concept of activation energy – energy barrier – Arrhenius equation. Theories of reaction rates – collision theory – derivation of rate constant of bimolecular gaseous reaction – failure of collision theory.

Lindemann's theory of unimolecular reaction. 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 ARRT.

## **Unit II: CATALYSIS AND ADSORPTION (15 HRS)**

Catalysis-general characteristics of catalytic reactions , auto catalysis , promotes , negative catalysis , poisoning of a catalyst – theories of homogeneous and heterogeneous catalysis – kinetics of acid – base and enzyme catalysis . heterogeneous catalysis adsorption – chemical and physical adsorption and the general characteristics – distinction between them different types of isotherms – Freundlich and Langmuir. Adsorption isotherms and their limitations – BET theory .

## **Unit III : PHOTOCHEMISTRY (10 HRS)**

Laws of photochemistry – Lambert –Beer , Grotthus – draper and stark – Einstein . quantum efficiency . photo chemical reactions – rate law – kinetics of  $H_2 - Cl_2$ ,  $H_2 - Br_2$  &  $H_2 - I_2$  reactions, comparison between thermal and photochemical reactions.

## **Unit IV: GROUP THEORY (10 HRS)**

Symmetry elements and symmetry operation of  $H_2O$  molecule, illustration of mathematical rules for the group using symmetry operation of  $H_2O$  molecule. Construction of multiplication table , for  $H_2O$  molecule . point group – definition elements (symmetry operations) of the following point groups  $C_n$  ( $C_2, C_3$ ),  $C_{nv}$  ( $C_{2v}, C_{3v}$ ) &  $C_{nh}$  ( $C_{2h}, C_{3h}$ ).

## **Unit V : ELECTROCHEMICAL CELLS (20 HRS)**

Electrolytic and galvanic cells – reversible and irreversible cells . conventional representation of electro chemicals cells . electromotive force of a cell and its measurement computation of emf calculation of thermodynamics quantities of cell reactions ( $\Delta G, \Delta H, \Delta S$  &  $K_{eq}$ ). application of Gibbs Helmholtz equation . calculation of emf Nernst equation . types of reversible electrodes – gas / metal ion – metal / metal ion ; metal/insoluble salt / anion and redox electrodes. Electrode reactions – Nernst equation derivation of cell emf and single electrode potential – standard hydrogen electrode – reference electrodes – standard electrodes potentials – sign convention – electro chemicals series and its significance . concentration cell with and without transport . liquid junction potential . application of emf concentration cells. Valence of ion , solubility product and activity coefficient . potentiometric titrations . determination of  $p^H$  using hydrogen, quinhydrone and glass electrodes. Determination of  $pK_a$  of acids by potentiometric method . corrosion – general and electro chemical theory passivity – prevention of corrosion.

## TEXT BOOK

1. Puri B.R., sharma L.R., Pathania M.S., principles of physical chemistry, 47<sup>th</sup> ed., vishal publishing co., 2016.
2. Sharma K.K and Sharma L.K., A Text Book of Physical Chemistry, 6<sup>th</sup> ed., S. Chand, 2016

### Books for References

1. Maron S.H. and Lamdo J.B Fundamentals of Physical Chemistry, Macmillan.
2. Glasstone S. and Lewis. D., Elements of Physical Chemistry, Macmillan
3. Kheterpal S.C. Pradeep Physical Chemistry, volume I & II, Pradeep Publications Jalandhur, 2004
4. Jain D.V.S and Jainhar S.P., Physical Chemistry, Principles and problems, Tata McGraw Hill, New Delhi, 1988.
5. Bajpai D.N., Advanced Physical chemistry, S. Chand Publishing, 2001
6. Negi A.S and Anand S.C., A Textbook of Physical Chemistry, John Wiley & Sons Pvt. Ltd., 1986.

## ELECTIVE – I PHARMACEUTICAL CHEMISTRY

### Unit I : (12 hrs)

Important terminologies used in pharmaceutical chemistry – drug pharmacology, pharmacognosy, pharmacodynamics, pharmacokinetics, antimetabolites , pharmacopeia (BP,IP,USP), National formulary, chemotherapy, vaccines, primary immunization, synergism, antagonist LD50, ED50, therapeutics index and drug dosage.

Various source of drugs, pharmacologically active constituents in plants. classification of drugs, chemical-biological-mechanism of drug action-action at cellular sites. drug receptors and biological responses. mechanism of different types of drug action.

### Unit II :(12 hrs)

Absorption of drugs – factors affecting absorption of drugs, routes of administration-local, enema, oral and external, parental routes-advantages and disadvantages-Common diseases-infective diseases insect borne-air borne and water borne. common diseases of the respiratory system and nervous system. Indian medicinal plants-thulasi, neem, keezhanelli.

### Unit III:(12 hrs)

Anaesthetic -general –ether, chloroform, ethyl chloride, halothane, nitrous oxide, local-esters, cocaine, benzococaine, procaine, amides-lignocaine, cinchocaine. analgesics-narcotic and synthetic.

Antipyretics and anti-inflammatory agents, Antibiotics- penicillin, streptomycin, chloramphenicol, tetracyclins. Antiseptics and disinfectants- phenol and its derivatives, nitrofurans derivatives.

#### **Unit 4 (12 hrs)**

Composition of blood – blood grouping and matching. Blood pressure – systolic and diastolic – hypertensive drugs. Diabetes- causes – hyperglycemic drugs.

Cardiovascular drugs – cardiac glycosides – antiarrhythmic drugs, antianginal drugs, vasodilators, antipsychotic drugs – antidepressants – sedatives and hypnotics.

#### **Unit 5 (12 hrs)**

Anticonvulsant agents – barbiturates – oxazolinediones – acetyl urea derivatives – succinimides. Diagnostic agents for kidney function (aminohippuric acid) – for liver function (sulfo bromophthalein). Lipid profile – HDL, LDL, cholesterol and lipid lowering drugs. Vitamins – fat soluble and water soluble – sources, biological role and deficiency conditions. Medicinal importance of inorganic compounds – compounds of aluminium – phosphorus – arsenic – mercury and iron. Biological importance of organic compounds – sodium and its compounds – potassium and its compounds – copper and its compounds.

#### **REFERENCES**

1. Jayashree Ghosh, A Text book of pharmaceutical chemistry, 5<sup>th</sup> ed., S.Chand and company ltd., 2014.
2. Lakshmi .s., pharmaceutical chemistry, S. Chand & sons, new delhi, 1995.
3. Ashuttoshkar, medicinal chemistry, wiley eastern ltd., new delhi, 1993.
4. Hakishan, V.K. Kapoor, medicinal and pharmaceutical chemistry, vallabhprakashan, 2012.
- 5.

### **INDUSTRIAL CHEMISTRY**

#### **UNIT 1 : Industrial requirements (12 hrs)**

Requirements of an industry – location – water – industrial water treatment – safety measures – pilot plants. Fuels – types of fuels with examples – coal – carbonization of coal – coal for distillation – liquid fuels – gaseous fuels – selection of fuels – nuclear fuels. Energy – source of energy – renewable and non-renewable energies – non conventional energies.

#### **Unit 2 : petrochemical industries(12 hrs)**

Crude oil – constitution and distillation – composition of different distillates – ignition point, flash point octane number – cracking – catalysts used in petroleum industries – structures, selectivity and applications. Manufacture of synthetic petrol – Bergius and Fischer Tropsch processes – manufacture of petrochemicals and petrochemical polymers – manufacture of higher olefins, acetaldehyde, acetic acid, phenol, carbon disulphide, vinyl acetate, butane diols, xylenes.

### **Unit 3 : fertilizers and speciality chemicals (12 hrs)**

Manufactures – properties and industrial uses of solvents – DMF, DMSO, THF and dioxane. Fertilizers – raw materials, manufacture (flow chart – chemical process with equations) of ammonium nitrate, ammonium sulphate, urea, calcium cyanamide, calcium ammonium nitrate, sodium nitrate, ammonium chloride, ammonium phosphate, super phosphate of lime, NPK fertilizers.

### **Unit 4 : oils, soaps and detergents (12 hrs)**

Oils – difference between oils and fats – manufacture of cotton seed oil and soya bean oil – manufactures of soaps – toilet and transparent soaps – detergents – synthetic detergents – surface active agents and their classification – manufacture of anionic, cationic and non ionic detergents and shampoo.

### **Unit 5 : metallurgy (12 hrs)**

General methods of metallurgy – ores – types – methods of concentration of ores – hydro metallurgy, pyrometallurgy – various of reduction process, refining of metals – extraction of Cr, Mn, V, Co, Pt, U and Th. Environment problems of chemical industries – methods of control – sewage treatment and waste management. Man power in chemical industries – labour problems – six sigma (basic concept only).

### **Books for reference**

1. Sharma B.K., industrial chemistry, goel publishing house, meerut, 2003.
2. Dryden C.E., outlines of chemical Technology, Gopala, eastern press, new delhi.
3. Shreve R.V., chemical process industries, tata Mc Graw Hill publishing company, Mumbai.
4. Steines H., introduction to petrochemicals, pergaman press.
5. Alan cottrel, an introduction to metallurgy, orient longman, 2000.
6. James A. kent, riegel's handbook of industrial chemistry, springer science and business media, 2013.
7. Davis K.H., handbook of industrial chemistry, vol2, CBS publishers & distributors, 2004.
- 8.

## **ELECTIVE II**

### **NANOMATERIALS AND GREEN CHEMISTRY**

#### **Unit 1: (12 hrs)**

nano phase materials – introduction – types of nano materials (carbon nano tubes and nanoclays) – microstructure – properties – application in different fields. Techniques for synthesis of nanophase materials – sol gel synthesis – electrodeposition – inert gas condensation – mechanical alloying – properties and applications of synthesized nanophase materials.

## **Unit 2 (12 hrs )**

Nanotechnology – background and definition of nanotechnology – nanotube technology – nanotube technology – fillers - nanodendrimers – nanopore channels – fibres – scaffolds – CVD – FCVA technology and its applications - nanoimaging techniques.

## **Unit 3 (12 hrs)**

Classification based on dimensionality – quantum dots, wells and wires – carbon – based nano materials (buckyballs, nanotubes, graphene)- metal based nano materials (nano gold, nano silver and nanometal oxides)- nanocomposites – nanopolymers – nanoglasses – nano ceramics – biological nanomaterials. Characterization techniques – x ray diffraction – electron microscopies (SEM,TEM)

## **UNIT 4 (12 hrs)**

Green chemistry : introduction – concept and principles of green chemistry – need of green chemistry – green synthesis – evaluation of the type of the reaction – atom economy reactions – rearrangements – addition reaction. Wittig reaction. Selection of solvent – aqueous phase reactions – reactions in ionic liquids, Heck reaction, epoxidation. Super critical CO<sub>2</sub> : preparation, properties and applications – decaffeination, dry cleaning.

## **Unit 5 (12 hrs)**

Green catalysis : Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis – biocatalysis: enzymes, microbes phase transfer catalysis (micellar/surfactant) microwave technology on chemistry – microwave heating – microwaves assisted reactions – sonochemistry and green chemistry.

## **REFERENCES**

1. Anatas P.T., and Warner J.C., green chemistry theory and practice.
2. Ahluwalia V.K., green chemistry, Narosa New Delhi.
3. Thomas J.M., Thomas M.J., John Principles and practice of heterogeneous catalysis,
4. Murty B.S, Shankar P., Raj B., Rath B.B., Murday J., A textbook of nanoscience and nanotechnology, Springer Science and Business Media, 2013.
5. Manasi Karkare, nanotechnology: fundamentals and applications, I K International Publishing House, 2008.

## **POLYMER CHEMISTRY**

### **UNIT-1(12 hrs)**

Introduction to polymers-general characteristics of polymers in comparison with common organic compounds. Basic concept of monomers and polymers. Classification of polymers-natural and synthetic polymers. Distinction between plastics, elastomers and fibres. Types of polymers thermoplastics and thermosetting plastics. Geometrical structures of polymer molecules-microstructures-chemical structures-geometrical structures-cross linked polymers-stereoregular polymers

Mechanism of polymerization: chain polymerization, free radical polymerization, ionic and coordination polymerization. Polyaddition and polycondensation polymerization, ring opening and group transfer polymerization.

#### **UNIT-2(12 hrs)**

Molecular weight of polymers-number average, weight average and viscosity average. Determination of polymer molecular weights-Osmometry(membrane, vapour phase), Viscometry methods. Light scattering and ultra centrifugation methods. Molecular weight and degree of polymerization-practical significance of polymer molecular weight.

Glass transition temperature-transition and associated properties-factors affecting Glass transition temperature-importance-glass transition temperature of copolymers.

Polymer crystallinity-crystallisability-effect of crystallinity on properties.

#### **UNIT-3(12 hrs)**

Industrially important polymers-preparation, properties and application. Polyethylene, polypropylene, polyamides, polyvinylchloride, polymethylmethacrylate, polyesters, polycarbonates, polyurethanes, phenol-formaldehyde, melamine-formaldehyde, polysilanes, polyaniline

#### **UNIT-4(12 hrs)**

Degradation of polymers by thermal-oxidative, mechanical and photodegradation methods. Polymerization techniques-bulk, solution, suspension, emulsion, polycondensation and interfacial polycondensation.

Polymer processing-compressin moulding, casting, extrusion, fibre spinning, injection moulding, thermoforming, vulcanization of elastomers.

#### **UNIT-5(12 hrs)**

Polymer reactions-hydrolysis, Acidolysis, Aminolysis, hydrogenation, addition and substitution-cyclisatin reactions-crosslining reactions.

Natural polymers-Rubber, Silk, Cellulose-structure and application

Supramolecular polymers-introduction-properties –application

#### **REFERENCES**

1. BILLMEYER.F.W. Textbook of polymer science, 3<sup>Rd</sup> ed., John wiley and sons,1984
2. Gowariker.V.R, Viswanathan.N.V. and Sreedhar.J, Polymer Science, 3<sup>rd</sup> ed., New age international Publishers, New Delhi.
3. Sharma.B.K, Polymer Chemistry, Goel Publishing House,
4. Odian, G., Prinicples of Polymerization,4<sup>th</sup> ed., John Wiley,2004

**ELECTIVE III**  
**a) ANALYTICAL CHEMISTRY**

**UNIT-1**(10 hrs)

Data Analysis-Theory of errors-idea of significant figures and its importance with examples-Precision-accuracy-methods of expressing accuracy-error analysis-minimizing errors methods of expressing precision-average deviation-standard deviation and confidence limit. Purification of solid compounds-extraction-use of immiscible solvents-soxhlet extraction Purification of liquids-experimental techniques distillation-fractional distillation-vacuum distillation-steam distillation-tests for purity.

**UNIT-2**(20 hrs)

Principles of gravimetric analysis-characteristics of precipitating agents- choice of precipitants and conditions of precipitation-specific and selective precipitants-DMG, cupferron, salicylaldehyde, ethylenediamine-use of sequestering agents-co-precipitation- post precipitation-peptisation-differences-reduction of error-precipitation from homogeneous solutions-calculations in gravimetric methods-use of gravimetric factor.

Thermal analytical methods-Principle involved in thermogravimetric analysis and differential gravimetric analysis-discussion of various components with block diagram-characteristics of TG and DTA-factors affecting TGA and DTA curves-Thermometric titrations.

Chromatography techniques-principles-adsorption, partition and ion exchange chromatography, column chromatography-adsorbents-preparation of column-elution, recovery of substance and applications. TLC-choice of adsorbent and solvent- preparation of chromatogram(R<sub>f</sub> value) and applications-paper chromatography-solvents use-factors affecting R<sub>f</sub> value-separation of amino acid mixtures.

**UNIT-3**(15 hrs)

Definition of spectrum-electromagnetic radiation-quantisation of different forms of energies of molecules-translational, vibrational, rotational, vibrational and electronic energies.

UV-visible spectroscopy-absorption laws-theory-electronic spectra-types of electronic transitions-chromophores and auxochromes-absorption bands and intensity-factors governing absorption maxima and intensity-instrumentation

IR spectroscopy-vibrations of diatomic molecules-harmonic and anharmonic oscillators, zero point energy, force constant, condition for a molecule to be IR active, selection rules-instrumentation.

**UNIT-4**(15 hrs)

NMR spectroscopy-principle-equivalent and non equivalent protons-shielded and deshielded protons, chemical shift-TMS, delta tau scales , spin-spin coupling-analysis of spectrum of ethanol-instrumentation

Mass spectrometry:

Basic principles of mass spectrum Instrumentation and block diagram molecular ion peak, base peak, isotopic peak, fragmentation – Nitrogen rule-determination of molecular formulae-fragmentation and mass spectrum of simple organic compounds-alcohols and carbonyl compounds-McLafferty rearrangement.

#### **UNIT-5(15 hrs)**

Polarography-principle-concentration polarization-dropping mercury electrode-advantages and disadvantages-migration and diffusion currents-Ilkovic equation (derivation not required) and significance-experimental assembly-electrodes-capillary-current voltage curve-oxygen wave-influence of temperature and agitation on diffusion layer-polarography layer-polarography as an analytical tool in quantitative and qualitative analysis. Amperometry-basic principles and uses.

#### **References**

1. Gopalan R., Rangarajan K., and Subramanian P.S., elements of analytical chemistry , 3<sup>rd</sup> ed. Reprint, sultan chand & sons, 2013.
2. Skoog D.a., West D.M., James Holler F. and Stanley R., Fundamentals of Analytical chemistry, 9<sup>th</sup> edition 2013.
3. Khopkar S.M., Analytical chemistry, New Age International.

## **SPECTROSCOPY**

### **UNIT – I (15 HRS)**

Definition of spectrum- Electromagnetic radiation – Quantization of different forms of energies in molecules (translational , rotational, vibrational and electronic) – Born Oppenheimer approximation. Microwave spectroscopy – Theory of microwave spectroscopy – Selection rule – Calculation of moment of inertia and bond length of diatomic molecules.

### **UNIT – II (15 HRS)**

UV – Visible spectroscopy – Absorption laws. Calculations involving Beer – Lambert’s law – instrumentation – photo calorimeter and spectrophotometer – block diagrams with description of components – theory – types of electronic transitions – Chromophore and auxochromes – absorption bands and intensity – Factors governing absorption maximum and intensity.

### **UNIT – III (15 HRS)**

IR Spectroscopy – principle – Modes of vibration of diatomic, triatomic linear (CO<sub>2</sub>) and non linear triatomic molecules (H<sub>2</sub>O) – Stretching and bending vibrations – Selection rules. Expression for vibrational frequency (derivation not needed) – instrumentation – Sampling techniques application of IR spectroscopy – interpretation of the spectra of alcohols , aldehydes, ketones and esters – Aliphatic and aromatic. Hydrogen bonding.

Raman spectroscopy: Rayleigh and Raman Scattering, Stokes and anti-Stokes lines . Difference between Raman and IR. Spectroscopy. Rotational Raman spectra of NonCentrosymmetric molecules (HCl). Mutual exclusion principle (CO<sub>2</sub> and NO<sub>2</sub>) Instrumentation .

#### **UNIT – IV (15 HRS)**

NMR Spectroscopy principle of nuclear magnetic resonance – basic instrumentation – number of signals – chemical shift – shielding and deshielding. Spin – Spin coupling and coupling constants. TMS as NMR standard. Interpretation of proton NMR Spectroscopy of simple organic compounds such as ethanol, acetone, benzaldehyde, ethyl acetate, ethylamine, ethyl bromide, Toluene and isopropyl phenyl ketone.

#### **UNIT – V (15 HRS)**

Mass spectroscopy - Basic principles instrumentation – molecular ion peak, base peak, metastable peak, isotopic peak their uses. Fragmentation – Nitrogen rule – determination of molecular formulae – mass spectrum of simple organic compounds – identification – alcohols, aldehydes, aromatic hydrocarbons. Interpretation of mass spectra of simple organic compounds such as Ethanol, Acetone, Anisole, Benzaldehyde, Ethyl acetate, Ethylamine, Ethyl bromide, Toluene and Isopropyl Phenyl Ketone. McLafferty Rearrangement.

#### **REFERENCE BOOKS:**

1. Gopalan R., Rangarajan K., and Subramanian P.S., elements of analytical chemistry , ed. S.Chand & sons, 2013.
2. Chatwal Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House-(2000).
3. William Kemp, Organic Spectroscopy, 3<sup>rd</sup> ed., Palgrave Macmillan, 2008.
4. Singh P.R and Dikshit S.K., Molecular Spectroscopy, S. Chand & Company Pvt Ltd., New Delhi.
5. Donald L.Pavia, Introduction to Spectroscopy, 4<sup>th</sup> ed., Cengage Learning, 2015.