

**Madurai Kamaraj University**  
*(University with Potential for excellence)*  
**NEW SYLLABUS - B.Sc. CHEMISTRY**  
**DIRECTORATE OF DISTANCE EDUCATION**  
**(Non-semester)**  
**(Effective from the academic year 2013 – 2014 onwards)**

**Eligibility for Admission :**

Passed in Higher Secondary Course, and other examination accepted by the Syndicate as equivalent.

**Duration of the course :** B.Sc. Chemistry – 3 years

**OBJECTIVES OF THE COURSE :**

1. To enable the students to understand the knowledge of chemistry.
2. To acquire skills in the field of life oriented, application oriented and job oriented chemistry.
3. To develop various skills in the field of chemistry which will enable the students to get a job.
4. To acquire basic knowledge of organic reaction mechanisms.
5. To develop skill in titrimetric analysis.

**Scheme of Examination**

**Course : B.Sc.**

**Subject : Chemistry**

**Medium: English**

**Passing minimum : 35 marks**

**I Year**

- |  |                     |
|--|---------------------|
| 1. Inorganic, Organic and Physical Chemistry – I | 100 marks : 3 hours |
| 2. Inorganic semi micro qualitative analysis     | 100 marks : 3 hours |

**II Year**

- |   |                     |
|---|---------------------|
| 1. Inorganic, Organic and Physical Chemistry - II | 100 marks : 3 hours |
| 2. Applied chemistry                              | 100 marks : 3 hours |
| 3. Volumetric analysis                            | 100 marks : 3 hours |
| 4. Environmental studies                          | 100 marks : 3 hours |

**III Year**

- |   |                     |
|---|---------------------|
| 1. Inorganic Chemistry                      | 100 marks : 3 hours |
| 2. Organic Chemistry                        | 100 marks : 3 hours |
| 3. Physical Chemistry                       | 100 marks : 3 hours |
| 4. Organic analysis and organic estimations | 100 marks : 6 hours |

5. Physical Chemistry practicals

100 marks : 6 hours

**Question pattern**

- Part – A**      **Answer all questions**      **(No choice)**      **2 x 10 = 20**
1. Unit I
  2. Unit I
  3. Unit II
  4. Unit II
  5. Unit III
  6. Unit III
  7. Unit IV
  8. Unit IV
  9. Unit V
  10. Unit V
- Part – B**      **Answer all questions - either (a) or (b)**      **7 x 5 = 35**
1. Unit I a      (or)      Unit I b
  2. Unit IIa      (or)      Unit II b
  3. Unit III a      (or)      Unit III b
  4. Unit IV a      (or)      Unit IV b
  5. Unit V a      (or)      Unit V b
- Part – C**      **Answer ANY THREE questions**      **3 x 15 = 45**
1. Unit I
  2. Unit II
  3. Unit III
  4. Unit IV
  5. Unit V

**First Year Paper –1**  
**In-organic, Organic and Physical Chemistry -I**  
**Organic Chemistry**

**UNIT I :**

1. Nomenclature: IUPAC nomenclature – rules for naming organic compounds – structure of organic compound from its IUPAC name.
2. Factors influencing electron availability: Inductive effect, Electromeric effect, Resonance effect, Mesomerism, hyperconjugation, steric effect.
3. Halogen derivatives of aliphatic hydrocarbons:
4. Alkyl halides - Halogenation of alkanes – free radical mechanism. Mechanism of substitution –  $S_N1$  and  $S_N2$  – stereochemistry – reactivity rearrangement of carbonium ion,  $E_1$  and  $E_2$  mechanism – orientation reactivity, Hofmann and Saytzeff rules, Elimination Vs Substitution.
5. Polyhalogen derivatives - Chlorofluorocarbons – Westron and Fireon – preparation and application.
6. Unsaturated hydrocarbons – Alkenes:  
Reactions of alkenes – hydrogenation, stability of alkenes, addition of HX regio-selective reactions and addition of HBr – peroxide effect. Electrophilic addition – mechanism, addition of halogens, polymerization, oxymercuration, hydroboration. Hydroxylation – Alkaline  $KMnO_4$ ,  $OsO_4$ , Ozonolysis.
7. Halogen derivatives - Vinyl chloride, allyl chloride, allyl iodide and chloroprene – preparation and uses.
8. Alkadienes and alkynes :
  - (i) Alkadienes – preparation, structure, properties, stability of conjugated dienes. Electrophilic addition to conjugated dienes (1,2 and 1,4 addition) - Free radical polymerization (rubber).
  - (ii) Alkynes – preparation, properties and uses.
9. Aromatic hydrocarbons: Benzene – structure, stability, aromatic character, Huckel's rule, nomenclature of benzene derivatives.
  - (i) Aromatic halogen compounds:
  - (ii) Preparation, properties and uses of chlorobenzene.
  - (iii) Preparation, properties and uses of nuclear and side chain halogen compounds of toluene. Distinction between nuclear and side chain halogen compounds. D.D.T.

**UNIT II:**

1. Aromatic Substitution :
  - (i) Aromatic Electrophilic substitution I:  
Introduction – effect of substituents – determination of orientation – determination of relative reactivity – orientation in disubstituted benzenes – orientation and reactivity .
  - (ii) Aromatic Electrophilic substitution II:  
Mechanism of aromatic – monosubstitution – halogenations, nitration, sulphonation and Friedal Craft's reactions.
  - (iii) Aryl halides:  
Nucleophilic aromatic substitution, unimolecular, bimolecular displacement,  $S_NAr$  mechanism, elimination.

2. Hydroxy compounds:

- (i) Alcohols - Classification with suitable examples. Preparation, properties and uses of ethanol, glycol and glycerol.
- (ii) Unsaturated monohydric alcohols – vinyl alcohol, allyl alcohol – preparation, properties and uses.
- (iii) Estimation of number of hydroxyl groups.

3. Phenols:

- (i) Nomenclature, physical properties, effect of substituents on acidity of phenols.
- (ii) Mechanism of Kolbe's reaction, Reimer-Tiemann reaction. Fries rearrangement – Tests for phenol.
- (iii) Nitrophenols – picric acid only, preparation, properties and uses.
- (iv) Dihydric phenols-catechol, resorcinol and quinol – preparation, properties and uses.
- (v) Trihydric phenols – pyrogallol, phloroglucinol and hydroxyl quinol – preparation, properties and uses.
- (vi) Aromatic alcohol – Benzyl alcohol – preparation, properties and uses. Distinction between phenol and benzyl alcohol.

4. Ethers:

- (i) Aliphatic ethers – classification – preparation, properties and uses of diethyl ether, Zeisel's method of estimation of alkyl groups.
- (ii) Aromatic ethers – preparation of anisole, phenetole and diphenyl ethers.

5. Sulphur and phosphorus compounds:

- (i) Thioalcohols – preparation, properties and uses of ethyl mercaptan.
- (ii) Thioethers – preparation, properties and uses of mustard gas.
- (iii) Sulphonal – preparation and uses.
- (iv) Aromatic sulphonic acids – preparation, properties of benzene sulphonic acid and uses – Saccharin, Chloramine T and dichloramine T.
- (v) Ylides – Definition with examples, mechanism of Wittig reaction.

6. Polynuclear Hydrocarbons and their derivatives

i. Isolated systems

Preparation of diphenyl, Benzidine, diphenic acid and stilbene.

ii. Condensed systems

Naphthalene: Preparation – properties, uses and structure of naphthalene.

Derivatives of naphthalene – preparation, properties and uses of naphthylamines, naphthols and naphthaquinones.

**UNIT III : INORGANIC CHEMISTRY**

1. Theory of qualitative analysis :

Principle and techniques of semi micro methods – Aims of semi micro qualitative analysis – Types of reactions involved in qualitative analysis – Dry reactions – Precipitation reactions – Applications of solubility product principle in qualitative analysis – Complexation reactions – Oxidation and Reduction reactions. Spot tests – Preparation of solutions for cation testing on semi micro scale. Removal of interfering ions in the analysis of cations – oxalate, tartarate, borate, fluoride, chromate, phosphate, arsenite.

2. Hydrogen:  
Position in the periodic table – hydrides – preparation, properties and uses.
3. Oxygen: Oxides and their classification.  
Hydrogen Peroxides: Preparation, properties and structure – estimation – problems on estimation.
4. Ozone: Preparation, properties and structure.
5. Water: Hard water – water softening – water pollution.
6. Basic principles of metallurgy – Froth floatation – magnetic separation – gravity separation – smelting – Roasting – flux – Calcination – purification – Electrolytic refining – zone refining – Van Arkel de-Boer process – Alumino thermite process.
7. Group IA elements: Group Discussion
  - (i) Lithium: Diagonal relationship with magnesium and comparison with other members of the family – justification of its position – Extraction, properties and uses.
  - (ii) Lithium compounds: Peroxide, carbonate, bicarbonate and carbide of Lithium.
  - (iii) Group I B coinage metals – group discussion – copper – ores, extraction, properties and uses. Alloys and their applications.
8. Group IIA Elements: Group Discussion  
Beryllium: Diagonal relationship with Aluminium and comparison with magnesium – justification of its position – Extraction – properties and uses.

#### **UNIT IV : PHYSICAL CHEMISTRY**

##### 1. Gaseous State:

Ideal gas laws – deviations – limiting Density of gases – van der Waals equation. Equation of state – Clausius. Berthelot and Dieterici – Reduced equation of state and the Law of corresponding states – compressibility factor for gases – Boyle and inversion temperatures of gases and their calculations – Determination of van der Waals constants.

##### 2. Critical phenomena of gases:

PV – Isotherms of real and van der waals gases. Critical state of gases – Definitions and determination of the critical constants – relation between van der waals constants and critical constants.

#### **UNIT V:**

##### 1. Kinetic theory of gases:

Maxwell – Boltzmann Law of distribution of molecular velocities – Derivation – graphical representation. Experimental verification of Maxwell Velocity distribution – Mean free path – viscosity of gases. Frequency or collision number. Brownian movement and determination of Avogadro Number – Loschmidt Number. Principle of Equipartition of energy.

##### 2. Liquid state:

Nature of cohesive forces in liquids – Vapourisation of liquids and their characteristics – Trouton's rule and its significance – Additive properties and

chemical constitution. Molar volume and its applications to isomeric compounds of similar constitution. Surface Tension – Influence of temperature on surface Tension – Parachor – Atomic and Structural Parachors – applications with suitable examples.

Viscosity – Influence of Temperature on viscosity – relation to chemical constitution – molecular viscosity – atomic and structural viscosities – Rheochor. Refraction – Refraction Index specific refractive index – Molar, atomic and structural refractions – Applications. Liquid crystals – Theory of different types of liquid crystals – their applications.

### **Reference**

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania; VISHAL PUBLISHING Company, 2008.
2. Textbook of Physical Chemistry, P.L. Sony, O.P. Dharmarha and U.N. Dash; Sultan Chand and Sons; (2006).
3. Organic Chemistry, G. D. Tuli, P. L. Soni; Edition 7, Premier Publishing Company.
4. Textbook of Organic Chemistry, B.R. Puri, H.M. Chawla; VISHAL PUBLISHING Company, 28th Edition.
5. Principles of Inorganic Chemistry by B.R. Puri and L.R. Sharma.
6. Inorganic Chemistry by P.L. Soni, 20th Edition 2000.
7. Practical Chemistry by O.P. Pandey, D.N. Bajpai, S. Giri. Publisher, S. Chand Limited,

### **Paper -2      Inorganic Semi-micro qualitative analysis**

Analysis of a mixture containing two anions of which one is an interfering anion – and two cations (semi micro method).

**I. Anion** : carbonate, sulphate, nitrate, chloride, bromide, oxalate, borate and phosphate.

**II. Cation** : ammonium, lead, bismuth, copper, aluminium, zinc, manganese, cobalt, nickel, barium, calcium, magnesium.

Maximum marks : 100

Passing minimum : 35

Distribution of marks

Record = 10 marks

Viva voce = 10 marks

20 x 4 radicals = 80 marks

## II Year - PAPER - 1

### INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY-II

#### UNIT I :

##### 1. Theoretical Basis of experimental organic chemistry:

- (i). First aid to be given for (i) burns, (ii) spilling of acids, alkalis, bromine and phenol.
- (ii). Principle and outline of the procedure adopted in i) column chromatography, ii) paper chromatography, iii) thin layer chromatography.

##### 2. Aliphatic aldehydes and ketones:

- (i) General methods of preparation and properties of aldehydes and ketones – Iodoform reactions and its significance – Distinction between aldehydes and ketones.
- (ii) Unsaturated aldehydes: acrolein, crotonaldehyde – preparation, properties and uses.
- (iii) Halogen substituted aldehydes – chloral – preparation stability of chloral hydrate.
- (iv) Hydroxyaldehyde and ketones – Glycolaldehyde, aldol, hydroxyl acetone and diacetone alcohol – preparation.
- (v) Dialdehydes and diketones – Glyoxal, succinaldehyde, dimethylglyoxal, acetylacetone preparations.

##### 3. Aromatic aldehydes and ketones:

- (i) Benzaldehyde: preparation, properties and uses of benzaldehyde. Mechanism of Cannizaro, Perkin, Claisen, Knoevenagel reaction and Benzoin condensation.
- (ii) Unsaturated aldehyde – cinnamaldehyde – preparation and properties.
- (iii) Phenolic aldehydes – vanillin – preparation and uses.
- (iv) Ketones – acetophenone, benzophenone – preparation by Friedel Crafts acylation – properties – Distinction between acetophenone and benzophenone.
- (v) Diketones – preparations and properties.
- (vi) Phenolic ketones – Phloroacetophenone – preparation by Houben – Hoesc synthesis.

#### UNIT II:

##### 1. Halogens:

- (i) Fluorine: Difficulties in isolation – isolation of fluorine – distinction from others.
- (ii) Chlorine: Oxides and oxyacids – bleaching powder – Estimation of available chlorine –  
manufacture – structure – properties and uses.
- (iii) Bromine: Oxides and Oxy-acids.

- (i) Iodine: Oxides and oxy-acids – periodic acid – basic iodine – comparative study of halogens – Interhalogen compounds – polyhalides – pseudohalogens.
  - (ii) Solubility of ionic compounds – Energies of formation of ionic compounds – Lattice energy, Born-Landé equation – Born-Haber cycle – Fajan's rule – van der Waals forces – ion-ion, ion-dipole interaction – Hydrogen bonding – intermolecular – intramolecular – theory and applications.
  - (iv) Ores – Occurrence – Extraction of the following metals, Titanium, Thorium, Molybdenum, vanadium, cobalt and platinum. Their important alloys and applications.
  - (v). Various oxidation states of vanadium – preparation and uses of  $\text{TiO}_2$ ,  $\text{ThO}_2$ , ammonium molybdate,  $\text{V}_2\text{O}_5$ , sodium-cobaltinitrate and chlorophloric acid.
2. Atomic structure and Wave mechanics :
- Particle and wave character of electron – de Broglie's theory – equation – Davisson – Germer experiment – photo electric effect – Compton effect – Heisenberg's uncertainty principle – The Schrodinger wave equation – Derivation – postulates of quantum theory – Eigen values and eigen functions – significance of  $\Psi$  and  $\Psi^2$  – solutions of Schrodinger equation for a simple system – particle in a box – quantum numbers. Zeemann effect – Pauli exclusion principle – Atomic orbitals – probability distribution curves – Radial probability distributions – shapes of orbitals – presentation of angular and radial parts – nodal planes and spheres –  $g$  &  $u$  character – filling up of orbitals – Aufbau Principle - Hund's Rule – Electronic configurations of the elements.
3. Chemical bonding
- 1. Valence bond theory – overlap of orbitals – viz.  $s$ - $s$ ,  $s$ - $p$  and  $p$ - $p$  orbitals – Sigma and Pi bonds – Hybridisation of orbitals  $sp$ ,  $sp^2$ ,  $sp^3$ ,  $dsp^3$  and  $d^2sp^3$  with suitable examples – shapes of such molecules – VSEPR theory.
  - 2. Molecular orbital theory – applied to  $\text{H}_2$  and He molecules – MO Diagram for simple homonuclear ( $\text{O}_2$ ,  $\text{F}_2$ ,  $\text{H}_2$  and  $\text{Cl}_2$ ) and heteronuclear ( $\text{HCl}$ ,  $\text{HF}$ ,  $\text{CO}$  &  $\text{NO}$ ) molecules – Bond order. Difference between valence bond and molecular orbital methods.

### UNIT III:

#### 1. Group V

- (i) Nitrogen: Active nitrogen – Hydrides of nitrogen.
  - a. Ammonia – manufacture with the principles involved – properties – uses.
  - b. Hydrazine – preparation – properties – uses – structure.
  - c. Hydrazoic acid - preparation – properties – uses – structure – Azides and their uses. Nitrosyl chloride, hydroxyl amine, nitramide, oxides of nitrogen – Fixation of nitrogen – Manufacture of nitric acid on metals and non-metals.
- (ii) Arsenic: Extraction – allotropy – Arsine – oxides and oxy acids – Distinction between the various salts of oxy acids.
- (iii) Antimony: Extraction – properties – uses Antimony oxide – trichloride – Tartar emetic – potassium pyroantimonate.
- (iv) Bismuth: Extraction – properties – uses – alloys Bismuth trioxide, trichloride – sodium bismuthate.



- (v) Ores – Extraction, properties – uses of Selenium, Tellurium, tungsten and uranium.

## 2. Solid State

Crystallography: Definition – unit cell, face and edge of a crystal interfacial angle, crystal lattice – lattice energy. Laws of crystallography: Law of constancy of interfacial angle

Law of rationality of indices. Law of symmetry – Symmetry elements – plane, axis and centre of symmetry. Crystallographic systems: Bravais lattices – simple, cubic, face centered cubic and body centered cubic.

### 3. Application of X-rays to the study of crystal structure

- (i) Bragg's equation – Determination of interplanar distance and wave length of X-rays.
- (ii) Types of Crystals: Ionic, Molecular, covalent and metallic crystals.
- (iii) Ionic Crystals: Analysis of sodium chloride, potassium chloride and caesium chloride – Determination of Avogadro number.
- (iv) Molecular Crystals: Water and Ammonia.
- (v) Covalent Crystals: Diamond and graphite.
- (vi) Metallic Crystals: Metallic bond in metals.
- (vii) Cohesive energy in ionic crystals: Nature of binding forces in crystals – ionic, covalent, van der Waals and hydrogen bonds.
- (viii) Conductors, insulators and semi-conductors.

## UNIT IV:

### 1. Physical properties and chemical constitutions

Constitutive properties

- (i) Dipole moment: Definition – Experimental determination – moments of linkages and groups – various applications.
- (ii) Magnetic properties: Magnetic susceptibility – Para, dia and ferro magnetic – specific molar magnetic susceptibility and constitution – Determination by Gouy's method.

### 2. Nuclear Chemistry

- (i) Constitution of the nucleus - stable and unstable nuclei and their relationship to (n-p) ratio – magic number – Mass defect and binding energy – whole number rule and packing fraction – mass energy relationships.
- (ii) Radioactivity - Natural Radioactivity: Detection and Measurement of Radioactivity – principles of detection and measurement of radioactivity laws of Radioactivity – Soddy's group displacement law radioactivity equilibrium rate of radio active disintegration – Half-life period – average life. Radioactivity series – modes of decay – alpha, beta and gamma and orbital electron capture – nuclear isomerism and internal conversion.
- (iii) Artificial Radioactivity: Definition – Different types of artificial radio activity brought about by accelerated particles - Artificial Transmutation– spallation.

- (iv) Nuclear fission and fusion: Theories of fission – application of fission and the principle of Atom Bomb – Nuclear fusion and emission of energy stellar energy and Hydrogen bomb.
- (v) Application of Radioactivity: Applications in medicine, agriculture and industry – as tracer elements in the elucidation of structure and in the investigation of reaction mechanisms in analytical chemistry – activation analysis – carbon dating.
- (vi) Particle Accelerators: Linear accelerator – Cyclotron and Synchrotron.

## UNIT V:

### 1. Chemical Equilibrium

Reversible and irreversible reactions – statement and mathematical formulation of the law of Mass action – Derivation of the law of Mass action from Kinetic theory – verification  $K_p$  and  $K_c$  and their relationship – Factors influencing an equilibrium – variation of  $K$  with temperature – van't Hoff isochore (no derivation).

Application of the law of Mass action to the following equilibria – HI,  $\text{PCl}_5$  –  $\text{NH}_3$ ,  $\text{SO}_3$ , NO,  $\text{N}_2\text{O}_4$ , ethylacetate, dissociation of  $\text{NH}_4\text{SH}$ , calcium carbonate and Salt Hydrate.

### 2. Le-Chatelier's principle

Statement – Application to the above equilibria and the following equilibria – solubility of gases in liquids and solids in liquids – pressure on the melting point of a solid with a specific volume lower and higher than that of liquid.

### 3. Phase Rule

Statement and significance of the terms involved – Derivation of Phase Rule.

- (i) Application of phase rule to One component systems. Water, Sulphur and  $\text{CO}_2$ .
- (ii) Application of phase rule to Two component systems.

### 4. Solutions

Gases in liquids – Bunsen absorption coefficient – solubility – factors affecting the solubility of gas in a liquid- Henry's law and its applications – Derivations from Henry's law.

### 5. Liquids in liquids

#### (i) Completely miscible liquid systems

Ideal and non-ideal systems – Raoult's law and Konowaloff's rule – Distillation of homogeneous binary liquid mixtures – Theory of fractional distillation and azeotropic distillation.

#### (ii) Partially miscible liquid systems

Variation of solubility with temperature – Critical solution temperature (consolute temperature); lower, upper and lower and upper critical solution temperature – influence of impurities on C.S.T and applications.

#### (iii) Immiscible liquid systems

Theory of Steam distillation and its applications.

### 6. Condensed Systems and Reduced Phase Rule

Reduced Phase Rule – Statement and reasons.

#### (i) Solids in solids: simple Eutectic, with suitable examples.

#### (ii) Compound formation with congruent and incongruent melting points with suitable examples.

(iii) Freezing point curves of solid solutions with suitable examples.

7. Two components systems involving salt and water

(i) Simple Eutectic systems: Sodium chloride – Water and KI – Water systems – production of Freezing mixtures.

(ii) Compound formation with a congruent melting point. Ferric chloride – Water and sodium sulphate – Water systems.

(iii) Salt Hydrates – Efflorescence deliquescence and hygroscopy – Dehydration of copper sulphate crystals.

8. Gas – Solid systems

Dissociation of calcium carbonate and ammonium hydrosulphide.

9. Distribution Law

Statement – Mathematical formulation – experimental verification – condition under which the distribution law is obeyed – Deviations from the distribution law – Derivation from the Kinetic theory and applications of the law.

### **Reference**

1. Advanced Inorganic Chemistry by Satya Prakash, Edition 17.
2. Modern Inorganic Chemistry by R.C. Agarwal
3. Inorganic Chemistry by P.L. Soni
4. Inorganic Chemistry by G.C. Shivhare and V.P. Lavania
5. A Text Book of Organic Chemistry by M.K. Jain
6. A Text Book of Organic Chemistry by R.K. Bansal
7. Physical Chemistry, Bahl and Tuli, S. Chand & Co.(P) Ltd.
8. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.
9. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.

## **PAPER-2 - APPLIED CHEMISTRY**

### **UNIT I**

1. Water Quality Analysis - Chemical and physical analysis of water quality parameters - Standards prescribed for water quality by WHO and other Indian Standards. Sea water as a source of drinking water - Electrodialysis method and reverse osmosis method for purifications of water.

2. Sewage Treatment - Municipal waste water - Sewage treatment - Aerobic and anaerobic Process - Miscellaneous method of sewage treatment.

3. Preparation of domestically useful chemical products - Washing Powder - Cleaning powder - Phenols (White, Black and Colored) Shampoo, Liquid Blue, Blue, Red and Green Inks, Soap Oil, Face Powder, Bleaching Powder.

### **UNIT-II**

1. Insecticides and Pesticide - Definition - classification Inorganic pesticides; lead arsenate, Paris green, lime, sulphur, hydrocyanic acid- organic pesticides, (DDT and Gammexane) Fungicides - repellants.

2. Fertilizer - Definition - nutrients for plant - role of various elements in plants growth natural and chemical fertilizers - classification of chemical fertilizers -urea, super phosphate and potassium nitrate - mixed fertilizer industry in India.

3. Petrochemicals - Elementary study - Definition - Origin - Composition - Chemical from natural gas, petroleum, light Naphtha and Kerosene - Synthetic Gasoline.

### **UNIT-III**

Paper Technology - Introduction, Manufacture of Pulp, various raw materials used for the preparation of Pulp. Preparation of Sulphite Pulp, Soda Pulp, Rag Pulp. Various Processes: Beating Refining, Filling sizing and colouring. Manufacture of paper, calendaring, uses.

### **UNIT-IV**

Sugar Chemistry - Sugar Industry in India- Sugarcane and Sugar Beet - Manufacture of Cane Sugar. Extraction of Juice- Concentration - Separation of crystals - Recovery of glucose from molasses defecation. Sulphitation and carbonation- Testing and Estimation of Sugar. Double Sulphitation process.

Preparation of Bagasse - Use of Bagasse for manufacture of paper and electricity - Preparation of Alcohol from Molasses - Preparation of Absolute Alcohol Manufacture of Wine, Beer, Methylated spirit - Power Alcohol.

### **UNIT-V : Pharmaceutical Chemistry**

1. Chemotherapy and Application of a few drugs.

- i. Sulpha drugs - Sulphadizine, Prontosil.
- ii. Antimalarials-Quinine and its derivatives.
- iii. Arsenical drugs-Salvarsan - 606 and neosalvarsan.
- iv. Antibiotics - Definition - Penicillin - Tetracycline - Streptomycin and chloromycetin Drug action.

2. Anesthetics

Gaseous anesthetics - Vinyl ether, Cyclopropane, Chloroform, Trichloroethylene – Intra-venous anesthetics - Thiopentone, local anesthetics - Cocaine and its derivative.

### **Paper –3 Volumetric Analysis – List of experiments**

A double titration involving the making up of the solution to be estimated and the preparation of a primary standard.

#### **I. Acidimetry & alkalimetry**

- i. Estimation of  $\text{Na}_2\text{CO}_3$
- ii. Estimation of  $\text{NaOH}$
- iii. Estimation of oxalic acid

## II. Redox Titration

- i. Estimation of ferrous ion
- ii. Estimation of oxalic acid

### Distribution of marks

Maximum marks : 100

Passing minimum : 35

Record = 10 marks

Viva voce = 10 marks

Procedure writing = 10 marks

Result = 60 marks

Error 1 – 2 % = 60 marks

2 – 3 % = 50 marks

3 – 4 % = 40 marks

4 – 5 % = 30 marks

>5 % = 15 marks

## III Year Paper – I Inorganic Chemistry

### Unit I

#### (i) Carbon

Preparation, properties, uses and structure of hydrogen cyanide, carbonyl chloride, carbon disulphide and cyanogen.

Carbides – classification with examples and uses.

#### (ii) Silicon

Preparation, properties, uses and structure of silicon tetrachloride, hydrofluosilicic acid, silicates, silicones and silanes.

#### (iii) Fluorine

Difficulties in isolation – Manufacture by modern method – Oxides of fluorine – Distinction from other halogen.

#### (iv) Chlorine

Oxides of chlorine – Bleaching powder, manufacture by Bachmann's process – properties, uses and constitution – Estimation of available chlorine.

#### (v) Iodine - Basic iodine.

#### (vi) Inter halogen compounds – polyhalides – pseudohalogens.

## Unit II

- (i) Important ores of the following metals and extraction from them – Titanium, Thorium, Molybdenum, Vanadium, Platinum and Uranium.
- (ii) The important oxidation states of the above metals with reference to their oxides and other compounds – their preparation and uses.
- (iii) The important alloys and uses of the above metals.
- (iv) Bioinorganic chemistry  
Role of metal ions in biological systems. Metalloporphyrins – Vitamin B -12, Chlorophyll. Haeme protein – elementary idea only.

## Unit III Co-ordination Chemistry

- (i) Nomenclature - IUPAC system.
- (ii) Isomerism : Structural isomerism – Various types of stereoisomerism (Geometrical and optical ) with examples.
- (iii) Werner theory – Sidgwick theory – EAN rule.
- (iv) Valence bond theory  
Assumptions – Application to octahedral, tetrahedral and square planar complexes of transition metals (like Fe, Co, Ni, Cu and Pt), and their magnetic properties – Limitations.
- (v) Crystal field theory  
Salient features – Application to octahedral, tetrahedral and square planar complexes with splitting of d orbitals and crystal field stabilization energies – Application of CFT, comparison between VBT and CFT.

## Unit IV

- (i) Concept of acids and bases - Bronsted & Lowry, Lewis, Lux flood and Usanovich concepts – Levelling effect and differentiating solvents – Non-aqueous solvents. Reactions in liquid ammonia.
- (ii) Solubility of ionic compounds – Lattice energy, Born–Lande equation – Born–Haber cycle – Fajan’s rule. Van der Waals forces - Types : Dipole-dipole, ion-dipole, dipole-induced dipole and instantaneous dipole-induced dipole interactions – Hydrogen bonding – conditions – Types : Inter and intra molecular hydrogen bonding - Applications - Metallic bond.

## Unit V

- (i) Error analysis  
Definition of absolute and relative errors – Precision and accuracy – Classification of errors – Determinate and indeterminate errors – Determination of accuracy of methods – Sources and minimization of errors – significant figures and computation.

(ii) Theory of analytical chemistry

Formation of precipitates – Specific and selective precipitants – Types of precipitates : Crystalline – Post precipitation – Adsorption – precipitation. Sequestration and sequestering agents in analytical chemistry – EDTA titration.

### III Year - Paper – 2 - Organic Chemistry

#### Unit- I

1. Stereoisomerism - kinds of stereoisomerism. Geometrical isomerism: E – Z system of nomenclature. Geometrical isomerism of aldoximes and ketoximes – determination of configuration by Beckmann rearrangement followed by hydrolysis. Optical isomerism.

2. Elements of symmetry – asymmetry - dissymmetry or chirality – chiral molecules – enantiomers – diastereoisomers. Configuration - specification of absolute configuration by R-S notation - Relative configuration & specification by D-L notation – Drawing the configurations (Fischer plane projection formulae) of D-and L-series of aldotetroses on the basis of D-and L –glyceraldehyde.

- i) Optical activity – cause of optical activity – specific rotation – determination of specific rotation.
- ii) Optical isomerism – definition – meso form – racemic form.
- iii) Racemisation – resolution of racemates - Walden inversion – Asymmetric synthesis.
- iv) Optical isomerism of compounds having chiral centres. Lactic acid, Tartaric acid, Quaternary ammonium compounds, tertiary amine oxides.
- v) Optical isomerism of compounds having chiral axes Allenes, Spirans, biphenyls.
- vi) Stereochemistry of certain addition reactions:
  - a) Stereospecific and stereoselective reactions. Two types of addition (syn and anti)
  - b) Addition of bromine to cis – and trans – 2 – butene, maleic and fumaric acids.
  - c) Addition of hydrogen bromide to and 2- butene
  - d) Hydroboration of but – 1 – ene and 1- methyl- cyclohexene.

3. Organic Photochemistry : Introduction;

Production, stability and reactivity of free radicals.

Photochemical reactions of olefins - photochemical cis – trans isomerisations - dimerisation.

#### Unit – II

1. Nomenclature, classification, preparation, properties, tests and use of :

- (i) Aromatic hydrocarbons : Benzene (structural elucidation) toluene, xylenes, mesitylene, styrene, naphthalene ( structural elucidation), anthracene (Structural

elucidation), phenanthrene (structural elucidation), diphenyl, diphenylmethane, triphenylmethane, Stilbene

(ii) Aryl halides: Chlorobenzene. Halogen compounds of toluene. Relative activity of alkyl, vinyl, allyl, aryl and benzyl halides. DDT.

(iii) Aromatic acids: Benzoic acid, toluic acids, phenylacetic acid, phthalic acid, isophthalic acid, terephthalic acid, cinnamic acid, mandelic acid, salicylic acid, diphenic acid, coumarinic acid, coumarin. Comparative study of aliphatic and aromatic acids.

(iv) Derivatives of aromatic acids :

i. Esters: methyl benzoate, methyl salicylate.

ii. Acid chlorides: benzoyl chloride.

iii. Acid anhydrides: Benzoic anhydride, phthalic anhydride. Amides: Benzamide, phthalimide.

(v) Aromatic nitro compounds: nitrobenzene, dinitro benzenes, nitro compounds of toluene, nitrophenols, nitroanilines, picric acid.

Aromatic amino compounds: aniline, toluidines, aminophenols, benzidine, naphthylamines, anthranilic acid.

Benzenediazonium chloride: synthetic applications. Aromatic sulphur compounds: benzenesulphonic acid p-toluenesulphonic acid, saccharin, chloramine-T, dichloramine-T.

Dyes – definition – classification.

Theory of colour and constitution.

Structure, preparation and application of the dyes

i) Methyl orange, Congo red, Bismark brown,

ii) Malachite green, Rosaniline, Crystal violet.

iii) Indigo

iv) Alizarin.

### Unit – III

#### 1. HETEROCYCLICS

i) Furan, thiophene, pyrrole : Method of numbering and nomenclature – manufacture of furan and pyrrole from furfural ; thiophene from n-butane – preparation of their nuclei from acetylene and 1,4 –dicarbonyl compounds – physical properties –structure - theory of electrophilic and nucleophilic substitutions on the basis of resonance – acidic / basic properties, reactions with acids & bases – reduction – oxidation – ring cleavage reactions - Diels-Alder reaction - polymerization and resinifications – halogenation, nitration, sulphonation, Friedel-Crafts reaction, reactions with organometallics, mercuration, formylation, reactions with diazonium compounds – Tests.

Comparative study : furan, thiophene , pyrrole ; thiophene and benzene, pyrrole and aniline pyrrole and phenol.

ii) Indole : method of numbering and nomenclature - synthesis from 2-nitrophenylacetic acid, Fisher-indole synthesis (mechanism) – physical properties –Structure –resonance- tautomerism – theory of substitution on the



- basis of resonance – reduction, oxidation, ring cleavage, acidic and basic properties, reactions with acids and bases, resinification – halogenation, nitration, sulphonation, mercuration, formylation, Mannich reaction.
- iii) Pyridine, quinoline and isoquinoline : Method of numbering and nomenclature – manufacture from coal tar. Preparation of pyridine from acetylene and pentamethylenediamine; quinoline by Skraup synthesis (mechanism); isoquinoline from cinnamaldehyde, Bischler – Napieralski reaction (mechanism) – physical properties -Structure - resonance – Theory of substitution on the basis of resonance - Basic properties, reactions with acids and alkyl halides – reduction, oxidation, ring cleavage reactions – halogenation, nitration, sulphonation – amination, hydroxylation, reactions with organometallic – Uses.
2. NATURAL PRODUCTS CHEMISTRY : Introduction – scope – importance of this branch in an agricultural country like India which also has a large reserve of medicinal plants.
3. Alkaloids: definition – occurrence – classification – general properties – physiological activity of coniine, nicotine, piperine, cocaine, atrophine, morphine.

#### UNIT-IV

##### 1. TERPENOIDS

Terpenoids / terpenes – definitions – reactions that led into isoprene rule – isoprene rule and special isoprene rule – classification - occurrence (general) isolation of essential oils and separation of mono and sesquiterpenoids – general properties - general methods of structural elucidation (D. 356-8) determination of number of rings using D.B.E. (D. 49).

Formulations of the following reactions and the inference derived upon the structure:

Conversion of citral to geraniol. Detailed study of occurrence, isolation, structural elucidation of : citral and menthol. Geometrical isomerism of citral and geraniol.

##### 2. STEROIDS

Sterols – definition – general structure – selenium dehydration

Cholesterol – occurrence – (structure elucidation – not required) – physiological functions.

Hormones – definition – classification of sex hormones and their functions.

Oestrone: synthesis from 6-methoxytetralone.

##### 3. CARBOHYDRATES.

Structures of alpha and beta D – glucopyranose ; alpha –and beta, D – fructopyranoses & furanoses, sucrose, maltose, amylase / amylopectin, cellulose – types of glycosidic linkages and selective hydrolysis by enzymes. Detailed structural elucidation (open chain formula, configuration ring structure, size of the ring) of glucose and fructose. A comparative study of the properties of glucose, fructose, sucrose and maltose and their uses.

Mutarotation – epimerization – interconversion among glucose and fructose – descent and ascent of the sugar series.

Properties and uses of starch and cellulose.

## UNIT- V

### 1. PROTEINS

Definition – classification – general properties and colour reactions – primary, secondary and tertiary structure. Enzymes and co-enzymes – their role in various biological processes – mechanism of enzyme action. Nucleic acid – nucleoside – nucleotide – RNA and DNA (General structure).

### 2. VITAMINS

Definitions. Vitamin B complex – names of various constituents – functions and deficiency diseases.

Vitamin A1 : synthesis from citral via beta – ionone.

### 3. ANTIBIOTICS

Chemotherapy – definition – definition and examples of drugs definition of antibiotics.

Penicillins – Structural elucidation of benzylpenicillin and its synthesis from phthalimide.

### 4. SPECTROSCOPY:

UV Spectroscopy: Introduction-origin of electronic spectra-Laws of absorbance. Types of electronic transitions- chromophores and auxochromes. Effect of conjugation. Applications of UV spectroscopy-Woodward-Fieser rules.

IR Spectroscopy: Principle - molecular Vibrations. Finger-print region. Applications of IR spectroscopy-Interpretation of IR spectra

NMR Spectroscopy: Introduction – Spinning of proton in a Magnetic field - various aspects of NMR spectrum-position of signals and chemical shift-Factors affecting Chemical Shift , Number of peaks in the NMR spectra - Equivalent and non-equivalent protons- Peak area and proton counting-splitting of signals. Interpretation of the NMR spectrum of simple compounds like ethanol, acetaldehyde etc..

Mass spectroscopy: Basic principles.

### References:

- A A text book of Organic chemistry – Arun Bhal and B.S.Bhal, S.Chand and Company.
- B Text book of Organic chemistry – Tewari
- C. ORGANIC CHEMISTRY VOL.1 (.I.Finar, ELBS Longman, V. Edn. (1975) Reprint (1982)
- D. ORGANIC CHEMISTRY, VOL.2, I.L. Finar ELBS/ Longman, V. Edn. (1975) Reprint (1982)
- E. STEREOCHEMISTRY, CONFORMATION AND MECHANISM, P.S.Kalsi, Wiley

Eastern Ltd., 11th Edn. (1993)

F. CHEMISTRY OF ORGANIC NATURAL PRODUCTS VOL.1-

O.P. Agarwal, Goel Publishing House, Meerut V. Edn. (1978).

G Elementary Organic Spectroscopy – Y.R. Sharma S. Chand and company,  
– Fourth edition.

### III Year - Paper – 3 Physical Chemistry

#### Unit – I

#### Chemical Kinetics

- a. **Introduction** – rate of reaction – rate law - rate constant and derivation of rate equation – order and molecularity of a reaction. First and Pseudo Unimolecular reactions. Catalytic decomposition of hydrogen peroxide – decomposition of dinitrogen pentoxide. Inversion of cane sugar and hydrolysis of ester by acid.
- b. **Second, third and zero order reactions** – examples – rate equation – half life period (no derivation required).
- c. Influence of temperature on the rate of reaction – Arrhenius rate equation and its significance – measurement of parameters. Theory of reaction rates: Bimolecular collision theory – Unimolecular reactions – Lindemann's hypothesis – Absolute Reaction Rate theory.

#### Unit – II

#### Photochemistry

- a. **Definition of photochemical reactions** – comparative study of thermal and photochemical reactions – laws of photochemistry – Lambert and Beer law – Grotthus – Draper law - Stark – Einstein law - quantum efficiency and its determination – consequence of light absorption by atoms and molecules – photophysical process – fluorescence, phosphorescence and other deactivating processes - Jablonski diagram. photosensitization- chemiluminescence- bioluminescence- applications of Photochemistry.
- b. **Photochemical process** - Kinetics of photochemical reactions.
  1. **Gaseous reactions:** Hydrogen – halogen reactions (formation of HCl, HBr and decomposition of HI)

#### Unit – III

#### Thermodynamics

- a. **First Law:** statement – mathematical formulation – internal energy – enthalpy or heat content – heat changes at constant volume and at constant pressure conditions – relationship between  $C_p$  and  $C_v$  – work done, heat change and enthalpy change for reversible isothermal expansion and compression of an ideal gas - calculation of  $q$ ,  $w$ ,  $\Delta E$ ,  $\Delta H$  for reversible adiabatic expansion of an ideal gas – relation between  $T$ ,  $V$  and  $P$  of an ideal gas undergoing adiabatic reversible expansion. Joule Thomson effect – Joule Thomson coefficient in the case of ideal and real gases – inversion temperature
- b. **Second Law of Thermodynamics:**

1. **Limitations of first law of thermodynamics** – spontaneous process – state of second law – conversion of heat into work – thermodynamic efficiency – Carnot's cycle – Carnot theorem.

2. **Entropy** – definition and significance – derivation of the concept of entropy – entropy changes in reversible and irreversible (spontaneous) processes.

3. **Free energy function** – Helmholtz free energy (A) – definition and its temperature dependence – Gibbs free energy (G) – definition, variation of Gibbs free energy with temperature and pressure. Gibbs – Helmholtz equation and its applications – criteria for reversible and irreversible processes in terms of entropy and free energy changes.

#### Unit – IV

#### Electrochemical Cells - I

- a. **Concept of electrochemical cells** – cell diagram and terminology – conventions regarding signs of cell e.m.f. – calculation of cell e.m.f. from single electrode potential – standard e.m.f. of the cell – Nernst equation.
- b. **Single electrode potentials** and cell e.m.f. measurement of single electrode potential – types of electrodes – reference electrodes – standard electrode potential – electrochemical series – experimental determination of cell e.m.f. – Weston cadmium cell.
- c. **Types of electrochemical cells:**
  1. Chemical cells with and without transference – examples liquid junction potential – salt bridge.
  2. Concentration cells – definition – types of concentration cells- examples – e.m.f. of electrolyte concentration cells with and without transference.
  3. **Commercial cells** – primary and secondary cells – dry cell – lead storage cell and fuel cells.
- d. **Applications of emf measurements.**
  1. Determination of solubility and solubility product of a sparingly soluble salt.
  2. Determination of pH using, glass electrode and Quinhydrone electrode.
  3. Potentiometric titrations.

#### Unit – V

#### Spectroscopy

- a. **Introduction** – electromagnetic radiation – different regions – absorption spectroscopy - molecular spectra – types of molecular spectra.
- b. **Rotational spectra of diatomic molecules** – rigid rotator – selection rule – determination of moment of inertia and bond length – intensities of spectral line.
- c. **Vibrational spectra** – IR spectra of diatomic molecules – Hooke's law – simple harmonic oscillator force constant – selection rule – vibrational energy level diagram – anharmonic oscillator – applications – force constant determination. Modes of vibration in polyatomic molecules – vibrational spectra of H<sub>2</sub>O and CO<sub>2</sub>.

- d. Rotational vibrational spectra of diatomic molecules.
  - e. **Raman spectra** – Raman effect – stokes and anti stokes lines – quantum theory of Raman effect – experimental study – comparison between IR and Raman spectra – applications of Raman spectra.
  - f. **Electronic spectra** – Franck – Condon principle.
- Nuclear magnetic resonance spectroscopy** – principle, instrumentation – interpretation of NMR spectra – spectra of ethanol.

### III Year - Paper-4 - Organic analysis and organic estimation

#### Organic analysis

Analysis of a compound with one functional group carboxylic acid, phenol, aldehyde, ester, nitro compound, primary amine, amide, anilide, aliphatic diamide, monosaccharide.

#### Organic estimation

- i. Estimation of phenol
- ii. Estimation of aniline

#### Distribution of marks

Maximum marks : 100

Passing minimum : 35

Record = 10 marks

Viva voce = 10 marks

Aromatic / aliphatic = 10 marks

Saturated / unsaturated = 10 marks

Elements other than C, H, O = 10 marks

Functional groups = 10 marks

Confirmatory / colour reaction = 10 marks

Result = 30 marks

Error 1 – 3 % = 30 marks    3 – 4 % = 25 marks

4 – 5 % = 20 marks    5 – 6 % = 10 marks

>6 % = 5 marks

#### Paper -5 - Physical Chemistry Practicals

1. Determination of molecular weight by transition temperature method – sodium thiosulphate pentahydrate, strontium chloride hexahydrate and sodium acetate trihydrate.
2. Phase diagram – Naphthalene and biphenyl system.
3. Critical Solution Temperature – Determination of CST of phenol-water system and effect of impurity on CST – strength of sodium chloride.
4. Heat of solution – Potassium dichromate, ammonium oxalate and oxalic acid.
5. Kinetics – Determination of relative strength of acids by acid catalyzed hydrolysis of ester.

6. Conductivity
  - i. Determination of cell constant of the cell and equivalent conductance of solution.
  - ii. Conductivity titration between an acid and a base (HCl vs NaOH).
  
7. Potentiometric titration
  - i.  $\text{KMnO}_4$  vs  $\text{FeSO}_4$
  - ii. HCl vs NaOH

**Distribution of marks**

Maximum marks : 100  
 Passing minimum : 35  
 Record = 10 marks  
 Completion of experiment = 40 marks  
 Graph = 20 marks  
 Calculation = 10 marks  
 Result = 20 marks  
 Error 1 – 4 % = 20 marks  
       4 – 5 % = 15 marks  
       5 – 6 % = 10 marks  
       > 6 % = 5 marks

**B.Sc. ANCILLARY CHEMISTRY**

**FIRST YEAR - PAPER I**

**GENERAL CHEMISTRY - I**

**UNIT -I**

1. **Hydrogen:** Isotopes of hydrogen-preparation, properties and uses of heavy hydrogen-ortho and para hydrogen-hydrides-definition-classification-examples.
2. **Oxides:** Definition-classification-examples.
3. **Water:** Hardness of water-types of hardness-removal of hardness-industrial implications of hardness in water-estimation by EDTA method (outline only) units of hardness of water.
4. **Hydrogen peroxide:** Manufacture, properties, structure and uses-estimation by permanganometry method-strength of hydrogen peroxide.
5. **Pollution:**

- a) Air pollution:** Definition, composition of air-chemical reactions occurring in air due to sunlight-sources of air pollution-classification and effects of air pollutants-effects of fluorocarbons-ozone layer-composition-formation-depletion-green house effect.
- b) Acid rain:** Formation theory and control of acid rain methods to control air pollution.
- c) Water pollution:** Types-sources-water sewages-industrial effluents-inorganic pollutants-organic pollutants-water pollution control-water treatment.
- d) Radioactive pollution:** Sources-nuclear traces-wastes-effect of radiation-preventive methods.

## UNIT-II

1. Detection and estimation of nitrogen and halogens in organic compounds-empirical formula-molecular formula-structural formula-calculation of EF and MF from percentage composition.
2. Nature of valency of carbon in organic compounds-tetrahedral arrangement of valency of carbon-bond-breaking and bond forming in organic reactions-homolytic cleavage-heterolytic cleavage-reaction intermediates-formation, stability of carbocation and free radicals.
3. Nucleophiles, Electrophiles, Definition, types and examples –specific reactions involving these.
4. **Types of reactions:** Substitution-addition-elimination-rearrangement and polymerization-illustration with examples.

### 5. Halogen compounds:

1. **Aliphatic halogen compounds:** Preparation, properties and uses of ethyl iodide, chloroform, iodoform and carbon tetrachloride.
2. **Aromatic halogen compounds:** Chlorobenzene, hexachlorobenzene -halogenation of toluene-preparation, properties and uses of benzoyl chloride, chlorotoluene-DDT-preparation and mode of application.
3. **Mechanism of aliphatic substitution** -  $S_N1$  &  $S_N2$  - illustration with examples-differences-Saytzeff & Hofmann rules.
4. **Organo metallic compounds:** Definition-preparation-synthetic application of Grignard reagent.

## UNIT-III

1. **Gaseous state:** Postulates of kinetic theory of gases-derivation of expression for pressure of an ideal gas on the basis of kinetic theory-deducing the basis gas laws.

**2. Deviation of real gases** from ideal behavior-reasons for deviation - derivation for van der Waals gas equation-explanation of behavior of real gases on the basis of van der Waals gas equation.

3. Average, rms, and most probable velocities-(equations only-no derivation) relationship between these different velocities.

**4. Liquefaction of gases:** critical phenomenon-modern methods-Joule-Thomson effect-inversion temperature.

**5. Nuclear chemistry:**

a) Composition of the nucleus -nuclear forces-mass defect-binding energy-nuclear stability.

b) Soddy's group displacement law-illustration-law of radioactive disintegration.

c) Nuclear fission: Definition-theories of fusion-application of fission-the principle of atom bomb.

d) Nuclear fusion: Definition-emission of energy-stellar energy-hydrogen bomb.

e) Application of radioactivity-In medicine, agriculture, industry and analytical fields-carbon dating.

## UNIT-IV

**1. Bonding:** V.B.theory -postulates of V.B. theory-application to the formation of simple molecules like  $H_2$  and  $O_2$  -overlap of atomic orbitals - s-s,s-p and p-p overlap-principle of hybridization-sp,sp<sup>2</sup> and sp<sup>3</sup> hybridisation -VSEPR theory.

**2. M.O. theory:** Formation of M.O.'s-bonding and antibonding and non bonding. M.O.'s-M.O. diagram for  $H_2$ , He and  $F_2$ .

## UNIT-V

**1. Colloids:** Colloidal state of matter - various types - classification - Sols-dialysis-electro osmosis-electrophoresis-stability of colloid-protective action-Hardy Schulze law-gold number. - Emulsion: Types of emulsions-emulsifier with examples- Gels: Classification, preparation - Application of colloids.

**2. Photochemistry:** Comparison of thermal and photochemical reactions-definition of photochemical reactions-laws of photochemistry-Grotthus-Draper law-Einstein law-quantum efficiency-reasons for low and high quantum yield with examples-consequence of light absorption by atoms and molecules-Jablonsky diagram-fluorescence-phosphorescence-photosensitization-chemiluminescence-bioluminescence-applications of photochemistry.



**SECOND YEAR - ANCILLARY  
PAPER II - GENERAL CHEMISTRY II**

**UNIT-I**

- 1. Stereoisomerism**-chiral center-optical activity of compounds containing one or two chiral centers-R-S notation-enantiomers-diastereoisomers-racemization-resolution. Geometrical isomerism of maleic and fumaric acids,E-Z notation of geometrical isomers.
- 2. Carbohydrates:**
  - a) **Monosaccharides:** properties and uses of glucose and fructose-configuration of glucose-Haworth structure-conversion of glucose to fructose and vice versa.
  - b) **Disaccharides:** Sucrose-manufacture-properties and uses-distinction between sucrose, glucose and fructose.
  - c) **Polysaccharides:** Starch and cellulose (structure only).
- 3. Amino acids and proteins:** Classification-synthesis-properties of amino acids-polypeptides-proteins-classification and biological functions.

**UNIT-II**

- 1. Dyes:** Definition-theory of colour and constitution-classification based on structure and applications-preparation of methyl orange-Bismark brown, malachite green - indigo.
- 2. Heterocyclic compounds:** Preparation and reactions of pyrrole, furan,pyridine,quinoline,isoquinoline, uracil,thiamine, adenine and guanine.
- 3. Alkaloids:** Pharmacological properties and importance of the following alkaloids-nicotine,quinine,piperine and cocaine (structural elucidation not necessary).
- 4. Vitamins and antibiotics:**

Classification and biological functions of vitamins A,B<sub>6</sub>,B<sub>12</sub>,C,D,E and K (structural elucidation not required).

Classification and biological functions of antibiotics-penicillin,chloroamphenicol,streptomycin and tetracyclins.

**UNIT-III**

- 1. Nitrogen compounds:** Manufacture of ammonia-nitric acid-ammonium nitrate-ammonium sulphate -physico-chemical principles in the manufacture of ammonia.
- 2. Coordination compounds:** Definition-nomenclature-definition of various terms involved in coordination chemistry-Werner's theory EAN rule-VB theory (outline only)-Nickel carbonyl- chelates, application of chelates in medicine.
- 3. Chromatographic technique:** Principle and application-partition and gas chromatography-thin layer chromatography-column chromatography-paper chromatography-gas-solid and gas-liquid chromatography, HPLC.

#### UNIT- IV

- 1. Adsorption:** Definition-difference between adsorption and absorption adsorbate,adsorbent-physical adsorption-chemical adsorption-differences between these two types-factors influencing adsorption-adsorption isotherm-Langmuir isotherm (no derivation, statement only) adsorption of gases on solid surface.
- 2. Catalysis:** Definition-different types of catalysis-acid base catalysis-surface catalytic reactions-definition and examples- auto-catalyst -catalytic poisoning-promoters-enzyme catalysis-characteristics.
- 3. Polymers:** Definition-classification of polymers-properties of polymers-addition and condensation polymerization reactions with examples-natural rubber-isoprene unit-vulcanization of rubber-preparation and application of polystyrene, urea-formaldehyde resin, Teflon and Buna-S-rubber.

#### UNIT - V

- 1. Thermodynamics:** Importance of thermodynamics-terms used in thermodynamics-open and closed systems, state functions and path functions, extensive and intensive properties, reversible and irreversible processes, statement and mathematical form of first law of thermodynamics-heat capacity at constant volume and pressure, relation between  $C_p$  and  $C_v$ . Statement of second law of thermodynamics-entropy-physical significance of entropy-Gibb's free energy and its significance.
- 2. Chemical kinetics:** Reaction rate-order and molecularity of a reaction-zero order-first order. First order rate equation and half life period-derivation. Examples of first order reactions-second order reactions-examples.Carbon dating-enzyme catalysis-Michaelis-Menten mechanism- Lineweaver Burk plot-significance of  $K_m$ .
- 3. Electrochemistry:** Faraday's law of electrolysis-specific and equivalent conductance-electrochemical cell-Nernst equation-convention regarding the sign of EMF of a cell-electrodes-reference electrodes-hydrogen and calomel electrodes-types of electrodes-metal-metal ion electrodes-metal-metal insoluble salt electrodes-glass and ion selective electrodes-pH measurement using glass electrode-membrane potential-hydrogen-oxygen fuel cell.
- 4. Basic principles of UV and IR spectroscopy-identification of simple organic molecules (ethanol and dimethyl ether,acetaldehyde and acetone) ethylene and**

acetylene ,cis-2-butene,methylamine,dimethyl amine and trimethylamine-proton NMR spectroscopy-principle instrumentation-chemical shift-spectrum of ethanol.

### Reference Books:

1. Bahl B.S., Tuli G.D. and Arun Bahl, **Essentials of Physical Chemistry**, Chand & Co., Delhi, 1995.
2. Puri.B.R., Sharma.L.R., & Kalia.C., **Principles of Inorganic Chemistry** , Vallabh publications, New Delhi, 2003.
3. Lee.J.D ., **A New Concise Inorganic Chemistry** , ELBS, London, 1996.
4. Morrison R. T, Boyd R.N., **Organic Chemistry** , 7<sup>th</sup> edition , Prentice Hall, New Delhi, 2008.
5. Soni. P.L, Chawala H.M., **Text book of Organic Chemistry**, 26<sup>th</sup> edition, Sultan Chand, Delhi , 1994.
6. Raj.K.Bansal, **Organic Reaction Mechanisms** , 3<sup>rd</sup> edition, Tata MCGraw-Hill Publishing Company Limited, New Delhi, 1998.
7. Madan.R.D. ., **Modern Inorganic Chemistry** , S.Chand & sons, New Delhi, 1987.
8. Soni P.L., **Textbook of Inorganic Chemistry** , Sultan Chand & Sons, New Delhi, 1991.
9. Finar I.L., **Organic Chemistry Vol. I** , Longman Publishing group, New York, 1998.
10. Finar I.L., **Organic Chemistry Vol. II**, Pearson Education, New Delhi, 2000.
11. Srivastava V.K., Srivastava K.K., **Introduction to Chromatography**, 2<sup>nd</sup> edition, 1981

## SYLLABUS FOR ANCILLARY CHEMISTRY PRACTICALS

### PRACTICAL I-VOLUMETRIC ANALYSIS

(At the end of I Year / II Year)

A double titration involving making up of the solution to be estimated on single titration involving making up of the solution to be estimated and the preparation of a primary standard.

#### I. ACIDIMETRY AND ALKALIMETRY

1. Titrations between a strong acid and strong base.
2. Titrations between a strong acid and weak base.
3. Titrations between a weak acid and strong base.

#### II. PERMANGANIMETRY

Titration between potassium permanganate and oxalic acid, ferrous sulphate and ferrous ammonium sulphate (Mohr's salt).

#### III. IODOMETRY

Titration of sodium thiosulphate with potassium permanganate and potassium dichromate.

## **DISTRIBUTION OF MARKS**

Max. Marks -100

Viva voce	10 marks
Record notebook	15 marks
Procedure	15 marks
Estimation	60 marks
Total	100 marks