



# SYLLABUS FOR B.SC. CHEMISTRY (COMPLEMENTARY)

## SEMESTER I

### CH1CMT01 - BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

(Common for students who have opted Life Sciences, Family & Community Science,  
Physical Sciences and Geology as core)

Credits - 2 (36 Hrs)

#### Unit 1: Atomic Structure and Chemical Bonding (9 Hrs)

*Atomic Structure:* Bohr atom model and its limitations, Dual nature of matter and radiation. Photoelectric effect, de Broglie equation, Heisenberg's uncertainty principle, Concept of orbital, Quantum numbers, shapes of orbitals (*s*, *p*, *d*), Electronic configuration of atoms - Aufbau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle.

*Chemical Bonding:* Introduction – Type of bonds. Ionic bond: Factors favouring the formation of ionic bonds - Lattice energy of ionic compounds and its applications. Covalent bond: Lewis theory - Valence bond theory – Coordinate bond. VSEPR theory and examples. Hybridisation: -  $sp^3$ ,  $sp^2$  and  $sp$  (ethane, ethene, ethyne). Intermolecular forces - Hydrogen bonding in  $H_2O$  - Dipole-dipole interactions.

#### Unit 2: Fundamental Concepts in Chemistry (9 hrs)

*Periodic Properties:* Modern periodic law – Long form of periodic table. Periodicity in properties: Atomic radii, ionic radii, ionization enthalpy, electron affinity (electron gain enthalpy) and electronegativity (Pauling scale). Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Oxidation number and valency - Equivalent mass. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm and millimoles.

*Concept of Equilibrium:* Acids and Bases - Arrhenius, Lowry-Bronsted and Lewis theories. Ionic product of water - pH and pOH, Strengths of acids and bases -  $K_a$  and  $K_b$ ,  $pK_a$  and  $pK_b$ . Buffer solution. Preparation of buffer solution having a known pH. Solvation, solubility, solubility product, common ion effect and their applications.

#### Unit 3: Basic Principles of Analytical Chemistry (9 Hrs)

*Laboratory Operations (Non-evaluative):* Laboratory safety and first aid. Use of different glassware like pipette, burette, standard measuring flask, distillation apparatus; heating methods, filtration techniques, weighing principle in chemical balance, weighing in electronic balance.

*Methods of Analysis:* Volumetric method of analysis - General principles. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, end point. Acid base, redox and complexometric titrations and corresponding indicators. Double burette method of titration: Principle and advantages. Microanalysis and its advantages. Gravimetric method of analysis: General principles.

*Reporting of Analytical Data:* Units, significant digits, rounding, scientific and prefix notation, graphing of data - Precision and accuracy – Types of errors – Ways of expressing precision – Methods to reduce systematic errors.



*Separation and Purification Techniques*: Recrystallisation, use of drying agents, sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure. Solvent extraction.

#### **Unit 4: Chromatographic Techniques**

**(9 Hrs)**

Chromatography - Principle of differential migration. Classification of chromatographic methods. Basic principle and uses of Thin layer chromatography (TLC), Paper chromatography (PC),  $R_f$  value, Column chromatography, Gas chromatography (GC), High performance Liquid chromatography (HPLC), Ion Exchange chromatography (IEC).

#### **References**

1. B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 3rd edn. Vishal Pub. Co., 2008.
2. C. N. R. Rao, *University General Chemistry*, Macmillan, 2009.
3. Manas Chanda, *Atomic Structure and Molecular Spectroscopy*.
4. P. L. Soni, *Inorganic Chemistry*.
5. R. A. Day Junior, A.L. Underwood, *Quantitative Analysis*, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988.
6. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th edn. Pearson Education (2003).
7. R. Gopalan, *Analytical Chemistry*, S. Chand and Co., New Delhi.



## SEMESTER II

### CH2CMT02 - BASIC ORGANIC CHEMISTRY

(Common for students who have opted Life Sciences, Family & Community Science, Physical Sciences and Geology as core)

Credits – 2 (36 Hrs)

#### Unit 1: Fundamental Concepts of Organic Chemistry (9 Hrs)

Introduction: Origin of organic chemistry – Uniqueness of carbon – Homologous series. IUPAC nomenclature of alkyl halides, alcohols, aldehydes, ketones, carboxylic acids and amines. Structural isomerism: Chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism. Arrow formalism in organic chemistry. Bond fission - homolytic and heterolytic fission. Types of reagents - Electrophiles and nucleophiles. Polarity of bonds. Reaction Intermediates: Carbocations, carbanions and free radicals (preparation, structure, hybridization and stability). Types of organic reactions: Addition, Elimination, Substitution, Rearrangement and Redox reactions (definition and one example each).

#### Unit 2: Mechanisms of Organic Reactions (9 Hrs)

Meaning of reaction mechanism. Polarity of bonds. Electron Displacement Effects: Inductive effect - Definition - Characteristics - +I and -I groups. Applications: Explanation of substituent effect on the acidity of aliphatic carboxylic acids. Mesomeric effect: Definition – Characteristics - +M and -M groups. Applications: Comparison of electron density in benzene, nitrobenzene and phenol. Hyperconjugation: Definition – Characteristics. Applications: Baker-Nathan effect, Comparison of stability of 2-methyl-1-butene & 2-methyl-2-butene. Steric effect (causes and simple examples). *Substitution reactions*: nucleophilic substitution of alkyl halides-  $S_N1$  and  $S_N2$  mechanisms. Electrophilic substitutions in benzene - reaction mechanism. Addition reactions: electrophilic addition to alkene and alkynes - Markwonikoff's rule, Peroxide effect. Elimination reactions: E1 and E2 mechanisms.

#### Unit 3: Stereochemistry of Organic Compounds (9 Hrs)

*Stereoisomerism* – definition, classification.

*Geometrical Isomerism*: Definition – Condition – Geometrical isomerism in but-2-ene and but-2-ene-1,4-dioic acid. cis and trans, *E* and *Z* configurations. Methods of distinguishing and interconversion of geometrical isomers.

*Optical Isomerism*: Optical activity – Chirality – Enantiomers - Meso compounds - Diastereoisomers – Optical isomerism in lactic acid and tartaric acid - Racemisation and resolution (elementary idea only).

*Conformations*: Newman projection, Saw-horse projection. Conformations of ethane, n-butane, and cyclohexane - Relative stability and energy diagrams. Conformation of methyl cyclohexane.

#### Unit 4: Natural and Synthetic Polymers (9 Hrs)

Introduction. Classification of polymers: Natural, synthetic; linear, cross-linked and network; plastics, elastomers, fibres; homopolymers and copolymers. Polymerization reactions. Typical examples: Polyethylene, polypropylene, PVC, phenol-formaldehyde and melamine-formaldehyde resins, polyamides (nylons) and polyesters. Natural rubber: structure, latex processing methods, vulcanization and uses. Synthetic rubbers: SBR, nitrile rubber and neoprene. Biodegradability of polymers, environmental hazards. Recycling of plastics.



## References

1. I. L. Finar, *Organic Chemistry Vol. I*, 6th edn. Pearson.
2. M.K. Jain, S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co. 2010.
3. S. M. Mukherji, S. P Singh, R. P Kapoor, *Organic Chemistry Vol.1*, New Age International Pvt. Ltd, 2006.
4. S. Sengupta, *Basic Stereochemistry of Organic Molecules*, 2014.
5. E. L. Eliel, S.H. Wilen, *Stereochemistry of Organic Compounds*, Wiley, 1994.
6. Peter Sykes, *A Guide Book to Mechanism in Organic Chemistry*, 6th edn. Orient Longman, 1988.
7. S. M. Mukherji, S.P Singh, *Reaction Mechanism in Organic Chemistry*, Macmillan, 3<sup>rd</sup> edn., 2003.
8. V.R. Gowarikar, N.V. Viswanathan, J. Sreedhar, *Polymer Science*, 2<sup>nd</sup> edn., New Age International Pvt. Ltd., 2015.



## SEMESTER-III

### CH3CMT03 - PHYSICAL CHEMISTRY – I

(For students who have opted Physical Sciences and Geology as Main)

Credits-3 (54 Hrs)

#### Unit 1: Solids and Crystalline State

(18 Hrs)

Classification of solids: amorphous, crystalline – differences. Lattice, lattice energy (general idea), unit cell, examples of simple cubic, bcc and fcc lattices, calculation of number of atoms in a unit cell, calculation of lattice parameters of cubic unit cell. Theories of Solid: band theory, conductors, semiconductors and insulators, mention of super conductors. Magnetic Properties: classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferrimagnetic, permanent and temporary magnets.

Symmetry of molecules-symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, crystallographic point groups, Schoenflies symbol. Symmetry elements in crystals - The seven crystal systems – Weiss and Miller indices - Bravais lattices – Bragg's equation (derivation required) and its applications (mention only), structure determination of NaCl by X-ray diffraction.

#### Unit 2: Liquid State and Solutions

(12 Hrs)

*Liquids:* Intermolecular forces, liquids compared with gases and solids (qualitative idea only), viscosity, surface tension (method of determination not expected), structure of liquids (a qualitative description). Liquid crystals – the intermediate phase between solid and normal liquid phases, thermographic behaviour, classification, structure of nematic and cholesteric phases.

*Solutions:* Kinds of solutions - Solubility of gases in liquids – Henry's law and its applications - Colligative properties - Osmotic pressure - Reverse osmosis and its applications - Determination of molecular mass using colligative properties.

#### Unit 3: Gaseous State

(9hrs)

*Gaseous State:* Introduction - Kinetic molecular model of gases – Maxwell distribution of velocities and its use in calculating molecular velocities – Average velocity, RMS velocity and most probable velocity (derivations not required) – Boyle's law – Charles's law – Ideal gas equation – Behaviour of real gases – Deviation from ideal behaviour - Van der Waals equation (derivation not required).

#### Unit 4: Surface Chemistry and Colloids

(9 Hrs)

Adsorption – types of adsorption of gases by solids, factors influencing adsorption, Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation not required).

True solution, colloidal solution and suspension. Classification of colloids: Lyophilic, lyophobic, macromolecular, multimolecular and associated colloids with examples. Purification of colloids by electrodialysis and ultrafiltration. Properties of colloids: Brownian movement – Tyndall effect – Electrophoresis. Origin of charge and stability of colloids – Zeta potential – Coagulation - Hardy Schulze rule – Protective colloids - Gold number. Emulsions. Applications of colloids: Delta formation, medicines, emulsification, cleaning action of detergents and soaps.



### Unit 5: Phase Equilibrium

(6Hrs)

The phase rule, definition, equilibrium between phases, one component system – water system, two component systems: solid- liquid equilibrium – simple eutectic, lead-silver system, solid solution. Distribution law, partition coefficient, applications.

#### References

1. B.R. Puri, L.R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 40th edn. Vishal Pub. Co. Jalandhar (2013)
2. B. R. Puri, L.R. Sharma and K.C. kalia, *Principles of Inorganic Chemistry*, Milestone Publishers New Delhi. 2013.
3. J.A. K. Tareen and T.R. N. Kutty, *A basic course in Crystallography*, University Press, 2000.
4. Anthony R West, *Solid State Chemistry and its Applications*”, Wiley Eastern
5. V.Ramakrishnan and M.S.Gopinathan, “Group Theory in Chemistry”, Vishal Publishing Co.
6. Gurdeep Raj, “Advanced Physical Chemistry”, Goel Publishing House.
7. Walter J. Moore, *Physical Chemistry*, 4thEdn. Longmans Green and Co. Ltd.
8. P. W Atkins, “Physical Chemistry”, Oxford University Press.
9. R. J Silby and R.A Alberty, “Physical Chemistry”, John Wiley & Sons.



## SEMESTER III

### CH3CMT04: INORGANIC AND ORGANIC CHEMISTRY (For students who have opted Life Sciences and Family & Community Science as core)

Credits - 3 (54 Hrs)

#### Unit 1: Nuclear Chemistry (12 Hrs)

Nuclear Stability - Mass defect, Binding energy, Nuclear forces, Magic number, Packing fraction, n/p ratio. Natural and induced radioactivity, radioactivity – detection, Units of radioactivity. Modes of decay – Group displacement law. Isotopes, isobars and isotones with examples. Nuclear fission - Atom bomb – Nuclear fusion – Hydrogen bomb - Nuclear reactors - Nuclear reactors in India. Application of radioactive isotopes –  $^{14}\text{C}$  dating – Rock dating – Isotopes as tracers – Radio diagnosis and radiotherapy.

#### Unit 2: Bioinorganic Chemistry (6 Hrs)

Thermodynamics of Living cell- Exergonic and endergonic reactions, coupled reactions. Metal ions in biological systems - Biochemistry of iron – Metalloporphyrins - Haemoglobin and myoglobin, pH of blood, cytochromes, Ferredoxine - Mechanism of  $\text{O}_2$  and  $\text{CO}_2$  transportation - Chlorophyll and photosynthesis (mechanism not expected) elementary idea of photophosphorylation. Photosynthesis and respiration – comparison. – Elementary idea of structure and mechanism of action of sodium potassium pump. Biochemistry of zinc and cobalt.

#### Unit 3: Chemistry and Agriculture (12 Hrs)

*Fertilizers:* NPK, superphosphates, triple super phosphate, uses of mixed fertilizers, micronutrients and their role, bio-fertilizers, plant growth hormones.

*Pesticides:* Classifications with simple examples, Biopesticides. Insecticides – stomach poisons, contact insecticides, fumigants. Method of preparation and use of DDT, BHC, pyrethrin. Herbicides - structure and function of 2, 4,-D and 2,4,5 -T, Fungicides- inorganic and organic- Bordeaux mixture. Excessive use of pesticides – environmental hazards.

#### Unit 4: Heterocyclic Compounds (12 Hrs)

Aromaticity – Huckel's rule, preparation (any one method), properties, structure and aromaticity of furan, pyrrole, pyridine and indole. Pyrimidines & purines - adenine, guanine, thymine, cytosine and uracil.

#### Unit 5: Drugs (6 Hrs)

Classification of drugs. Structure, therapeutic uses and mode of action (synthesis not required) of Antibiotics: Ampicillin, Sulpha drugs: Sulphanilamide, Antipyretics: Paracetamol, Analgesics: Aspirin, Antacids: Ranitidine, Antimalarials: Chloroquine and Anti-cancer drugs: Chlorambucil. Psychotropic drugs: Tranquilizers, antidepressants and stimulants with examples. Drug addiction and abuse. Prevention and treatment.



**Unit 6: Food Additives and Cosmetics**

**(6 Hrs)**

*Food Additives:* Food preservatives, artificial sweeteners, flavours, emulsifying agents, antioxidants, leavening agents and flavour enhancers (definition and examples, structures not required) – Structure of BHT, BHA and MSG - Commonly used permitted and non-permitted food colours (structures not required) - Fast foods and junk foods & their health effects – Soft drinks and their health effects.

*Cosmetics:* Introduction, classification. Dental cosmetics, Shampoos, Hair dyes, Skin products, Shaving cream, Talcum powder, Perfumes and Deodorants (composition and health effects).

**References**

1. H.J. Arnikaar, *Essentials of Nuclear Chemistry* (Revised IV edn.), New Age, 1995.
2. B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 3rd edn. Vishal Pub Co., 2008.
3. I. L. Finar, *Organic Chemistry* Vol. 1 & 2, 6th edn., Pearson, 2002.
4. C.N. R. Rao, *University General Chemistry*, Macmillan 2009.
5. B. R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers New Delhi. 2013.
6. G. R. Chatwal, *Synthetic Drugs*, Himalaya Publishing House, Bombay, 1995.
7. J.Ghosh, *A Textbook of Pharmaceutical Chemistry*, S. Chand & Co Ltd., 1997
8. B. Sreelakshmi, *Food Science*, New Age International Pvt. Ltd, New Delhi, 2015.
9. J.W. Hill, T.W. McCreary, D.K. Kolb, *Chemistry for Changing Times*, Prentice Hall, 12<sup>th</sup> edn., 2010.





## SEMESTER-IV

### CH4CMT05 - PHYSICAL CHEMISTRY – II (For students who have opted Physical Sciences and Geology as Main)

Credits-3 (54 Hrs)

#### Unit 1: Introduction to Spectroscopy (9 Hrs)

Interaction of electromagnetic radiation with matter, electromagnetic spectrum, quantization of energy, electronic, vibrational and rotational energy levels, Boltzmann distribution of energy (formula only), population of levels.

UV- Visible Spectroscopy: Beer Lambert's law, molar extinction coefficient and its importance, UV spectrum, max, chromophore, auxochrome, red shift, blue shift, types of transition.

Infra-red spectroscopy: vibrational degrees of freedom, types of vibrations – symmetric and asymmetric stretching and bending, calculation of force constant, concept of group frequencies-frequencies of common functional groups in organic compounds, Fingerprint region in IR spectra.

Rotational Spectroscopy: diatomic molecules, determination of bond length.

#### Unit 2: Nano Chemistry (9 Hrs)

Terminology- scales of nanosystems- nanoparticles. Nanomaterials – synthesis – chemical precipitation, mechano-chemical method, micro emulsion method, reduction technique, chemical vapour deposition and sol-gel method (brief study). Properties and applications of fullerenes and carbon nanotubes. Nanochemical devices- optoelectronic devices- photodetectors- LEDs and lasers.

#### Unit 3: Kinetics, Catalysis & Photochemistry (18 Hrs)

*Kinetics*: Rates of reactions - Factors influencing rate of reactions - Order and molecularity - Zero, first, second and third order reactions - Derivation of integrated rate equations for first order and second order reactions (single reactant only) - Half-life period for first order reaction - Units of rate constants - Influence of temperature on reaction rates - Arrhenius equation - Calculation of Arrhenius parameters - Collision theory of reaction rate, Activated complex theory-basic concepts-no derivation required.

*Catalysis*: Types of catalysis – Homogeneous and heterogeneous catalysis. Theories of catalysis: Outline of intermediate compound formation theory and adsorption theory.

Laws of photochemistry, Grothus Draper law, Stark-Einstein's Law, Beer Lambert's Law. Photochemical equivalence and quantum explanation for low and high quantum yields. Photosensitization, Jablonski diagram- Fluorescence and phosphorescence, flash photolysis and chemiluminescence.

#### Unit 4: Electrochemistry (18 Hrs)

Introduction- Faraday's laws of electrolysis, electrochemical equivalent and chemical equivalent, Specific conductance, equivalent conductance and molar conductance – Variation of conductance with dilution - Kohlrausch's law - Degree of ionization of weak electrolytes - Application of conductance measurements –Determination of degree of dissociation of weak electrolytes, conductometric titrations involving strong acid- strong base, strong acid-weak base, weak acid- strong base, and precipitation titration.



Galvanic cells - Cell and electrode potentials - IUPAC sign convention, Types of electrodes: Reference electrodes – Standard hydrogen electrode and calomel electrode, Indicator electrodes-metal-metal ion electrodes, Quinhydrone electrode and Redox electrodes. Standard electrode potential - Nernst equation, electro chemical series. Gibbs Helmholtz equation and EMF of a cell.

Fuel cells- H<sub>2</sub>-O<sub>2</sub> fuel cell. Potentiometric titrations of acid-base and redox reactions-precipitation reactions.

### References

1. Banwell, C. N. & Mc Cash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. D. L. Pavia, G. M. Lampman, G. S. Kriz, *Introduction to spectroscopy* 3rd edn, Thomson Brooks/Cole, 2001.
3. V. S. Muraleedharan and A. Subramania, *Nanoscience and nanotechnology*, Ane Books Pvt. Ltd. New Delhi, 2009
4. T. Pradeep, *Nano: The Essentials*, McGraw-Hill education, New Delhi, 2006.
5. K.K. Sharma and L.K. Sharma, *A Textbook of Physical Chemistry*, 5th Edition, Vikas Publishing House, New Delhi, 2012.
6. B. R. Puri, L.R. Sharma, M. S. Pathania, *Elements of Physical Chemistry*, 40th edn. Vishal Pub. Co. Jalandhar (2003).
7. G. M. Barrow, *Physical Chemistry*, 5th Edition, Tata McGraw Hill Education, New Delhi, 2006.
8. G. K. Vemulapalli, *Physical Chemistry*, Prentice-Hall of India Pvt. Ltd. (1997)
9. Gurdeep Raj, *Photochemistry*, 6th Edn, Goel Publishing House, 2014.



## SEMESTER IV

### CH4CMT06 ADVANCED BIO-ORGANIC CHEMISTRY

(For students who have opted Life Sciences and Family & Community Science as core)

Credits - 3 (54 Hrs)

#### Unit 1: Natural Products (6 Hrs)

*Terpenoids*: Classification with examples – Isoprene rule – Isolation of essential oils by steam distillation – Uses of lemongrass oil, eucalyptus oil and sandalwood oil - Source, structure and uses of citral and geraniol.

*Alkaloids*: Classification – Isolation, general properties. Source, structure and physiological activity of nicotine, coniine and piperine.

#### Unit 2: Lipids (6 Hrs)

*Lipids*: Classification – Oils, fats and waxes (definition, structure, biological functions and examples). Hydrogenation and Rancidity - Acid value, Saponification value and Iodine value –. Biological functions of phospholipids and glycolipids

*Soaps and Detergents*: Soaps – Types of soaps. Cleansing action of soaps. Synthetic detergents - Classification. Comparison between soaps and detergents. Environmental aspects.

#### Unit 3: Amino Acids and Proteins (12 Hrs)

*Amino acids*: Classification – Zwitter ion formation and isoelectric point- Synthesis of glycine, alanine, and phenyl alanine (any one method). Peptides: Peptide bond. Synthesis of peptides (upto dipeptides). Proteins: Classification of proteins – Primary, secondary and tertiary structure of proteins – Denaturation of proteins – Tests for proteins.

#### Unit 4: Enzymes and Nucleic Acids (9 Hrs)

*Enzymes*: Nomenclature, classification and characteristics. Mechanism of enzyme action. Theory of enzyme catalysis – Michaelis-Menten theory. Cofactors and coenzymes. Enzyme inhibitors. Uses of enzymes.

*Nucleic acids*: Structure of pentose sugar, nitrogenous base, nucleoside and nucleotide – Double-helical structure of DNA – Differences between DNA and RNA. Biological Functions – Replication and protein biosynthesis. Transcription and Translation. Genetic code.

Energy rich molecules: Elementary structure of ATP, ADP and AMP.

#### Unit 5: Carbohydrates (12 Hrs)

Carbohydrates: Classification with examples. Preparation and properties of glucose, fructose and sucrose. Cyclic structures and Haworth projections of glucose, fructose, maltose and sucrose (ring size determination not expected). – Mutarotation. Conversion of glucose to fructose and vice versa. – Structure of starch and cellulose (structure elucidation not expected). Industrial applications of cellulose.

#### Unit 6: Vitamins, Steroids and Hormones (9 Hrs)

*Vitamins*: Classification. Structure, biological functions and deficiency diseases of vitamins A, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>5</sub>, B<sub>6</sub>, B<sub>12</sub> (structure not required), C and D.

*Steroids*: Introduction. Structure and functions of cholesterol. Elementary idea of HDL and LDL. Bile acids.



*Hormones:* Introduction. Steroid hormones, peptide hormones and amine hormones (examples, endocrine gland and biological functions, structure not required). Artificial hormones (elementary study only).

### References

1. Maya Shankar Singh, L.G.Wade, *Organic Chemistry*, 6th Edition, Pearson Education, New Delhi, 2013.
2. P.Y. Bruice, *Essential Organic Chemistry*, 1st Edition, Pearson Education, New Delhi, 2013.
3. I.L. Finar, *Organic Chemistry Vol. I & II*, 5th Edition, Pearson Education, New Delhi, 2013.
4. M.K. Jain, S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co. 2010.
5. K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, *A Textbook of Organic Chemistry*, 2nd Edition, Vikas Publishing House (P) Ltd., New Delhi, 2004.
6. A. Bahl and B.S. Bahl, *Advanced Organic Chemistry*, 1st Multicolour Edition, S. Chand & Company, New Delhi, 2010.
7. A.C. Deb, *Fundamentals of Biochemistry*, 9<sup>th</sup> Edn. New Central Book Agency, 2001.
8. Rastogi, *Biochemistry*, Tata Mc Graw –Hill Publication, 1996.
9. Bhat S.V., Nagasampagi, B.A. & Sivakumar M. *Chemistry of Natural Products*, Narosa, 2005.



## PRACTICAL-I

(Semester I and II)

(Common to Physical sciences, Life sciences, Geology and Family & Community sciences)

### CH2CMP01 - VOLUMETRIC ANALYSIS

Credit – 2 (72 Hrs)

Standard solution must be prepared by the student.

#### 1. Acidimetry and Alkalimetry

1. Standardization of HCl with standard  $\text{Na}_2\text{CO}_3$  solution
2. Standardization of NaOH with standard oxalic acid solution
3. Estimation of any acid using standard NaOH
4. Estimation of any alkali using standard HCl.

#### 2. Permanganometry

1. Standardization of  $\text{KMnO}_4$  using (i) oxalic acid (ii) Mohr's salt
2. Estimation of  $\text{Fe}^{2+}$  in Mohr's salt and crystalline Ferrous Sulphate using standard  $\text{KMnO}_4$ .

#### 3. Dichrometry

1. Estimation of Ferrous ions (external indicator)
2. Estimation of Ferrous ions (internal indicator)
3. Estimation of  $\text{FeSO}_4 \cdot 7 \text{H}_2\text{O}$  (external indicator)

#### 4. Iodimetry and Iodometry

1. Standardization of Iodine solution
2. Standardization of Sodium thiosulphate
3. Estimation of  $\text{KMnO}_4$
4. Estimation of Copper

#### References

1. D. A. Skoog, D. M. West, and S. R. Crouch, *Fundamentals of Analytical Chemistry* 8th edn, Brooks/Cole Nelson
2. *Vogel's Textbook of Quantitative Chemical Analysis* 6th edn., Pearson Education. Ltd.
3. G. D. Christian, *Analytical Chemistry*, JohnWiley and Sons
4. R.D Day, A.L. Underwood, *Quantitative Analysis*, 6<sup>th</sup> Edn., Prentice Hall of India Pvt. Ltd.



**PRACTICAL – II**  
**(Semesters III and IV)**

**CH4CMP02 - PHYSICAL CHEMISTRY PRACTICALS**  
**(For students who have opted Physical Sciences and Geology as Main)**

**Credit – 2 (72 Hrs)**

1. Viscosity-percentage composition of sucrose solution.
2. Determination of Partition coefficient of a non-volatile solute
3. Transition temperature of salt hydrates, eg. Sodium thiosulphate Sodium acetate etc.
4. Critical solution temperature of phenol water system
5. Phase diagram of two component systems
6. Heat of Solution  $\text{KNO}_3$ ,  $\text{NH}_4\text{Cl}$
7. Heat of neutralization
8. Determination of equivalent conductance of an electrolyte
9. Conductometric titration of strong acid Vs. strong base
10. Potentiometric titrations :  $\text{Fe}^{2+}$  Vs.  $\text{Cr}_2\text{O}_7^{2-}$  and  $\text{Fe}^{2+}$  Vs.  $\text{KMnO}_4$
11. Determination of molecular weight by Rast's method. (Using naphthalene, or biphenyl as solvent and acetanilide, p-dichlorobenzene etc.as solute)
12. Kinetics of simple reactions, e.g. Acid hydrolysis of methyl acetate

**References**

1. W. G. Palmer: 'Experimental physical chemistry', Cambridge University Press.
2. J. B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
3. R. C. Das and B. Behra; 'Experiments in Physical Chemistry' , Tata McGraw hill.
4. K. K. Sharma : 'An Introduction of Practical Chemistry': Vikas Publishing House, New Delhi



**CH4CMP03 - ORGANIC CHEMISTRY PRACTICALS**  
(For students who have opted Life Sciences and Family & Community Science as Core)

**Credit – 2 (72 Hrs)**

1. Tests for elements: Nitrogen, Halogen and Sulphur
2. Determination of physical constants
3. Study of reactions of common functional groups.
4. Qualitative analysis with a view to characterization of functional groups and identification of the following compounds: Naphthalene, anthracene, chlorobenzene, benzyl chloride, p-dichlorobenzene, benzyl alcohol, phenol, o-, m- and p- cresols,  $\alpha$ -naphthol,  $\beta$ -naphthol, resorcinol, benzaldehyde, acetophenone, benzophenone: benzoic acid, phthalic acid, cinnamic acid, salicylic acid, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, o-, m- and p- toluidines, dimethyl aniline, nitrobenzene, o-nitrotoluene, m-dinitrobenzene and glucose. (minimum of ten compounds to be analysed).
5. Organic preparation involving halogenation, nitration, oxidation, reduction, acetylation, benzylation, hydrolysis, diazotization.
6. Isolation of an organic compound from a natural source.

**References:**

1. A. I Vogel, *A Text Book of Practical Organic Chemistry*, Longman.
2. F. G. Mann and B.C. Saunders, *Practical Organic Chemistry*, 4th Edn., Pearson Education.
3. V. K. Ahluwalia and S. Dhingra, *Comprehensive Practical Organic Chemistry*, Universities Press.

**N. B: These complementary courses are applicable to relevant Model-II and other course**