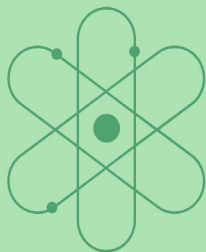
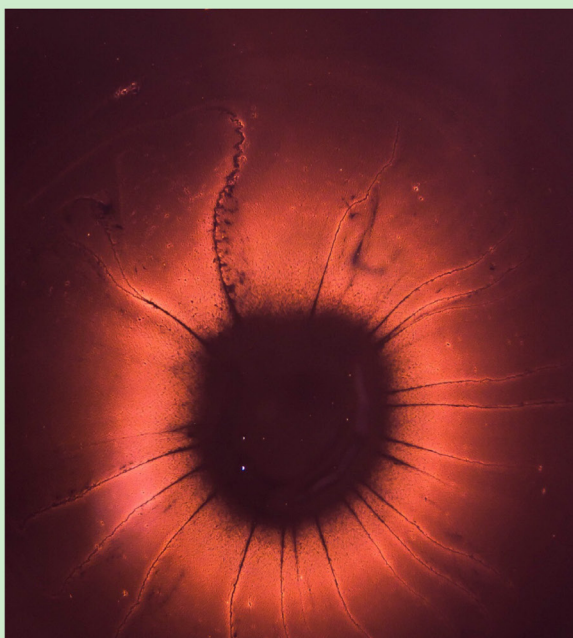


2022-2023

# SYLLABUS

— DEPARTMENT OF CHEMISTRY—

C. Kandaswamy  
Naidu College  
for Men,  
Chennai-102



Compile and edited

by

Dr. S. Hariharan

Assistant Professor & Head

APPENDIX - 19 (R&S)  
UNIVERSITY OF MADRAS  
B.SC. CHEMISTRY  
(With effect from the academic year 2021-2023)

## Semester I

| Course Components | Name of the course                 | Inst. Hrs | Credits                            | Exam Hrs. | Max. Marks |            |       |
|-------------------|------------------------------------|-----------|------------------------------------|-----------|------------|------------|-------|
|                   |                                    |           |                                    |           | Ext. Marks | Int. Marks | Total |
| Part-I            | Language -paper-II                 | 6         | 3                                  | 3         | 75         | 25         | 100   |
| Part-II           | English-Paper-I                    | 6         | 3                                  | 3         | 75         | 25         | 100   |
| Part-III          | Core paper-I-General Chemistry-I   |           | 5                                  | 3         | 75         | 25         | 100   |
|                   | Core paper-III-Major practicals I  | 3         | Examination at the end II semester |           |            |            |       |
|                   | Paper-IV-Allied theory             | 6         | 5                                  | 3         | 75         | 25         | 100   |
|                   | Paper-III & IV - Allied Practicals | 2         | Examination at the end II semester |           |            |            |       |
| Part-IV           | Soft skill -I                      | 2         | 2                                  |           | 50         | 50         | 100   |
|                   | Chemistry in everyday life (NME)   | 2         | -                                  | 3         | 75         | 25         | 100   |

| Semester | Subject                         | Total Hours | Credits |
|----------|---------------------------------|-------------|---------|
| I        | Core paper -I-General Chemistry | 75          | 5       |

| Units | Learning Objectives  |
|-------|--|
| 01    | To know the fundamental concept of atomic structure                              |
| 02    | To know the periodicity of properties  |
| 03    | To understand chemical bonding and to know about solid state and liquid crystals |
| 04    | To learn the principles of inorganic qualitative and quantitative analysis       |
| 05    | To know the basic concepts of organic chemistry                                  |

## Unit –I Atomic Structure an 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). Schrödinger 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 Rules – 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 (10 hrs)

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

## Unit-III

## 3.1 Chemical Bonding(19 hrs)

Ionic bond- factor 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.

## 3.2 Solid State and Liquid Crystals (10 hrs)

Classification of solids, isotropic and anisotropic crystals, representation of planes, Miller indices, space lattice, unit cell, crystal systems, packing of ions in crystals { CCP and HCP}. X-Ray 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 (15 hrs)

Common ion effect, solubility product, applications 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, alizarin and Nessler's reagent. Volumetric analysis – Definitions – normality, molarity, molality and mole fraction, primary and secondary standards, theories of acid – base, redox, complexometric, iodometric and iodimetric titrations, calculations of equivalent weights, theories of acid – base, redox, metal ion and adsorption indicators and choice of indicators.

Unit – V Basic Concepts of Organic Chemistry (15 hrs)

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 – hemolytic and heterolytic fissions. Reactive intermediates – Carbocations, carbocations 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. Puri, B.R., L.R. Sharma and M.S. Pathania. Principles of Physical Chemistry 44th 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; Milestone Publishers and Distributors, 2009.
3. Arun Bahl and B.S. Bahl, Text book of Organic Chemistry, S. Chand and company Pvt. Ltd 21st ed.
4. Soni, P.L., and H.M. Chawla. Text book of Organic Chemistry. 29th e., New Delhi: Sultan Chand & Sons, 2007.

Reference Books:

1. Glasstone Samuel. Textbook of Physical Chemistry. 2nd ed., New Delhi: Macmillan India Ltd., 1990.
2. Fiblert W. Castellan, University of Maryland, Physical Chemistry, 3rd ed., Narosa Publishing House, New Delhi.
3. Lee, J.D. Concise Inorganic Chemistry. 5th ed., Blankwell Science, 2005.
4. Brown, G.I. A New Guide to Modern Valence Theory. 3rd ed., Longman.
5. Soni, P.L. and Mohan Katyual. Textbook of Inorganic Chemistry. 20th e., New Delhi: Sultan Chand & Sons, 2006

6. Dr. S. Sundaram and Dr. Vangahr S. Srinivasan, Text book of Inorganic Chemistry. A new approach, Margham Publications, Madras
7. Gopalan, R., P.S. Subramanian and K. Rangarajan, Elements of Analytical Chemistry, New Delhi: Sultan Chand & Sons, 1991.
8. Graham Solomons, T.W. Organic Chemistry. 3rd ed., New York: John Wiley & Sons. 1984.
9. Morrison, R.T. and R.N. Boyd. Organic Chemistry, 6th ed., Delhi: Pearson Education (Singapore) Pte., Ltd., 2002
10. Dr. S. Sundaram and Dr. Vangahr S. Srinivasan, Text book of Inorganic Chemistry. A new approach, Margham Publications, Madras
11. Jain, M.K, and Sharma, S.O, Modern Organic Chemistry, 3rd ed. Vishal Publications, Jalandhar, Delhi.
12. Dr. O.P. Agarwal, Reactions and Reagents, 9th ed., Goel Publishing House, Meerut.

**I SEMESTER – Non- Major elective  
CHEMISTRY IN EVERY DAY LIFE**

(30 hours ) 2 Credits

Unit-I

- 1.1 General survey of chemicals used in every day life.
- 1.2 Air-Components and their importance; photosynthetic reaction 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 materials – cement, cerment, ceramics, glass and refractories-definition, composition and application only.
- 2.2 Plasticspolythene, PVC, Bakelite, polysters, melamine 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 Pharmaceutical 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 (4th Edition) R. Norris Shreve, Joseph A. Brink, Jr.
2. Perfumes, Cosmetics and Soaps V.V.A.Poucher (Vol.3)
3. Environmental Chemistry A.K. DE

## Semester II

| Course Components | Name of the course                 | Inst. Hrs | Credits | Exam Hrs. | Max. Marks |            |       |
|-------------------|------------------------------------|-----------|---------|-----------|------------|------------|-------|
|                   |                                    |           |         |           | Ext. Marks | Int. Marks | Total |
| Part-I            | Language -paper-II                 | 6         | 3       | 3         | 75         | 25         | 100   |
| Part-II           | English-Paper-II                   | 6         | 3       | 3         | 75         | 25         | 100   |
| Part-III          | Core paper-II-General Chemistry-II | 5         | 5       | 3         | 75         | 25         | 100   |
|                   | Core paper-III-Major practicals I  | 3         | 2       | 3         | 60         | 40         | 100   |
|                   | Paper-II-Allied theory             | 6         | 5       | 3         | 75         | 25         | 100   |
|                   | Allied practicals                  | 2         | 2       | 3         | 60         | 40         | 100   |
| Part-IV           | Soft skill -II                     | 2         | 2       |           | 50         | 50         | 100   |
|                   | Diary chemistry (NME)              | 2         | -       | 3         | 75         | 25         | 100   |

| Semester | Subject                          | Total Hours | Credits |
|----------|----------------------------------|-------------|---------|
| II       | Core paper -II-General Chemistry | 75          | 5       |

| Units | Learning Objectives   |
|-------|---|
| 01    | To equip learners with concepts in comparative study of s-Block elements  |
| 02    | To equip learners with concepts in comparative study of p-Block elements  |
| 03    | To understand the aspects in gaseous state  |
| 04    | To understand liquid state, colloids and nanomaterials  |
| 05    | To enable them to understand chemistry of alkanes cycloalkanes, alkenes and alkynes and conformational analysis |

## GENERAL CHEMISTRY-II

Unit-I Chemistry of s- Block Elements [ Group IA and IIA] (10 hrs)

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

Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates.

Diagonal relationship of Li with Mg. Extraction of Li from its silicate-ores. Preparation, properties and uses of  $\text{NaOH}$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{KBr}$ ,  $\text{KClO}_3$  alkaline earth metals: Comparative study of the elements with 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 –III A]; 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 –IV A): comparison of carbon with silicon. Manufacture and uses of  $\text{CO}$  and  $\text{CO}_2$  ( includes dry ice). Carbides types, preparation and industrial applications. Silicates – classification and structure, silicones – preparation, properties and uses.

Tin- Allotropic forms of Tin, alloys of tin, tinning, tin plating. Lead-Lead accumulator (discharging and recharging), Lead pigments.

Unit –III Gaseous State (15 hrs)

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 viscosity, thermal conductivity, diffusion. Principle of equipartition of energy. Real gases - Van der waals equation of state –derivation. Boyle temperature. Significance of critical constants. Law of corresponding states, coefficient of compressibility, coefficient of thermal expansion. Joule Thompson effect.

Unit –IV 4.1 Liquid State (5 hrs)

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 in every day life. Parachor- definition, calculation and applications. Viscosity or fluidity- definition, measurement and calculation, factors affecting viscosity, viscosity in every day life.

#### 4.2 Colloids ( 10 hrs)

Definition, types, preparation and purification of colloids, properties- kinetic, optical and electrical stability of colloids, gold number, associated colloids, Emulsions –types, preparation, properties and applications, Gels-types, preparation, properties and applications. Donnan membrane equilibrium. Osmosis, reverse osmosis , dialysis and desalination. Macromolecules-determination of molecular weight by osmotic pressure method and light scattering methods.

#### 4.3 Nanomaterials ( 5 hrs)

Elementary concepts of nanomaterials: Nanoparticles of Au, Ag and TiO<sub>2</sub> –preparation, properties and uses.

#### Unit-V (20 hrs)

5.1 Chemistry of Alkanes and Cycloalkanes: General methods of preparation and properties of alkanes and cycloalkanes, conformational analysis of ethane and n-butane. Bayer's strain theory.

5.2 Alkanes, alkynes and Dienes: Preparation of alkenes preparation of alkynes (Dehydrohalogenation, dehalogenation) Addition (with mechanisms) of H<sub>2</sub>, X<sub>2</sub>, HX, (Peroxide effect; free radical reaction mechanism) to alkenes and alkynes. Allylic substitution of alkenes by NBS. Dienes types, stability, preparation of 1,3 butadiene, isoprene, and chloroprene. Reactivity: 1,2- and 1,4- additions to butadiene. Diels Alder reaction. Introduction to Polymers : Polymerisation- types, natural rubber.

#### Textbooks:

1. Puri, B.R., L.R. Sharma and M.S. Pathania. Principles of Physical Chemistry, 44th ed., New Delhi, Vishal Publishing Co., 2009.
2. Puri, B.R., L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 30th ed., New Delhi, Milestone Publishers and Distributors, 2009.
3. Arun Bahlan B.S. Bahl, A Text Book of Organic Chemistry, S. Chand and Company Pvt. Ltd., 21st ed. Sons, 2007.

#### Reference Books

1. Glastone Samuel Textbook of Physical Chemistry, 2nd ed., Macmillan India Ltd., 1990
2. Soni, P.L. O/P/ Dharmarha and U.N. Dash. Textbook of Physical Chemistry, 23rd ed., New Delhi, Sultan Chand & Sons.2011
3. Negi, A.S. and S.C. Anand. Textbook of Physical Chemistry, New Delhi, New Age International Pvt. Ltd. 2002.
4. Lee, J.D., Concise Inorganic Chemistry, 5th ed., Blackwell Science, 2005
5. Soni, P.L. and Mohan Katyal. Textbook of Inorganic Chemistry, 20th ed., Sultan Chand & Sons, 2006
6. Liptrot, G.F. Modern Inorganic Chemistry, 2nd ed., The English Language Book Society and Mills



7. Madan, R.D., Sathyaprakash's Modern Inorganic Chemistry, 3rd ed., S. Chand and Company Ltd., New Delhi.
8. Gurdeep R. Chatwal and Harish Mehra, Advanced Inorganic Chemistry, 7th ed., Goel Publishing House, Meerut (U.P)
9. Graham Solomons, T.W. Organic Chemistry, 3rd ed., John Wiley & Sons.
10. Morrison, R.T. and R.N. Boyd. Organic Chemistry, 6th ed., Pearson Education, Asia, 2002.
11. Carey Francis A., Organic Chemistry, 7th ed., New Delhi, Tata MacGraw Hill Education Pvt., Ltd., 2009
12. Mukherji, S.M. and S.P. Singh, Reaction Mechanism in Organic Chemistry 3rd ed., Macmillan India Ltd. 2009
13. Agarwal, O.P., Reactions and Reagents, Goel Publishing House, Meerut (U.P)

## II SEMESTER – Non- Major elective

### 2. DIARY CHEMISTRY

#### 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, viscosity and conductivity – Rancid 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 – desibutter – salted butter estimation of acidity and moisture content in butter.

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 – Incitation milk – Vegetable 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, culture milk. Definition of culture – example, conditions – cultured cream butter milk – Bulgaxious milk – acidophilous milk – yoheer Indigeneour products – Khoa an chchana 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.

## Rooks 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, Outlines of Dairy technology.

## **Semester III**

### Revised Regulations AND SYLLABUS FOR II & III YEARS

This revised Syllabus and scheme of Examinations will take effect for the students admitted from the academic year 2017-18 onwards..

| Course Components | Subjects                       | Inst. Hrs | Credits | Exam Hrs. | Max. Marks                              |            |       |
|-------------------|--------------------------------|-----------|---------|-----------|---|------------|-------|
|                   |                                |           |         |           | Ext. Marks                              | Int. Marks | Total |
| Part-I            | Language -paper-III            | 6         | 3       | 3         | 75                                      | 25         | 100   |
| Part-II           | English-Paper-III              | 6         | 3       | 3         | 75                                      | 25         | 100   |
| Part-III          | Paper-VI-General Chemistry-III | 5         | 5       | 3         | 75                                      | 25         | 100   |
|                   | Paper-V-Major practicals II    | 3         |         |           | Examination will be held in IV semester |            |       |
|                   | Paper-III-Allied theory        | 4         | 3       | 3         | 75                                      | 25         | 100   |
|                   | Paper-III- Allied Practical    | 3         | 3       |           | Examination will be held in IV semester |            |       |
| Part-IV           | 2. Soft skill -III             | 2         | 3       |           | 60                                      | 40         | 100   |
|                   | 3. Environmental studies       | 2         | -       |           | Examination will be held in IV semester |            |       |

| Semester | Subject                              | Total Hours | Credits |
|----------|--------------------------------------|-------------|---------|
| III      | Core paper -IV-General Chemistry-III | 75          | 5       |

| Units | Learning Objectives   |
|-------|---|
| 01    | To equip learners with concepts in comparative study of s-Block elements  |
| 02    | To equip learners with concepts in comparative study of p-Block elements  |
| 03    | To understand the aspects in gaseous state  |
| 04    | To understand liquid state, colloids and nanomaterials  |
| 05    | To enable them to understand chemistry of alkanes cycloalkanes, alkenes and alkynes and conformational analysis |

### GENERAL CHEMISTRY-III

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

1.1 Group VA elements: General characteristics of Group VA elements; chemistry of  $\text{H}_2\text{N}-\text{NH}_2$ ,  $\text{NH}_2\text{OH}$ ,  $\text{HN}_3$  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 properties of group VIA elements-Structure 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 :  $\text{SN}_1$ ,  $\text{SN}_2$  and  $\text{SN}_i$  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 (15hrs)

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 ( $\mu_{JT}$ )-Calculation of  $\mu_{JT}$  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 and 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, 47th ed., New Delhi, Vishal Publishing Co., 2016.
2. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 33th ed., New Delhi, Milestone Publishers and Distributors, 2016.
3. Soni P.L., and Chawla H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.

#### Reference Books

1. Lee J.D. Concise Inorganic Chemistry, 5th ed., Blackwell Science, 2005.
2. Soni, P.L. and Mohan Katyal. Textbook of Inorganic Chemistry, 20th ed., Sultan Chand & Sons, 2006.
3. Glasstone Samuel. Textbook of Physical Chemistry, 2nd ed., Macmillan India Ltd., 1990.
4. Soni P.L., Dharmarha O.P. and Dash U.N Textbook of Physical Chemistry, 23rd ed., New Delhi, Sultan Chand & Sons, 2011..
5. Graham Solomons T.W. Organic Chemistry, 3rd ed., John Wiley & Sons.
6. Morrison R.T. and Boyd R.N., Organic Chemistry, 6th ed., Pearson Education, Asia, 2002.

**Allied Chemistry –I (60 Hours) 4 credits**  
**( For Maths and Physics Students)**

**Unit 1: Nuclear Chemistry**

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

**Unit II: Industrial Chemistry**

Fuel - Classification – gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, compressed natural gas – Fertilizers- Classifications- 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 – 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 - Classifications of reactions – addition, substitution, elimination and polymerization – 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 chlorine reaction (Elementary idea only) Photosynthesis, Photosensitisation, Phosphorescence Fluorescence, Chemiluminiscene – Definition with examples.

### Books for reference

1. Gopalan R. and Sundaram S., Allied Chemistry , Sultan Chand & Sons Publishers, New Delhi 2nd ed.
2. Soni P.L. and Mohan Katyal, Text book of Inorganic Chemistry, Sultan Chand an Company Pvt. Ltd, New Delhi, 20th ed.
3. Bahl B.S. and Arun Bahl, A text book of Organic Chemistry 21st ed., Sultan Chand an Company Pvt Ltd
4. Puri B.R., Sharma L.R. and Pathania M.S, Textbook 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 elhi, 2006.
7. Billmayer F.W, Text book of Polymer science, Wiley India Pvt. Ltd., 3rd Edition, 2007
8. Gowrikar V.R, Viswanathan N. V and Sreedhar J, Polimer science, New Age, International publication, New Delphi, Reprint ed. 2005.

## **CORE MODULE SYLLABUS FOR ENVIRONMENTAL STUDIES FOR UNDER GRAUVAATION COURSE ALL BRANCHES OF HIGHER EDUCATION**

Unit -1 The multi disciplinary nature of environmental studies (2lectures)  
Definition, scope and importance Need for public awareness

Unit -2 Natural Resources (8 lectures)

Renewable and non –renewable resources: Natural resources and associated problem a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining dams and their effects on forests and tribal people. b) Water resources: Use an over- utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems. c) Mineral resources: Uses and exploitation, environmental effects of existing and using mineral resources, case studies. d) Food resources:

World food problems, changes caused by agriculture and overgrazing, effects modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non renewable energy sources use of alternate energy source, case studies. f) Land resources: Land of resource land degradation, man induced and slides, soil erosion and desertification

Role of an individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles.

### Unit- 3 Ecosystems (6 lectures)

Concept of an ecosystem. Structure and function of an ecosystem Producers, consumers and decomposers Energy flow in the ecosystem

Ecological succession: Food chains, food webs and ecological pyramids

Introduction, types, characteristic features, structure and function of the following ecosystem: a. forest ecosystem, b. grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (Ponds, streams, lakes, rivers, oceans, estuaries)

### Unit -4 Biodiversity and its conservation (8 Lecturer)

Introduction definition genetic species and ecosystem diversity, Bio-geographical classification of India. Types of biodiversity, consumptive use, productive use, social ethical, aesthetic and option values. Biodiversity at global, national and local levels. India as a mega – diversity nation

Hot spots of biodiversity: Threats to biodiversity, habitat loss, Poaching of wildlife, man/wildlife conflicts.

Endangered and endemic species of India

Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity

## Semester IV

| Course Components | Subjects                           | Inst. Hrs | Credits | Exam Hrs. | Max. Marks |            |       |
|-------------------|------------------------------------|-----------|---------|-----------|------------|------------|-------|
|                   |                                    |           |         |           | Ext. Marks | Int. Marks | Total |
| Part-I            | Language -paper-IV                 | 6         | 3       | 3         | 75         | 25         | 100   |
| Part-II           | English-Paper-IV                   | 6         | 3       | 3         | 75         | 25         | 100   |
| Part-III          | Paper-VI-General Chemistry-IV      | 5         | 5       | 3         | 75         | 25         | 100   |
|                   | Paper-V-Major practicals II        | 3         | 2       | 3         | 60         | 40         | 100   |
|                   | Paper-IV-Allied theory             | 4         | 3       | 3         | 75         | 25         | 100   |
|                   | Paper-III & IV - Allied Practicals | 2         | 2       | 3         | 60         | 40         | 100   |
| Part-IV           | 2. Soft skill -IV                  | 2         | 3       |           | 60         | 40         | 100   |
|                   | 3. Environmental studies           | 2         | -       | 3         | 75         | 25         | 100   |

| Semester | Subject                            | Total Hours | Credits |
|----------|------------------------------------|-------------|---------|
| III      | Core paper -V-General Chemistry-IV | 75          | 5       |

## 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 reactions and half reactions – oxidising 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, ionisation energy, oxidation state, reactivity, colour and tendency to form complexes- Group study of Scandium, Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel and Zinc groups – galvanization, Evidences for the existence of mercurous ion as  $Hg_2^{2+}$ .

### 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, Quinoline 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, dehydrogenation using copper and esterification.

Thiols: Nomenclature, structure, preparation and properties

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

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

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



## UNIT 5: Thermodynamics-II (20 hrs )

Second Law of Thermodynamics – Limitations of first law & Need for the second law – Different statements 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 relations.

### Text Books

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 44th ed., New Delhi, Vishal Publishing Co., 2009.
2. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 30th ed., New Delhi, Milestone Publishers and Distributors, 2009.
3. Soni P.L., and Chawla H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.

### Books for References

1. Glasstone S. And Lewis D., Elements of Physical Chemistry, 2nd ed., Mac-Millan & Co. Ltd., London.
2. Morrison R.T. and Boyd R.N., Organic Chemistry, 6th ed. Pearson Education, Asia, 2002
3. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, 12th ed., Sultan Chand & Co., New Delhi, 1997.
4. Madan R.D. SathyaPrakash's Modern Inorganic Chemistry, 2nd ed., S.Chand& Co. Ltd, New Delhi, 1990.

## **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 Chlorophyll (elementary idea only) – Application 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 reactions 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 and Partially miscible liquid systems – upper and lower critical solution temperatures

## Unit IV: ElectroChemistry

Galvanic cells – emf – standard electrode potential – reference electrochemical series and its applications – Electroplating process – Nickel and Chrome plating – Different types 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. Applications of pH and buffer in biological processes and industries.

## Unit V: Analytical Chemistry

Introduction to Qualitative and Quantitative Analysis – Principle of volumetric 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 2nd ed.
2. Soni P.L. and Mohan Katyal, Text Book of Inorganic Chemistry, Sultan Chand and Company Pvt. Ltd, New Delhi, 20th ed.
3. Bahl B.S. and Arun Bahl, A text book of Organic Chemistry 21st 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.
7. Gopalan R., Subramanian P.S. and Rangarajan K, elements of analytical Chemistry, Sultan Chand & Sons Publishers, New Delhi, 1991,

**CORE MODULE SYLLABUS FOR ENVIRONMENTAL STUDIES FOR UNDER GRADUATION COURSE  
ALL BRANCHES OF HIGHER EDUCATION**

**Unit -1 Environmental Pollution (8 Lectures)**

Definition Causes, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal Pollution g. Nuclear hazards Solid waste Management, causes, effects and control measures of urban and industrial wastes Role of an individual, prevention of pollution Pollution case studies Disaster management, floods, earthquake, cyclone and landslides.

**Unit - 2: Social issues and the Environment From Unsustainable to sustainable development Urban problems relate to energy Water conservation, rain water harvesting, watershed management Resettlement and rehabilitation of people; its problems and concerns, case studies Environmental ethics; Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depleting, nuclear accidents and holocaust case studies**

Wasteland reclamation Consumerism and waste products Environment Protection Act Air (Prevention and control of pollution) Act, Water (Prevention and control of pollution) Act, Wildlife protection Act, Forest Conservation Act. Issue involve in enforcement of environmental legalization Public awareness (7 lectures)

**Unit -3 Human Population and the environment Population Explosion-Family Welfare Programme Environment and human health Human Rights Value Education HIV/AIDS Women and Child Welfare Role of information Technology in Environment and human health Case Studies**

( 6 Lectures)

**Unit - 4 Field work**

Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain. Visit to a local polluted site – Urban / Rural/ Industrial/ Agricultural, Study of common plants, insects, birds. Study of simple ecosystems – pond, river, hill slopes etc. (Field work Equal to 5 lecture hours)

## Semester V

| Course Components | Subjects  | Inst. Hrs  | Credits | Exam Hrs.                               | Max. Marks |            |       |     |
|-------------------|---|--|---------|---|------------|------------|-------|-----|
|                   |   |  |         |   | Ext. Marks | Int. Marks | Total |     |
| Part-III          | Core paper -VII- Inorganic chemistry I                            | 5  | 5       | 3                                       | 75         | 25         | 100   |     |
|                   | Core paper- VIII- Organic Chemistry I                             | 5  | 5       | 3                                       | 75         | 25         | 100   |     |
|                   | Core paper -IX- Physical chemistry I                              | 5  | 5       | 3                                       | 75         | 25         | 100   |     |
|                   | Core paper-X-Gravimetric Analysis (Practical-III)                 | 3  |         | Examination will be held in VI semester |            |            |       |     |
|                   | Core paper -XI- Organic analysis and preparation (Practical - IV) | 3  |         |   |            |            |       |     |
|                   | Core paper -XII- Physical chemistry (Practical V)                 | 3  |         |   |            |            |       |     |
|                   |   | Elective paper-I (Pharmaceutical/Industrial chemistry) | 5       | 5                                       | 3          | 75         | 25    | 100 |
|                   | Elective paper -II (Nano materials/Polymer chemistry)             |  |         |   |            |            |       |     |
| Part-IV           | Value education   | 1  | 1       |   |            |            |       |     |

| Semester | Subject | Total Hours | Credits |
|----------|---------|-------------|---------|
|----------|---------|-------------|---------|

### INORGANIC CHEMISTRY – I

#### 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 of 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 (15 hrs)

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 Sidgwick's EAN concept , Valence Bond theory – 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  $[\text{CoF}_6]^{3-}$ . Crystal field theory – spectrochemical series , splitting of d- 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 (12 hrs)  
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 - B12 . (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 (10 hrs)  
Classification, preparation, properties and uses of hydrides, borides, carbides and nitrides

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

Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 33rd ed., New Delhi, Mile stone publishers and distributors, 2016.

#### BOOKS FOR REFERENCE

1. Lee J.D., Concise Inorganic Chemistry, 5th ed., Blackwell Science, 2005.
2. Sharpe Alan G. Inorganic Chemistry, ELBS and Longman, 1981.
3. Soni P.L., and Mohan katyal, Text book of Inorganic Chemistry, 20th ed., S.Chand& Co., New Delhi, 2006.
4. Malik Wahid U., Tuli G.D. and Madan R.D., Selected Topics in Inorganic Chemistry, 7th ed., S.Chand& Company Ltd., New Delhi, 2007.
5. James E.Huheey, Ellen A.Keiter, Richard L.Keiter and OkhilK.Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Pearson India, 2011.
6. Gurdeep Raj Chatwal and Harish Mehre, Advanced Inorganic Chemistry, 7th ed., Goel Publishing House, Meerut

| Semester | Subject                            | Total Hours | Credits |
|----------|------------------------------------|-------------|---------|
| V        | PAPER - VIII ORGANIC CHEMISTRY --I | 60          | 4       |

## ORGANIC CHEMISTRY --I

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

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, Riemer-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. (15 hrs)

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-Ponndorf-Verley reduction, Clemmenson reduction, Wolf-Kishner reduction, aldol condensation, Claisen-Schmidt reaction, Cannizzaro reaction, haloform reaction, Perkin and Benzoin condensation reaction.

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

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 – from alkyl cyanides, cyclic ketones and halo esters. Reactions – action of heat, action of PCl<sub>5</sub> and NH<sub>3</sub>.

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 (12 hrs)

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. Reactions 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, sulphanilic acid and sulfanilamide

### TEXT BOOKS

1. ArunBahland Bahl B.S., A Text book of Organic Chemistry, S.Chand Publishing, 2016.
2. Soni, P.L., and Chawla H.M., Text book of Organic Chemistry, 29 th ed., New Delhi, Sultan Chand & Sons, 2007.

### REFERENCE BOOKS:

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

| Semester | Subject                           | Total Hours | Credits |
|----------|-----------------------------------|-------------|---------|
| V        | PAPER - IX PHYSICAL CHEMISTRY – I | 60          | 4       |

## 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 heart theorem – Statement of third law and concept of residual entropy – Evaluation of absolute entropy from heat capacity data.



## UNIT II: SOLUTIONS (12 hrs)

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 applications of steam distillation - Nernst Distribution Law- thermodynamic derivation, application to solvent extraction, limitations of distribution law

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

Definition of terms in the phase rule – Derivation and application to one component system water and sulphur – super cooling, sublimation. Two component 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 system and CuSO<sub>4</sub>-H<sub>2</sub>O systems

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

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 Kohlraush's bridge. Arrhenius theory of electrolytic dissociation and its limitations. Weak and strong electrolyte according to Arrhenius theory Ostwald's dilution laws– applications and limitation. Variation of equivalent conductance with concentration. Migration of ion-ionic mobility. Kohlraush's law and its applications. 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 & Hittorf's rule. Determination by moving boundary method. Application of conductance measurements – 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, 47th ed., Vishal Publishing Co., 2016.

## REFERENCE BOOKS

1. Atkins P.W., Physical Chemistry, 5th ed., Oxford University Press, 1994.
2. Castellan G.V., Physical Chemistry, New Delhi, Orient Longmans.
3. Levine I.N., Physical Chemistry 6th ed., 2009.
4. Rajaram J. and Kuriacose J.C., Thermodynamics for students of chemistry 3rd ed., ShobanLal& Co., 2013.
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

| Semester | Subject              | Total Hours | Credits |
|----------|----------------------|-------------|---------|
| V        | INDUSTRIAL CHEMISTRY | 60          | 4       |

### 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 - sources 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 - structure, selectivity and applications. Manufacture of synthetic petrol - Dergius and Fischer Tropsh 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 (12hrs)

Manufacture - 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 (12hrs)

Oils - difference between oils and fats - manufacture of cotton seed oil and soya bean oil - manufacture 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 (12hrs)

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. Environmental 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 Rao, Eastwest Press, New Delhi.
3. Shreve R.V., Chemical Process Industries, Tata McGraw Hill publishing company, Mumbai.
4. Steines H., Introduction to Petrochemicals, Pergamon Press.
5. Alan Cottrell, An Introduction to Metallurgy, Orient Longman, 2000.
6. James A. Kent, Riegel's Handbook of Industrial Chemistry, Springer Science & Business Media, 2013.
7. Davis K.H., Handbook of Industrial Chemistry, Vol2, CBS Publishers & Distributors, 2004.

#### ELECTIVE - II

| Semester | Subject           | Total Hours | Credits |
|----------|-------------------|-------------|---------|
| V        | POLYMER CHEMISTRY | 60          | 4       |

#### 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 applications. 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. Polymerisation techniques – bulk, solution, suspension, emulsion, polycondensation and interfacial polycondensation.

Polymer processing – compression moulding, casting, extrusion, fibre spinning, injection moulding, thermoforming, vulcanization of elastomers.

## Unit 5 (12 hrs)

Polymer reactions – hydrolysis, Acidolysis, Aminolysis, hydrogenation, addition and substitution - cyclisation reactions – crosslinking reactions.

Natural polymers - Rubber, Silk, Cellulose – structure and applications

Supramolecular polymers – introduction – properties – applications.

## REFERENCES

1. Billmeyer, F.W. Textbook of polymer Science, 3rd ed., John Wiley and Sons, 1984.
2. Gowariker, V.R, Viswanathan, N.V. and Sreedhar, J, Polymer Science, 3rd ed., New Age International Publishers, New Delhi, 2015.
3. Sharma, B.K, Polymer Chemistry, Goel Publishing House, Meerut, 2014.
4. Odian, G., Principles of Polymerization, 4th ed., John Wiley, 2004.

## VALUE EDUCATION

### Syllabus Key Notes

#### Unit I – Value:

Values are belief idea and ideals that regulate and guide human behavior and action in daily life. I. Value of feelings II. Values of desires III. External values IV. Norms of values Universal Values: 1) JUSTICE, Social, economic and political 2) Liberty of thoughts, expression, belief, faith and worship 3) Equality of status and opportunity 4) Fraternity, Assuring the dignity of the individual of the nation Types of values: 1 Human Values, 2. National or institutional values, 3. Social values 4. Vocational /Professional values, 5. Religious values and 6 art and literature values.

Value education: Aims in bringing the good qualities of an individual known in the society and there by he becomes a person profile respect and honor. Following are some of the good qualities in an individual 1. Honest 2. Truth 3. Integrity 4 Trustworthy 5. Humbleness, Sincerity, 7 . Empath 8 Generosity, 9 Sacrifies, 10. Gratitude

#### Components of value education

1. Moral Education 2 Human rights and duties 3. Population education environmental education 4. Environmental Education 6. Physical Education, 7. Indian culture 8. Yoga Education 9. History of Indian freedom movement.

Role of the educations: 1. To facilitate the learners awareness 2. To help them examine their choices and preferences 3. Enable them have dialogue on value issues. 4. Expand their ways of looking of things, understanding situations an events 5. According to their well thought and responsible decisions.

Holistic living: holistic or conscious living consists of harmony an balance to the physical, mental, emotional and spiritual aspects of all living things, beyond the self.

Moral Education: I. A constituent of value education II. Based on the ideality of society III. Only the personal growth IV. Relation existing between individual and society

#### Unit-II Values for life

I Honesty is the quality of being truthful II Integrity is regarded as the ability to follow to a strict moral and ethical conduct. III Sharing, taking care of the homeless IV Compassion, children in foster care V Empathy, old age home. VI commitment is dedication to a cause r belief. VII Responsibility is an ability to answering or responding to others, for the completion or jobs assigned. VIII Discipline is behavior that order an individual life and his/her social interactions. IX. Respect includes taking some one's feelings, needs, thoughts, ideas, wishes an preferences into consideration X Punctuality is a quality of being n time. XI Courtesy means polite behaviors, r a polite action or remark. XII Dedication means when you give a lot of time and energy to something because it is important. XIII Sacrifice is to give up something that is valuable to you in order to help another person.

XIV Love and affection are an integral part our value system. XV Attitude is a feeling or opinion about something or a way of behaving that is caused by this XVI time management is only a set of skills and tool to help us more efficiently control the events of our lives. XVII team work is a no. of people who do something together as a group XVIII Self assessment is a judgment about self examination and comparison of self with others in the society. XIX collaboration is co- operative which is working together t create the same thing or achieve a common goal. XX Creative thinking is about generating ideas on issues, problems, challenges and possibility thinking.

National values

I Land of Diversity- Social, cultural, religious, racial, linguistic and geographical. II Discourse of religion – Respect for human dignity

III Democracy – Constitution of Indian envisages is representative democracy. IV. Socialism – Concerned with establishment of a new social and economic order on the basis of equality of opportunities and on the social,

political and economic justice. V. Secularism – Giving equal regard for all faiths, towards achievements f unity and integrity VI Peace (a) Equality (b)

Liberty, (c) Freedom Can bring happiness in every one.

Need for international understanding

a. To develop an sense of world citizenship b. To prevent human exploitations. c. To stop competition and promise Co-operation d. To safeguard the national interest e. To synchronize cultures.

Unit III Human Rights: A life long process by which people at all levels of development and in all strata of society learn respect for the dignity of other and the means and methods of ensuring that respect in all societies.

Universal education of human rights (UDHR) The general assembly had finally adopted the UDHR on December 10, 1948. December 10 is celebrate as human rights ay to mark the UDHR and the fundamental freedoms f human, beings, which were recognize university without any discrimination as to race, religion, sex, language and culture. Major Human Rights:

1) Dignity 2) Equality 3) Justice 4) Ethics and morals 5) Unity in Diversity

Types of Human Rights: 1. Right to life, claim, liberty and dignity 2. Right to law 3. Positive and negative rights. 4. Right to equality 5. Right against exploitation 6. Cultural and educational rights 7. Economic Rights 8. Political Rights 9. Autonomic Rights 10. Political Rights 11. Social Rights 12.

Universal Rights.

Dr. A.PJ Abdul kalam's ten point for enlightened citizenship 1. My education

or work with dedication 2. I will teach at least 10 persons 3. I will plant at least 10 saplings 4. I will visit rural and Urban arcas 5. To remove the pain f my suffering brethren 6. I will support any religious, caste 7. I will be honest and Endeavour to make a corruption free society 8. Make my family righ-

teous

#### Unit IV Environmental values:

I Natural Resources – Water, minerals, petroleum products and wood. II Renewable resources: Tinker and water etc. III Non renewable : Minerals an oil etc. Environmental pollution nPollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. Types of environmental pollution 1. Air pollution 2. Water pollution 3. Soil pollution 4. Marine pollution 5. Noise pollution 6. Thermal pollution 7. Nuclear hazards

#### Unit V Social Evils

Social evils in India are follows; 1. Poverty 2. Caste 3. Corruption 4. Alcoholism and drug abuse 5. Crimes against women 6. Dowry 7. Child abuse 8. Erosion of family values and apathy towards elders 9. Religious intolerance 10. Major crimes I Terrorism – Aim to cause hardship to the common man and strike at public places. Cyber crime: 1. Hacking – Illegal intrusion into a computer system or network 2. Child Pornography – Reach and abuse children sexually world wide 3. Cyber stalking – Repeated acts harassment or threatening behavior of the cyber criminal 4. Virus dissemination – Virus, worms, Trojan horse, time bomb, logic bomb, rabbit and bacterium. 5. Software piracy – Theft of software through the illegal copying of genuine programs. 6. Phishing- The website, however, is bogus and setup only t steal the users information Crimes/ violence against women: Threats, Sexual abuse, Emotional abuse, Domineering, Intimidation, Stalking, Rape, Abduction, Kidnapping, Murder (dowry death) etc.

### Semester VI

| Course Components | Subjects  | Inst. Hrs | Credits | Exam Hrs. | Max. Marks |            |       |
|-------------------|---|-----------|---------|-----------|------------|------------|-------|
|                   |   |           |         |           | Ext. Marks | Int. Marks | Total |
| Part-III          | Core paper -XIII- Inorganic chemistry II                          | 5         | 5       | 3         | 75         | 25         | 100   |
|                   | Core paper- XIV- Organic Chemistry II                             | 5         | 5       | 3         | 75         | 25         | 100   |
|                   | Core paper -XV- Physical chemistry II                             | 5         | 5       | 3         | 75         | 25         | 100   |
|                   | Core paper-X-Gravimetric Analysis (Practical-III)                 | 3         | 3       | 3         | 60         | 40         | 100   |
|                   | Core paper -XI- Organic analysis and preparation (Practical - IV) | 3         | 3       | 3         | 60         | 40         | 100   |
|                   | Core paper -XII- Physical chemistry (Practical V)                 | 3         | 3       | 3         | 60         | 40         | 100   |
|                   | Elective paper-III (Spectroscopy/Analytical chemistry)            | 5         | 5       | 3         | 75         | 25         | 100   |
| Part-V            | Extension Activities  | 1         | 1       |           |            |            |       |

| Semester | Subject                               | Total Hours | Credits |
|----------|---------------------------------------|-------------|---------|
| VI       | PAPER - XIII INORGANIC CHEMISTRY – II | 75          | 5       |

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

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 – Chemistry of OrganoCopper, OrganoLead, OrganoPhosphorus and OrganoBoron compounds. Organometallic compounds of alkenes, alkynes and cyclopentadiene

## UNIT III: NUCLEAR CHEMISTRY (15 hrs)

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 (15 hrs)

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 Gieger-Nuttal 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 (15 hrs)

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

Puri, B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 30th ed., Mile stone publishers and distributors, 2009.

## BOOKS FOR REFERENCE

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



| Semester | Subject                           | Total Hours | Credits |
|----------|-----------------------------------|-------------|---------|
| VI       | PAPER - XIV ORGANIC CHEMISTRY –II | 75          | 5       |

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

Carbohydrates –Definition and Classification of carbohydrates with examples. Mono saccharides:Explanation of enantiomers, diastereomers, epimers and anomers with examples. Mechanism mutarotation, osazoneformation.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 (15 hrs)

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 (15 hrs)

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 (10 hrs)

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

#### Unit-5: STEREOCHEMISTRY OF ORGANIC COMPOUNDS (20 hrs)

Stereoisomerism - definition, classification into geometric and optical isomerism. Optical isomerism — Optical activity, asymmetric centre(chirality), symmetry elements ( $\sigma$ ,  $S_n$  and  $i$ ), meaning of (+) or d and (-) orl 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. [3 D visualization through computers]



## TEXTBOOK

Bahl B.S. and ArunBahl, Advanced Organic Chemistry, 12th ed., Sultan Chand and Co., New Delhi, 1997.

## BOOKS FOR REFERENCE

1. Finar I.L., Organic Chemistry, Vol. 1&2, 6th ed., Addison Wesley Longman Ltd., London, 1996.
2. Marrison R.T., Boyd R.N., Organic Chemistry, 4th ed., Allyn& Bacon Ltd., New York, 1976.
4. Pine S.H., Organic Chemistry, 4th ed., McGraw-Hill International Book Company, (1986)
5. Peter Sykes, A Guidebook to Mechanism in Organic Chemistry, 6th ed., Pearson Education, 2003.
6. Kalsi, P.S., Stereochemistry of Organic Compounds: Principles and Applications, New Age International, 2011
7. Sujata V Bhat, Nagasampagi B.A., and MeenakshiSivakumar, Chemistry of Natural Products, Springer, 2006.
8. Agarwal O.P., Organic Chemistry Reactions & Reagents, 49th ed., Goel Publishing House, 2014.

| Semester | Subject                           | Total Hours | Credits |
|----------|-----------------------------------|-------------|---------|
| VI       | PAPER - XV PHYSICAL CHEMISTRY- II | 75          | 5       |

## UNIT I: CHEMICAL KINETICS ( 20hrs )

Rate of reaction- Average and instantaneous rates, factors influencing rate of reaction - molecularity of a reaction - rate equation - order of reaction. order and molecularity of simple and complex 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, promoters, negative catalysis, poisoning of a catalyst – theories of homogenous and heterogeneous catalysis – Kinetics of Acid – base and enzyme catalysis. Heterogenous catalysis

Adsorption – Chemical and physical adsorption and their 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 photo chemistry – Lambert – Beer, Grotthus – Draper and Stark – Einstein. Quantum efficiency. Photo chemical reactions – rate law – Kinetics of  $H_2-Cl_2$ ,  $H_2-Br_2$  and  $H_2-I_2$  reactions, comparison between thermal and photochemical reactions.

## UNIT IV : GROUP THEORY (10 hrs)

Symmetry elements and symmetry operation symmetry operation of  $H_2O$  molecule, Illustration of mathematical rules for the group using symmetry operations of  $H_2O$  molecule. Construction of multiplication table, for  $H_2O$  molecule. Point group - Definition Elements (symmetry operations) of the following point groups  $C_n$  ( $C_2$ ,  $C_3$ ),  $C_{nv}$  ( $C_2V$ ,  $C_3V$ ) and  $C_{nh}$  ( $C_2h$ ,  $C_3h$ )

## UNIT V: ELECTROCHEMICAL CELLS (20 hrs )

Electrolytic & Galvanic cells – Reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement computation of E.M.F. calculation of thermodynamic quantities of cell reactions ( $\Delta G, \Delta H, \Delta S$  and  $K_{eq}$ ). Application of Gibbs Helmholtz equation. Calculation of E.M.F. 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 E.M.F. and single electrode potential - standard hydrogen electrode – reference electrodes – standard electrodes potentials – sign convention – Electrochemical series and its significance. Concentration cell with and without transport. Liquid junction potential. Application of EMF concentration cells. Valency of ion, solubility product and activity co-efficient. Potentiometric titrations. Determination of pH using Hydrogen, quinhydrone and glass electrodes. Determination of  $pK_a$  of acids by potentiometric method. Corrosion - general and electrochemical theory - passivity - prevention of corrosion.

## TEXT BOOKS

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th ed., Vishal Publishing Company, 2016.
2. Sharma K.K. and Sharma L.K., A Text Book of Physical Chemistry, 6th ed., S.Chand, 2016.

## Books for References

1. Maron S.H. and Lando 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 III

| Semester | Subject              | Total Hours | Credits |
|----------|----------------------|-------------|---------|
| VI       | ANALYTICAL CHEMISTRY | 75          | 5       |

### Unit – I (10hrs)

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 – II (20hrs)

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 TGA 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 ( Rf value) and applications - Paper chromatography - Solvents used - factors affecting Rfvalue – separation of amino acid mixtures.

### Unit – III (15hrs)

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 – IV (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 –V (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 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, 3rd ed. Reprint, Sultan Chand & Sons, 2013.
- 2.SkoogD.A., West D.M., James Holler F. and Stanley R., Fundamentals of Analytical Chemistry,9th ed., 2013
- 3.Khopkar S.M., Analytical Chemistry , New Age International.

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