Department of Chemistry

S. No	Subject Code	Subject Title
1	16UCH1MC01	BASIC CONCEPTS IN INORGANIC CHEMISTRY
2	16UCH1MC02	ANALYTICAL CHEMISTRY
3	16UCH1MC03	VOLUMETRIC ANALYSIS
4	16UMT1AL03	MATHEMATICS FOR CHEMISTRY – I
5	16UCH2MC01	CHEMISTRY OF HYDROCARBONS
6	16UCH2MC02	CHEMICAL BONDING AND MAIN GROUP ELEMENTS
7	16UCH2MC03	ORGANIC QUALITATIVE ANALYSIS
8	16UCH3MC01	THERMODYNAMICS
9	16UCH3MC02	STEREOCHEMISTRY AND ORGANIC FUNCTIONAL GROUPS-I
10	16UCH3MC03	INORGANIC QUALITATIVE ANALYSIS
11	16UPH3AL01	PHYSICS FOR CHEMISTRY – I
12	16UPH3AL02	PHYSICS FOR CHEMISTRY PRACTICAL – I
13	16UCH4MC01	ELECTROCHEMISTRY
14	16UCH4MC02	PHYSICAL CHEMISTRY PRACTICAL
15	16UCH4ES01	CHEMISTRY OF FOOD AND CONSUMER PRODUCTS
16	16UCH4ES02	MATERIALS SCIENCE
17	16UPH4AL01	PHYSICS FOR CHEMISTRY – II
18	16UPH4AL02	PHYSICS FOR CHEMISTRY II LAB
19	16UCH5MC01	COORDINATION CHEMISTRY

20	16UCH5MC02	PHASE EQUILIBRIA AND KINETICS
21	16UCH5MC03	ORGANIC FUNCTIONAL GROUPS-II
22	16UCH5MC04	APPLIED CHEMISTRY LAB
23	16UCH5ES01	BIOCHEMISTRY AND NATURAL PRODUCTS
24	16UCH5ES02	MEDICINAL AND PHARMACEUTICAL CHEMISTRY
25	16UCH5SK01	INDUSTRIAL CHEMISTRY
26	16UCH6MC01	QUANTUM CHEMISTRY AND PHYSICAL PROCESSES
27	16UCH6MC02	TRANSITION ELEMENTS AND NUCLEAR CHEMISTRY
28	16UCH6MC03	SYNTHETIC ORGANIC CHEMISTRY AND HETEROCYCLIC COMPOUNDS
29	16UCH6MC04	GRAVIMETRIC ANALYSIS AND ORGANIC PREPARATIONS
30	16UCH6MS01	SPECTROSCOPY
31	16UCH6TP01	INDUSTRIAL INTENSHIP

16UCH1MC01 BASIC CONCEPTS IN INORGANIC CHEMISTRY

Category: MC **Credits: 3**

Semester: I **Hrs/Wk: 3**

Objectives

1. To know the arrangement of elements in the periodic table and the periodic properties.
2. To understand the nature of chemical bond in inorganic compounds.

Unit 1: Atomic Structure and Periodic Table (1+6+1h)

1.1 Electronic configuration: dual nature of electrons, Heisenberg uncertainty principle, Bohr theory-atomic structure, arrangement of electrons-Pauli's exclusion principle, Hund's rule, sequence of energy levels (Aufbau principle). Isoelectronic molecules.

1.2 Periodic table: periodic law and arrangement of elements, group number.

1.3 Periodicity properties of atoms-size of atoms and ions-atomic, ionic and covalent radii; trend in ionic radii, ionization potential, electron affinity; electronegativity-applications, Pauling, Mulliken-Jaffe, Allred-Rochow scales and calculations. Horizontal, vertical and diagonal relationships in the periodic table. Inert-pair effect.

Unit 2: Concepts of Chemical Reactions and Acids and Bases (1+8+1 h)

2.1 Oxidation number and oxidation state-methods for calculating oxidation number for elements. Oxidation, reduction, redox and half reactions. Oxidizing and reducing agents. Equivalent weight of oxidizing and reducing agent-calculations.

2.2 Types of chemical reactions: disproportionation reaction (self-oxidation-reduction reaction), electron transfer and double decomposition reactions. Balancing chemical reactions by

oxidation number and ion-electron method. Direct and indirect (electrochemical cell) redox reactions and importance.

2.3 Theories of acids and bases: Arrhenius theory in protic solvents. Bronsted-Lowry, Lewis, the solvent system, Lux-Flood and Usanovich theories.HSAB concept.

2.4 Nonaqueous solvents: Classification-protic and aprotic solvents. Liquid ammonia as solvent.Acid-base, precipitation and complex formation reactions. Solutions of alkali and alkaline earth metals in ammonia.

Unit 3: Covalent Bond (1+7+1 h)

3.1 Lewis theory-octet rule and its exception, electron dot structural formula; Sidgwick-Powell theory-prediction of molecular shapes; Valance Bond theory-arrangement of electrons in molecules- Pauling Slater's rule- σ- and π-bond. Hybridization and geometry of molecules-BeX_2, $SnCl_2$, $PbCl_2$, NH_3, PCl_3, CH_4, OF_2, PCl_5, and SF_6.

3.2 VSEPR model-effect of bonding and nonbonding electrons on the structure, effect of electronegativity. Illustration of structures-structure and shape of molecule containing σ-bondsand π-bonds (NH_3, SF_4, ICl_4^-, ICl_2^-, XeF_4, XeF_6, XeO_3 and CO_3^{2-}).

Unit 4: MO Theory and Metallic Bond (1+7+1 h)

4.1 MO theory: LCAO method-criteria of orbital overlap, types of molecular orbitals-σ-, π- andδ-MOs; combination of atomic orbitals to give σ- and π-MOs and their schematic illustration; qualitative MO energy level diagram of homodiatomic molecules-$H_2$to $X_2$and heteronuclear diatomic molecules (HCl, NO, CO), magnetic properties, bond order and stability of molecules and ions.

4.2 Metallic bond: metallic properties, band theory of metals; semiconductors: n- and p-type.

4.3 Super conductivity and super conducting material-theories, mechanism, piezoelectric and pyroelectric crystals,two examples, Meissner effect.

Unit5: Chemistry of Halogens (1+7+1 h)

5.1 Group-17:anomalous behavior of F, ionic-, covalent-, bridging halides, reactivity of halogens, reduction by thiosulfate and application to iodo/iodimetry.

5.2 Halogen oxides: oxygen difluoride, dioxygendifluoride, dichlorine monoxide, chlorine dioxide, bromine dioxide, iodine pentoxides-preparation, properties and structure. Bleaching powder-estimation of available chlorine.

5.3 Oxoacids of halogens: hypohalous acid, halous acid, halicacid, perhalic acid. Oxidation state, strength of oxoacids and hybridization.

5.4 Interhalogen compounds: ClF, ClF_3, IF_3,ClF_5, $BrF_5$and IF_7, poly halides; structure-VSEPR model.

5.5 Psuedohalogens: cyanide, thiocyanate, and azide-structure and properties.

Books for study

1. J.D. Lee, *Concise Inorganic Chemistry*, 5th edn., Blackwell Science, London, 2006.
2. B.R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry*, ShobanLalNagin Chand and Co., 2005.
3. Satyaprakash, G. D. Tuli, S. K. Basu, R. D. Madan, *Advanced Inorganic Chemistry*, Vol.II 5th ed., S. Chand & company, 2000.

Books for reference

1. F.A. Cotton, G. Wilkinson and P.L. Guas, *Basic Inorganic Chemistry*, 3rd edn., John Wiley, 2002.
2. B. Douglas, D. McDaniel and J. Alexander, *Concepts and Models of Inorganic Chemistry*, 3rd edn., John Wiley, 1994.
3. J. E. Huheey, E. A. Kieter and R. L. Keiter, *Inorganic Chemistry*, 4th edn., Harper Collins, New York, 2006.

4. D. F. Shriver and P. W. Atkins, *Inorganic Chemistry*, 3rd edn., W. H. Freeman and Co, London, 2010.
5. T. Moeller, *Inorganic Chemistry: A Modern Introduction*, Wiley, New York, 1990.

16UCH1MC02 ANALYTICAL CHEMISTRY

Category: MC **Credits: 3**
Semester: I **Hrs/Wk: 3**

Objectives

1. To enable the student handle chemicals safely.
2. To learn the principles of basic analytical methods and their applications.

Unit 1: Handling of Chemicals and Data Analysis (1+7+1 h)

Safety and hygiene in the Chemistry Lab -Storage and handling of chemicals, handling of acids, ethers, toxic and poisonous chemicals. Antidotes, threshold vapour concentration and first aid procedure. Material safety data sheet (MSDS), Control of substances hazardous to health (COSHH).

Calibration of volumetric apparatus: Burette, pipette and standard flask.

Error in chemical analysis - Accuracy and precision, Types of errors – Determinate and indeterminate errors. Methods of eliminating or minimizing errors. Precision: mean, median, average deviation and coefficient of variation. Significant figure and its relevance.Normal error curve and its importance.

Unit 2: Titrimetric Methods of Analysis (1+7+1 h)

Methods of expressing concentration of solutions – Molarity, molality, formality, normality, mole fraction, ppm and ppb. Law of volumetric analysis. Types of titrations. Requirements for titrimetric analysis. Primary and secondary standards. Limitation of volumetric analysis.

Acid-base Equilibria - pH of strong and weak acid solutions. Buffer solutions. Henderson equations. Preparation of acidic

and basic buffers. Application of buffers in biological system – maintenance of pH of blood. Relative strength of acids and bases from K_a and K_b values. Neutralization-titration curve, theory and choice of indicators.

Complexometric titrations - Stability of complexes. Titration involving EDTA. Usage of metal ion indicators.

Unit 3: Solubility Equillibria (1+7+1 h)

Precipitation titrations - Concept of sparingly soluble salts. Relation between solubility and solubility products. Argentometric titrations, indicators for precipitation titrations involving silver nitrate. Determination of chloride by Volhard's method. Adsorption indicators.

Gravimetric methods of analysis - Separation by precipitation. Factors affecting solubility, gravimetric factor. Purity of precipitates, Von Weimarn ratio. Co-precipitation and post precipitation. Precipitation from homogeneous solution.

Unit 4: Separation and Purification Techniques (1+7+1 h)

Chromatographic techniques and applications - Principles of adsorption and partition chromatography: Column and Paper chromatography. TLC, ion-exchange chromatography - technique and applications.

General purification techniques - Purification of solid organic compounds: re-crystallization, sublimation. Use of miscible solvents. Use of drying agents and their properties. Purification of liquids. Techniques of distillation. Chemical methods of purification and test of purity.

Unit 5: Thermal Analysis (1+7+1 h)

Thermogravimetric analysis (TGA) and differential thermal analysis (DTA): Principle, instrumentation and applications.

Factors affecting TGA and DTA curves. Thermogram of $AgNO_3$, $CaC_2O_4.H_2O$, Sulphur, $CuSO_4.\ 5H_2O$.

Books for study

1. R.A. Day and A.L. Underwood, *Quantitative Analysis*, 6th edn., Prentice Hall of India Private Ltd., New Delhi, 1993.
2. U. N. Dash, *Analytical Chemistry: Theory and Practice*, Sultan Chand and sons Educational Publishers, New Delhi, 2011.
3. R. Gopalan, P. S. Subramanian and K. Rengarajan, *Elements of Analytical Chemistry*, Sultan Chand, New Delhi, 2007.
4. S. Usharani, *Analytical Chemistry*, McMillan Publisher,2000.

Books for reference

1. D. A. Skoog, D. M. West and F. J. Holler, *Analytical Chemistry: An Introduction*, 5th edn., Saunders college publishing, Philadelphia, 1998.
2. H. Kaur, *Instrumental Methods of Chemical Analysis,*Pragati Prakashan, Meerut, 2010.
3. V.K. Srivastava, K.K. Srivastava, *Introduction to Chromatography: Theory and Practice*, S. Chand and Company, New Delhi, 1987.
4. A.K. Srivastava, P.C. Jain, *Chemical Analysis: An Instrumental Approach for B.Sc. Hons. and M.Sc. Classes*, S. Chand and Company Ltd., Ram Nagar, New Delhi, 2010.
5. M.Dekker,*Inorganictitrimetric analysis:contemporarymethods*, Clarence Joseph Hull, 1971.
6. R. Speyer, *Thermal Analysis of Materials*, CRC Press, 1993.

16UCH1MC03 VOLUMETRIC ANALYSIS

Category: MC **Credits: 3**
Semester: I **Hrs/Wk: 3**

Objective

To enable the students to acquire the quantitative skills in volumetric analysis.

Volumetric Practicals

1. Calibration of volumetric apparatus: Burette, pipette and standard flasks.
2. **Acid-base titrations:**
   a. Estimation of HCl.
   b. Estimation of oxalic acid.
3. **Redox titrations:**
   a. Estimation of Ferrous ammonium sulphates (permanganometry).
   b. Estimation of calcium (permanganometry).
   c. Estimation of $KMnO_4$ (iodometry)
   d. Estimation of copper (iodometry).
   e. Estimation of Fe^{2+} -Fe^{3+} mixture using diphenyl amine (dichrometry)
4. **Complexometric titrations:**
   a. Estimation of calcium.
   b. Estimation of magnesium.

B. Inorganic Preparations

a. Cuprous chloride
b. Potash alum
c. Ferrous sulfate
d. Preparation of Ferrous ammonium sulphate.
e. Microcosmic salt
f. Reinecke's salt
g. Mohr's salt

Books for study

1. S. Sundaram and K. Raghavan, *Practical Chemistry*, S. Viswanathan Co. Pvt., 1996.

2. P.C. Kamboj, *Advanced University Practical Chemistry*, Part-I, Vishal Publishing Co. 2014.
3. Books for reference
4. G. Svehla, *Vogel's Qualitative Inorganic Analysis*, 7th edn., Pearson education, Chennai, 2002.

16UMT1AL03 MATHEMATICS FOR CHEMISTRY – I

Category: AL **Credits: 3**

Semester: I **Hrs/Wk: 6**

Objective

1. To get a good exposure to the basic concepts of Mathematics.
2. Tofamiliarizethelearnerwithapplicationsofmathematicsto chemistry.

Unit1: Differentiationofstandardfunctions-hyperbolic andinversehyperbolicfunctions- differentiationof one function withrespecttoanother-slope-tangent andnormal-maximaand minima of functions of one variable-angleofintersectionofcurvesin Cartesianandpolarcoordinates – partial differentiation – maxima and minima of functions of two variables. (2+14+2 Hrs)

Unit2: Binomial,exponentialand logarithmicseries (no proof) – Expansions and applicationtosummation. (2+14+2 Hrs)

Unit3: Integration - Methods of integration - integration of rational and irrational functions - integration by parts-Bernoulli's formula-Reduction Formula – Definite integrals - properties of definite integrals. (2+14+2 Hrs)

Unit 4: Complex numbers - DeMoivre's theoremand applications - expansions of $\sin n\theta, \cos n\theta, \sin^n\theta, \cos^n\theta, \sin\theta, \cos\theta$ - Fourier series. (2+14+2 Hrs)

Unit5: Probability- Basic Terminology – mean - standard deviation- Correlation – Rank Correlation - Regression - Binomial,PoissonandNormaldistributions.(2+14+2 Hrs)

Books for Study:

1. Narayanan, S. and Manickavachagam Pillai, T.K., Calculus Vol. I, S. Viswanathan Printers & Publishers, 1996.

   Unit 1: Chapter 2: 1, 2.1 – 2.6, 3.1 – 3.14, 4.1,4.2, 7;

   Chapter 5: 1.1 – 1.5;

   Chapter 8: 1.1, 1.2, 1.6, 4, 4.1;

   Chapter 9: 1.2, 1.4, 2, 4.1 – 4.5

2. Narayanan, S. and Manickavachagam Pillai, T.K., Calculus Vol. II, S. Viswanathan Printers & Publishers, 1996.

   Unit 3: Chapter 1: 2 – 4, 6.2 – 6.6, 7.3, 7.4, 8

   (case i & ii), 11, 12, 13.1 – 13.6; 15.1.

   Chapter 7: 2 – 5.

3. ManickavachagamPillai,T.K,Natarajan,T.andGanapathy,K.S. Algebra,Vol.I, S.ViswanathanPrinters&Publishers,1994.

   Unit 2: Chapter 3: 9 (Expansions only), 10;

   Chapter 4: 1 - 3, 5 – 7, 9.

4. S.P.Gupta., V.K. Kapoor, Fundamentals of Mathematical Statistics,SultanChandandsonsPublishers, 2002.

   Unit 5: Chapter 2: 2.5, 2.13.4;

   Chapter 3: 3.1 – 3.5,

   Chapter 8: 8.4, 8.4.1, 8.4.6, 8.5, 8.5.2, 8.5.5, 8.5.9;

   Chapter 9: 9.2, 9.2.1, 9.2.5, 9.2.14;

   Chapter 10: 10.4, 10.4.2, 10.7.1;

   Chapter 11: 11.2, 11.2.1, 11.2.2

5. Singaravelu, A., Allied Mathematics, Meenakshi Agency, 2010.

   Unit 4: Chapter 6: pg no. 6.1 – 6.30,

   Chapter 12: pg no. 12.5 – 12.57

Books for Reference:

- Allan Gut, Probability: A Graduate Course, Second Edition, Springer, New York, e-Book, 2012.

- Duraipandian,P.,VectorAnalysis,EmeraldPublishers,1984.
- Harry G. Hecht, Mathematics in Chemistry An Introduction to Modern Methods,1990
- P. Kandasamy, K. Thilagavathy, Allied Mathematics Vol I, S Chand, e-Book, 2014.
- P. Kandasamy, K. Thilagavathy, Allied Mathematics Vol II, S Chand, e-Book, 2014.
- ShanthiNarayanan,DifferentialCalculus,S.Chand&Co.,1964.
- Vittal,P.R.Trigonometry,MarghamPublications,1988.
- Venkataraman,M.K.EngineeringMathematics,III-A,TheNationalPublishing,Co.,1995.

16UCH2MC01 CHEMISTRY OF HYDROCARBONS

Category: MC **Credits: 3**

Semester: II **Hrs/Wk: 3**

Objectives

1. To learn the method of naming organic compounds
2. To understand the chemistry of hydrocarbons with their preparation and properties

Unit 1: Nomenclature and Electronic Effects of Organic Compounds (1+10+1 h)

1.1 Trivial and IUPAC nomenclature. Classification of organic compounds; hybridization and geometry of hydrocarbons (CH_4, C_2H_4, C_6H_6 and C_2H_2)

1.2 Cleavage of bonds: Homolytic and heterolytic cleavages, bond energy, bond length and bond angle.

1.3 Electron displacement effects: Inductive, inductomeric, electromeric, mesomeric, resonance, hyperconjugation and steric effects.Tautomerism: Keto-enol, amido-imidol and nitro-acinitro forms - Identification, acid and base catalyzed interconversion mechanism.

1.4 Formation and stability of reaction intermediates: carbocation, carbanion, free radicals, carbene and benzyne.

Unit 2: Alkanes and Cycloalkanes (1+7+1 h)

2.1 Alkanes: Preparation by Wurtz reaction, reduction or hydrogenation of alkenes, Corey-House method, petroleum refining. Reactions: Mechanism of halogenation, free radical substitution, sulphonation, nitration, oxidation, cracking and aromatisation.

2.2 Cycloalkanes: Preparation using Wurtz reaction, Dieckmann's ring closure and reduction of aromatic hydrocarbons. Reactions: Mechanism of substitution and ring-opening reactions. Baeyer's strain theory and theory of strain less rings.

2.3 Conformational isomerism of cycloalkanes: Conformers, dihedral angle, torsional strain. Conformational analysis of ethane, n-butane, and cyclohexane (Chair, boat and skew-boat forms), axial-equatorial positions and their interconversions.

Unit 3: Alkenes (1+5+1 h)

3.1 Alkenes: General methods of preparation by dehydrogenation, dehydrohalogenation, dehydration, Hoffmann and Saytzeff rules, cis and trans eliminations. Reactions: Mechanism of electrophilic and free radical addition, addition of hydrogen, halogen, hydrogen halide (Markownikoff's rule), hydrogen bromide (peroxide effect), sulphuric acid, water, hydroboration, ozonolysis, dihydroxylation with $KMnO_4$, allylic bromination by NBS.

3.2 Dienes: Stability of alkenes and dienes (conjugated, isolated and cumulative dienes). General methods of preparation, mechanism of dehydrohalogenation of dienes.Reactions: Mechanism of 1,2- and 1,4-additions, Diels-Alder reactions. Addition polymerization reactions, mechanism of Ziegler Natta polymerization.

3.3 Geometrical isomerism in alkenes:*cis-trans*, *syn-anti* and E-Z notations.

Unit 4: Alkynes (1+5+1 h)

4.1 Preparation: Mechanism of dehydrohalogenation and dehydrogenation. Reactions: acidity of alkynes, formation of acetylides, mechanism of addition of water, hydrogen halides and halogens, oxidation, ozonolysis and hydroboration/oxidation.

4.2 Preparation and properties of conjugated alkynes.

Unit 5: Aromatic Hydrocarbons (1+8+1 h)

5.1 Aromaticity and resonance: Huckel's rule, antiaromaticity, Mobius model.

5.2 Benzene: extraction, industrial and laboratory preparations, purification. Properties: Electrophilic substitution reactions: nitration, sulphonation, halogenation, Friedel Crafts alkylation and acylation with mechanisms. Disubstitution reactions of aromatic compounds: nitration and halogenation; orientation and reactivity - ortho/para ratio.

5.3 Polynuclear aromatic hydrocarbons: extraction, preparation and properties of naphthalene, anthracene and phenanthrene.

Books for study

1. B. Y. Paula, *Organic Chemistry*, 3rd edn., Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.
2. T. W. Graham Solomons, *Organic Chemistry*, 6thedn., John Wiley and sons, 1996.
3. R. T. Morrison and R. N. Boyd, *Organic Chemistry*, 6th edn., Printice-Hall of India Limited, New Delhi, 1992.
4. Arun Bahl and B. S. Bahl, *Organic Chemistry*, S. Chand and sons, New Delhi, 2005.

Books for references

1. J. March and M. Smith, *Advanced Organic Chemistry*, 6thedn., John-Wiley and sons, 2007.
2. S. H. Pine, *Organic Chemistry*, 5thedn., McGraw Hill International Edition, Chemistry Series, New York, 1987.

3. S. N. Ege, *Organic Chemistry*, Structure and Reactivity, 3rdedn., A.I.T.B.S., New Delhi, 1998.
4. D. J. Cram,G. S. Hammond, *Organic Chemistry*, 3rd edn., McGraw-Hill, Kogakusha, Limited, 1970.
5. F. A. Carey, *Organic Chemistry*, 3rd edn., Tata-McGraw Hill Publications, New Delhi, 1999.
6. I.L. Finar, *Organic Chemistry*, Vol-1, 6thedn., Pearson Education Asia. 2004

***e*-books**

1. R. T. Morrison, R. N. Boyd, *Organic Chemistry*, 6th edn., Printice-Hall of India Limited, New Delhi, 1992. https://docs.google.com/file/d/0B1dYE8NwC2E3d3RwN05kZnd6VTA/edit
2. B. Y. Paula, *Organic Chemistry*, 3rd edn., Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002. ftp://178.213.241.33/incoming/Organic%20Chemistry%20(5th%20Edition)%20by%20Paula%20Yurkanis%20Bruice.pdf
3. J. March, M. Smith, *Advanced Organic Chemistry*, 6thedn., John-Wiley and sons, 2007. files.rushim.ru/books/mechanizms/march6ed.pdf

16UCH2MC02 CHEMICAL BONDING AND MAIN GROUP ELEMENTS

Category: MC **Credits: 3**

Semester:II **Hrs/Wk: 3**

Objectives

1. To understand the different kinds of chemical bonding in molecules.
2. To identify the nature of chemical bond in ionic compounds.
3. To know the chemistry of s- and p-block elements.

Unit 1: Ionic Bond (1+7+1 h)

1.1 Properties of ionic compounds, factors influencing the formation of ionic compounds-ionization potential, electron affinity, and electronegativity.

1.2 Lattice energy (U_o): Born-Lande equation (derivation not required). Factors affecting lattice energy. Born-Haber cycle-enthalpy of formation (ΔH_f). Stability and solubility of ionic compounds. Hydration and lattice energy

(ΔH_f and U_o). Enthalpy of solvation and enthalpy of solution.

1.3 Covalent character of ionic compounds-Fajan's rules; effects of polarization-solubility, melting point, and thermal stability of ionic compounds.

Unit 2: Structure of Solids (1+7+1 h)

2.1 Classification: amorphous and crystalline solids-elements of crystal symmetry, lattice points and crystal lattice.Unit cell, simple, primitive, body centered and face centered (bcc, fcc).

2.2 Seven crystal systems and 14-Bravais lattices.

2.3 Weiss and Miller indices-drawing various planes in a cubic lattice.

2.4 Structure of ionic solids: packing of ions in solids, radius ratio, coordination number in ionic crystals, crystal structures-sodium chloride, zinc blende, wurtzite, cesium chloride, (unit cell diagrams); identification of simple cubic, *bcc*, *fcc*lattices.

2.5 Crystal defects: Schottky and Frenkel defects, F-center.

Unit 3: Weak Bonds (1+7+1 h)

3.1 Weak bonds: hydrogen bonding-intra- and intermolecular, influence on the physical properties of molecules, comparison of hydrogen bond, strength and properties of hydrogen bonded N, O, and F compounds-structure of ice and water, separation of ortho- and para isomers of organic compounds-variation of boiling point of hydrides of VA, VIA and VIIA groups.

3.2 van der Waals forces, ion dipole-dipole interactions, London forces.

3.3 Crystalline hydrates and clathrates-preparation, properties uses and structure.

Unit 4: Chemistry of *s*-block Elements (1+7+1 h)

4.1 Chemical properties of the metals: reaction with water, air, nitrogen; uses of *s*-block metals and their compounds.

4.2 Compounds of *s*-block metals: oxides, hydroxides, peroxides, superoxides-preparation and properties; Na_2CO_3, $NaHCO_3$, anomalous behavior of Li and Be, extraction of beryllium.

4.3 Complexes of s-block metals: complexes with crown ethers, biological importance of sodium and potassium.

Unit 5: *p*-Block Elements (1+7+1 h)

5.1 Boron group: extraction of B; hydrides of boron-classification of boranes and carboranes. Diborane- preparation, properties and structure elucidation, types of compounds-borates, and borax. Borazine-preparation and structure.

5.2 Carbon group: catenation and heterocatenation, allotropy of carbon-graphite, diamond, carbides-salt-like carbides, interstitial carbides, covalent carbides.

5.3 Silicates-classification, three dimensional silicates and their properties and structures.

5.4 Nitrogen group: group discussion, metallic and nonmetallic character of group 15 elements;hydrides and halides of group 15 elements-hydrazine, hydroxylamine. Structure of oxides of nitrogen (NO, N_2O, NO_2, N_2O_4, N_2O_5) - structure of oxyacids of nitrogen- HNO_2, HNO_3, $H_2N_2O_2$, HN_3,

5.5 Oxides and oxoacids of phosphorus: structure and oxidation state of phosphorous inortho-, meta-, hypophosphorous acid; di-, tri-, tetra- and polyphosphoric acids-oxidation state of phosphrous. Preparation, properties uses and structure of nitrosyl chloride and sodiumnitroprusside, Nitrides-classification with examples- preparation properties and uses.

Salts of phosphorus acids- distinction among ortho-, meta- and pyrophosphate- permonophosphoric acid, triphosphazenes.

Books for study

1. J. D. Lee, *Concise Inorganic Chemistry*, 5th edn., Blackwell Science, London, 2010.
2. B. R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry*, ShobanLalNagin Chand and Co., New Delhi, 2005.
3. Satyaprakash, G. D. Tuli, S.K. Basu, R.D. Madan, *Advanced Inorganic Chemistry*. Vol.II 5th edn., S. Chand & company, New Delhi, 2000.

Books for reference

1. F. A. Cotton, G. Wilkinson, P.L. Guas, *Basic Inorganic Chemistry*, 3rd edn., John Wiley, 2002.
2. B. Douglas, D. McDaniel, J. Alexander, *Concepts and Models of Inorganic Chemistry*, 3rd edn., John Wiley, 1994.
3. J. E. Huheey, E. A. Kieter and R. L. Keiter, *Inorganic Chemistry*, 4th edn., Harper Collins, New York, 2006.
4. D. F. Shriver, P. W. Atkins, *Inorganic Chemistry*, 3rd edn., W. H. Freeman and Co, London, 2010.
5. T. Moeller, *Inorganic Chemistry: A Modern Introduction*, Wiley, New York, 1990.

16UCH2MC03 ORGANIC QUALITATIVE ANALYSIS

Category: MC **Credits: 3**
Semester: II **Hrs/Wk: 3**

Objective

1. To develop analytical skills in organic qualitative analysis.

Practicals

1. Organic analysis of mono- and bifunctional compounds.
    a. Identification of acidic, basic, phenolic, and neutral organic substances.

b. Detection of nitrogen, sulphur and halogens.
c. Test for aliphatic and aromatic nature of substances.
d. Test for saturation and unsaturation.
e. Identification of functional groups:
(i) Carboxylic acids (ii) Phenols (iii) Aldehydes (iv) Ketones(v) Esters (vi) Carbohydrates
(vii) Amines (viii) Amides(ix) Anilides
(x) Nitro (ix) Halogen compounds
f. Preparation of derivatives for the functional groups.

2. Determination of melting and boiling points of organic compounds (Demonstration)

Books for study

- N.S. Gnanapragasam and G. Ramamurthy, *Organic Chemistry – Lab manual*, S. Viswanathan Co. Pvt., 2002.
- Jeyavathana Samuel, *Chemistry Practical Book*, G. G. Printers, Chennai.

Books for reference

- J.N. Gurthu and R. Kapoor, *Advanced Experimental Chemistry* (Organic), S. Chand and Co., 1987.
- B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, *Vogel's Text Book of Practical Organic Chemistry*. 5thedn., Pearson Education, 2005.
- S. Sundaram, P. Krishnan and P. S. Raghavan, *Practical Chemistry*, Part-II, S. Viswanathan Pvt. Ltd, Chennai, 1996.

16UMT2AL03 MATHEMATICS FOR CHEMISTRY –II

Category: AL **Credits: 3**
Semester: II **Hrs/Wk: 6**

Objectives:

1 To prepare the students to apply mathematical skills to carry out research in chemistry
2 To solve chemical problems using mathematical techniques.

Unit 1: Change of order of integration-change of variables-Jacobian-double and triple integrals in polar, spherical polar and cylindrical polar coordinates-Beta and Gamma integrals and their properties. (2+14+2 Hrs)

Unit 2: Ordinary differential equations-solutions of first order and first degree equations-exact equations Mdx + Ndy = 0-second order differential equations with constant coefficients-partial differential equations (all types). (2+14+2 Hrs)

Unit3: Laplace transform ofelementaryfunctions and periodicfunctions - inverse transform-applicationtodifferentialequations. (2+14+2 Hrs)

Unit 4: Solutions to simultaneous linear equations-Guass elimination-Gauss-Seidal iterative method-successive bisection-Newton-Raphson method-interpolation-Newton's interpolation formulae. (2+14+2 Hrs)

Unit 5: Group – abelian and non abelian group - Cayley's table - subgroup - cyclic group - cosets and Lagrange's theorem – Normal subgroups - definition and simple problems only (no proof for theorems) (2+14+2 Hrs)

Books for Study:

- Narayanan, S. and Manickavachagam Pillai, T.K., Calculus, Vol.II, S.Viswanathan Printers &Publishers,1996.Unit 1: Chapter 5: 1 – 4,

Chapter 6: 1.1, 1.2, 2.1 – 2.4;
Chapter 7: 2 – 5Narayanan, S., and

- Manickavachagam Pillai, T.K., Calculus,Vol. III, S.ViswanathanPrinters&Publishers,1996.

Unit 2: Chapter 1: 2.1 – 2.4, 3.1;

Chapter 2: 1 – 4; Chapter 5: 1 – 9

- Narayanan, S. and Manickavachagam Pillai, T.K., Ancillary Mathematics Vol II, S. Viswanathan Printers & Publishers, 1996.

Unit 3: Chapter 7: 1 - 6

- Santiago,M.L., Modern Algebra, Arul Publications,1988.

Unit 5: Chapter 2: 2.1, 2.2, 2.4 – 2.7

- Vedamurthy, V.N., Iyengar, Numerical Methods, Vikas Publishing House, 1998.

Unit 4: Chapter 3: 3.2,3.3,3.5;

Chapter 4: 4.1, 4.2, 4.10;

Chapter 6: 6.1 – 6.3.

Books for Reference:

- Babu Ram, Numerical Methods, Pearson Publishing, First Edition, e-Book, 2010.
- Donald A. Mcquaire and John D. Simon, Physical Chemistry A Molecular Approach*,*1998.
- Dipak Chatterjee, Abstract Algebra, PHI Learning, Third Edition, e-Book, 2015
- Harry G. Hecht, Mathematics in Chemistry An Introduction to Modern Methods,1990.
- P. Kandasamy, K. Thilagavathy, Allied Mathematics Vol II, S Chand, e-Book, 2014.
- D. Vaughan Griffiths, I.M.Smith, Numerical Methods for Engineers, Chapman &hall / CRC, Second Edition, e-Book, 2006.
- Venkataraman, M.K. Engineering Mathematics,III-A, The National Publishing Co.,1995.

- Venkataraman, M.K. Numerical Methods in Science and Engineering, 3rd edition, The National Publishing Co. 1995.

16UCH3MC01 THERMODYNAMICS

Category: MC **Credits: 4**

Semester: III **Hrs/Wk: 4**

Objectives

- To understand the laws of thermodynamics
- To apply it to physical and chemical systems.

Unit1: Gaseous State and First Law of Thermodynamics

(1+10+1 h)

1.1 Behaviour of ideal gases. Kinetic theory of gases – postulates and derivation of the equation $PV = 1/3\ mnc^2$ Derivation of the gas laws- Maxwell's distribution of molecular velocities-Effect of temperature-types of molecular velocities-Degrees of freedom-Principle of equipartition of energy.

1.2 Behaviour of Real gases Deviation from ideal behavior, derivation-van der Waals equation of state , critical constants -Virial equation of state

1.3 Terminology used in thermodynamics-Thermodynamic processes- Exact & inexact differentials, state & path functions. First law of thermodynamics: Statement -matematical formulation concept of internal energy & enthalpy.

Unit2:Applications of First Law of Thermodynamics and Thermochemistry (1+12+1 h)

2.1 Applications of first law of thermodynamics to ideal gases: Heat capacity, relation between C_P and C_V. Isothermal process: Change in internal energy, enthalpy change, heat absorbed, $W_{(rev)}$ and $W_{(irrev)}$. Adiabatic process: Calculation of q,w , ΔE and ΔH.

2.2 Applications of first law of thermodynamics to real (van der Waals) gases: Isothermal process- Work done, change in internal energy, heat absorbed. Adiabatic process: Work done - Joule - Thomson effect- Joule- Thomson coefficient and its significance, inversion temperature.

2.3 Measurements of thermal changes. Heat of reaction. Calculation of change in internal energy from the enthalpy change, standard states and standard heat of formation; Variation of enthalpy change of reaction with temperature (Kirchoff's equation).

2.4 Integral and differential heat of solution and dilution, heat of neutralization, heat of hydration; heat of transition, heat of combustion. Bond energy and its applications, Hess's law – applications. Determination of calorific value using Bomb calorimeter.

Unit3: Second Law of Thermodynamics (1+10+1 h)

3.1 Limitations of first law and the need for the second law. Statements of second law -Carnot cycle-Efficiency. Thermodynamic principle of working of refrigerator.

3.2 Concept of entropy-Helmholtz work function-Gibbs free energy-Criteria of spontaneity. Evaluation of ΔG and ΔS for the mixing, Maxwell's equations and thermodynamic equation of state. Gibbs-Helmholtz equation and its applications.

Unit 4: Thermodynamics of Reversible Processes (1+8+1 h)

4.1 Law of mass action: Various forms of equilibrium constants. Relationship between K_p and K_c; significance of equilibrium constants. van't Hoff isotherm. Derivation of thermodynamic equilibrium constant, and its relationship with change in standard free energy. van't Hoff isochore.

4.2 Le-Chatelier-Braun principle: Formation of ammonia. Application of law of mass action and Le-Chatelier-Braun principle to homogeneous gaseous reactions: Dissociation of N_2O_4, NH_3, HI and PCl_5.

Unit 5: Third Law of Thermodynamics and Statistical Thermodynamics (1+10+1 h)

5.1 Nernst heat theorem- Planck and Lewis Randall formulation of third law.

5.2 Absolute entropy of solids, liquids and gases. Evaluations of the standard entropy of oxygen, on the basis of heat capacity. Exceptions to third law of thermodynamics.

5.3 Difference between classical thermodynamics and statistical thermodynamics. Thermodynamic probability – macro and microstates, most probable distribution. Stirling's approximation. Maxwell–Boltzmann statistics. Partition function –separation and relation between partition function and energy. Partition function for translational, rotational and vibrational entropy and probability. Translational entropy: Sackur-Tetrode equation.

Books for study

- B. R. Puri, L.R. Sharma, M.S. Pathania, *Principles of physical Chemistry*, ShobanLalNagin Chand and Co., Delhi, 2013.
- S.H. Maron and J.B. Lando, *Fundamentals of Physical Chemistry*, Macmillan limited, New York, 1974.
- P.W. Atkins, *Physical Chemistry*, 7th edn.,Oxford university press, 2001.
- S.K. Dogra, S. Dogra, *Physical Chemistry Through Problems*, New age international, 4thedn., 1996.

Books for reference

- G. Rajaram, J.C. Kuriacose, *Thermodynamics*, Shoban Lal Nagin Chand and Co. 2006.
- 2. G. W. Castellan, *Physical Chemistry*, Narosa publishing house, 3rdedn., 1985.
- I. M. Klotz and R.M. Rosenberg, *Chemical Thermodynamics*, John Wiley and sons, Inc. 1994.
- M. C. Gupta, Statistical Thermodynamics, 1stedn.,Halsted Press, 1991.
- R.C.C. Srivastava, S. Saha, A. K. Jain, *Thermodynamics: A Core Course*, 3rdedn., PHI Learning Pvt. Ltd.,, 2007.

16UCH3MC02 STEREOCHEMISTRY AND ORGANIC FUNCTIONAL GROUPS-I

Category: MC **Credits: 4**

Semester: III **Hrs/Wk: 4**

Objectives

- To explore the chemistry of functional groups of organic compounds.
- To learn the preparation of organic compounds of halide, oxygen and nitrogen based functional groups.
- To understand the physical and chemical properties of functionalized organic compounds.

Unit 1: Stereochemistry (1+11+1 h)

1.1 Optical isomerism, optical activity, prochirality, optical and specific rotations, conditions for optical activity, asymmetric center, chirality, achiral molecules, meaning of (+) and (-) and D and L notations, elements of symmetry, racemization, methods of racemization (by substitution and tautomerism), methods of resolution (mechanical, seeding, biochemical and conversion to diastereomers), asymmetric synthesis (partial and absolute synthesis), Walden inversion.

1.2 Projection Formula, Fischer, flying wedge, sawhorse and Newmann projection formulae – notation of optical isomers. Cahn-Ingold-Prelog rules, R and S notations for optical isomers with one and two asymmetric carbon atoms, erythro and threo representations.

1.3 Optical activity in compounds not containing asymmetric carbon atoms namely biphenyls, allenes and spiranes (atropisomerism).

Unit 2: Aliphatic and aromatic halides (1+10+1 h)

2.1 Nomenclature and classification. Preparation of aliphatic and aromatic halides: Free radical mechanism, addition and Substitution reactions.

2.2 Reactions: Nucleophilic substitutions, S_N1, S_N2, S_NAr and S_Ni mechanisms, stereochemistry and reactivity, effects of substrate, solvent, nucleophile and leaving groups.

2.3 Eliminations: E1 and E2 mechanisms, evidences, orientations and stereochemistry.

Unit 3: Hydroxy derivatives (1+10+1 h)

3.1 Aliphatic alcohols: Preparation by hydroboration, oxidation, Reduction of carbonyl compounds, epoxidation, Grignard synthesis and haloform reaction. Reactions with reference to C-OH bond cleavage and O-H bond cleavage.

3.2 Aromatic alcohols: Phenols: Nomenclature, physical properties, hydrogen bonding. Preparation: Industrial source, preparation from diazonium salts and sulphonic acids.

3.3 Reactions: acidity, ether formation, ester formation, mechanism of ring substitution, nitration, sulphonation, halogenation, Friedel-Craft's reaction, nitrosation, coupling reactions, Kolbe's reaction and Riemer-Tiemen reaction. Reduction of carbonyl compounds and hydroxylation of alkenes.

Unit 4: Ethers and Epoxides (1+8+1 h)

4.1 Nomenclature and classification. Preparation of aliphatic, aromatic and cyclic ethers including crown ethers by Williamson's synthesis, alkoxymercuration-demercuration and bimolecular dehydration of alcohols. Reactions: cleavage by acids and oxidation to peroxides.

4.2 Preparation and reactions of epoxides. Ring opening reactions by acid and base catalysts and organometallic reagents.

Unit 5: Nitro and Amine Compounds (1+11+1 h)

5.1 Nitrocompounds: Nomenclature and classification. Aliphatic and aromatic nitro compounds, General properties. Preparation by nitration and oxidation of amines. Reactions: reduction by chemical and electrolytic methods.

5.2 Di- and tri-substitution of aromatic nitro compounds: synthesis of o-, m-, p-dinitrobenzenes and trinitrobenzene.

5.3 Aromatic amines. Preparation of primary, secondary and tertiary amines: Hinsberg test, separation of primary, secondary and tertiary amines. Reactions: basicity of amines, effect of substituents on basicity of aromatic amines. sulpha drugs: sulphonamide, sulphadiazine, and sulphaguanidine.

5.4 Diazonium salts: Preparation, diazotisation reactions, replacement reactions: Sandmeyer, Gatterman and Gomberg reactions, coupling reactions.

Books for study

- R. T. Morrison, R.N. Boyd, *Organic Chemistry*, 6thedn., Printice-Hall of India Limited, New Delhi, 1992.
- T. W. Graham Solomons, *Organic Chemistry*, 6thedn., John Wiley and Sons, 1996.
- B. Y. Paula, *Organic Chemistry*, 3rd edn., Pearson Education, Inc.(Singapore), New Del hi, reprint, 2002.
- Bahl and Arun Bahl, *Organic Chemistry*, S. Chand and Sons, New Delhi, 2005.

Books for references

- J. March and M. Smith, *Advanced Organic Chemistry*, 6thedn., John-Wiley and sons, 2007.
- S. H. Pine, *Organic Chemistry*, 5thedn., McGraw Hill International Edition, Chemistry Series, New York, 1987.
- Sehan. N. Ege, *Organic Chemistry, Structure and Reactivity*, 3rdedn., A.I.T.B.S., New Delhi, 1998.
- J. B. Hendrickson, D. J. Cram andG.S. Hammond, Organic Chemistry, 3rdedn., McGraw-Hill Kogakusha, Ltd, 1970.
- Francis A. Carey, *Organic Chemistry*, 3rd edn., Tata-McGraw Hill Publications, New Delhi, 1999.

e-books:

- R.T. Morrison, R. N. Boyd, *Organic Chemistry*, 6th edn., Printice-Hall of India Limited, New Delhi, 1992. https://docs.google.com/file/d/0B1dYE8NwC2E3d3RwN05kZnd6VTA/edit
- B.Y. Paula, *Organic Chemistry*, 3rdedn., Pearson Education, Inc.(Singapore), New Delhi, reprint 2002. ftp://178.213.241.33/incoming/Organic%20Chemistry%20(5th%20Edition)%20by%20Paula%20Yurkanis%20Bruice.pdf
- J. March, M. Smith, *Advanced Organic Chemistry*, 6thedn., John-Wiley and sons, 2007. files.rushim.ru/books/mechanizms/march6ed.pdf

16UCH3MC03 INORGANIC QUALITATIVE ANALYSIS

Category: MC **Credits: 4**

Semester: III **Hrs/Wk: 4**

Objectives

- To develop analytical skills in inorganic qualitative analysis.To understand the various chemical reactions of metal ions.

Semimicro Qualitative Analysis

1. Analysis of mixture containing interfering and non-interfering anions.
2. Mixture of cations of simple radicals to familiarize with the inter group separation techniques.
3. Simple anions: carbonate, nitrate, sulphate, sulphide, sulphite, chloride and bromide.
4. Interfering anions: borate, fluoride, oxalate and phosphate.
5. **Cations:**

   Group I: lead.

Group II: copper, cadmium, bismuth, antimony, tin.

Group III: aluminium, ferrous, ferric, chromium.

Group IV: cobalt, nickel, manganese, zinc.

Group V: barium, strontium, calcium

Group VI: magnesium.

Zero group: ammonium.

Preparations of Coordination Complexes

1. Preparation of tetraamminecopper(II) sulphate.
2. Preparation of potassium trisoxalatoaluminate(III).
3. Preparation of potassium trisoxalatochromate(III).
4. Preparation of hexamminecobalt(III) chloride

Books for References

1. V.V. Ramanujam, *Inorganic Semi Micro Qualitative Analysis*, 3rdedn., The National Publishing Company, Chennai, 1974.
2. *Vogel's Text Book of Inorganic Qualitative Analysis*, 4thedn., ELBS, London, 1974.

16UPH3AL01 PHYSICS FOR CHEMISTRY – I

Category: AL 3 **Credits: 2**

Semester: III **No of Hours/Week: 4**

Objective:

This paper is offered to the students of chemistry as allied. While the chemical properties are learnt in the major, the study of physical properties will complement their studies.

Unit 1: Mechanics (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

a) Particle dynamics: Displacement, velocity and acceleration – distance-time graph – velocity- time graph – projectile motion – uniform circular motion – acceleration in circular motion –

angular momentum – conservation of momentum – relative velocity.

b) Simple Harmonic Motion: Formula for acceleration, velocity and displacement – oscillation in spring mass system – potential and kinetic energy exchanges – springs in series and parallel – simple pendulum – energy method for period – oscillations of liquid in U – tube.

Unit 2: Properties of matter (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

a) Elastic properties: Elastic limit – Hooke's law – moduli of elasticity – Poisson's ratio –relation between q, n , and k – force in a bar due to contraction or expansion – energy stored in a wire – rigidity modulus – torsion in a wire – torsional oscillations method (without mass).

b)Viscosity and surface tension: Newton's formula – Stoke's formula – Poiseuille's flow – molecular theory of surface tension – excess pressure over curved surface – spherical and cylindrical drops – surface energy – capillary rise – Quincke's method for mercury.

Unit 3: Thermodynamics (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

a) Gas laws: Boyle's law – Charles's law – Expansivity of gas – Absolute temperature – Ideal gas equation, the gas constant – Avogadro's Hypothesis: Molar gas constant – General gas equation- Application – Mixture of gases: Dalton's law – Unsaturated and saturated vapors – Gas laws for vapors.

b) Basic Thermodynamics: Work done by gas – Internal energy of gas – First law of thermodynamics – Internal energy changes, Ideal gas – Work done from p-v graphs – Isothermal changes – Kinetic theory in isothermal change – External work done in expansion – Adiabatic change – Heat and mechanical work in engines –Refrigerators and the second law – Real gases, critical temperature.

Unit 4: Crystal Physics (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

a) Crystal structures: Introduction – periodic array of atoms – crystal lattice – unit cell – basis – symmetry considerations – classification of crystals – Bravais lattices in three dimensions – crystal planes and Miller indices – simple crystal structures.

b) Crystal diffraction: Bragg's law – experimental X-ray diffraction methods: rotating crystal method – powder method.

Unit 5: Special theory of relativity(Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

Frames of reference – inertial frames and non-inertial frames – Galilean transformations – Michelson-Morley experiment – interpretation of results – postulates of special theory of relativity – Lorentz transformation equations – length contraction – time dilation – transformation of velocities – variation of mass with velocity – Mass-energy equation.

Books for study:-

1 M.Narayanamurthy and N.Nagarathnam, Dynamics – The national publisher – 8thedition (1976).
2 2. D.S.Mathur, properties of matter – S.Chand and Co., New Delhi (Reprint 2007).
3 3. Nelkon and Parker, Advanced level physics — Arnold Publishers – 7th edition (2006).
4 C.Kittel, Introduction to solid state physics – Wiley eastern – 8th edition (2012).
5 Robert Resnick, Introduction to special relativity – Wiley Eastern – 7th edition (Reprint 2007).

Books for Reference:-

1 D.Halliday and R.Resnick, Physics, Part 1 (Wiley eastern) - 5th edition (2005).
2 Richard P. Feynman, Robert B. Leighton & Mathew Sands, Feynman lectures on physics series, vol. 1 & 2, Narosa publishing House, New Delhi, 8th reprint (1995).

3 M.A.Wahab, Solid State Physics – Narosha Publishing House, 2nd edition (2009).

16UPH3AL02 PHYSICS FOR CHEMISTRY - PRACTICAL - I

Category: AL3 **Credits: 1**

Semester: III **No of Hours/Week: 2**

LIST OF EXPERIMENTS

1 Young's modulus by stretching - vernier microscope
2 Rigidity modulus -torsional pendulum
3 Surface tension and interfacial tension - method of drops
4 Surface tension - capillary rise
5 Viscosity - capillary flow
6 Specific heat of liquid - electrical heating
7 Sonometer -verification of laws
8 Compound bar pendulum - determination of 'g'and radius of gyration

16UCH4MC01 ELECTROCHEMISTRY

Category: MC **Credits: 3**

Semester: IV **Hrs/Wk: 3**

Objectives

- To understand the interconversion of chemical and electrical energy and to link thermodynamics with electrochemistry.
- To understand the concepts of non-equilibrium electrochemistry (conductance, transport number, overvoltage).

Unit 1: Equilibrium Electrochemistry (1+8+1 h)

1.1 Single and standard electrode potentials. Reference electrodes: Primary and secondary reference electrodes. Determination of standard electrode potentials of zinc and copper electrodes. Different types of electrodes - Metal/Metal ion, gas, Metal/insoluble salt and redox electrodes.

1.2 Electromotive force (EMF) Measurement using potentiometer. Construction and working of Weston cell. Conventions regarding sign of EMF. Calculation of cell EMF from single electrode potentials. Electrochemical series and its applications.

Unit 2: Electrochemical Reactions (1+8+1 h)

2.1 Thermodynamics of electrochemical reactions - Derivation of Nernst equation and its applications - relationship between EMF and free energy, enthalpy and entropy changes and equilibrium constants for electrochemical reactions.

2.2 Classification of electrochemical cells - Chemical and concentration cells with and without transference. Derivation of EMF -liquid junction potential.

2.3 Applications of EMF - Calculation of valency of ions, free energy, enthalpy and entropy changes in electrochemical reactions, solubility product of sparingly soluble salt, determination of pH using hydrogen, quinhydrone and glass electrodes; Potentiometric titrations - acid-base, redox and precipitation.

2.4 Energy conversion - Dry cell, lead acid storage battery, H_2-O_2 fuel cell.

Unit 3: Non-equilibrium Electrochemistry (1+8+1 h)

3.1 Quantitative aspects of Faraday's laws of electrolysis.

3.2 Equivalent and molar conductance and their variation with concentration. Kohlrausch's law and its applications.

3.3 Applications of conductance measurements – determination of degree of dissociation and conductometric titrations – acid-base and precipitation.

3.4 Transport number: Absolute velocity of ions and ionic mobilities. Hittorf's rule, determination of transference numbers – Hittorf's and moving boundary method.

Unit 4:Ionics (1+5+1 h)

4.1 Ostwald's dilution law. Arrhenius theory of electrolytic dissociation – evidences and limitations – van't Hoff factor.

4.2 Activities and activity coefficients of electrolytes – ionic strength - Debye-Huckel theory of activity coefficients and Debye-Huckel-Onsager equation (no derivation required).

Unit 5:Overvoltage and Polarisation (1+6+1 h)

5.1 Overvoltage- Decomposition potential, Hydrogen overvoltage, Applications of overvoltage -Metal deposition, electrolytic separation of metals. Electrochemical theory of corrosion.

5.2 Concentration polarization of electrodes - Polarography –Principle, dropping mercury electrode – advantages and disadvantages, Ilkovic equation, significance of half-wave potential and diffusion current.

Books for study

- S. Glasstone, *An Introduction to electrochemistry*, Affiliated East-West Press Pvt. Ltd., New Delhi, 2008.
- B.R. Puri, L.R. Sharma and M.S.Pathania, *Principles of physical chemistry*, Shoban Lal Nagin Chand and Co. 46thedn., 2013.
- S.K. Dogra and S. Dogra, *Physical chemistry through problems*, New age international, 2ndedn., 2015.

Books for reference

- Gilbert. W. Castellan, *Physical chemistry*, Narosa publishing house, 3rdedn., 1985.
- P. Atkins and J.D. Paula,*Physical chemistry*, Oxford university press, 9thedn.,2010.
- K.L. Kapoor, *A textbook of Physical chemistry*, Vol. 3 Macmillan, India Ltd, 2013.

16UCH4MC02 PHYSICAL CHEMISTRY PRACTICAL

Category: MC | Credits: 3
Semester: IV | Hrs/Wk: 3

Objectives

To acquire analytical skills for quantitative analysis and apply the concepts of physical chemistry to various experiments

Experiments

1. Determination of partition coefficient of iodine between water and carbon tetrachloride
2. Determination of equilibrium constant for the formation of potassium triiodide from iodine and KI.
3. Phase diagram of a simple eutectic system and determination of unknown composition.
4. Determination of critical solution temperature of phenol - water system.
5. Effect of impurities on critical solution temperature.
6. Determination of molecular weight – Rast's method.
7. Kinetics of acid catalyzed hydrolysis of an ester.
8. Kinetics of persulphate - iodide reaction.
9. Determination of strength of a strong acid by conductometric titration (HCl vs NaOH).
10. Determination of strength of a weak acid by conductometric titration (CH_3COOH vs NaOH).
11. Determination of limiting molar conductance of a strong electrolyte (KCl) by conductometry.
12. Determination of strength of a strong acid by potentiometric titration (HCl vs NaOH).
13. Determination of strength of a weak acid by potentiometric titration (CH_3COOH vs NaOH).
14. Determination of solubility product of a sparingly soluble substance by potentiometric titration.
15. Determination of the strength of Fe(II) by potentiometric redox titration.

Books for reference

1. R. Veeraswamy, V. Venkateswaran and A. R. Kulandaivelu, *Basic principles of practical Chemistry*, Sultan Chand & Sons, 2nd edn., 2015.
2. J.N.Gurthu and R. Kapoor,*Advanced Experimental Chemistry*, S. Chand and Co., 1987.
3. Sundaram, Krishnan, Raghavan, *Practical Chemistry (Part II)*, S. Viswanathan Co. Pvt. 1996.
4. David P. Shoemaker, Carl W. Garland, Joseph W. Nibler, *Experiments in Physical Chemistry*, 5th edn., McGraw- Hill Book company, 1989.

16UCH4ES01 CHEMISTRY OF FOOD AND CONSUMER PRODUCTS

Category: ES **Credits: 4**

Semester: IV **Hrs/Wk: 6**

Objectives

This skill based course provides

- Basic knowledge in chemical consumer Products and Food Chemistry
- Training in consumer product analysis and Food analysis

Unit 1: Soaps and Detergents (1+13+1 h)

1.1 Saponification of oils and fats. Manufacture of soaps. Formulation of toilet soaps. Different ingredients used. Their functions.Classification and types. BIS specifications.Testing procedures and limits.

1.2 Anionic detergents: Manufacture of LAB (linear alkylbenzene). Sulphonation of LAB– preparation of acid slurry. Different ingredients in the formulation of detergent powders and soaps.Liquid detergents. Foam boosters.AOS (alpha olefin sulphonates).Cationic detergents: examples. Manufacture and applications. Non-ionic detergents: examples. Manufacture of ethylene oxide condensate.

1.3 Mechanism of action of detergents. Comparison of soaps and detergents. Biodegradation–environmental effects. BIS specifications.

Unit2: Cosmetics (1+8+1 h)

2.1 Shampoos- Manufacture of SLS (Sodium Lauryl Sulfate) and SLES (Sodium Lauryl Ether Sulfate).Ingredients, functions. Different kinds of shampoos– anti-dandruff, anti-lice, herbal, anti hair fall and baby shampoos.

2.2 Hair dye. Manufacture of conditioners. Cocobetaines or cocodi-ethanol amides–BIS specifications. Testing procedures and limits.

2.3 Skin lightening materials: face and skin powders. Ingredients, functions. Different types. Snows and face creams. Chemical ingredients used. Antiperspirants. Sun screen preparations. UV absorbers. Skin bleaching agents. Depilatories.Turmeric and Neem preparations.Vitamin oil.

2.4 Nail polishes: nail polish preparation, composition of nail polish removers, Lipsticks, eyebrow pencils. BIS specifications.

Unit3: Introduction and Constituents of Foods (1+33+1 h)

3.1 Food: source, functions of food–balanced food-food groups–food guide–food pyramid, usage of the food guide–food in relation to health –objectives of cooking- Different modes of cooking

3.2 Proteins: amino acids, peptides, proteins, modification of food products through heat processing. Effect of cooking–steaming or cooking under pressure of legumes. Detoxificcation. Analysis of proteins- principles in the determination of moisture content, ash content, nitrogen content–Kjeldahl's method.

3.3 Enzymes: Enzymes used in food processing. Enzymic browning–mode of action, secondary reaction of o-quinones, prevention of enzymic browning– thermal inactivation, Non-enzymic browning- Maillard reaction, prevention of non-

enzymic browning. Estimation of the activity of catalase in Chow-chow and radish (Titrimetry)

3.4 Carbohydrates: Classification and structure of glucose, fructose, sucrose, maltose, lactose and starch. Effect of cooking on the nutritive value of rice and of baking of wheat– bread and biscuit, processing and storage of carbohydrates. Estimation of carbohydrates in wheat flour

3.5 Lipids: Nomenclature and classification. Emulsions and emulsifiers, rancidity of fats – chemistry of fat and oil processing–function and storage of fats. Heat treatment on the nutritive value of oil seeds and nuts. Role of MUFA (Mono Unsaturated Fatty Acids) and PUFA (Poly Unsaturated Fatty Acids) in preventing heart diseases. Analysis of oils and fats–analysis of crude fats and determination of iodine number, RM (*Reichert Meissl*)value, acid number and saponification values–principles (No determination required).

3.6 Mineral sand vitamins: Sources, functions, bioavailability and deficiency of calcium, iron, iodine, fluorine, sodium and potassium. Vitamins- classification, sources, functions and deficiencies of fat- soluble vitamins–A, D, E and K, water-soluble vitamins–C, B-complex, and Folic acid. Fortification with vitamins and minerals. Effect of cooking on vitamins and minerals–different methods of cooking of vegetables, fruits–dehydrated fruits, canned fruit, canned fruit juices. Principles of estimation of thiamine and riboflavin (fluorimetry),

Unit 4: Food Additives, Modern Foods and Nutrition (1+13+1 h)

4.1 Foodadditives: Artificial sweeteners– saccharin, cyclamate, aspartame–Food flavours– esters, aldehydes and heterocyclic compounds. Antioxidants. Permitted and non Permitted Food colours. preservatives – leavening agents. Baking powder–Yeast. Taste enhancers– MSG (Mono Sodium Glutamate) - vinegar

4.2 Modern food: Mushroom cultivation and types, spirulina composition, Candy manufacturing, Caramellisation, Fast

foods, Instant foods, Dehydrated foods, Oleoresin of spices. Condiments. Milk Products, heat processing of milk, Pasteurization, cheese, butter, ghee and khoa.

4.3 Beverages: Carbonation. Addiction toalcohol. Cirrhosis of liver.Composition of soft drinks. Excessive use leading to urinary bladder stones. Preservation of tetrapack. Nitrogen preservation and packing of fruit juices. Coconut water.

4.4 Nutrition– calorific value of food stuff– RQ of food (Respiratory quotient of food)– basal metabolic rate – factors influencing BMR, specific dynamic action (SDA) of food.

4.5 Thermogenic effect– energy requirements of individuals– diet and its components, biological value of proteins, supplementary value of proteins. Diseases associated with protein malnutrition. Nutritional value of carbohydrates. Fibers in the diet, dietary sugars– nutritional aspects of lipids.

Unit5: Food Adulteration and Hygiene (1+13+1 h)

5.1 Adulterants: Common adulterants in different foods, milk and dairy products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages. Contamination with toxic chemicals, pesticides and insecticides. Principles involved in the analysis of detection and prevention of food adulteration.

5.2 Microbial growth: growth curve of bacteria. Effect of environmental factors on growth of microorganisms. pH, water activity, oxygen availability temperature, beneficial effect of microorganisms. Food borne illness, bacteria, virus, moulds and parasites (any two illnesses caused by each).Enzyme production from microorganisms. Application of enzymes in food processing.

5.3 Quality control: Specifications and standards, PFA, FPO, FDA, drug license, WHO standards, BIS specifications, packing and label requirements, AGMARK, FSSAI.

Books for study

- S.GobalaRao, *Outlines of Chemical Technology*, Affiliated EastWest press,1998
- Kafaro, *Wasteless chemical processing*, Mirpublishers,1995.
- W.Sawyer, *Experimental cosmetics*, Dover publishers, New York, 2000.
- Unit 2 – Indusrial Chemistry, P.K.Sharma
- M.Swaminathan, *Advanced Text Book on Food and Nutrition*, Vol.I & II, Printing and Publishing Co., Ltd., Bangalore.1993.
- M.Swaminathan, *Text Book on Food chemistry*, Printingand Publishing Co., Ltd., Bangalore, 1993.
- N.Norman Potter, *Food Science*, CBS publishers and distributors, NewDelhi,1994.
- L.H.Meyer, *Food Chemistry*, CBS publishers and distributors, NewDelhi, 1994.

Books for References

- K.Bagavathi sundari, *Appliedchemistry*, MJP Publishers, 2006.
- V.K. Ahluwalia, *Organic chemistry*, Narosa publishing house, 3rdedn., 2010.
- Owen R Fennema, *Food Chemistry*, Marcel Decker Inc., NewYork.1996(Advanced).
- B.Srilakshmi, *Food Science*, New age International Pvt. Ltd. Publishers, 3rdedn., 2003.
- B. SivaSankar, *Food Processing and Preservation*, Prentice–Hall of India Pvt .Ltd., New Delhi, 2002.
- S. Ramakrishnan, K.G. Prasannam and R.Rajan, *Text book of medical biochemistry*, Orient Longman Ltd. 2ndedn., 2001.
- N. Shakuntala Manay and M. Shadaksharaswamy, *FOODS: Facts and Principles*. New age
- International pvt.Ltd. Publishers, 2ndedn., 2002.Mary George and Geetha Swaminathan, Laboratory *Chemical*

Methods in Food Analysis, Margham Publications, Chennai, 2002.
- Nielsen, Suzanne (Ed.),*Food Analysis,* Springer, USA, 2010.
- Tanupriya – D drive, Food Chemistry text book.

16UCH4ES02 MATERIALS SCIENCE

Category: ES **Credits: 4**
Semester: IV **Hrs/Wk: 6**

Objectives

1. To understand the importance of materials science, sensors, polymers and nanomaterials.
2. To make the students to understand the types and mechanisms involved in materials science.

Unit 1: Nanomaterials (1+18+1 h)

Nanostructured materials - bottom-up approach and top-down approach with examples, synthesis - physical methods - inert gas condensation and arc discharge. Chemical methods - sol-gel method, solvothermal and hydrothermal methods and chemical vapour deposition. Biological methods - role of bacteria and fungi for nanomaterials synthesis.

Classification of nanomaterials - Carbon nanotubes – Synthesis and purification, single and multiwalled carbon nanotubes – advantages and disadvantages, filling of nanotubes, mechanism of growth, electron structure. Properties of carbon nanotubes – transport, mechanical and physical properties, applications. Nanoparticles - types of nanoparticles, Pure metals - gold and silver. Metal Oxides - silica and alumina. Synthesis and properties. Characterization of nanostructures - SEM and TEM (principle and instrumentation only).

Unit 2: Electrical, Magnetic and Superconducting Properties (1+13+1 h)

Conductors – variation of conductivity with temperature - semiconductors - p and n types, pn- junction – applications in transistors, rectifiers and photo-splitting of water. Photo voltaic cell and photogalvanic cell.

Magnets - classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferri magnetic - magnetic susceptibility, Variation with temperature - Curie-Weiss law, Curie temperature and Neel temperature. Permanent and temporary magnets, Domain theory.

Superconductors – definition, Meissner effect, Bardeen, Cooper and Schrieffer theory and Cooper pairs - examples of superconducting oxides, applications of superconducting materials.

Unit 3: Sensors and Types of Sensors (1+18+1 h)

Definition, types of sensors - optical, mass sensitive, heat sensitive, temperature, electromagnetic, mechanical and electrochemical sensors.

Humidity sensors - relative humidity, requirements of humidity sensors, miniaturisation of humidity sensors - capacitive, resistive, hygrometric, gravimetric and optical. Materials as humidity sensors - metal oxides - single and doped metal oxides and polymers. Sensing mechanism.

Volatile Organic Compounds (VOC): VOC sensors - sources of VOCs, health effects of VOCs, need for detection of VOCs, different materials used as VOC sensors - metal oxides - single and doped metal oxides and polymers. Sensing mechanism.

Biosensors - definition, principle of detection, types of biosensors - optical and electro chemical biosensors. Applications – cancer, point of care testing.

Unit 4: Polymers – Mechanism and Techniques (1+23+1 h)

Introduction - Monomers, Oligomers, Polymers and their characteristics. Plastics, elastomers, fibres, homopolymers and

co-polymers. Bonding in polymers: Primary and secondary bond forces in polymers; cohesive energy. Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers. Impact on human health and ecosystems

Mechanism and techniques of Polymerization - Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers: Ziegler-Natta polymerization, Step growth polymerisation, Bulk, Solution, Emulsion, Suspension, interfacial and gas phase polymerization, Kinetics of polymerization, polymer degradation.

Unit 5: Industrial Polymers and Polymer Processing Techniques (1+8+1 h)

Industrial Polymers - Thermoplastics: Polyethylene, Polypropylene, Polyacrylonitrile, Polyvinyl chloride, Polytetrafluoro ethylene, nylon and polyester (Synthesis and applications only). Thermosetting Plastics: Phenol-formaldehyde and epoxide resin. Elastomers: Natural rubber and synthetic rubber - Buna-N, Buna-S and neoprene (Synthesis and applications only). Conducting Polymers: Polyphenylene, polypyrrole and polyacetylene.

Polymer Processing Techniques - Calendaring, die casting, compression moulding, injection moulding, blow moulding and reinforcing, Vulcanisation.

Ecofriendly polymers – Synthesis, recycling and downcycling processes.

Books for study

- P. K. Palanisamy, *Materials Science*, Scitech Publications, India, 2002.
- T. Balachandran, *Materials Science*, Charulatha Publications, India, 2003.
- Charles P. Poole, Jr., Frank J. Owens, *Introduction to nanotechnology*,Wiley-India, 2009.
- T. Pradeep, *A Text book of nanoscience and nanotechnology*, Tata Mc-Graw-Hill, New Delhi, 2012.

- Anthony and Andrady, *Plastics and environmental sustainability*, Wiley, 2015.
- V. R. Gowariker, *Polymer Science*, Wiley Eastern, 1995.
- G.S. Misra, *Introductory Polymer Chemistry*, New Age International (Pvt) Limited, 1996.

Books for references

- D. F. Shriver, P.W. Atkins, *Inorganic chemistry*, 3rd edn., Oxford University Press, 2004
- H. P. Meyers, *Introductory Solid State Physics*, Viva Books Private Limited, 1998.
- A. R. West, *Solid State Chemistry and its applications*, John-Wiley and sons, 1987.
- F. N. Billmeyer, *Textbook of Polymer Science*, Wiley Interscience, 1971.
- J. George Odian, *Principles of Polymerization*, Wiley & sons 4thedn., 2004.
- A. Kumar and S. K. Gupta, *Fundamentals and Polymer Science and Engineering*, Tata McGraw Hill, 1978.
- Subbiah Balaji, *Nanobiotechnology*, MJP Publishers, Chennai, 2010.
- Sulabha K. Kulkarni, *Nanotechnology - Principles and Practices*, Capital Publishing Company, New Delhi, 2007.
- J. Fraden, *Handbook of Modern Sensors: Physics, Designs, and Applications*, Springer Science & Business Media, 2010.
- R. J. Young, P. A. Lovell, *Introduction to Polymers*, *Technology & Engineering*, 2011.

16UPH4AL01 PHYSICS FOR CHEMISTRY – II

Category: AL4 **Credits: 2**
Semester: IV **No of Hours/Week: 4**

Objectives:

This paper is offered to the students of chemistry as allied. This paper aims to give some fundamental physics required for their higher studies.

Unit 1: Electronics (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

a) Semiconductor devices: Semiconductors – intrinsic and extrinsic semiconductor – PN junction diode – LED – solar cell. Transistor: Construction – Mechanism of amplification – current components – modes of operation.

b) Operational amplifier: Ideal op-amp – inverting and non-inverting amplifiers – summing amplifier – differential amplifier – integrator – differentiator.

Unit 2: Atomic physics (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

a) Atomic physics: Bohr's atom model – hydrogen spectrum – fine structure splitting: sodium doublet – quantum numbers- Pauli's exclusion principle- periodic table.

b) X- rays and photo electric effect: Production of X-rays- continuous and characteristic X- ray spectra – industrial and medical applications of X- rays. Laws of photo electric emission – Einstein's photoelectric equation- Millikan's experiment – Photo electric cells (emissive, electric and voltaic) – photo multiplier tubes.

Unit 3: Nuclear physics (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

a) General properties of nuclei: Nuclear mass and binding energy- B.E/A versus A curve - nuclear spin and magnetic

moment- mass, half-life and spin of neutron - semi empirical mass formula.

b) Nuclear models and elementary particles: nuclear reactions: cross section – nuclear fission – liquid drop model –nuclear forces- elementary particles: classification- Quarks and leptons.

Unit 4: Molecular forces and solid materials (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

(a) Molecular forces: Particle nature of matter, molecules – size and separation of molecules – intermolecular forces and potential energy – properties of solids from molecular theory – elasticity, thermal expansion, latent heat of vaporization – bonds between atoms and molecules.

b) Solid materials: Classification of solids – crystalline, amorphous, glassy, polymeric solids – imperfections in crystals – mechanical behavior of solids – structure of polymers – branching and cross linking of polymer molecules – thermosetting and thermoplastic polymers.

Unit 5: Quantum mechanics (Introduction: 1 hr, Content: 9 hr, Revision: 2 hr)

Black body radiation spectra – Planck's theory – matter waves – De Broglie wavelength- Davisson and Germer experiment- Heisenberg's uncertainty principle – applications: binding energy of the hydrogen atom and radius of the Bohr's orbit – proving the non- existence of electron in the nucleus- Schrodinger equation – wave function and its interpretation.

Books for Study:-

1. V.K.Mehta, Principles of electronics, S.Chand Publishers – 11th edition (2010).

2. A.B.Gupta and Dipak Ghosh, Atomic and nuclear physics – Books and allied (sp) Ltd, Calcutta (1997).

3. H.S.Mani and Mehta. G.K., Introduction to modern physics – East West Press Pvt Ltd, New Delhi – (Reprint 2000).

4. Nelkon and Parker Advanced level physics — Arnold Publishers – 7th edition (2006).

5. Powell and Crasemen, Quantum mechanics – Narosa Publishing House (1988).

Books for Reference:-

1. Richard P. Feynman, Robert B. Leighton & Mathew Sands, Feynman lectures on physics series, vol. 3 , Narosa publishing House, New Delhi, 8th (Reprint 1995).

2. R. Murugesan, Modern Physics – S. Chand & Company, 15th edition (2011).

16UPH4AL02 PHYSICS FOR CHEMISTRY - PRACTICAL II

Category: AL4 **Credits: 1**

Semester: IV **No of Hours/Week: 2**

1. Determination of Young's Modulus (Non-uniform bending) - Pin and Microscope

2. Determination of Rigidity Modulus (Pointer method) - Static Torsion

3. Determination of focal length - concave and convex lenses

4. Determination of thickness of wire - Air wedge

5. Determination of wavelengths (Grating) - mercury spectrum

6. Universal building block - NAND gates

7. Inverting and non-inverting amplifier op-amp

8. PN- Junction Diode characteristics

16UCH5MC01 COORDINATION CHEMISTRY

Category: MC **Credits: 4**
Semester: V **Hrs/Wk: 4**

Objectives

1. To understand the nature of bonding in coordination compounds.
2. To understand the nature of metal-ligand bonding in organometallic compounds and their reactivity.
3. To know the method of synthesizing coordination compounds.
4. To understand the importance and application of coordination compounds in catalysis and in industry.
5. To know the role of transition metal ions in primary bioinorganic systems and the importance of coordination compounds in medicine.

Unit 1: Theory of Coordination Compounds (1+10+1 h)

1.1 Introduction: ligands-mono-, bi-, and polydentate ligands; terminology, nomenclature of mono- and dinuclear complexes; thermodynamics of formation of coordination compounds.

1.2 Isomerism: linkage-, ionization-, hydrate-, coordination-, coordination position isomerism, geometrical- (*cis*/*trans* and *fac*/*mer*), and optical isomerism.

1.3 Theories: Werner's theory; Sidgwick theory-EAN and stability, formation of metal-metal bond in dimers, limitations of Sidgwick theory; valence bond theory-hybridization, formation of tetrahedral and octahedral complexes, geometry-magnetic property relationship, drawbacks of VBT.

Unit 2: Theories of Coordination Compounds (1+10+1 h)

2.1 Crystal field theory: assumptions, crystal field splitting in octahedral and tetrahedral geometries-qualitative crystal field splitting diagrams, high- and low-spin complexes, CFSP and factors affecting, computation of CFSE. Evidences of crystal field splitting, spectrochemical series.

2.2 Jahn-Teller theorem, crystal field splitting in tetragonally distorted octahedral and square planar geometries.

2.3 Covalency in transition metal complexes: evidences, intensity of *d-d* transitions, nephelauxetic effect, adjusted crystal field theory.

2.4 MO Theory: Metal orbitals and LGOs suitable for σ- and π-bonding in octahedral geometry, construction of qualitative MO energy level diagram for σ-bonding in octahedral geometry.

Unit 3: Reaction Mechanisms of Coordination compounds

(1+10+1 h)

3.1 Substitution reactions in octahedral complexes: dissociative, associative and interchange mechanisms. Thermodynamic stability of complexes- methods of determining stability constant- spectrophotometric-principles. Kinetic inertness and lability.

3.2 Substitution reactions in square complexes: dissociative and associative mechanisms-*cis*- and *trans*-effects in synthesis of square planar and octahedral complexes.

3.3 Electron transfer reactions: inner-sphere and outer-sphere, complementary and non-complementary electron transfer reactions.

3.4 Metal template synthesis-metal phthalocyanins and Schiff bases

3.5 Vaska's complexes: structure and reactivity, oxidative addition and reductive elimination reactions.

Unit 4: Organometallic Compounds **(1+10+1 h)**

4.1 Nomenclature of organometallic compounds, 16- and 18-electron rule.

4.2 Structure and bonding in transition metal carbonyls: polynuclear carbonyls, bridging and terminal carbonyls

4.3 Transition metal alkyls, carbenes, and carbynes, and metallocenes-ferrocene, synthesis and structure.

4.4 Wilkinson's catalyst and alkene hydrogenation, hydroformylation, Monsanto acetic acid process, Ziegler-Natta catalyst and polymerization of olefins.

Unit 5: Bioinorganic Chemistry (1+10+1 h)

5.1 Biological roles of transition metal ions containing proteins and enzymes: apoenzymes and coenzymes; heme proteins-hemoglobin and myoglobin-general structures features.

5.2 Biological role of cytochromes, carboxypeptidase A, superoxide dismutase; *in vivo* and *in vitro* nitrogen fixation.

5.3 Inorganic medicinal chemistry: radiopharmaceuticals, chelate therapy, and contrast agents in MRI.

Books for Study

1. J. E. Huheey, E.A. Keiter, R.L. Keiter, *Inorganic Chemistry, Principles of Structure and Reactivity*, 4th edn., Harper Collins, 2006.
2. R. Gopalan, V. Ramalingam, *Concise Coordination Chemistry*, S. Chand, 2001.
3. D. F.Shriver, P.W Atkins, C.H. Langford, *Inorganic Chemistry*, 3rd edn., Oxford University press, 2000.

Books for Reference

1. M. L.Tobe, J.Burgess,*Inorganic Reaction Mechanisms*, Addison Wesley Longman, 1999.
2. S.Arunachalam, *Inorganic Photochemistry*, Kala Publications, Trichirapalli, 2002.
3. F.A. Cotton,G.Wilkinson,C.A. Murillo, M.Bochmann, *Advanced Inorganic Chemistry*, 6th edn., John Wiley, 1999.

16UCH5MC02 PHASE EQUILIBRIA AND KINETICS

Category: MC **Credits: 5**
Semester: V **Hrs/Wk: 5**

Objectives

To enable the students to understand the effect of pressure and temperature on phase equilibrium.

To know the relation between colligative properties and molecular weight of solutes

Unit 1: Phase Equilibria (1+13+1 h)

1.1 Phase Rule: Concepts of phase, component and degrees of freedom, with examples. Gibb's phase rule – derivation. Clapeyron and Clausius-Clapeyron equations and their applications to equilibria in phase transitions (solid – liquid, liquid – vapour, solid – vapour)

1.2 Application of phase rule to one component system- Water and Sulphur.

1.3 Reduced phase rule- Two component system:

(i) Simple eutectic: Lead-silver system.
(ii) Formation of compound with congruent melting point: Ferric chloride – water system.

(iii) Formation of compound with incongruent melting point.

1.4 Three component system: General account of graphical representation of three component systems, acetic acid-chloroform-water system.

Unit 2: Solutions (1+18+1 h)

2.1 Ideal solutions -Vapour pressure- Composition diagrams of solutions. Raoult's law, positive and negative deviations.

2.2 Principle of fractional distillation - Binary systems. Vapour diagram and azeotropic distillation, Partially miscible binary systems (Critical Solution Temperature (CST), upper and lower CST). Effect of addition of solute on CST.Steam

distillation.Solubility of gases in liquids; Henry's law, its relationship with Raoult's law.

2.3 Colligative properties -Lowering of vapour pressure: Thermodynamic derivation for elevation of boiling point and depression of freezing point. Relationship between osmotic pressure and vapour pressure, vant Hoff's theory of dilute solutions.Analogy between solute particles and gas molecules.

2.4 Distribution law (Nernst) - Thermodynamic derivation; limitation of the law and its application in association, dissociation and solvation, study of formation of complex ions.Extraction with solvents; efficiency of extraction.

Unit 3: Kinetic Parameters (1+8+1 h)

3.1 Definition of activation energy, rate, order, rate law, rate constant and molecularity. Differential form of rate expression and reactions involving zero, first, second and third order reactions.

3.2 Derivation of integrated rate equations for zero, first and second order reactions (both equal and unequal concentration of reactants), Half-life period.

3.3 Pseudo-first order reactions- acid and base catalyzed hydrolysis of ester and inversion of cane sugar. Determination of order by different methods.

Unit 4: Types and Theories of Chemical Reaction Rates (1+13+1 h)

4.1 Types of reactions - opposing reactions, parallel reactions, consecutive and thermal chain reactions – hydrogen-bromine reaction and dissociation of acetaldehyde (only mechanism and no derivation required)

4.2 Factors affecting chemical reactions – nature of reactants, concentration, catalyst, solvent polarity and ionic strength (only qualitative ideas). Arrehenius theory of chemical reaction rates.

4.3 Collision theory of bimolecular and unimolecular reactions -Lindemann hypothesis. Transition state theory – significance of entropy and free energy of activation.

Unit 5: Catalysis (1+13+1 h)

5.1 Properties of catalysts, action of catalytic promoters and inhibitors- homogeneous and heterogeneous catalysis – Intermediate compound formation and adsorption theories – acid-base catalysis.

5.2 Kinetics of enzyme catalysis – Michaelis-Menten equation and its verification, turnover number - effect of temperature and pH on enzyme reaction. Reversible and irreversible enzyme inhibitions, degree of inhibition.

Books for study

1. Keith J. Laidler and John H. Meiser, *Physical chemistry*, CBS Publishers, 2nd Indian edn., 2006.
2. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of physical chemistry*, Shoban Lal Nagin Chand and Co. 46th edn., 2013.
3. S. K. Dogra and S. Dogra, *Physical chemistry through problems*, New age international, 2nd edn., 2015.

Books for reference

1. J. Rajaram, J. C. Kuriakose, *Kinetics and Mechanism of chemical Transformations*, Macmillan India Ltd., New Delhi, 2011.
2. P. Atkins, J. D. Paula, *Physical chemistry*, Oxford university press, 9thedn., 2010.
3. K. L. Kapoor, *A textbook of Physical chemistry*, (Vol. 1 & 3) Macmillan, India Ltd, 2012.

16UCH5MC03 ORGANIC FUNCTIONAL GROUPS-II

Category: MC **Credits: 5**
Semester: V **Hrs/Wk: 5**

Objectives

1. To learn and understand the chemistry of carbonyl compounds.
2. To appreciate the synthetic uses of active methylene compounds.
3. To learn and practice the molecular rearrangements and the reaction mechanisms.

Unit 1: Aldehydes and Ketones (1+15+1 h)

1.1 Nomenclature and classification. Preparation and reactivity of carbonyl groups, acidity of alpha hydrogen.Physical and chemical properties of carbonyl compounds. Mechanism of aldol, Perkin, Knoevenagel reactions, benzoin and Claisen condensation, Wittig, Cannizarro and Reformatsky reactions.

1.2 Mechanisms of reduction with $NaBH_4$, $LiAlH_4$, Wolf-Kishner and MPV reduction. Mechanism of haloform and Michael addition.

1.3 Photochemical reactions of carbonyl compounds: Norrish type I and II reactions.

Unit 2: Carboxylic Acids and their Functional Derivatives. (1+16+1 h)

2.1 Nomenclature and classification of aliphatic and aromatic carboxylic acids.

2.2 Preparation and reactions. Acidity (effect of substituents on acidity) and salt formation. Reactions: Mechanism of reduction, substitution in alkyl or aryl group. Physical properties of acetic acid, phthalic acid, halogenated acids, cyano acids, lactic, pyruvic and tartaric acids.

2.3 Preparation and properties of dicarboxylic acids such as oxalic, malonic, succinic, glutaric, adipic and phthalic acids and unsaturated carboxylic acids such as acrylic, crotonic and cinnamic acids. Reactions: Action of heat on hydroxy and amino acids, and saturated dicarboxylic acids, stereospecific addition to maleic and fumaric acids.

2.4 Preparation and reactions of acid chlorides, acid anhydrides, amides and esters-acid and alkaline hydrolysis of esters, trans-esterification.

Unit 3: Molecular Rearrangements (1+13+1 h)

3.1 Classification as anionotropoic, cationotropic, free radical, inter and intramolecular.

3.2 Mechanism of Pinacol-pinacolone and semi-pinacol pinacolonerearrangements and their Stereochemical aspects; ring contraction and ring enlargement rearrangements, Beckmann, Hoffmann and Lossen rearrangements, Curtius and Benzilic acid rearrangements.

3.3 Claisen rearrangement (sigmatropic-evidence for intramolecular nature and allylic carbon attachment)-paraClaisen, Cope and oxycope rearrangements, and Fries and photo-Fries rearrangements.

Unit 4: Active Methylene Compounds (1+8+1 h)

4.1 Malonic and acetoacetic esters: Preparation, properties and characteristic reactions of active methylene group, synthetic uses of malonic, acetoacetic and cyanoacetic ester.

4.2 Diazomethane and diazoacetic ester: Preparation, properties,structure and synthetic applications.

Unit 5: Organometallic Compounds (1+13+1 h)

5.1 Introduction, classification and importance. Preparation and properties of organometallic compounds of Li, Mg, Cu and Zn metals: Grignard reagents. Preparation from halo derivatives, thio ethers and by substitution.

5.2 Reactions with alkylating agents and carbonyl compounds by substitution and coupling reactions.

5.3 Synthetic uses: Metal ion extraction and catalytic properties of crown ethers.

Books for study

1. R. T. Morrison, R.N. Boyd, Organic *Chemistry*, 6th edn., Printice-Hall Of India Limited., New Delhi, 1992.
2. B. Y. Paula, *Organic Chemistry*, 3rd edn., Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.
3. Bahl and Arun Bahl, *Organic Chemistry*, S. Chand and Sons, New Delhi, 2005.
4. V. K. Ahluwalia, *Organic Reaction Mechanism*, Ane Books Pvt. Ltd, 2007.

Books for references

1. J. March, M. Smith, *Advanced Organic Chemistry*, 6th edn., John-Wiley and sons, 2007.
2. S. H. Pine, *Organic Chemistry*, 5th edn., Mcgraw Hill International Edition, Chemistry Series, New York, 1987.
3. Sehan. N. Ege, *Organic Chemistry, Structure and Reactivity*, 3rd edn., AITBS, New Delhi, 1998.
4. J. B. Hendrickson, D.J. Cram, G. S. Hammond, *Organic Chemistry*,3rd edn., McGraw-Hill, Kogakusha, Limited, 1970.

e-books:

1. R. T. Morrison, R.N. Boyd, *Organic Chemistry*, 6th edn., Printice-Hall of India Limited, New Delhi, 1992. https://docs.google.com/file/d/0B1dYE8NwC2E3d3RwN05kZnd6VTA/edit
2. B. Y. Paula, *Organic Chemistry*, 3rd edn., Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002. ftp://178.213.241.33/incoming/Organic%20Chemistry%20(5th%20Edition)%20by%20Paula%20Yurkanis%20Bruice.pdf
3. J. March, M. Smith, *Advanced Organic Chemistry*, 6th edn., John-Wiley and sons, 2007. files.rushim.ru/books/mechanizms/march6ed.pdf

16UCH5MC04 APPLIED CHEMISTRY LAB

Category: MC **Credits: 4**
Semester: V **Hrs/Wk: 4**

Objectives

- To understand the importance of chemicals in day to day life
- To learn various methods of preparation of consumer products
- To learn the application of software that is easily available in the market and apply it
- To estimate the amount of chemical substance present in consumer products.

To take a given set of data and enter into a standard program and carry out either a Calculation-routine, plot it as a graph or chart and if needed print it out to get a hardcopy of the results

Analysis of Food Related Products

Estimation of hardness of water and removal of hardness.

Estimation of iodine value, acid value and RM (Reichert Meissel) value of edible oil.

Estimation of iodine in iodised salts.

Estimation of ascorbic acid.

Estimation of calcium content in sugar cane juice.

Estimation of glucose.

Estimation of glycine.

Estimation of acetic acid content in vinegar.

Isolation of caesein and lactose from milk.

Detection of adulterants in common food products.

Application of computers for chemists

General introduction to MS Excel 2010

Building worksheets

Calculations involving standard mathematical functions.

Data – Editing, manipulation.

Data presentation –Table, Chart, Graph.

Printing of spread sheet data and graph.

Small scale preparation of following consumer products.

Hard Soap	Soft Soap
Pain Balm	Chalk piece
Tooth paste	Shampoo
Detergent powder	Ink
Phenoyl (Toilet Cleaner)	Soda
Bleaching powder	Hand sanitizer
Natural mosquito repellent	Perfumes
Shoe polish	Nail polish

Books for study

- R. Norris shreve, and A.Joseph Brink, *Chemical process industries*, 4thedn., Mcgraw – hill Kogakusha Ltd, 1977.
- George T. Austin. *Shreve's Chemical Process Industries*, 5thedn., McGraw – Hill: 1984.
- N. S. Subbarao*, Biofertilizers in agriculture,* Oxford and IBH publishing Co.: New Delhi,1982.
- K.V. Raman, *Computers in Chemistry*, Tata McGraw-Hill Ltd., New Delhi, 1993.
- N. S. Gnanapragasam and G. Ramamurthy, *Organic Chemistry Lab Manual*, S.Viswanathan printers and publishers Ltd, 2002.

Books for reference

- P. Kamaraj,R. Jeyalakshmi, V. Narayanan, *Chemistry in engineering and technology*; Sudhandhira publications: Chennai, 2001.
- J.C. Kuriakose, J. Rajaram, *Chemistry in engineering and technology*. Vol. 2,Tata Mcgraw hill: New Delhi, 1988.

- Jugal, Kishore, Agrawal, *Practicals in Engineering Chemistry,* Oxford and IBH Publishing Co., New Delhi, 1976.
- Gini Courter, Annette Marquis, *Microsoft Office 2000*, BPB Publications, New Delhi, 1999.
- Julia Kelly, *Using Microsoft Excel 2000*, Prentice-Hall of India, New Delhi, 1999.
- Robert de Lavie, *A spreadsheet workbook for Quantitative chemical analysis*, McGraw-Hill, Inc. New Delhi, 1997.
- Mary George and Geetha Swaminathan, *Laboratory Chemical Methods in Food Analysis*, Margham Publications, Chennai, 2002.

16UCH5ES01 BIOCHEMISTRY AND NATURAL PRODUCTS

Category: ES **Credits: 4**

Semester: V **Hrs/Wk: 6**

Objectives

- To develop a sound knowledge of fundamental concepts in biochemistry.
- To enumerate the molecular motif of a living cell, structural and functional hierarchy of biomolecules and their metabolism events.
- To introduce chemistry of natural products.
- To provide understanding of the methods of isolation, purification and structural elucidation of natural products.

Unit 1: Amino Acids and Proteins (1+18+1 h)

1.1 Living Cell– Plant and Animal cell. Cell membrane – organelles – functions of major subcellular components – Anabolism and catabolism and their relation to metabolism.

1.2 Amino acids– classification –Synthesis of α-amino acids and their identification.Peptide bond- stereochemistry, synthesis of peptides by solution and solid phase techniques.

1.3 Proteins– classification – properties-3D structure-determination of amino acid sequence –denaturation and renaturation of protein molecules.Separation and purification of proteins – dialysis – gel filtration - electrophoresis.Catabolism of amino acids: Transamination, oxidative deamination, decarboxylation. Urea cycle and other possibilities of detoxification of ammonia.

Unit 2: Enzymes and Lipids (1+18+1 h)

2.1 Nomenclature, classification and properties-specificity, factors influencing enzyme action.

2.2 Mechanism of enzyme action – Lock and Key model and induced fit models. Coenzymes, cofactors, prosthetic groups of enzymes (TPP, NAD, NADP, FAD, ATP).Their importance in enzyme action.Mechanism of inhibition (competitive, non- and uncompetitive and allosteric).Immobilization of enzymes. Enzyme specificity,

2.3 Classification - neutral lipids, Phospho lipids (lecithins, cephalins, plasmalogens) and glycolipids – importance, synthesis and degradation.

2.4 Fatty acids – saturated, unsaturated fatty acids, essential fatty acid. Properties – Hydrolysis-acid number, saponification number. Auto-oxidation (Rancidity), lypolysis, addition reactions-Iodine value, Polenske number, Reichert-Meissl number, acetyl number.Hydrogenation.

2.5 Metabolism: Oxidation of glycerol – β-oxidation of fatty acids; biosynthesis of lipids – synthesis of fatty acids and synthesis of triglycerides.

Unit 3: Carbohydrates and Nucleic acids (1+18+1 h)

3.1 Classification – reducing and non-reducing sugars. Glucose: structure-conformation, stability. Carbohydrates of the cell membrane – starch, cellulose and glycogen. (Structure and utility)

3.2 Metabolism: Glycolysis and its reversal; TCA cycle. Relation between glycolysis and respiration.Principles of bioenergetics, electron transport chain and oxidative phosphorylation.

3.3 Nucleosides and nucleotides – purine and pyrimidine bases,difference between DNA and RNA. Classification of RNA.

3.4 Biosynthesis of DNA: Replication. Biosynthesis of mRNA: Transcription. Genetic code – mutations and mutants.DNA repair. Biosynthesis of proteins.DNA sequencing and PCR, recombinant DNA technology, DNA polymorphism.

Unit 4: Alkaloids and Terpenoids (1+13+1 h)

4.1 Introduction and functions of alkaloids. Classification, isolation and general methods of structural elucidation Structural elucidation and synthesis of coniine, piperine, nicotine and papaverine.

4.2 Terpenoids: Introduction, Isoprene rule and special isoprene rule, classification and isolation. General methods of determining structure.Structural elucidation and synthesis of citral, menthol, geraniol, camphor, β-carotene and vitamin-A.

Unit5: Anthocyanines and Steroids (1+13+1 h)

5.1 Anthocyanines: Introduction to anthocyanines.Structure and general methods of synthesis of anthocyanines.Cyanidine chloride: structure and determination.

5.2 Steroids: Introduction, stereochemistry and nomenclature. Ring structure determination. Biosynthesis of cholesterol.

Books for study

- Lehninger, *Principles of Biochemistry*, 4thedn., by David L. Nelson and Michael M. Cox, Worth Publishers, New York, 2005.
- L. Veerakumari, *Biochemistry*, MJP publishers, Chennai, 2004.
- L. Stryer, *Biochemistry*, W. H. Freeman and company, New York, 1975.

- J. L. Jain, *Biochemistry*, Sultan Chand and Co.1999
- O. P. Agarwal, *Chemistry of Natural Products*, Vol-1& 2, Goel Publishing House, 1997.
- Gurdeep Chatwal and Anand, *Chemistry of Natural Products*, Vol 1 & 2, Himalayan Publishing Co, 2001

Books for references

- Mazur and B. Harrow, *Text book of biochemistry*, 10th edn., W.B. Saunders Co., Philadelphia, 1971.
- Paula Yurkanis Bruice, *Organic chemistry*, 3rd edn., Pearson Education, Inc. (Singapore), New Delhi, reprint, 2002.
- P. W. Kuchel and G.B. Ralston, Shaum Series, *Theory and Problems of Biochemistry*, McGraw-Hill Book Company, New York, 1988.
- L. Finar, *Organic Chemistry*, Vol.2, 5th edn., Pearson education, London, 1975.

16UCH5ES02 MEDICINAL AND PHARMACEUTICAL CHEMISTRY

Category: ES **Credits: 4**

Semester: V **Hrs/Wk: 6**

Objectives

The student is expected to learn about

- Important drugs and the mode of actions.
- health management and drug development

Unit 1: Clinical Hygiene and Biochemical Analysis **(1+10+1 h)**

1.1 Definition of health. Role of WHO.

1.2 Sterilization of surgical instruments. Disinfectants, antiseptics, sanitation.Treatment for specific poisons- acids, alkalis, arsenic and mercury compounds.

1.3 Body Fluid Blood volume, blood groups, coagulation of blood. Plasma lipoprotiens. Blood pressure. Arteriosclerosis, diseases affecting red cells: Hyperchromic and hypochromic anaemia. Blood transfusion. Coagulation, biochemical analysis of urine, serum and fecal matter, Methods of determination of blood sugar and diabetes.

1.4 Biotechnology: heredity, recombinant DNA, Genetic engineering and its possible hazards, Gene splicing-Manufacture of interferon and human insulin (Humulin), Drug manufacture based on fermentation (only antibiotics).

Unit 2: Introduction to Pharmaceutical Chemistry

(1+10+1 h)

2.1 Important terminologies used-molecular pharmacology-Pharmacodynamics-Pharmacognosy, Pharmacophore, metabolites, Virus antimetabolites, bacteria, fungi, actinomycetes.

2.2 Name of drugs, code number, chemical proprietary, trivial trade, Non proprietary Names, synonyms (meaning only), dosage of drugs, storage of drugs, different temperature conditions.

2.3 Assay- biological, chemical immunological- statement only, Metabolism of drugs and their effect on pharmacological activity.

2.4 Physiological effects of different functional groups in drugs (any 2 functional groups).Testing of potential drugs and their side effect- Ethical clearance and clinical trials.

Unit3: Common Drugs **(1+20+1 h)**

3.1 Manufacture of drugs (quinine, reserpine, only structure for atopside and d–tubocurarine) from Indian medicinal plants.

3.2 Testing of drugs: biological variation, screening and toxicity. Use of pharmacopeia and therapeutic index.

3.3 Types of drugs and their modes of action: Depressant drugs (special reference to sedatives and hypnotics). Anticonvulsant drugs (sodium valproate, hydantoins). Narcotic analgesics (only morphine compounds). Antipyretic analgesics

(acetylsalicyclic acid, p–amino–phenol derivatives). Muscle relaxants. Type 1: Actingatneuromuscular junction (d–tubocurarinechloride). Type 2 : Actingatspinalcordalone (glycerylguaiacolate, diazepam). Antibiotics (pencillin, streptomycin, tetracyclin, chloramphenicol). Cardiovascular drugs-nitrates, betablockers (propranalol and atinelol) and calcium channel blockers. Stent

3.4 Nuclear medicine (Radiation therapy), chemotherapy, nanomedicine, nutraceuticals, antidiabatic drugs.

Unit4: New Drugs and Drug Action (1+20+1 h)

4.1 Genesis of new drugs: serendipity, random screening, extraction of active principles from natural sources, molecular modification of known drugs, selection or synthesis of soft drugs, drug latentiation and rational drug design.

4.2 Compounds of medicinal interest: Structure, structural modifications, mechanism of action and therapeuticuses of taxanes, camptothecin, artemisinin, ginkgolides and gymnemic acids.

4.3 Theoretical aspects of drug action: Types of drug action, physiochemical parameters and pharmacological activity, non-empirical electronic parameters, steric parameters and stereochemical aspects of drugs. Drug receptors, receptor types and isolation, drug receptor interaction, theories of drug action, and mechanism.

4.4 Structure activity relationship of quinine and antimalarials, tetra hydro cannabinols, barbiturate, chloramphenicol, penicillin, streptomycin, erythromycin and rifamycin.

Unit 5: Drug Discovery and Drug Design (1+20+1 h)

5.1 Modern methods of drug discovery target validation: Introduction to discovery of lead molecule, rational drug discovery models. Target structure, active site identification and methods of validation.

5.2 Rational Drug Design: QSAR and QSPR (Introduction only).QSAR parameters-lipophilicity (Polarisabiltiy, electronic

and stericparameters).Quantitative models. Hansch analysis, free Wilson analysis and their relationships, linear relationships and applications of Hansc hand free Wilson analysis.

5.3 Computer aided drug design (CADD): Virtual screening: concept, drug likeness screening, focused screening libraries for lead identification, pharmacophore screening, structure based virtual screening and applications.

5.4 Molecular modeling: Introduction, numerical methods, known and unknown receptors.

Books for study

- J.Ghosh, *A text book of Pharmaceutical Chemistry*, S.Chand and Co.Ltd, 3rd revised edn.,2003: Reprint 2014.
- S.C.Rastogi, *Biochemistry*, Tata McGraw Hill Publishing Co.,1993
- O.Kleiner and J. Martin, *Bio-Chemistry*, Prentice-Hall of India (P) Ltd, New Delhi, 1974.
- A.Kaur,*Medicinal Chemistry*, Wiley Eastern Limited, NewDelhi, 1993.
- D.J. Abraham, D. P. Rotella,*Burger's Medicinal Chemistry, Drug Discovery and Development,* 7th edn., Vol- 8, Wiley Publications, New York, 2010.
- S.V. Bhat, B. A. Nagasampagi, M.Sivakumar, *Chemistry of natural products*, New Delhi, Narosa Publishing House, 2005.

Books for reference

- O.LeRoy, *Naturaland synthetic organic medicinal compounds*, Ealemi,1976.
- R.B.Silvermann, *Organic Chemistry of Drug Design and drug Action*, 2ndedn., Academic Press, 2004.
- Corwin, Hansch, *Comprehensive Medicinal Chemistry*,Vol- 1 to 6, Pergamon Press, UK, 1990.
- D.A. William, Lemke, T.L.Foye's, *Principles of Medicinal Chemistry*, 5th edn., Wolters Kluwer Health (India) Pvt. Ltd, 2006.

- P.Testa Band Jenner, *Drug Metabolism Chemical &Biochemical Aspects*, MarcelDekker Publications.
- Ariens, *Drug design medicinal chemistry a series of monograph*, Vol- II,III, academic press, an imprint of Elsevier publications.
- Durairaj,*Compendium of Organic Medicinal compounds,* Vol-1-6, PharmaMedPres, Hyderabad, 2013.
- L. Finar, *Organic Chemistry- Stereochemistry and the chemistry of natural products*, 5th edn.Vol-2.Delhi:DorlingKindersley(India)Pvt.Ltd.2006.
- AtaurRahman,*Chemistryof Natural Products*, Edinburgh:Saunders.2004.
- O. P. Agarwal, *Organic chemistry- natural products*, 30th edn.Vol. 1-2.Meerut:GoelPublishingHouse, 2006.
- T. E. Wallis, *Text book of Pharmacognosy*, 5th edn, CBSPublishers&Distributors,2002.

16UCH5SK01 INDUSTRIAL CHEMISTRY

Category: SK **Credits: 4**

Semester: V **Hrs/Wk: 6**

Objectives

- To enable a student to understand
- The generation of energy from various types of fuels.
- Methods employed for purification of water for industry and home.
- Pollution occurring from various industrial sources and resulting toxic effects.

Unit 1: Industrial fuels (1+16+1 h)

1.1 Energy: Types- heat, electrical, mechanical, light, nuclear energy, solar energy, hydrogen, fuel cells. Sources: renewable and non-renewable, classification of fuels: solid,

liquid and gaseous. Calorific value of fuels and its determination.

1.2 Solid fuels: Coal- types– lignite, sub-bituminous coal, bituminous coal and anthracite. Coking and non-coking coal – properties and uses

1.3 Liquid fuels: Refining of crude petroleum and uses of fractions. Hydrodesulphurisation. Cracking: thermal and catalytic (fixed bed and fluidised bed cataylsis). Octane number, cetane number. Uses of tetraethyl lead, Ethyl tertiarybutyl ether and Methyl tertiarybutyl ether.

1.4 Gaseous fuels: Natural gas and gobar gas: production, composition and uses. Gobar electric cell.

Unit 2: Chemistry and Agriculture (1+16+1 h)

2.1 Fertilizers: NPK, superphosphate, triple superphosphate, uses of mixed fertilizers. Micronutrients and their role, biofertilizers, plant growth hormones.

2.2 Pesticides: Classification of pesticides with examples. Insectides; stomach poisons, contact insecticides, fumigants. Manufacture and uses of aldrin, dieldrin, endrin and pentachlorophenol (and its sodium salts) and Bio pesticides. Herbicides: 2,4-D and 2,4,5-T Fungicides: Preparation of Bordeaux mixture. Mention of lime-sulphur and creosote oil.

2.3 Sugar industry: Refining and grading of sugar. Saccharin: synthesis and use of sugar substitutes- aspartame. Ethanol: manufacture from molasses by fermentation.

Unit 3: Water Treatment (1+16+1 h)

3.1 Introduction: Hardness of water-temporary or carbonate hardness, permanent hardness or non-carbonate hardness. Units of hardness, disadvantages of hard water – In domestic, in industry and in steam generation in boilers. Effect of iron and manganese in water. Estimation of hardness – EDTA method – Estimation of total hardness – O. Hehner's method or alkali titration method.

3.2 Water softening methods: Lime – soda process, Zeolite process; Ion-exchange - demineralisation - deionisation process.

Mixed – bed deionisation. Removal of suspended impurities. Removal of microorganism – Chlorination, break point chlorination. Reverse osmosis. Desalination. Waste water treatment.

Unit 4: Pollution and Chemical Toxicology (1+16+1 h)

4.1 Pollution: Air pollution - Acid rain. Green house effect (global warming), ozone layer depletion - photochemical oxidants. Smog and Control of air pollution. Water pollution – organic pollutants, Chemical oxygen demand (COD), Biological oxygen demand (BOD), total organic carbon. International standards for water and air quality and regulations.

4.2 Chemical toxicology: Effect of toxic chemicals on enzymes. Lead, mercury and cyanide pollution and their biochemical effects. Carbon monoxide, sulfur dioxide, oxides of nitrogen, ozone – biochemical effects.

Unit 5: Seminar - Common Industrial Chemical Products (1+16+1 h)

5.1 Corrosion; Types of corrosion-causes–prevention methods, anodic protection, cathodic protection-sacrificial anodic method.

5.2 Super conductors, semi conductors, N- type and P- type semiconductors, silicones – inorganic polymers.

5.3 Manufactures of Glass, Cement, Dyes, Paints, Special paints, paper

5.4 Lubricants and greases, Refractories, Abrasives,

5.5 Preparation of Plastics, Perfumes matches and Explosives.

5.6 Rubber industries: reinforced fiber tyres, Vulcanization of rubber.

Books for study

- A.K. De, *Environmental Chemistry*, 7th edn., New Age International (P) Limited, Publishers New Delhi, 2010.

- B.K. Sharma, *Industrial Chemistry: Including Chemical Engineering*, Goel Publishing house, Meerut, India, 1994.
- P.C. Jain,M. Jain, *Engineering chemistry*, 15th edn., Dhanpat Rai publications, 2015.
- Books for reference
- C.A. Heaton,*An Introduction to Industrial Chemistry*, Springer Science & Business Media, 1996.
- J.C. Kuriakose, J. Rajaram, *Chemistry in engineering and technology*. Vol.2. TataMcgraw hill: New Delhi, 1988.
- Jugal, Kishore, Agrawal, *Practicals in Engineering Chemistry*; Oxford and IBH Publishing Co., New Delhi, 1976.

16UCH6MC01 QUANTUM CHEMISTRY AND PHYSICAL PROCESSES

Category: MC **Credits: 6**

Semester: VI **Hrs/Wk: 6**

Objectives

- The student should be able to understand
- The transition from classical to quantum mechanics.
- Symmetry aspects of the molecules and fundamentals of computational chemistry
- The aspects of photochemistry and study the surface related phenomenon.

Unit 1: Quantum Mechanics (1+18+1 h)

1.1 Classical mechanics: Basic assumptions of Classical Mechanics – failures-Photoelectric effect, Compton effect, Heat capacity at constant volume, Energy distribution in black body radiation – Ultraviolet catastrope, Wien's and Stefan-Boltzmann's laws of emissive power, Hydrogen atomic spectrum.

1.2 Postulates of quantum mechanics. Concepts of operators, eigen function, eigen values. Derivation of Time independent Schrodinger wave equation, particle in one-dimensional box - derivation for energy, Application to linear conjugated polyenes (ethylene and butadiene).

Unit 2: Molecular Symmetry (1+16+1 h)

2.1 Molecular Symmetry: Symmetry operations, product of symmetry operations, symmetry elements, classes, group, sub-group, Abelian group, group multiplication table – properties of a group – point groups C_s, C_i, C_1, C_{2v}, C_{3v}, C_{4v}, C_{2h}, and C_{3h}.

2.2 Application of symmetry operations in predicting the optical activity and dipole moment of the molecules.

Unit 3: Fundamentals of Photochemistry (1+14+1 h)

3.1 Comparison of thermal and photochemical reactions. Laws of photochemistry: Grotthus-Draper Law, Kasha's rule and Stark-Einstein law Jablonski diagram - radiative and non-radiative processes – IC and ISC. Photosensitization and photosynthesis.

3.2 Primary and secondary processes – Conditions for phosphorescence emission (spin-orbit coupling), chemiluminescence, bio-luminescence. Derivation of ground state atomic term symbols, R-S coupling.

Unit 4: Kinetics and Characterization of Photochemical Reaction (1+14+1 h)

4.1 Experimental techniques of photochemical reactions – chemical actinometers (Uranyl oxalate, ferric oxalate and Malachite green) –quantum yield.

4.2 Kinetics of photochemical reactions between hydrogen and chlorine, hydrogen and bromine – Flash photolysis, Photosynthesis.

4.3 Quenching (static and dynamic), Bimolecular quenching – Stern-Volmer equation.

Unit 5: Surface Chemistry and Colloids (1+18+1 h)

5.1 Physical and chemical adsorption – Adsorption isotherms – Langmuir, Freundlich and Brunauer–Emmett–Teller (BET) equations (No derivation for BET) – Gibb's adsorption equation – Mathematical derivation – Determination of surface area using Langmuir and BET equations.

5.2 Colloids: Lyophobic and lyophilic sols, origin of charge and stability of lyophobic colloids – Coagulation abd Schultz-Hardy rule, Zeta potential abd Stern double layer (qualitative idea) – Optical properties – Tyndall effect. Mechanical properties – Brownian motion. Electrokinetic phenomenon (qualitative idea only), Micelles and Reverse micelles, critical micelle concentration (CMC) – Application of Colloids.

Books for study

1. I.N. Levine, *Quantum Chemistry*, 6thedn., Pearson Education, London, 2008.
2. P.W. Atkins, *Physical Chemistry*, 8thedn., W. H. Freeman, New York, 2006.
3. F. A. Cotton, *Chemical Applications of Group theory*, Wiley Eastern, Singapore, 2nd edn., 1992.
4. B.R. Puri, L. R. Sharma, M. S. Pathania, *Principles of physical chemistry*, Shoban Lal Nagin Chand and Co. 46th edn., 2013.
5. S.H. Maron, J. B. Lando, C. F. Prutton, *Fundamentals of Physical Chemistry*, Macmillan, 1974.

Books for reference

1. D.A. McQuarrie, *Quantum Chemistry*, 3rdedn., Univ. Sci. Books, Mill Valley, California, 1983.
2. J.P. Lowe, *Quantum Chemistry*, 3rdedn., Academic Press, New York, 2008.
3. V.Ramakrishnan and M. S. Gopinadhan, *Group theory in Chemistry*, Vishal Pub. New Delhi, 1996.
4. J.P. Lowe, *Quantum Chemistry,*3rdedn., Academic Press, New York, 2008.
5. P.Atkins, J. D. Paula, *Physical chemistry*, Oxford university press, 9thedn., 2010.
6. R.K. Prasad, *Quantum Chemistry*, 2ndedn., New Age International, 2001.

7. A.K. Chandra, *Introductory Quantum Chemistry*, 4th edn., Tata McGraw-Hill Education, 1994.
8. K.K. Rohatgi Mukharjee, *Fundamentals of Photochemistry,* Revised edn. New Age International Publisher, New Delhi, 1978.

16UCH6MC02 TRANSITION ELEMENTS AND NUCLEAR CHEMISTRY

Category: MC **Credits: 7**

Semester: VI **Hrs/Wk: 7**

Objectives

1. To enable the students to understand the chemistry of transition elements and inner transition elements.
2. To know the importance of nuclear reactions in the modern world.
3. To understand the theoretical basis for the practical methods involved in metallurgy.

Unit 1: Metallurgy and Introduction to Transition Elements

(1+23+1 h)

1.1 Occurrence of elements in nature- minerals and ores, types of ores.

1.2 General principles of extraction of metal –Different steps of metallurgy, pulverisation of the ores, concentration-electromagnetic and hydraulic leaching, and froth flotation process, calcinations and roasting, reduction-thermite welding process/alumino thermic process, smelting process, electrolytic reduction, purification or refining–zone refining, van-Arkel, Mac-Arther forest cyanide process. Mineral benefication.

1.3 Factors influencing the choice of extraction process, thermal decomposition methods; displacement of metal; high temperature chemical reduction methods-reduction by carbon, metal. Self-reduction, reduction of oxides with hydrogen; electrolytic reduction-in aqueous solution, in nonaqueous solvents, in fused melts; thermodynamics of reduction processes-Ellingham diagram.

1.4 Metallurgy of Ti, V, Fe, and Cr.

1.5 General characteristics of first row *d*-block elements: - Introduction, atomic radii, ionic radii, atomic volumes, density, metallic character, melting and boiling points, ionization energy, reactivity, oxidation states, complex formation, reducing properties, color and magnetic properties, catalytic properties, Variable oxidation states, lower oxidation states and stabilization.

1.6 Differences between the first and the other rows of *d*-block elements.

Unit 2: Chemistry of Transition Elements (1+23+1 h)

2.1 Iron triad Group discussion; horizontal comparison with Fe, Co, Ni groups, occurrence and commercial forms of iron, manufacture of cast iron, properties of cast iron manufacture of steels- Heat treatments of steel, classification of steels-properties of iron passivity, corrosion, compounds of iron-potassium ferrocyanide and potassium ferricyanide, sodium nitroprusside-uses of compounds of ion in blue prints,test of iron.

2.2 Cobalt and nickel: similarities between nickel and copper- compounds of cobalt and nickel- nickel complexes, organometallic compounds; Test for nickel- production of nickel from NiS, Orford process, Mond process.

2.3 Platinum triads, light platinum triad-German process, Ruthenium, Rhodium, and palladium-compounds (any two), Extraction of palladium.Compounds of palladium, heavy platinum triads- osmium-extraction.Catalytic application of OsO_4in organic chemistry. Iridium- platinum compounds of platinum (any two)–metallurgy of platinum-various types of platinum-spongy platinum, platinum black, platinized asbestos, colloidal platinum.

2.4 Copper group: Similarities and gradation in their properties among Cu, Ag, Au Compounds of Cu, Halides of Ag-photography,silvering of mirrors. Gold-compounds of gold: electroplating of metals.

Unit 3: Inner Transition Elements and Chemistry of Nucleus (1+23+1 h)

3.1 Lanthanides: lanthanide series, position in the periodic table, abundance and natural isotopes, lanthanide contraction, similarity in properties, occurrence, oxidation states, chemical properties of lanthanide(III) cations, electronic spectra of lanthanide compounds. Separation of lanthanides: solvent extraction, ion exchange, chemical properties of Ln(III) metal ions.

3.2 Actinides: actinide series, abundance and natural isotopes, occurrence, separation of actinides, oxidation states, general properties, the later actinide elements. Uranium-occurrence, metallurgy; chemical properties of hydrides, oxides, and halides.

3.3 Chemistry of nucleus: types of nucleons- Nature of subatomic particles.isotopic mass–meson exchange theory of the origin of nuclear forces–density of nucleus-radioactive elements.

3.4 Isotopes, isobars, isotones and nuclear isomers.

3.5 Nuclear stability: Neutron to proton ratio, packing fraction, mass defect, Binding energy of nucleus and its calculations.

3.6 Nuclear model: shell (magic numbers) and liquid drop model.

Unit 4: Radiation Chemistry (1+13+1 h)

4.1 Natural and induced radioactivity: radioactive decay-α, β- and γ-decays; neutron emission, positron emission, electron capture; unit of radioactivity (Curie); half-life period; Geiger-Nuttal rule, radioactive displacement law, Natural and artificial radioactivity -types of radioactive reactions -Soddy-Fajans and Russel Group displacement law.

4.2 Disintegration constant or decay constant; Average life period (t_{avg}); radioactive equilibrium; law of successive disintegration; activity of radioactive substances, calculations.

4.3 Transmutation of elements: important particles, artificial transmutation induced by different bombarding projectiles-synthesis of manmade elements, higher actinides.Natural and artificial radioactive series. Calculation of number of α, and β particles ejected in each series.

4.4 Measurement of radioactivity: ionization chamber, Geiger counters scintillation counters, pulse radiolysis.

Unit5: Nuclear Reactions (1+13+1 h)

5.1 Nuclear reactions: types of nuclear reactions, nuclear cross section, spallation, nuclear fission and fusion.Theory of fission-chain reaction, critical mass; nuclear reactors-fast breeder reactor, fuels used in nuclear reactors-fissile,fertile separation of isotopes, moderators, coolants.Nuclear fusion; nuclear reactors in India.

5.2 Stellar energy, carbon-nitrogen and, proton-proton cycles, atom- and hydrogen bomb-principles.

5.3 Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labeling studies, nuclear medicine-^{99m}Tc radiopharmaceuticals-isotopes used in nuclear fission reactions. Radioisotopes used in noninvasive imaging techniques in nuclear medicine.

Books for Study

1.J. D. Lee, *Concise Inorganic Chemistry*, 5thedn., Blackwell Science, London, 2010.

2.D. F. Shriver, P. W. Atkins, *Inorganic Chemistry*, 4th edn., W.H. Freeman and Co, London, 2010.

3.H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th edn., New Age International, New Delhi, 2007.

4.B.R. Puri, L.R. Sharma, K.C. Kalia, *Principles of Inorganic Chemistry*, ShobanLalNaginChand and Co., New Delhi, 2005.

5.SatyaPrakash, G.D. Tuli, S.K. Basu, R.D. Madan, *Advanced Inorganic Chemistry*, Vol. II 5th edn., S. Chand & company, New Delhi, 2000.

Book for Reference

1.J.E. Huheey, E.A. Kieter, R.L. Keiter, *Inorganic Chemistry*, 4th edn., Harper Collins, New York, 1993.

2.F.A. Cotton, G. Wilkinson, C. Murillo, M. Bochman, *Advanced Inorganic Chemistry*, 6th edn., John Wiley, New York, 1999.

3.T. Moeller, *Inorganic Chemistry: A Modern Introduction*, Wiley, New York, 1990.

16UCH6MC03 SYNTHETIC ORGANIC CHEMISTRY AND HETEROCYCLIC COMPOUNDS

Category: MC **Credits: 7**

Semester: VI **Hrs/Wk: 7**

Objectives

The course should prepare the students for

1. Looking at the molecular complexity of carbon skeletons, applying disconnection approach and identifying suitable synthons.

2 Identifying suitable reaction sequences to achieve the synthesis of target molecules.

3 Studying various synthetically important reactions with a view to appreciate their scope, limitations and potential use in synthetic sequences.

Unit1: Planning an Organic Synthesis and Control Elements (1+19+1 h)

1.1 Preliminary Planning – knowns and unknowns of the synthetic system studied.Analysis of the complex and interrelated carbon framework into simple rational precursors.

1.2 Retrosynthetic analysis, alternate synthetic routes. Key intermediates that would be formed, available starting materials and resulting yield of alternative methods.Linear Vs convergent synthesis.Synthesis based on umpolung concepts of Seebach.

1.3 Regiospecific control elements. Use of protective groups, activating groups and bridging elements.

1.4 Synthesis of simple organic compounds: N,N-dipropylamine, amelfolide, daminozide, 2,4-dichlorophenoxyacetic acid, cetaben ethyl ester and ofornine.

Unit 2: Organic Reactions of Importance in Synthesis (1+19+1 h)

2.1 Catalytic hydrogenation and dehydrogenation.

2.2 Reductions with LAH, $NaBH_4$ and DIBAL.Hydroboration and oxidation.Birch, Clemmenson and Wolf-Kishner reduction.

2.3 Oxidation with Cr(VI) and Mn(VII) reagents. Oxidation by peracids and DMSO with oxalyl chloride.

Unit 3: Introduction to Pericyclic Reactions (1+19+1 h)

3.1 Cycloaddition reactions: Diels alder reactions.Electrocyclization reaction.

3.2 Sigmatropic rearrangements: (3,3), (5,5)-sigmatropic rearrangements.Group transfer reactions.

3.3 Thermal and photochemical Frontier Molecular Orbital approach.

Unit 4: Heterocyclic Compounds (1+19+1 h)

4.1 Introduction, classification and aromaticity.

4.2 Five membered rings: Preparation of Furan, pyrrole and thiophene. Reactions: electrophilic and nucleophilic substitutions, oxidation and reduction reactions.

4.3 Six membered rings: Pyridine; Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.

Unit 5: Fused Ring Heterocyclic Compounds (1+19+1 h)

5.1 Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties.

5.2 Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.

5.3 Saturated and partially saturated heterocyclic compounds: Reactions and synthesis of tetrahydrofuran, dioxan, sulpholones, tetrahydropyrrole, tetrahydrothiophene, pyrrolidine, piperidine and derived systems.

Books for study

1. M.B. Smith, *Organic Synthesis*, McGraw Hill International Edition 1994.
2. Ian Fleming, *Pericyclic Reactions*, Oxford Science Publications, Cambridge, 1999
3. V. K. Ahluwalia and Renu Aggarwal, *Organic Synthesis; Special Techniques*, Narosa Publishing House, New Delhi, 2001.
4. J.A. Joule, G.F. Smith, *Heterocyclic Chemistry*, Garden City Press, Great Britain, 2004.

Books for references

1. R.E. Ireland,*Organic synthesis*, Prentice Hall India, Goel publishing house, 1990
2. R. T. Morrison and R. N. Boyd, *Organic Chemistry*, Prentice Hall Inc., 6thedn., 1992.
3. Kiochi Tanaka, *Solvent Free Organic Synthesis*, Wiley VCH, Weinheim, 2003.
4. V. K. Ahluwalia, *Organic Reaction Mechanism*, Ane Books Pvt. Ltd, 2007.
5. J. A. Joule, K. Mills, *Heterocyclic Chemistry*, 4thedn., John-Wiley, 2010.

16UCH6MC04 GRAVIMETRIC ANALYSIS AND ORGANIC PREPARATIONS

Category: MC **Credits: 4**

Semester: VI **Hrs/Wk: 4**

Objectives

1. To acquire the quantitative skills in gravimetric analysis and in organic preparations.
2. To obtain the skills in organic preparations.

1. Gravimetric Analysis

Estimation of sulphate as barium sulphate.

Estimation of barium as barium chromate.

Estimation of copper as copper thiocyanate.

Estimation of nickel as Ni-DMG.

Estimation of lead as lead chromate

Estimation of magnesium as magnesium pyrophosphate.

Estimation of calcium as calcium oxalate.

Estimation of copper in an alloy.

Estimation of lead as lead sulphate.

2. Organic Preparations

1. Single stage organic preparations involving bromination, hydrolysis, nitration, oxidation, and benzoylation.
2. Books for reference
3. Sundaram, Krishnan, Raghavan, *Practical Chemistry (Part III)*, S. Viswanathan Co. Pvt., 1996.
4. *Vogel's Text Book of Quantitative Chemical Analysis*. 5th ed., ELBS/Longman England, 1989.
5. N.S. Gnanapragasam and G. Ramamurthy, *Organic chemistry–Lab manual*, S. Viswanathan Co. Pvt. Ltd., 2002.

16UCH6MS01 SPECTROSCOPY

Category: MS **Credits: 4**

Semester: VI **Hrs/Wk: 6**

Objectives

1. To understand the importance of various branches of spectroscopy.
2. To learn the basic analytical methods of various spectral analysis and their significance.

Unit 1: Basic Concepts of Spectroscopy (1+13+1 h)

1.1 Electromagnetic spectrum and interaction of radiation with matter, quantization of energy, electronic, vibrational and

rotational energy levels. Transitions in atoms and molecules, Absorption and emission spectra.

1.2 Boltzmann Distribution (formula only), Relative population of translational, vibrational and rotational energy levels at different temperatures, Born-Oppenheimer approximations, Franck-Condon Principle.

1.3 Selection rules, transition probabilities, Factors affecting the line width and intensity of the spectral lines, resolution, signal-to-noise ratio.

Unit 2: Electronic Spectroscopy (1+18+1 h)

2.1 Absorption laws, Beer –Lambert's law – verification and its limitations, Instrumentation of spectrophotometer, block diagrams.

2.2 Types of electronic transitions, chromophores and auxochromes, Shift of absorption bands, absorption bands and intensity, factors governing absorption maximum and intensity, Solvent effects.

2.3 Applications of electronic spectroscopy: Calculation of λ_{max} of conjugated dienes and α,β-unsaturated ketones using Woodward – Fieser Rules.

2.4 Atomic absorption spectroscopy and flame photometry – principles and applications (No instrumentation).

Unit 3: Infrared and Raman Spectroscopy (1+18+1 h)

3.1 IR spectroscopy: Principle, Hooke's law and harmonic oscillator, Normal degrees of freedom, types of stretching and bending vibrations, vibrational frequencies, instrumentation, cell sampling techniques, factors affecting the fundamental vibrational frequencies.

3.2 Raman spectroscopy: Rayleigh and Raman scattering, stokes and anti-stokes lines, instrumentation – block diagram, differences between IR and Raman spectroscopy, mutual exclusion principle, structural elucidation of simple organic compounds.

3.3 Applications of IR and Raman spectroscopy: Functional group identifications from characteristic IR and Raman bands.

Unit 4: Nuclear Magnetic Resonance (NMR) Spectroscopy

(1+15+1 h)

4.1 Principle, instrumentation, chemical shift, spin - spin coupling, factors affecting the chemical shift values. NMR reference compounds: Tetramethyl silane (TMS) and 4,4-dimethyl-4-silapentane-1-sulfonic acid(DSS) – advantages and disadvantages.

4.2 Coupling constant, vicinal, geminal, allylic, long-range coupling, factors affecting the coupling constant.

4.3 ^{13}C–NMR spectrum, coupled and decoupled spectra, Deuterium labeling.

4.4 Elementary problems involving ^{1}H and ^{13}C NMR.

Unit 5: Mass Spectrometry (1+16+1 h)

5.1 Principle, Fragmentation pattern, molecular ion peak, base peak, isotopic peak, metastable peak and their uses– nitrogen rule, Mclafferty rearrangement, Retro-Diels-Alder reaction.

5.2 Instrumentation, determination of molecular formulae, mass spectrum of simple organic compounds. Identification: alcohols, aldehydes, aromatic hydrocarbons and amines.

5.3 Structural elucidation of organic compounds by combined spectral techniques.

Books for study

1. C. N. Banwell, *Fundamentals of Molecular Spectroscopy*, 3rdedn., TMH, New Delhi, 1983.
2. G. M. Barrow, *Introduction to Molecular Spectroscopy*, McGraw Hill, New York, 1964.
3. Y. R. Sharma, *Elementary Organic Spectroscopy – Principles and Chemical Applications*, 5th revised edn.,S. Chand, 2013.
4. H. Kaur, *Spectroscopy*, Pragati Prakashan, 2010.
5. P. S. Kalsi, *Spectroscopy of Organic Compounds*, 5thedn., New Age International Publication, 2004.
6. Books for reference
7. J. R. Dyer, *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice Hall, 1965.

8. William Kemp, *Organic Spectroscopy*, 3rdedn., ELBS.
9. P. M. Silverstein, F. X. Webster, *Spectroscopic Identification of Organic Compounds*, 6thedn., Wiley 1998.
10. D. H. Williams and I. Fleming,*Spectroscopic Methods in Organic Chemistry*, 4thedn.,McGraw-Hill, 1985.
11. D. L. Pavia, G. M. Lampman, G. A. Kriz, and J. R. Vyvyan, *Introduction to Spectroscopy*, 5th edn., Cengage Learning, 2009.
12. L. D. S. Yadav, *Organic Spectroscopy*, Springer, 2005.

CHEMISTRY ALLIED OFFERED TO OTHER DEPARTMENTS

16UCH3AL01 GENERAL CHEMISTRY FOR PHYSICS-I

UG	Offered to: Physics
Category: AL	Credits: 2
Semester: III	Hrs/Wk: 4

Objectives

1. To get a good exposure to the basic concepts of chemistry
2. To enable them to apply concepts related to chemistry in their careers.

Unit 1: Coordination Compounds

(1+9+1 h)

1.1 Double salts and coordination compounds. Basic concepts of coordination compounds.

1.2 Types of ligands. IUPAC nomenclature of mononuclear complexes.

1.3 Theories: Werner, valence bond and Sidgwick-Powell theories. Crystal field theory: Splitting of d-orbital degeneracy in tetrahedral and octahedral complexes. Relationship between magnetism and geometry.Spectral behavior (Colour).

1.4 Mention of biologically important coordination compounds: Haemoglobin and Chlorophyll.

Unit 2: Basic concepts in Organic Chemistry

(1+10+1 h)

2.1 Electronic displacement effects: Inductive, resonance and steric effects.

2.2 Organic reactions and their basic mechanisms: Addition – ionic, free radical, electrophilic, nucleophilic. Substitution – S_N1 and S_N2 reaction of alkyl halides. Elimination - E1 and E2 reactions.

2.3 Isomerism-geometrical isomerism: methods of differentiating cis and trans isomers on the basis of boiling point, melting point, dipole moment and chemical reaction. Optical isomerism with special reference to lactic and tartaric acids.Conformational isomerism of ethane, n-butane.

Unit 3: Ionic Equilibria and Electrochemistry

(1+11+1 h)

3.1 Ionic Equilibria: Acids and bases-Arrhenius and Lewis concept. Strong and weak electrolytes.Ionic product of water, pH, pK_a, pK_b, buffer solutions, solubility, solubility product of sparingly soluble salts.

3.2 Electrochemistry: Electrode potential, standard hydrogen electrode and calomel electrode, cell potential -Standard Weston cell,electrochemical cell – galvanic and electrolytic cell. Derivation of Nernst equation, calculation of EMF of the cell. Corrosion – causes and prevention.

Unit 4: Kinetics and Photochemistry

(1+11+1 h)

4.1 Kinetics and catalysis: Rate, rate law, rate constant, order and molecularity. Derivation of rate expression for first and second order reaction-equal and unequal concentrations of

reactants. Methods of determining order of a reaction. Catalysis - homogeneous and heterogeneous.Energy of activation and Arrhenius equation.

4.2 Photochemistry: Comparison between thermal and photochemical reactions, Grotthus-Drapper law, Stark-Einstein law, Beer-Lambert law, Chemiluminescence, fluorescence, phosphorescence, quantum yield, photosensitization and photosynthesis.

Unit 5: Industrial chemistry

(1+9+1 h)

5.1 Water treatment: hardness of water- temporary and permanent hardness, disadvantages of hard water. Estimation of hardness by EDTA method.Purification process – ion exchange, reverse osmosis, activated charcoal treatment.Desalination, Disinfection – ozone, UV, chlorination, BIS- specification of drinking water.

5.2 Polymers: monomers, oligomers and polymers. Addition and condensation polymerization with suitable examples.Thermo and thermosetting plastics with examples.Vulcanization of rubber.

Books for study

1. R. Gopalan, S. Sundaram, *Allied Chemistry*, 4thedn., Sultan Chand and Sons, 2006.
2. P.C. Jain, M. Jain, *Engineering Chemistry*, 16thedn., Dhanpatrai and sons: Delhi, 2004.
3. V.R. Gowariker, *Polymer Science*, Wiley Eastern, 1995.
4. C.N.R. Rao, *University General Chemistry*, Macmillan Co., India Ltd, 1973.
5. M.J. Sienko, R.A. Plane, *Chemistry-Principles and Properties*, international Student ed., 1995.

Books for reference

1. G.C. Hill, J.S. Holman, *Chemistry in Context*, ELBS, 1998.

2. W.R. Kneen, M.J.W. Rogers, P. Simpson, *Chemistry – Facts, patterns and principles*, ELBS, 1999.
3. Bruce H. Mahan, *University Chemistry*, 3rd edn., Addition-Wesley Publishing Company, 1977.
4. B.R. Puri, L.R. Sharma, M.S. Pathania, *Principles of Physical Chemistry*, 46th edn., Vishal Publishing Co. Jalandhar, 2013.

16UCH3AL02 CHEMISTRY PRACTICAL FOR PHYSICS-I

UG	Offered to: Physics
Category: AL	Credits: 1
Semester: III	Hrs/Wk: 2

Objective

To understand the principle and carry out the qualitative organic analysis systematically.

Organic Analysis

a) Detection of nitrogen, sulphur and halogens
b) Tests for aromaticity
c) Tests for saturation
d) Identification of chemical nature (acidic/basic/neutral) and the following functional groups

i) Carboxylic acid
ii) Phenols
iii) Aldehydes
iv) Ketones
v) Carbohydrates
vi) Primary amines
vii) Amides

Books for study

1. V.Venkateswaran, R.Veeraswamy and A.R.Kulandaivelu, *Basic Principles of Practical Chemistry*, 2nd edn., S.Chand Publications, New Delhi, 2004.
2. N.S. Gnanapragasam, G. Ramamurthy, *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd., 2002.
3. Raj K.Bansal, *Laboratory Manual of Organic Chemistry*, 4th edn., New AgePublishers, 2001.
4. J.N. Gurtu and R. Kapoor, *Advanced Experimental Chemistry* (Organic), S. Chand and Co., 1987.

16UCH3AL03 GENERAL CHEMISTRY FOR BIOLOGY-I

UG Offered to: Adv. Zoology & Plant Biology
Category: AL Credits: 2
Semester: III Hrs/Wk: 4

Objective
To enable the students understand the concepts of chemistry.

Unit 1: Handling of Chemicals and Data Analysis
(1+13+1 h)

1.1 Storage and handling of chemicals: Handling of acids, ethers, toxic and poisonous chemicals. Antidotes, first aid procedure.
1.2 Errors in chemical analysis: Accuracy, precision. Types of error-absolute and relative errors.Methods of eliminating and minimizing errors.
1.3 Separation techniques: Solvent extraction. Principle of adsorption and partition chromatography, paper chromatography, thin layer chromatography, column chromatography and their applications

Unit 2: Chemical Bonding
(1+13+1 h)

2.1 Ionic Bond: Characteristics of ionic compounds, Structure of NaCl and CsCl, Factors influencing the formation of ionic bond.
2.2 Covalent Bond: Characteristics on covalent compounds.

Structure of CH_4, NH_3, H_2O based on hybridisation.

2.3 Coordinate Bond: Nature of coordinate bond. Coordination complexes - Werner's theory.Isomerism in square planar and octahedral complexes.Structure and functions of chlorophyll and hemoglobin.

2.4 Hydrogen Bond: Types, theory and importance of hydrogen bonding. Hydrogen bonding in carboxylic acids, alcohol, amides, polyamides, DNA and RNA.

2.5 Stabilizing forces in protein and DNA, van der Waal's forces, dipole-dipole and dipole-induced dipole interactions.

Unit 3: Volumetric Analysis

(1+8+1 h)

3.1 Methods of expressing concentration: normality, molarity, molality, ppm, ppb.

3.2 Primary and secondary standards: preparation of standard solutions

3.3 Principle of volumetric analysis: end point and equivalence point.

3.4 Strong and weak acids and bases - Ionic product of water, pH, pK_a, pK_b. Buffer solutions, Henderson-Hasselbalch equation and its significance.

Unit 4: Kinetics and Catalysis

(1+8+1 h)

4.1 Chemical Kinetics: Rate, rate constant, rate law, order and molecularity. Derivation of rate expression for the first order reaction.

4.2 Catalysis-Homogeneous and heterogeneous catalysis.

Unit 5: Chemistry of Biomolecules

(1+8+1 h)

5.1 Fats – Occurrence and composition. Hydrolysis of fats.

5.2 Vitamins – Source, provitamin, properties and classification. Structure and function of vitamin A, C, D, K and E

5.3 Hormones – Thyroxin, adrenaline and sex hormones (structure and functions only)

Books for study

1. R. Gopalan, S. Sundaram, *Allied Chemistry*, Sultan Chand & Sons (P) Ltd, 4th edn.,2006.
2. U. N. Dash, *Analytical Chemistry: Theory and Practice*, Sultan Chand and sonsEducational Publishers, New Delhi, 2011.
3. U. Sathyanarayana, *Biochemistry*, Books and allied (P) Ltd, 4th edn.,2013.
4. B.R.Puri and L.R.Sharma, M.S. Pathania,*Principles of physical chemistry*, Vishal Publication Co., 46th edn., 2013.

Books for reference

1. D.A. Skoog, D.M. West, F.J. Holler, *Analytical Chemistry: An Introduction*, Saunders college publishing, 5th edn.,1998.
2. B.R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry*, ShobanLalNaginChand and Co., 2014.
3. G.C. Hill, J.S. Holman, *Chemistry in Context*, ELBS, 1998.
4. W.R. Kneen, M.J.W. Rogers, P. Simpson, *Chemistry – Facts, patterns and principles*, ELBS, 1999.

16UCH3AL04 CHEMISTRY PRACTICAL FOR BIOLOGY-I

UG Offered to: Adv. Zoology & Plant Biology
Category: AL Credits: 1
Semester: III Hrs/Wk: 2

Objective

To understand the principle and carry out the qualitative organic analysis systematically.

Organic Analysis

a) Detection of nitrogen, sulphur and halogens
b) Tests for aromaticity

c) Tests for saturation
d) Identification of chemical nature (acidic/basic/neutral) and the following functional groups

viii) Carboxylic acid
ix) Phenols
x) Aldehydes
xi) Ketones
xii) Carbohydrates
xiii) Primary amines
xiv) Amides

Books for study

5. V.Venkateswaran, R.Veeraswamy and A.R.Kulandaivelu, *Basic Principles of Practical Chemistry*, 2nd edn., S.Chand Publications, New Delhi, 2004.
6. N.S. Gnanapragasam, G. Ramamurthy, *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd., 2002.
7. Raj K.Bansal, *Laboratory Manual of Organic Chemistry*, 4th edn., New AgePublishers, 2001.
8. J.N. Gurtu and R. Kapoor, *Advanced Experimental Chemistry* (Organic), S. Chand and Co., 1987.

16UCH4AL01 GENERAL CHEMISTRY FOR PHYSICS-II

UG | Offered to: Physics
Category: AL | Credits: 2
Semester: IV | Hrs/Wk: 4

Objectives

To understand the basic concepts of chemistry

Unit 1: Analytical Chemistry

(1+8+1 h)

1.1 Methods of expressing concentration: normality, molarity, molality,mole fraction, ppm, ppb

1.2 Primary and secondary standards: preparation of standard solutions

1.3 Principle of volumetric analysis: end point and equivalence point.

1.4 Accuracy-Precision-Types of error.

Unit 2: Solid State Chemistry

(1+13+1 h)

2.1 Classification, amorphous and crystalline solids; types of crystals- ionic, vander Waals and covalent.

2.2 Determination of lattice energy by Born-Haber cycle, properties of ionic compounds.

2.3 Structure of ionic solids: radius ratio, coordination number in ionic crystals, crystal structures-sodium chloride, zinc blende, cesium chloride and wurtzite.

Unit 3: Biomolecules and Dyes

(1+13+1 h)

3.1 Carbohydrates: Classification and functions of carbohydrates. Structure of glucose and fructose, (no elucidation required) interconversions, mutarotation. Differences between reducing and non-reducing sugars.

3.2 Structure of sucrose (no elucidation required), inversion of cane sugar.

3.3 Components of nucleic acids: structure of purine and pyrimidine bases, structure of DNA and RNA. Hydrogen bonding in nitrogeneous bases in DNA, differences between DNA and RNA. Replication, translation and transcription of DNA, mutation, genetic engineering.

3.4 Dyes: Colour and constitution: chromophores and auxochromes. Classification based on structure and mode of dyeing, uses of mordants.

Unit 4: Thermodynamics and Electrochemistry

(1+8+1 h)

4.1 Energetics: First law of thermodynamics: Concepts of internal energy and enthalpy. Hess's law, heat of formation, combustion, neutralization, bond energy, Kirchoff's equation

4.2 Electrochemistry: Faraday's law, electrolysis of aqueous NaCl and $CuSO_4$ solutions using corresponding metal or inert electrodes. Electrolytic conductance: Determination, variation of conductance with concentration. Equivalent conductance at infinite dilution: Determination, Kohlrausch's law, determination of K_a and K_{sp}. Conductometric titrations.

Unit 5: Industrial Chemistry

(1+8+1 h)

5.1 Nuclear energy: principle of fission and fusion reaction, uses of radio isotopes in medicine, agriculture and industry.

5.2 Solar energy conversion-photovoltaic and photogalvanic cell. Batteries- Lead acid storage, dry cell.Fuel cells-principle, hydrogen –oxygen fuel cells.

5.3 Glass-physical and chemical properties, manufacture of glass, types and uses, borosilicate -photochromic and safety glass.

5.4 Ceramics-general properties- permeable and impermeable wares.

Books for study

1. R.Goplalan, S.Sundaram, *Allied Chemistry*, Sultan Chand and sons, 2006.
2. C.N.R. Rao, *University General Chemistry*, Macmillan Co. India, Ltd, 1973.
3. M.J.Sienko and R.A.Plane, *Chemistry: Principles and properties*, International Student Edition, 1995.

Books for references

1. B. R. Puri, L.R. Sharma, K.C. Kalia, *Principles of Inorganic Chemistry*, ShobanLalNagin Chand and Co., Delhi, 1996.
2. B.R. Puri, L.R. Sharma, M. S. Pathania, *Principles of physical Chemistry*, ShobanLalNagin Chand and Co., Delhi, 2013.
3. B.K.Sharma, *Industrial Chemistry*,Goel Publishing House,Merrut,13th edn., 2002.

4. W.R. Kneen, M.J.W.Rogers and P.Simpson, *Chemistry: Facts, patterns and Principles*, ELBS, 1999.
5. Bruce H.Mahan, *University Chemistry*, 3rd edn., Addition-Wesley Publishing company, 1977.
6. Darrell D. Ebbing, Steven D. Gammo, *Fundamentals of Chemistry*, Houghton Mifflin College, 2010.

16UCH4AL02 CHEMISTRY PRACTICAL FOR PHYSICS-II

UG — Offered to: Physics
Category: AL — Credits: 1
Semester: IV — Hrs/Wk: 2

Objectives
To understand the concepts of volumetric analysis

Experiments:

I. Acidimetry and Alkalimetry
1. Estimation of NaOH
2. Estimation of Na_2CO_3
3. Estimation of HCl
4. Estimation of mixture of $Na_2CO_3$and $NaHCO_3$

II. Permanganometry
1. Estimation of Oxalic acid.
2. Estimation of ferrous ammonium sulphate.

III. Iodometry
1. Estimation of $K_2Cr_2O_7$
2. Estimation of $KMnO_4$
3. Estimation of copper.
4. Estimation of ascorbic acid.

IV. Complexometric Titrations
1. Estimation of zinc.

Applications of Volumetric Analysis
1. Determination of acetic acid in commercial vinegar using NaOH.

2. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
3. Estimation of hardness of water by EDTA.

Books for references

1. J.N. Gurtu and R. Kapoor, *Experimental Chemistry*,S.Chand and Co, 1987.
2. N.S. Gnanapragasam and G. Ramamurthy, *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd., 2002.

16UCH4AL03 GENERAL CHEMISTRY FOR BIOLOGY-II

UG Offered to: Adv. Zoology & Plant Biology
Category: AL Credits: 2
Semester: IV Hrs/Wk: 4

Objective

1. To understand the chemistry of biomolecules and natural products.
2. To understand the concepts of agricultural chemistry.

Unit 1: Proteins and Enzymes

(1+10+1 h)

1.1 Amino acids: Classification, preparation and properties, zwitter ions, isoelectricpoint,peptide linkage and peptide synthesis.
1.2 Proteins: Classification based on structure and functions, primary and secondary structure, N-terminal analysis, denaturation and renaturation, test for protein- Ninhydrin Test, Biuret Test.
1.3 Enzymes: Classification, factors affecting enzyme activity, mechanism of enzyme action, kinetics of enzyme reaction. Michaelis-Menten equation (no derivation), types of enzyme inhibition.

Unit 2: Lipids

(1+8+1 h)

2.1 Types and functions of lipids (fatty acids, glycerides, complex lipids and non-glycerides),fats and oils (rancidity,saponification, hydrogenation of oils), waxes, phospholipids (lecithins, cephalins, plasmalogens)

2.2 Steroids: structure and functions cholesterol, types and functions of plasma lipoproteins. Bile salts, steroid hormones.

Unit 3: Nucleic Acids

(1+10+1 h)

3.1 Components of nucleic acids, structure of purine and pyrimidine bases, structure of DNA and RNA.

3.2 Hydrogen bonding in nitrogeneous bases in DNA, properties and types of DNA and RNA,differences between DNA and RNA.

3.3 Replication, translation and transcription of DNA, regulatory metabolism, mutation, genetic engineering, codon.

Unit 4: Carbohydrates

(1+10+1 h)

4.1 Classification and functions of carbohydrates. Structure of glucose and fructose, interconversions, mutarotation.Differences between reducing and non-reducing sugars. Test for carbohydrates.

4.2 Structure of sucrose, inversion of cane sugar.

4.3 Glycolysis, TCA cycle, relationship between glycolysis and respiration, photosynthesis.

Unit 5: Natural Products and Agricultural Chemistry

(1+12+1 h)

5.1 Alkaloids: Classification, isolation and biological importance (mention of papaverine, nicotine, coniine).

5.2 Terpenes: isoprene rule, classification, extraction and biological importance (mention of Camphor, Citral, and α-Pinene).

5.3 Flavones and flavonoids: Structure, isolation and importance.

5.4 Types of soil, soil analysis, fertilizers– role of macro and

micro nutrients, NPK fertilizers, urea, superphosphate of lime and potassium nitrate.

5.5 Insecticides [dichlorodiphenyltrichloroethane (DDT) andbenzenehexachloride(BHC)], herbicides [2,4-Dichlorophenoxyacetic acid (2,4-D) and 2,4,5-Trichlorophenoxyacetic acid(2,4,5-T)], fungicides (bordeauxmixture, lime-sulphur) – structure and uses.

Books for study

1. G.P. Talwar, L.M. Srivatsava and K.D. Moudgil, *Text book of Biochemistry and Human Biology*, Printice-Hall of India Pvt. Ltd.New Delhi, 2003.
2. J.L. Jain, *Biochemistry*, S. Chand & Co., 2004
3. A.Lehninger, D. L. Nelson, M. Cox and M. M. Cox, *Principles of Biochemistry*, MPS Publishers, New York, 2009.
4. A.V.S.S. Rama Rao, *Text Book of Biochemistry*, 9thedn.,U B S Publishers, 2008.
5. Gurudeep R. Chatwall, *Organic chemistry of natural products*, Vol-I&II, Himalaya publishing House Pvt.Ltd, Mumbai, 1981.

Books for reference

1. T.Palmer, P. Bonner, *Enzymes: Biochemistry, Biotechnology, Clinical Chemistry*,2ndedn., First East West Press Pvt Ltd., New Delhi2008.
2. J.M.Herg, J.L. Tymoczko,L. Stryer, 2002. *Biochemistry*, 5thedn., WH-Freeman and Co, New York.
3. KeshavTrehan, *Biochemistry*, Wiley Eastern Ltd, 1987.
4. E.J. Wood, W.R. Piekering, *Introducing Biochemistry*, ELBS, 1984.
5. K.H. Buchel, *Chemistry of Pesticides*, John Wiley & Sons, New York, 1983.

16UCH4AL04 CHEMISTRY PRACTICAL FOR BIOLOGY-II

UG — Offered to Adv. Zoology & Plant Biology
Category: AL — Credits: 1
Semester: IV — Hrs/Wk: 2

Objectives

1. To understand the concepts of quantitative analysis
2. To understand the separation technique in the analysis of biologically important compounds

Experiments

1. Estimation of ascorbic acid using iodimetric method.
2. Estimation of glucose using benedict's method.
3. Estimation of acetic acid in vinegar.
4. Estimation of glycine.
5. Determination of hardness of water.
6. Determination of strength of H_2O_2.
7. Estimation of calcium in milk.
8. Determination of iodine value of oil.
9. Determination of saponification value of oil.
10. Determination of available chlorine in bleaching powder.
11. Determination of available iodine in table salt.
12. Determination of available CO_2 in baking powder.

Demonstration Experiments:

1. Column chromatography of leaf and flower extract.
2. TLC – Separation of triglycerides.
3. Paper Chromatography – Separation of amino acids.
4. Determination of pH of soil, water.
5. Tests for carbohydrates and amino acids

Books for study

1. R. Veeraswamy, V. Venkateswaran and A. R. Kulandaivelu, *Basic principles of practical Chemistry*, Sultan Chand & Sons, 2nd edn., 2015.

2. N.S. Gnanapragasam, G. Ramamurthy, *Organic chemistry–Lab manual*, S. ViswanathanCo. Pvt. Ltd., 2002.
3. J.N. Gurtu and R. Kapoor,*Advanced experimental chemistry*, S. Chand and Co.,1987.
4. R.Mukhopadhyay, P.Chatterjee, *Advanced practical chemistry*, 3rdedn.,Books and allied P.Ltd., 2007.