St. Teresa's College, (Autonomous)

Department of Chemistry

OBJECTIVES OF THE PROGRAMME

1) By the end of first year (second semester)

The first two semesters of the course enable the students to get an idea about science, scientific methods and evolution of chemistry as a branch of science. They are taught the fundamentals of atomic structure, periodic table and periodic properties of elements as well as various synthetic and analytical methodologies and separation techniques commonly used in chemistry. Significance of quantum numbers structure of solids, defects in crystals, dynamics of molecules of liquids and gases, theoretical approach to adsorption and role of surface area, superconductivity, adsorption and various types of adsorption crystal systems and fourteen Bravais lattices, real gas behaviour Liquefaction of gases (based on Joule-Thomson effect) was discussed. Reactive intermediates also form an important part of the syllabi.

2) By the end of second year (fourth semester)

At the beginning of third semester, the students are introduced into the fascinating world of organic Chemistry. They are taught from the basics of organic chemistry beginning with IUPAC system of nomenclature, study of properties of hydrocarbons and then moved on to the chemistry of various functional groups of organic compounds. The importance of different classes of organic compounds in synthetic and commercial fields is also taught. Concept of aromaticity is introduced and various Benzenoid and Non – Benzenoid compounds studied.

2) By the end of third year (fifth and sixth semesters)

Coordination chemistry, coordination compounds in qualitative and quantitative analysis role of complexes in biological systems chelates, organometallic chemistry, toxic metal ions and their effects and fluxional behavior of metal carbonyls are discussed in the inorganic chemistry section.

Industrially important organic compounds such as dyes, polymers, Soaps and Detergents, Organic Reagents, Chemotherapy and Green Chemistry are taught in the organic chemistry part. Nuclear chemistry, metallurgy, chemical bonding is also part of the curriculum.

Due importance is also given to quantum mechanics, rotational, vibrational, Raman Spectroscopy, electronic and NMR spectroscopy, molecular symmetry and crystallographic point groups.

The open course and choice based course on Environmental Management and Impact Assessment, Chemical Toxicology, Air pollution, Water pollution, Effluent and waste management, Soil Pollution, Environmental management system – ISO-14001 are the topics covered under the open course environmental chemistry.

Food additives and flavours, synthetic detergents, cosmetics plastics, paper and dyes, drugs, chemistry and agriculture are topics included in the open course and choice based course titled chemistry in everyday life.

The open course in food science covers food adulteration, food poisons, food additives, beverages and edible oils.

Research Methodology, data analysis, nanochemistry, analytical techniques, introduction to computational chemistry, natural products and heterocyclic compounds.

Phase equilibria, kinetics, acids and bases, electrical conductance, electromotive force, photochemistry are also included.

Laws of thermodynamics, solutions and colloids are other topics covered in the fifth and sixth semesters.

The physical chemistry practical section includes experiments in physical chemistry, such as determination of critical solution temperature, transition temperature, viscosity, conductivity measurements, and potentiometric measurements.

Organic chemistry practicals include analysis of organic compounds, solvent extraction, purification techniques, synthesis of organic compounds and determination of physical constants.

Inorganic practicals cover the analysis of cations and anions. Volumetric practicals include acidimetry-alkalimetry, various redox titrations and complexometric titrations.

SYLLABI OF COURSES

[CORE]

Semester I (Core) - Paper I

Name of the Course: Science Methodology and Fundamental Chemistry

Duration: One Semester **Total Lecture Hours: 36**

Course Code: CH1B01TB **Credits: 2**

Aim of the course: To introduce the methodology of science and so also to give an introductory concepts in atomic structure and analytical chemistry.

Course Overview and Context: The Course seeks to introduce Chemistry as a discipline of science, to refresh the basic concepts of chemistry so that the students have a sound foundation as they move to advanced level of chemistry during the study of the programme. It also aims to create awareness about the various analytical and synthetic methodologies in Chemistry.

Syllabus Content:

Module - I : **Chemistry as a discipline of science** **(9 hrs)**

What is science? Scientific statements, Scientific methods–observation-posing a question-formulation of hypothesis-experiment-theory-law. Falsification (disproving) of hypothesis, inductive and deductive reasoning, revision of scientific theories and laws.

Methods of science as illustrated through the following

i) Laws of chemical combination- Faradays laws of electrolysis- Daltons atomic theory, atom models- J.J.Thomson, Rutherford, Bohr model and quantum mechanical model of atom. ii) n-P-V-T relation of gases-gas laws-kinetic molecular theory. Role of concepts and models in science.

Evolution of Chemistry- ancient speculations on the nature of matter, early form of chemistry-alchemy, origin of modern chemistry. Structure of chemical science: scope of chemical science, theory and experiment, branches of chemistry. Role of Chemistry as a central science connecting Physics, Biology and other branches of science. Interdisciplinary areas involving Chemistry- Nanotechnology, Biotechnology.

Module - II Atomic Structure (9 hrs)

Bohr model of hydrogen atom, Bohr's equation for the energy of electron in hydrogen atom, the hydrogen spectrum, limitations of Bohr theory, photoelectric effect, idea of de Broglie matter waves, Heisenberg's uncertainity principle and its significance, Schrodinger wave equation (derivation not expected), wave functions, significance of ψ (psi) and ψ 2 - atomic orbitals, Nodal planes in atomic orbitals, quantum numbers (n, l, m), Zeeman effect, Stern-Gerlach experiment, spin quantum number (s), shapes of s, p and d orbitals. Aufbau and Pauli's exclusion principles, Hund's rule, energy level diagram of a multielectron atom, concept of effective nuclear charge, Slater's rules and applications, Electronic configuration of atoms.

Module -III Periodic table and Periodic properties (9hrs)

Modern periodic law, long form periodic table, Periodic trends in atomic volume, atomic and ionic radii, ionisation enthalpy, electron affinity (electron gain enthalpy), electronegativity and metallic character,

Electronegativity, Paulings, Mulliken, Allred Rochow's Scale of electronegativity.

Classification of elements as s, p, d & f block. Anomalous behaviour of 1st element of a group, diagonal relationship.

Module - IV Analytical and synthetic methodologies in chemistry (9 hrs)

Titrimetric analysis: fundamental concepts - mole, molarity, molality, ppm and ppb primary standard-secondary standard, quantitative dilution, problems. Acid base

titrations- titration curves, pH indicators. Redox titrations, titration curve, Redox titrations, permanganometric and dichrometric, Complexometric titrations, EDTA titrations, titration curves, indicators, Gravimetric analysis: Unit operations in gravimetric analysis- Illustrations using iron and barium estimation.

Separation and purification techniques – Filtration, Crystallization and precipitation, Chromatographic techniques, concept of solubility product as applied in group separation of cations, problems. Fractional distillation, Solvent extraction.

Competencies of the course:

C1. Has enabled the students to get an idea about science, scientific methods and evolution of chemistry as a branch of science.

C2. Has acquired the fundamentals of atomic structure.

C3. Has been able to discuss the concept of periodic table and periodic properties of elements .

C4. Has been able to differentiate between synthetic and analytical methodologies in Chemistry.

C5. Electronegativity and various scales of electronegativity were discussed

C6. Different types of titrimetry was discussed

C7. Various separation techniques were discussed.

C8. Gravimetric analysis was taught using iron and barium estimation.

9. Titration curves and the role of pH indicators was studied.

10. Significance of quantum numbers was discussed.

11. The foundation of quantum chemistry was studied.

12. Interdisciplinary areas involving Chemistry- Nanotechnology, Biotechnology was introduced.

Learning Resources:

1. Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.

4. Reference books available in the library.

5. Research seminars and lectures

6. Prescribed text books

7. Science magazines.

Textbooks: Anu Gopinath, Chandradasan, Dominic Thomas, Methodology of chemistry as a discipline of science, Vishal Publishers, 2014

References:

1. J. A. Lee, Scientific Endeavor, Addison Wesley Longman

2. C. N. R. Rao, University General Chemistry, MacMillan (India) Ltd

3. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, 31st edn., Milestone Publishers, Delhi, 2013-2014.

4. D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch, Fundamentals of Analytical Chemistry 9th edn, ENGAGE learning, 2014.

5. J.Mendhan, R.C Denney, J.D Barner, M.Thomas, B.Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd., 2013.

6. G. D. Christian, Analytical Chemistry, JohnWiley and Sons.

7. C. N. R. Rao, University General Chemistry, Macmillan India., 1973

8. F. A. Cotton, G. Wilkinson, Carlos A. Murillo, Manfred Bochmann., Advanced Inorganic Chemistry, 6th edn., John Wiley, 2007.

9. B. Douglas, D. Mc Daniel, J. Alexander, Concepts and models in Inorganic Chemistry, Wiley, 3rd edition, 2013.

Semester II (Core) Paper II

Name of the Course: **States of Matter**

Course Code: CH2B02TB **Credits: 2**

Duration: One Semester **Total Lecture Hours: 36**

Aim of the course: To understand the general characteristics of different states of matter

Course Overview and Context: The course is intended to impart knowledge about the different states of matter, the behaviour and general characteristics of the three states and to learn about different types of liquid crytals. It also discusses about the phenomena of an important physical process - adsorption which has wide chemical applications.

Syllabus Content:

Module I- Gaseous state **(12hrs)**

Kinetic molecular model of gases: pressure of an ideal gas, derivation of gas laws, Maxwell's distribution of velocities – molecular velocities (average, root mean square and most probable velocities)

Collision diameter, mean free path, viscosity of gases – temperature and pressure dependence. Relation between mean free path and coefficient of viscosity, Law of equipartition of energy, degrees of freedom.

Real gases: compressibility factor z, van der Waals equation of state – derivation and application in explaining real gas behaviour. Virial equation of state, van der Waals equation expressed in virial form – calculation of Boyle temperature, Isotherms of real gases, continuity of states. Critical phenomena.

Liquefaction of gases (based on Joule-Thomson effect).

Module II- Liquid State and Liquid crystals (6hrs)

Intermolecular forces in liquids (qualitative idea only)- viscosity, the viscometer method- surface tension - structure of liquids. Unusual behaviour of water.

Liquid crystals thermographic behaviour. Classification, structure of nematic and cholestric phases.

Module III- Solid state (12 hrs)

The nature of the solid state- anisotropy, The law of constancy of interfacial angles, Law of rational indices - Miller indices, Seven crystal systems and fourteen Bravais lattices, X-ray diffraction, Bragg's law, Detailed study of simple, face centred and body centred cubic systems – Bragg's X-ray diffractometer method and powder pattern method. Analysis of powder diffraction patterns of NaCl and KCl, Density of cubic crystals, Identification of cubic crystal from crystallographic data.

Close packing of spheres- ccp and hcp arrangements. Structure of ionic compounds of the type AX (NaCl, CsCl, ZnS) and AX2 (CaF_2, Na_2O). Defects in crystals – stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects. Electrical conductivity, Semiconductors- n-type, p-type, Superconductivity – an introduction.

Module IV-Adsorption (6hrs)

Adsorption – types, adsorption of gases by solids – factors influencing adsorption – Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation). The BET theory (no derivation) – use of BET equation for the determination of surface area.

Competencies of the course:

C1. Structure of solids were discussed

C2. Has been able to understand defects in crystals

C3. Comprehensive study of gaseous and liquid states and the intermolecular forces in liquids and gases were discussed.

C3. The dynamics of molecules of liquids and gases were evaluated

C4. Conditions for phase change was recognized

C5. To built up an awareness about the theoretical approach to adsorption and role of surface area.

C6. Defects of solids which have a profound impact on their mechanical properties was studied.

C7. Understand the phenomenon called superconductivity .

C8. Adsorption and various types of adsorption were discussed.

C9. The BET theory (no derivation) – use of BET equation for the determination of surface area.

C10. Seven crystal systems and fourteen Bravais lattices were discussed

C11.Van der Waals equation of state – derivation and application in explaining real gas behaviour.

C12. Liquefaction of gases (based on Joule-Thomson effect) was discussed.

Learning Resources:

1. Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.

4. Reference books available in the library.

5. Research seminars and lectures

6. Prescribed text books

7. Science magazines.

Textbooks:

1. States of Matter (Core Course in Chemistry)- Prof. Gokulachandran, Dr. Joby Thomas K, First Edition, May, 2014, Manjusha Publications, Calicut,
2. States of Matter(Physical chemistry) B.S Lark and Siby Joseph, 2013-14, Vishal Publishing CO; Jalandhar - Delhi.

References:

1. K. L. Kapoor, A Textbook of Physical chemistry, Volume 2, Macmillan India Ltd, 3rd edn, 1999.
2. P. Atkins and J. Paula, The elements of Physical chemistry, 7th edn., Oxford University Press.
3. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach, 1st edn, Viva Books Pvt. Ltd., 2006.
4. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical Chemistry, Vishal Publishing Co.
5. F. A. Alberty and R J Silby, Physical Chemistry, 4th Edn, John Wiley, 2004 .
6. D. K. Chakraborthy – Adsorption and catalysis by solids, New Age International (P) Limited, Publisers, 1991
7. P.W. Atkins, Julio De Paula, Physical Chemistry, 6th edition, Oxford University Press, 2006.

Semester III (Core)- Paper III

Name of the Course: **Organic Chemistry - I**

Course Code: CH3B03TB **Credits: 3**

Duration: One Semester **Total Lecture Hours: 54**

Aim of the course: To promote understanding of basic facts and concepts and to inculcate interest in Organic Chemistry

Course Overview and Context: The Course seeks to introduce the topics in chemistry such as IUPAC nomenclature, reaction mechanism, aromaticity and hydrocarbons, which are essential basics for students who wish to pursue organic chemistry.

Syllabus Content:

Module I. IUPAC Nomenclature and Introduction to Organic Reaction Mechanisms

(18 hrs)

Classification of organic compounds, Rules of IUPAC system of nomenclature of common organic compounds –alkanes, alkenes, alkynes, cycloalkanes, bicycloalkanes, alkyl halides, alcohols and phenols. Aldehydes, ketones, carboxylic acids and its derivatives, amines, nitro compounds. (Both aliphatic and aromatic)

Drawing electron movements with arrows- curved arrow notation. Half headed and double headed arrows. Nature of bond fission – Homolytic and Heterolytic. Types of reagents – Electrophiles and Nucleophiles.

Reactive intermediates with examples – Carbocations, Carbanions and Free radicals. Electron displacement effects - Inductive, inductomeric, electromeric, mesomeric, resonance, hyper conjugation and steric effects.

Types and sub types of following organic reactions with definition and at least one example of each- Substitution, Addition, Elimination and Rearrangement.

Aliphatic nucleophilic substitutions, mechanism of SN1,SN2- effects of structure-substrate, solvent, nucleophile and leaving groups - Stereochemistry- Waldeninversion, Elimination Reactions:-Hoffmann and Saytzeff rules- cis and trans eliminations – mechanisms of E1 and E2 reactions. Elimination versus substitution.

Addition reactions- mechanisms of addition of Bromine and hydrogen halides to double bonds- Markownikoff's rule and peroxide effect

Polymerisation reactions-Types of polymerisation - free radical, cationic and anionic –

polymerisations –including mechanism

Module II. Aromaticity (18 Hrs)

Concept of resonance- resonance energy. Heat of hydrogenation and heat of combustion of Benzene, mention of C-C bond lengths and orbital picture of Benzene. Structure of naphthalene and anthracene (Molecular Orbital diagram and resonance energy)

Concept of aromaticity – aromaticity (definition), Huckel's rule – application to Benzenoid - Benzene, Naphthalene- and Non – Benzenoid compounds -cyclopropenyl cation, cyclopentadienyl anion and tropylium cation.

Reactions – General mechanism of electrophilic substitution, mechanism of halogenation, nitration, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution – Definition of ortho, para and meta directing groups. Ring activating and deactivating groups with examples -Electronic interpretation of various groups like NO2 and Phenolic-Orientation of (i). Amino, methoxy and methyl groups (ii). Carboxyl, nitro, carbonyl and sulfonic acid groups. (iii). Halogens

Reactivity of naphthalene towards electrophilic substitution. Nitration and sulfonation. Aromatic Nucleophilic substitutions- bimolecular displacement mechanism- Elimination – addition mechanism.

Module III. Hydrocarbon I- Alkanes (9 hrs)

Natural sources, method of preparation, physical properties, chemical properties including halogenation, nitration, sulphonation, oxidation, pyrolysis, aromatization. Ascent and decent in alkane series

Conformational analysis - Conformational analysis of ethane and n-butane including energy diagrams - conformers of cyclohexane (chair, boat, half chair and skew boat forms) - axial and equatorial bonds-ring flipping showing axial equatorial interconversions, conformation of methyl cyclohexane.

Introduction to Petroleum refining- synthetic petrol-Bregius process, Fischer-Tropsch Process-

octane number, cetane number.

Module 4. Hydrocarbon II- Alkenes and Alkynes (9 hrs)

Alkenes- method of preparation- physical properties- chemical properties - addition reaction, oxidation reaction. Dienes- Preparation and properties of 1,3-butadiene.

Geometrical isomerism - cis-trans, syn-anti and E-Z notations - geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes - methods of distinguishing geometrical isomers using physical and chemical properties.

Alkynes- Acidity of alkynes- methods of preparation- physical properties- chemical properties - addition reaction, oxidation reaction. Ascent and decent in series

Competencies of the course:

C1. Basic understanding about the classification and nomenclature of organic compounds.

C2. Discussion on organic reaction mechanisms.

C3. Basic awareness about hydrocarbons –its preparation, properties and isomerism.

C4. Concept of aromaticity

C5. Theoretical knowledge required for the qualitative analysis of organic compounds

C6. Introduction to Petroleum refining

C7. Interpret Geometrical isomerism

C8. Benzenoid and Non – Benzenoid compounds

C9. Markownikoff's rule and peroxide effect

C10. Comparison between Electrophiles and Nucleophiles

C11. Explanation of reactive intermediates

C12. Differentiate between nitration and sulfonation of aromatic compounds.

Learning Resources:

1. Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Text Books:

1. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House, 2004.
2. Arun Bahl and B.S.Bahl 'A Text Book of Organic Chemistry'16th Edition, 2006.

References:

1. R. T. Morrison and R.N Boyd, S.K Bhattacharjee, 'Organic Chemistry', 7th Edition – Pearson Prentice Hall of India
2. I. L. Finar, 'Organic Chemistry '- Vol.- 6th Edition I, Pearson Education , 2013.
3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co., 2000.
4. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 2th Edition, Vikas Publishing House, 2000.
5. Peter Sykes, A Guide book to Mechanism in Organic Chemistry :, 6th Edition, Pearson Education
6. Arun Bahl and B.S.Bahl 'A Text Book of Organic Chemistry'16th Edition, 2000.
7. P. S. Kalsi' 'Organic Reactions and their Mechanisms'' New Age International Publishers

S. C. Pal, Nomenclature of Organic Compounds, Narosa Publishing Company

Semester IV (Core) - Paper IV

Name of the Course: **Organic Chemistry – II**

Duration: One Semester **Credits-3**

Course Code: CH4B04TB **Total Lecture Hours: 54**

Aim of the course: To familiarize the students with various classes of organic compounds and their physical, chemical properties as well as their synthetic applications

Course Overview and Context: The Course is intended to discuss in details about the chemistry of various classes of organic compounds in a systematic manner. Uses of various synthetic reagents and mechanisms of a number of named reactions are discussed.

Syllabus Content:

Module I : Alcohols, Phenols and Ethers **(12 hrs)**

Methods of prepration and properties of alcohols with special reference to methanol and ethanol, Dihydric alcohols- oxidation with lead tetra acetate, periodic acid, pinacol, pinacolone rearrangement, trihydric alcohol- glycerol, industrial applications of glycerol, unsatutrated alcohol –preparation and uses of vinyl alcohol and cinnamyl alcohol, thio alcohols- preparation and use of mustard gas. Tests to distinguish between primary, secondary and tertiary alcohols.

Preparation and properties of phenols, mechanism of Reimer- Tiemann reaction, Lederer-Manasse reaction, Fries rearrangement preparation and structure of catechol, resorcinol, quinol and pyrogallol. Preparation and uses of nitrophenol and picric acid.

Ethers- preparation and properties, estimation of alkoxy groups by Ziesel's method, Epoxides- preparation and properties.

Module II: Carbonyl Compounds **(12 hrs)**

Preparation and properties of aldehydes and ketones – addition with ammonia derivatives and Grignard reagents, condensation, reactions with special reference to the mechanism of the

following reactions - Aldol, Benzoin, Claisen, Claisen-Schmidt, Perkin and Knoevenagel condensation, Wittig reaction, Mannich reaction, Cannizaro's reaction,

Oxidation and reduction reactions - Baeyer Villiger Oxidation, reduction using metal hydrides – $LiAlH_4$ and $NaBH_4$, Meervein - Poundorff -Verley reduction, Clemmenson reduction, Wolff – Kishner reduction.

Acidity of alpha hydrogen, comparison between aldehydes and ketones, aliphatic and aromatic aldehyde, acetaldehyde and formaldehyde.

Module III: Carboxylic acids and their derivatives (18 hrs)

Preparation, properties and uses of monocarboxylic acids - acetic and benzoic acid. Structure of carboxylate ion, effect of substituents on the acid strength of aliphatic and aromatic carboxylic acids, ascent and descent in fatty acid series- Hell Volhard Zelinski reaction.

Preparation and properties of the following acids : a) unsaturated carboxylic acids- acrylic acid and cinnamic.acid b) dicarboxylic acid-oxalic acid, adipic acid, malonic acid, maleic acid, fumaric acid and phthalic acid c) Preparation and uses of anthranilic acid, coumarin. and Aspirin from salicylic acid – structure of citric acid d) Structure of Arachadonic acid and its importance in prostaglandin biosynthesis

Derivatives of carboxylic acids- acid chlorides, esters, anhydrides and amides- preparation and synthetic importance.

Module IV: Amines and Nitro compounds (12 hrs)

Preparation of aryl and alkyl amines by reduction of nitro compounds and nitriles, reductive amination of aldehydes and ketones, Gabriel's Phthalimide reaction, Hoffmann's bromamide reaction, stereochemistry of amines, separation of a mixture of primary, secondary and tertiary amines, factors affecting the basicity of aliphatic and aromatic amines, preparation and uses of sulpha drugs, comparison between aliphatic and aromatic amines.

Nitro compounds - reduction in acidic, alkaline and neutral media, electrolytic reduction and selective reduction of poly nitro compounds, formation of charge transfer complexes.

Diazonium salts - preparation, mechanism of Sandmeyer, Gattermann, Schiemann and Gomberg

reaction.

Competencies of the course:

C1. To study the preparation and properties of closely related organic compounds

C2. Gain knowledge about synthetic utility of various reactions

C3. Comparative studies about carbonyl compounds

C4. To know about various classes of acidic compounds

C5. Comparison between phenols and alcohols

C6. Preparation of aryl and alkyl amines

C7. Preparation and uses of sulpha drugs,

C8 . Comparison between aliphatic and aromatic amines

C9. Comparison of Preparation and properties of various acids

C10. Summarise the factors affecting the basicity of aliphatic and aromatic amines

C11. Discussed the derivatives of carboxylic acids.

C12. Comparison of various types of condensation reactions of carbonyl compounds.

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Textbooks:

1. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House, 2004.
2. Arun Bahl and B.S.Bahl 'A Text Book of Organic Chemistry'16th Edition,

2006.

References :

1.R. T. Morrison And R. N. Boyd, Organic Chemistry, 6th Edition, Printice-Hall Of India Limited, New Delhi, 1992.

2. T. W. Graham Solomons, Organic Chemistry, 6th edition, John Wiley and Sons, 1996.

3. B. Y. Paula, Organic Chemistry, 3rd Edition, Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.

4. Bahl and Arun Bahl, Organic Chemistry, S. Chand and Sons, New Delhi, 24th edn.2014.

5.M.B Smith, Jerry March, Advanced Organic Chemistry, 6th Edition, John Wiley And Sons, New York, 2013.

6. S. H. Pine, Organic Chemistry, 5th Edition, McGraw Hill International Edition, Chemistry Series, New York, 2007.

7. Sehan. N. Ege, Organic Chemistry, Structure And Reactivity, 3rd Edition, A.I.T.B.S., New Delhi, 1998.

8. S.H Pine, Hendrickson, Cram and Hammond, Organic Chemistry, 4th Edition, McGraw-Hill Kogakusha, Limited, 1985.

9: A.L. Lehninger, D.L. Nelson, M.M. Cox-principles of Biochemistry, 5th addition, W.H. Freeman, 2008

Semester V (Core) - Paper V

Name of the Course: **Chemistry of Inorganic Compounds**

Duration: One Semester

Course Code: CH5B05TB **Credits-3**

Total Lecture Hours: 54

Aim of the course: To study about coordination compounds, transition, inner transition elements and bio-inorganic chemistry.

Course Overview and Context: Chemistry of reprasentitive elements, transition and inner transition elements, coordination compounds and the role of minor and major trace elements are discussed.

Syllabus Content:

Module I : Chemistry of representative elements **(9 hrs)**

General characteristics of s block elements – electronic configuration, size, density,ionisation energy, melting point, boiling point, flame colour.

General characteristics of p block elements – Electronic configuration, size,oxidation state, ionization energy, electron affinity, electronegativity.

Preparation, properties and structure of diborane, borazine, boric acid, boron nitride and interhalogen compounds (ClF, ICl3, ClF3, IF5 and IF7), Styx number in boranes

Module II : Chemistry of d and f block elements **(12 hrs)**

Transition metals – general characteristics, metallic character ,oxidation states ,size , density, melting and boiling points, ionization energy, colour , magnetic properties , reducing properties, catalytic properties , Non stoichiometric compounds – complex formation , alloy formation, difference between first row and other two rows.

Lanthanides – Electronic configuration and general characteristics, occurrence of lanthanides, separation by ion exchange method, lanthanide contraction.

Actinides - Occurrence of lanthanides Electronic configuration and general characteristics, importance of actinides in nuclear chemistry.

Module III: Coordination compounds (12 hrs)

Coordination number and geometry of complexes, Werner's theory , Electronic interpretation of co-ordination compounds, EAN rule , types of ligands , Nomenclature, Isomerism in coordination compounds- Geometrical and optical, stability of complexes, factors influencing stability, chelates and chelate effects, Application of coordination compounds in qualitative and quantitative analysis.

Theories of bonding in coordination compounds – VBT, CFT and MOT- merits and demerits, CFT – crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting crystal field splitting , CFSE of complexes , spectrochemical series , explanation of geometry, magnetism and colour on the basis of the above theories. Jahn Teller effect- factors affecting, impact on properties of complexes.

Module IV: Organometallics and Metal carbonyls (12 hrs)

Preparation of Grignard reagent, Organolithium compounds, Organo zinc compounds, Organo copper compounds. Reformatsky reaction. Ferrocene – Preparation, properties and structure – Bonding in ferrocene (only qualitative treatment).

Metal carbonyls – 18 electron rule – Mononuclear and polynuclear carbonyls (give examples of Fe, Co, Ni) – Bonding in metal carbonyls – Preparation and structure of polynuclear carbonyls of Fe, Mn and Ni. Fluxional behavior of metal carbonyls.

Applications of coordination/organometallic compounds: cis-platin in cancer therapy, EDTA in the treatment of heavy metals (Pb, Hg) poisoning, Wilkinson's Catalyst in alkene

hydrogenation, Monsanto acetic acid process. Synthesis of organic compounds using Grignard reagent and alkyl lithium.

Module V: Bioinorganic Chemistry (9 hrs)

Biologically important major, trace and ultratrace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na^{+}, K^{+}, Mg^{2+}, Ca^{2+}, $Fe^{3+/2+}$, $Cu^{2+/+}$, and Zn^{2+}). Metal ion transport across biological membrane Na+-ion pump, ionophores.

Biological functions of hemoglobin and myoglobin, cytochromes and ferredoxins, carbonate bicarbonate buffering system and carbonic anhydrase. Photosynthesis: Photosystem-I and Photosystem-II (elementary idea with diagrams).

Toxic metal ions and their effects (Pd, Cd, Hg, As), chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal dependent diseases.

Competencies of the course:

C1**.** To understand about coordination chemistry

C2. Has been able to understand the role of complexes in biological systems

C3. Application of chelates

C4. Application of coordination compounds in qualitative and quantitative analysis

C5. Discussed in details about crystal field theory

C6. Organometallic chemistry was studied from an industrial point of view

C6. Bonding in organometallics was introduced

C7. Role of organometallic in synthetic organic chemistry was studied

C8. To relate actinides with nuclear chemistry

C9. Focus on toxic metal ions and their effects

C10. Ascertain the role of chelation therapy in toxicity studies

C11. Ascertain Importance of Na+-ion pump

C12. Explain fluxional behavior of metal carbonyls.

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Textbooks:

1. Sathyaprakash, G.D.Tuli, S.K.Basu and R.D.Madan Advanced Inorganic Chemistry Vol II, S.Chand and Company, NewDelhi

References :

1) J. E. Huheey, E. A. Kieter and R. L. Keiter, Inorganic Chemistry, 4th ed.,2006, Harper Collins,New York.

2) F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman, Advanced Inorganic Chemistry,

6th ed., John Wiley, New York, 2007.

3) T. Moeller, Inorganic Chemistry: A Modern Introduction, Wiley, New York, 2nd Edition 1990.

4) Mischler, Cordination Chemistry 3rd Edition, 2003

Semester V (Core) - Paper VI

Name of the Course: Advanced Organic Chemistry

Duration: One Semester

Course Code: CH5B06TB **Credits-3**

Total Lecture Hours: 54

Aim of the course: To give the students a thorough knowledge about the mechanisms of reactions of some selected functional groups in organic compounds and also to give an outline of applied organic chemistry and the applications of organic chemistry in various spheres of chemical sciences.

Course Overview and Context: To familiarize students with green chemistry, common analytical reagents, synthetic reagents and optical isomerism of organic compounds. Chemotherapy and chemotheraputical reagents are also discussed

Syllabus Content:

Module I. Optical isomerism (9 hrs)

Optical isomerism - optical activity, optical and specific rotations, conditions for optical activity, asymmetric centre, chirality, achiral molecules , meaning of (+) and (-) Elements of symmetry.

Racemisation - methods of racemisation (by substitution and tautomerism) - Resolution - methods of resolution (mechanical, seeding, biochemical and conversion to diastereoisomers), Asymmetric synthesis (partial and absolute synthesis).

Optical activity in compounds not containing asymmetric carbon atoms- Biphenyls. R-S notations for optical isomers with one and two asymmetric carbon atoms.

Module II. Chemsitry of diazo and active methylene compounds (9 hrs)

Synthetic uses of malonic ester, acetoacetic ester and cyanoacetic ester. Keto-enol tautomerism of ethyl acetoacetate.

Diazomethane and diazoacetic ester - preparation, structure and synthetic uses. Arndt Eistert

synthesis- mechanism –Wolff rearrangement

Module III. **Industrially important organic compounds** **(9 hrs)**

Dyes: Theory of colour and constitution. Classification - Preparation and uses of 1) Azo dye-methyl orange and Bismark brown 2) Triphenyl methane dye -Malachite green. 3) Phthalein dye - phenolphthalein and fluroescein 4) Vat dye - indigo 5) Anthraquinone dye - alizarin.

Soaps and Detergents**:** Composition of soaps- detergent action of soap-Synthetic detergents- - their functions – comparison between soaps and detergents- Environmental aspects.

Organic Polymers**:** Polymerisation , synthesis and applications of following polymers, Addition Polymers- Polythene, PVC and Teflon.

Condensation polymers **-** terephthalates - Nylon 6 , phenol formaldehyde resins,

Module IV. Chemistry of Organic Reagents **(9hrs)**

Analytical reagents – Tollens reagent, Fehling solution, Schiff's reagents, Borsche's reagent, Benedict solution, Barford's reagent

Synthetic reagents –NBS, Lead tetra acetate, Periodic acid, OsO4 , Ozone, LDA, Raney Nickel, Ziegler –Natta Catalyst, Selenium dioxide, DCC (elementary idea)

Module V. Chemotherapy **(6 Hrs)**

Drugs- introduction –classification –mode of action. Elementary idea of the structure and mode of action of the following drugs Sulphanilamide, Amphicillin and Chloramphenicol,

Elementary idea of the structure and application of Chloroquine, Paracetamol and Analgin.

Drugs in cancer therapy- Chlorambucil.

Module VI. Green Chemsitry **(6 Hrs)**

Principle of green chemistry: Basic concepts, atom economy, twelve principles of green chemistry.Principles of green organic synthesis, Illustrative examples.Green solvents, ionic liquids, super critical CO_2.

Module VII. Pericyclic Reactions **(6 Hrs)**

Classification- electrocyclic, sigmatropic, cycloaddition reactions. High lighting pericyclic reactions in organic synthesis such as Claisen rearrangement and -Diels_Alder reaction.

Stereochemical aspects.

Competencies of the course:

C1. Orientation about Green Chemistry

C2. Knowledge about Synthetic reagents

C3. Created awareness about chemotherapeutic agents

C4. Organic polymers and polymerization reactions were discussed

C5. Chemistry of active methylene compounds and diazo compounds were studied

C6. Classification and uses of synthetic dyes was discussed

C7. Stereochemical aspects of Diels_Alder reaction interpreted.

C8. Ziegler –Natta Catalyst and its applications in polymer chemistry was studied.

C9. Concept of green solvents was introduced.

C10. pericyclic reactions in organic synthesis

C11. Laboratory use of common analytical reagents was taught.

C12. Environmental impacts of soaps and detergents was discussed.

Learning Resources

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Textbooks:

1. B.S. Bahl 'Advanced organic Chemistry', S. Chand.

References :

1. R. T. Morrison and R.N Boyd, 'Study guide to Organic Chemistry', 3rd Edition 1975-

Prentice Hall of India. (Chapters-4,13)

2. I. L. Finar, 'Organic Chemistry '- Vol.- 6th Edition I, 1973, Pearson Education (Chapters-3,4,17)

3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co. (Chapters-6,7)

4. K. S. Tewari and N. K. Vishnoi 'A text book of Organic Chemistry', 3rd Edition,1987, Vikas Publishing House (Chapter-32)

5.Anastas, Green principles 2000.

6. Billmeyer F.W., Text book of polymer science,wiley India edition, 2007, Jr.John Wiley and Sons, 1994.

7. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar, Polymer Science, 2003, Wiley Eastern Ltd., New Delhi.

8. A. I. Vogel, 'A Text Book of Practical Organic Chemistry'6th Edition,1989, Longman.

9. F. G. Mann and B.C. Saunders, 'Practical Organic Chemistry', 4th edn.1970, Longman.

10. . N. K. Vishnoi, 'Advanced Practical Organic Chemistry', 2nd Edition Vikas Publishing House.

11. V. K. Ahluvalia, Green Chemistry, Ane Books, 1st Edition 2009.

12, P. Sykes, A Guide book to Mechanism in Organic Chemistry, 6th Edition, 2009, Orient Longman(Chapter-12 and p.198)

13. P.S. Kalsi' 'Organic Reactions and their Mechanisms'' 2nd Edition 2009 New Age International Publishers. (Chapter-17)

14. P. Y. Bruice, 'Organic Chemistry' - 3rd Edn.2004 Pearson Education. (Chapter-28)

Semester V (Core) - Paper VII

Name of the Course: Nuclear Chemistry, Metallurgy and Chemical Bonding

Duration: One Semester

Course Code: CH5B07TB **Credits-3**

Total Lecture Hours: 36

Aim of the course: To introduce the concepts of chemical bonding, nuclear chemistry and metallurgy.

Course Overview and Context: To familiarize metallurgical operations, various alloys of commercial use. To study about nuclear chemistry and its applications. An introduction to chemical bonding.

Syllabus Content:

Module I : Nuclear Chemistry (12 hrs)

Natural radioactivity, Modes of decay, group displacement law ,theories of disintegration, Rate of decay, Decay constant, Half life period,Gieger Nuttal rule, Radioactive equilibrium, Disintegration series, Transmutation reactions, using protons, deutrons, α-particles and neutrons, Artificial radioactivity, Positron emission and K electron capture, Synthetic elements.

Nuclear stability, N/P ratio, Packing fraction, Mass defect, binding energy, nuclear forces, exchange theory and nuclear fluid theory, Nuclear fission, fusion, hydrogen bomb, atomic bomb, nuclear reactor.

Isotopes, Application of radioactive isotopes, C - 14 dating, rock dating, isotopes as tracers, study of reaction mechanism (ester hydrolysis), Radio diagnosis and radiotherapy.

Module II: Metallurgy (9 hrs)

Occurrence of metals based on standard electrode potential, concentration of ores, calcination, roasting and smelting ,reduction using carbon and other reducing agents, electrolytic reduction, hydrometallurgy, Ellingham diagram. Refining of metals, electrolytic

refining, oxidative refining, zone refining, Van Ankel method. Extractive metallurgy of Ti and U, Alloys, composition and uses of German silver, Brass, Broze, Gunmetal, Alnico.

Module III : Chemical Bonding (15 hrs)

Concept of Hybridization: Definition, need of hybridization. Types of hybridization- Hybridization and shapes of simple molecules - BeF_2, PCl_3, PCl_5, SF_6,CH_4, Ethane, Ethene, Ethyne

Bonding in metals: Qualitative idea of free electron approximation and tightbinding approximation. Formation of bands in a one-dimensional solid. Fermi level. Explanation of electrical properties using these models.

Ionic bond – Lattice energy of ionic compounds,- Born-Lande equation, Born-Haber cycle, its applications, Lattice energy ,solubility, polarisation of ions, Fajan's rules.

Covalent bond: Polarity of covalent bond, percentage of ionic character, dipole moment and molecular structure.

Weak chemical forces - hydrogen bond, inter and intra molecular hydrogen bonds, effects of hydrogen bonding - van der Waal's forces.

MO diagrams of homonuclear and heteronuclear diatomic molecules – He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, CO and NO. Comparison of VB and MO theories.

Competencies of the course:

C1. Fundamental aspects of Bonding in diatomic molecules - with suitable examples were studied

C2. Fundamental aspects of Bonding in polyatomic molecules with suitable examples were discussed

C3. Enabled the students to understand the fundamentals of nuclear chemistry were discussed.

C4. Extraction techniques of some useful metals through metallurgy were discussed

C5. Bonding in metals

C6. Types of bonds

C7. Compared the relationship between hybridization and shapes of simple molecules

C8. Justified the properties of compounds using inter and intra molecular hydrogen bonds

C9. Produced the MO diagrams of homonuclear and heteronuclear diatomic molecules

C10. Collected data for the composition and uses of alloys such as German silver, Brass, Broze, Gunmetal, Alnico.

C11. Essential differences between calcination, roasting and smelting of ores were discussed

C12. Highlighted Artificial radioactivity and its applications.

Textbooks:

1. Anu Gopinath, Chandradasan, Dominic Thomas, Methodology of Chemistry as a discipline of science, Vishal Publishers, 2014

References:

1. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science,2008, London
2. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 6th Edition 1976, New Delhi
3. C. N. R. Rao, University General Chemistry, Macmillan India.
4. F. A. Cotton, G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd edn., John Wiley.
5. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, 4th edn.2006, Oxford University Press.
6. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
7. H. J. Arnikar, Essentials of Nuclear Chemistry,New Age International Publishers, 4th revised edition, 2011.
8. R. Gopalan, Elements of Nuclear Chemistry,1999, Vikas Publ. House.
9. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry, 4th edn., Harper Collins, 1993.
10. G. Wulfsberg, Inorganic Chemistry, 2000, Viva Books
11. W. L Jolly, Modern inorganic Chemistry, 1989, Tata Mc Graw Hill.
13. M. N. Greenwood and A. Earnshaw, Chemistry of the elements 2nd edn,1997, Butterworth

14. Manas Chanda, Atomic structure and chemical bonding 3rd Edition, 1995.

15. H. J. Emeleus, A. G. Sharpe, Modern Aspects of Inorganic Chemistry, 4th Edition 1973 Universal Book Stall

17. A. Cottrel, An introduction to metallurgy, 2nd edn., 1990, University press.

Semester V (Core) - Paper VIII

Name of the Course: Quantum Chemistry, Molecular symmetry and Spectroscopy

Duration: One Semester

Course Code: CH5B08TB **Credits-3**

Total Lecture Hours: 54

Aim of the course: To understand the fundamentals of quantum mechanics and its applications in the study of structure of atoms, to understand the basics of Group Theory and to introduce the concepts of molecular spectroscopy

Course Overview and Context: Introduction to quantum mechanics and its applications, spectroscopic techniques - rotational, vibrational, electronic and NMR, concepts in molecular symmetry.

Syllabus Content:

Module I: Quantum Mechanics **(18hrs)**

Classical mechanics: concepts, failure of classical mechanics, qualitative idea about the energy distribution in black body radiation. Plank's radiation law, Compton effect. Binding energy of an electron in hydrogen atom, radius of the hydrogen atom, de Broglie hypothesis, dual nature of electrons – Davisson and Germer's experiment. Heisensberg's uncertainty principle and its significance. Sinusoidal wave equation (no derivation needed). Wave function – physical interpretation, concept of operators, eigen functions, eigen values. Postulates of quantum mechanics, Particle in one-dimensional box – derivation for energy, application to linear conjugated polyene

(butadiene). Introductory treatment of Schrödinger equation for hydrogen atom. Quantum numbers and their importance, hydrogen like wave functions – radial and angular wave functions, radial distribution curves.

Molecular orbital theory: basic ideas – criteria for forming MO from AOs, construction of molecular orbital by LCAO method, H_2^+ ion (elementary idea only), physical picture of bonding and anti bonding wave functions, concept of ψ and ψ^2 orbitals and their characteristics. Introduction to valence bond model of hydrogen molecule, comparison of MO and VB methods.

Module II: Rotational, Vibrational and Raman Spectroscopy (18hrs)

Introduction: electromagnetic radiation, regions of the spectrum, interaction of electromagnetic radiation with molecules, various types of molecular spectroscopic techniques, Born-Oppenheimer approximation. Rotational spectrum: diatomic molecules, energy levels of a rigid rotator, selection rules, determination of bond length.

Vibrational spectrum: the simple harmonic oscillator – energy levels, force constant, selection rules. Anharmonic oscillator – pure vibrational spectra of diatomic molecules, selection rules, fundamental frequencies, overtones, hot bands. Degrees of freedom for polyatomic molecules, concept of group frequencies – frequencies of common functionalgroups in organic compounds.

Raman spectrum: quantum theory of Raman Effect (elementary idea), concept of polarizability, qualitative treatment of pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules, rule of mutual exclusion. Complementary nature of IR and Raman Spectra.

Module III: Electronic and NMR Spectroscopy (12 hrs)

Electronic spectrum: concept of potential energy curves for bonding and anti-bonding molecular orbitals, electronic transition, the Frank-Condon principle, dissociation energy.

Concept of auxochroms and chromophores. Polyatomic molecules – qualitative description of σ , σ^*, π , π^* and n- molecular orbitals, their energy levels and the respective transitions.

NMR Spectroscopy – Basic principle, Nuclear spin, Larmor precision, Nuclear shielding and deshielding (Only PMR), Chemical shift, Scales, Spin-spin splitting, Coupling constant, Interpretation of first order spectra of simple molecules – ethanol, acetaldehyde, toluene, aceto phenone.

Module 1V: Molecular Symmetry (6hrs)

Symmetry of molecules-symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, combination of symmetry elements, molecular point groups, Schoenflies symbol, crystallographic point groups.

Competencies of the course:

C1 Concepts in classical mechanics rare discussed.

C2. Postulates of quantum mechanics and the quantum mechanical model of the hydrogen atom were studied

C3. Discussion on the difference between classical and quantum mechanics

C4. Treatment of particle in a one dimensional box based on Quantum mechanics

C5. Development of Valence bond and molecular orbital theory from quantum mechanics was introduced.

C6. Detailed study on the applications of microwave, infra red, Raman and electronic spectroscopy.

C7. Molecular orbital theory: basic ideas were studied

C8. Introduction to the concepts of molecular symmetry.

C9. Complementary nature of IR and Raman Spectra was discussed

C10. Selection rules were studied.

C11. Concept of group frequencies – frequencies of common functional groups in organic compounds was introduced

C12. Crystallographic point groups and its importance was studied.

C13. Introduced the basic concepts in NMR with focus on chemical shift, shielding and deshielding and spin-spin splitting.

Learning Resources

1. Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.

4. Reference books available in the library.

5. Research seminars and lectures

6. Prescribed text books

7. Science magazines.

Textbooks:

1.Puri, Sharma and Phthania " Quantum mechanics and spectroscopy " for B.Sc. Core programme in chemistry, Vishal Publishers, Jalandhar, 2013

2. Gokulachandran A.M. and Joby Thomas K. "Core chemistry- Quantum mechanics and spectroscopy" Ist edition, Manjusha Publications, 2015

References :

1. K. L. Kapoor, A Textbook of Physical chemistry, Volume 4, 3rd Edition, 2006, Macmillan India Ltd.

2. Mc Quarrie, J. D. Simon, Physical Chemistry – A molecular Approach, Viva Books Pvt. Ltd., 2006.

3. I. N. Levine, Physical Chemistry, 5th Edition, 2007, Tata Mc Graw Hill,

4. A. Bahl, B. S. Bahl, G. D. Tuli, Essentials of Physical Chemistry, S. Chand and Company. 24th Edition, 1998.

5. K. J. Laidler, John H.Meiser, Physical Chemistry,3nd edn., 2011.

6. P Atkins, J Poula, Physicl Chemistry, 8 th edn 1998.

7. Mc Quarrie, Quantum Chemistry, 2007, Viva Books

8. I. N. Levine, Quantum Chemistry 5th edn, Pearson.

9. R. K. Prasad, Quantum Chemistry,4th Edition, 2010, New Age.

11.C. N. Baanwell and E M Mc Cash, Fundamentals of molecular spectroscopy 4thedn,2011, TataMc Graw Hill.

12. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, 31st Edition 2014 Vishal Pub. Co.

13. D. L. Pavia, G. M. Lampman, G. S. Kriz, Introduction to spectroscopy 3rd edn, Thomson

Brooks/Cole, 2001.

14. D. N .Satyanarayana, Electronic absorption spectroscopy and related techniques, 2001, Universities Press.

15. G. K. Vemulapalli, Physical Chemistry,1993, Prentice-Hall India Pvt. Ltd.

SEMESTER V - (OPEN COURSE)

Paper IXA

Name of the Course: Environmental Chemistry

Course code : CH5B09TB **Credits : 3**

Duration: One Semester

Total Lecture Hours: 72 hrs

Aim of the course: The aim of the course is to enable students to study the concept and techniques in monitoring, analyzing and solving environmental issues and to develop programmes to inculcate environmental awareness among the common mass.

Course Overview and Context: Environmental Management and Impact Assessment, Chemical Toxicology, Air pollution, Water pollution, Effluent and Waste management , Soil Pollution.

Syllabus Content:

Module 1: Environmental Management and Impact Assessment (12hrs)

Basic principles, concepts and scope of environmental planning, Conservation of energy – Renewable and non renewable energy sources-nuclear energy, solar energy, hydrogen, non conventional energy sources. Environmental pollution – concepts and definition.

Impact assessment- aim, concepts and methods, Environmental management system – ISO-14001.

Module 2: Chemical Toxicology (12hrs)

Toxicity -effects, toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, Co, NOx, SO_2 , O_3, PAN, CN, pesticides, Biomagnifications, LD_{50} , carcinogenic substances. Endosulfan disaster in Kasargod district of Kerala.

Module 3: Air pollution (12 Hrs)

Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution -acid rain, ozone layer depletion. Indoor air pollution. Effect of electric and magnetic fields in the environment .

Air pollution accidents – Bhopal and Chernobyl incidents. Air quality standards. Sampling and analysis of pollutants – CO, SO_2, H_2S, hydrocarbons, SPM. Noise pollution –Measurement, Classification, Hazards.

Module 4. Water pollution (12 Hrs)

Types, effects and sources of water pollution. Pollution of fresh water, ground water and ocean.

Sampling and measurement of water quality – odour,color,EC,turbidity,TDS, salinity, COD, BOD, DO, coliform, pH, acidity, CO_2, alkalinity, hardness, NO_3^-, NO_2^-, NH_3, phosphate, fluoride, chloride, cyanide, sulphide, sulphate and metals- As, Cd, Fe, Pb, Hg, SAR, WQI,.

Water quality parameters and standards. Waste water treatment techniques.

Module 5: Effluent and waste management (12 Hrs)

Effluent – definition and characteristics. Methods for water and waste water treatment and systems (physical, chemical, and biological). Air pollution emission control devices – principle methods. Plants, animals and microorganisms for controlling pollution and treatment of effluents.

Waste treatment and disposing methods - recycling and reuse. Methods for management for hazardous and toxic wastes. Principle and strategies of green chemistry – Illustrate with examples (elementary idea).

Module 6: Soil Pollution (12 Hrs)

Composition, reactions in soil. Sampling procedures and analysis of soil- cation exchange capacity, lime status, lime requirement, gypsum requirement, pH, N, P, K, S, Ca, Mg.

Industrial effluents and their interactions with soil components, Contamination by radio-nuclides.

Solid waste pollution: sources, nature, classification and environmental effects.

Competencies of the course:

C1. Environmental management and impact assessment in relation to ISO-14001

C2. Central issues of toxic effects of pollutants was discussed

C3. Impacts of Air, water, and soil pollution was summerized

C4. Various effluent and waste management procedure were compared

C5. Limitations of methods for management for hazardous and toxic wastes was highlighted

C6. Facts about Solid waste management was ascertained

C7. , Environmental management system – ISO-14001 was introduced

C8. Air pollution accidents – Bhopal and Chernobyl incidents were discussed

C9. Water quality parameters and standards were listed out

C10. Environmental Sampling procedures were discussed

C11. Focused on hazards of noise pollution

C12. Created an awareness on Industrial effluents and their interactions with soil components.

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Textbooks:

1.Anu Gopinath, Chandradasan, " Environmental Chemistry", Vishal Publishers, III edition,

2013

References:

1. A. K. De, Environmental Chemistry, 3rd Edition 1994 New age International Ltd.

2. G.T.T yler, Living in the Environment, Tomson Brooke/Cole international edition, 2011.

3. N. Manivasakam, Physico-chemical examination of water, sewage and industrial effluents, Pragathi Prakashan 1984.

4. D. Clarson, Soil and water analytical methods, ISBN:81-901483-0-3.

5. R. K. Khitoliya, Environmental Pollution – Management and Control for sustainable development, S.Chand & Company Ltd 2004.

6. B. B. Kebbekus and S. Mitra, Enveronmental chemical analysis, Blacke Academic & Professional 1997.

7. S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand & Company Ltd 7th Edition 2007.

8. R. A. Malaviya, Environmental Pollution and its control under international law 1987.

9. Pramod Singh, Environmental pollution management 1985.

10. G. K. Ghosh, Environmental pollution – A scientific study 2008.

11. Nelson L. Nemerow, Industrial water pollution 1971.

12. James W. Moore and S.Ramamoorthy, Organic chemicals in natural waters 1984.

13. Hutzinger, Aquatic pollutants 2013.

14. F. Kreith, George tchobanogous Handbook of Solid waste management, 6th Edition, 2002 Mc Graw Hill Inc.

15. Standard methods for examination of water and waste water, APHA 2013.

16. Peter O' Neil, Environmental Chemistry, Blackie Academic and Professional, London 3rd Edition, 1998

17. S P Mishra and S N Pandey, Essential Environmental Studies, 3rd Edition 2011 Ane Books Pvt. Ltd, New Delhi.

18. V K Ahluwalia,Environmental studies,2013, Ane Books Pvt Ltd, New Delhi.

SEMESTER V - (OPEN COURSE) - IX B

Name of the Course: **Chemistry in Every Day Life.**

Course code : CH5B09TB **Credits : 3**

Duration: One Semester

Total Lecture Hours: 72 hrs

Aim of the course: This course provides a basic understanding of chemistry in every aspects of our life.

Course Overview and Context: Chemistry is an integral part of everyday life. Whether it is the food we eat, the clothes we wear , the drugs we consume or the cosmetics we apply- there is chemistry in it. This course gives a general information of the chemistry behind these will create an awareness as to what is good and what is bad and to be discarded.

Syllabus Content:

Module I: Food additives and Flavours (12 Hrs)

Functional food additives, adulteration , food laws. Food colours - permitted and non – permitted- Toxicology. Flavours – natural and synthetic- Toxicology .Other functional additives- Soft drinks- formulation Health drinks.

Module II : Soaps (7 Hrs)

Soaps – Introduction , detergent action of soap. Toilet soap, bathing bars, washing soaps,

liquid soap manufacture- additives, fillers and flavours. Significance of acidity and alkalinity.

Module III: Synthetic Detergents (9 Hrs)

Detergents- Introduction, detergent action, types of detergents-cationic, anionic, amphiphilic detergents. Common detergent chemicals. Additives, excipients colours and flavours. Enzymes used in commercial detergents . Environmental hazards.

Module IV: Cosmetics (12 Hrs)

Cosmetics- Introduction, classification – bathing oils, face creams, toilet powder, skin products, dental cosmetics, hair dyes, shaving cream, shampoo, general formulation of each type. Toxicology of cosmetics.

Module V : Plastics , Paper and Dyes (14 Hrs)

Plastics in every day life . Brief idea of polymerization-Thermoplastic and thermosetting polymers. Use of PET, HDPE, PVC, LDPE, PP, ABS. Recycling of plastics. Biodegradable plastics. Environmental hazards of plastics. News print paper, writing paper, paper boards, cardboards. Organic materials, wood, cotton, jute and coir. International recycling codes, and symbols for identification. Natural and synthetic dyes
(basic idea only).

Module VI: Drugs (6 Hrs)

Chemotherapy- types of drugs- analgesics, antipyretics, antihistamines, antacids tranquilizers, sedatives, antibiotics, antifertility drugs.

Module VII: Chemistry and Agriculture (12 Hrs)

Fertilizers- natural, synthetic, mixed, NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Bio fertilizers. Plant growth hormones.

Pesticides- Classification-insecticides, herbicides, fungicides. Excessive use of pesticides – environmental hazards. Bio pesticides. Antiseptics and Disinfectants-Oils - vegetable oils, mineral oil, essential oil-Sugars, artificial sugars

Competencies of the course:

C1: Enabled the students to understand about food, additives, flavours and their toxicological effects.

C2: Soaps and their chemical nature were discussed.

C3: Detergents, classification of detergents and their pollution aspectes were discussed.

C4: Cosmetics and their harmful effects were discussed.

C5: Plastics, papers, dyes etc were discussed with their environmental hazards.

C6: Enabled the students to understand chemotherapy.

C7: Chemical nature of fertilizers were discussed.

C8: Pesticides, classification of pesticides and environmental hazards of pesticides were discussed in detail.

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research Seminars and lectures
6. Prescribed text books
7. Science magazines.

References:

1. T.P. Coultate, Food- The Chemistry of its components. Royal Society of Chemistry, London(Paper back)
2. Shashi Chowls,Engineering Chemistry, Danpat Rai Publication.
3. B.K. Sharma. Industrial Chemistry
4. CNR Rao- Understanding chemistry, Universities Press.
5. Puri and Sharma. Advanced Organic Chemistry.
6. Brown, Insect control by chemicals
7. A. K. De, Environmental Chemistry, New age International Ltd.
8. S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand & Company Ltd.
9. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillian Publishing Company, New York, 1990.
10. Buchel, K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983
11. P.C Pall, K. Goel, R.K Gupta, Insecticides,pesticides and agrobased industries.

12. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi.
13. I.I Singh, V.K Kapoor, Organic Pharmaceutical Chemistry

SEMESTER V (OPEN COURSE) IX C

Name of the Course: Food Science

Course code : CH5B09TB **Credits : 3**

Duration: One Semester

Total Lecture Hours: 72 hrs

Aim of the course: To get a basic understanding of the different aspects of food science

Course Overview and Context: This course provides an overview of food adulteration, food poison and food additives. This paper also focusses on the chemistry behind beverages and edible oils.

Syllabus Content:

Module I : Food Adulteration (18hrs)

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, mlk, butter etc. with clay stones, water and toxic chemicals – Common adulterants. Ghee adulterants and their detection. Detection of adultered Foods by simple analytical techniques.

Module II : Food Poisons (9hrs)

Food poisons - natural poisons (alkaloids - nephrotoxic) - pesticdes. (DDT, BHC, Malathion) - Chemical poisons - First aid for poison consumed victims.

Module III: Food Additives **(18hrs)**

Food additives - artificial sweeteners - Saccharin - Cyclomate and aspartate. Food flavours - esters, aldehydes and heterocyclic compounds. Food colours - restricted use - spurious colours – Emulsifying agents - preservatives ,leavening agents. Baking powder yeast - taste makers – MSG, vinegar.

Module IV : Beverages **(9hrs)**

Beverages - Soft drinks - soda - fruit juices - alcoholic beverages examples. Carbonation – addiction to alcohol - cirrhosis of liver and social problems.

Module V : Edible Oils **(18hrs)**

Fats, oils - Sources of oils - Production of refined vegetable oils - Preservation. Saturated and unsaturated fatty acids – Iodine value - Role of MUFA and PUFA in preventing heart diseases - determination of iodine - value , RM value, saponification value and their significance. Estimation of I2 and RM values in Edible oils

Competencies of the course:

C1: Enabled the students to understand the chemistry of food adulteration and adulterants

C2: Helped the students to know the methods of analyzing the adulterants

C3: The chemistry of food poisoning was studied in detail.

C4. Acquired knowledge about food additives

C5: Understood the chemistry of beverages and soft drinks

C6: Familiarized with the methods of preparing the soft drinks by field visits

C7: Acquired knowledge about various edible oils and the processing techniques

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

References:

1. Swaminathan M., Food Science and Experimental oods, Ganesh and Company.
2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S. Chand & Co. Publishers
3. Thankamma Jacob, Text Books of applied chemistry for Home Science and allied Sciences, Macmillan.
4. B. Sreelakshmi, Food Science, New Age

Semester VI (Core) Paper- X

Name of the Course: Research Methodology, Nanochemistry, Analytical Techniques and Computational Chemistry

Duration: One Semester

Course Code: CH6B10TB **Credits-3**

Total Lecture Hours: 54

Aim of the course: To introduce the basic ideas of nanochemistry, computational chemistry and analytical techniques and to give further orientation towards methodological pathways in research.

Course Overview and Context: Research methodology, data analysis, various analytical techniques in chemistry as well as current topics such as nano chemistry and computational chemistry.

Syllabus Content:

Module I: Research Methodology **(9 hrs)**

Selecting a topic – hypothesis-design of experiment: variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results, discussion of results, models. Summary of the scientific methods. Writing Science.

Background Reading - Selected Internet Resources in chemistry, Major Publishers in

Chemical science, Author, Citation, Computer Searching, Reviews, Keywords

Module II: Data Analysis (9 hrs)

Units, significant digits, rounding, scientific and prefix notation, graphing of data - Precision and accuracy – Types of errors – Ways of expressing precision – Ways to reduce systematic errors - reporting analytical data ,Statistical treatment of analytical data – population and samples –Mean and standard deviation – distribution of random errors– confidence limits – tests of significance – Correlation and regression – linear regression analysis, calculation of regression coefficients (slope, Intercept) using scientific calculator - methods of least squares.

Module III: Nanochemistry (9 hrs)

History of nanoscience and technology, terminology, scales of nano systems- Introduction-atoms to molecules-, Different types of nanoparticles, fullerenes, carbon nanotubes. sol gel synthesis. Electrical and optical properties of nanoparticles. Applications of nanotechnology in biology, medicine, (detailed discussion not required).

Module IV: Analytical Techniques (18 hrs)

Thermo analytical methods: Principle of thermo gravimetry, differential thermal analysis, differential scanning calorimetry. Applications - TGA of calcium oxalate monohydrate, DTA of calcium acetate monohydrate

Chromatography : Column Chromatography - Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications.

Thin Layer Chromatography - Principle, choice of adsorbent and solvent, Preparation of Chromatoplates, Rf-Values, significance of Rf values.

Paper Chromatography - Principle, Solvents used, Development of Chromatogram, ascending, descending and radial paper chromatography.

Ion - Exchange Chromatography – Principle - Experimental techniques.

Gas Chromatography - Principle - Experimental techniques - Instrumentation and applications. High Performance Liquid Chromatography (HPLC) - Principle- Experimental techniques, instrumentation and advantages.

Polarography, Dropping Mercury electrode.

Module V: Introduction to Computational Chemistry (9 hrs)

Computational chemistry as a tool and its scope. General introduction to the basics in

different methods of computational chemistry: Molecular mechanics methods, Ab initio methods, Semiempirical, Density Functional Theory (DFT) methods. Comparison of molecular mechanics, ab initio, semiempirical and DFT methods.

Competencies of the course:

C1. Understand various elementary aspects of research in chemistry

C2. Analyse data using statistical tools

C3. Understand the preparation and application of nanomaterials

C4. Understand the fundamentals different thermal and chromatographic techniques

C5. Understand fundamentals of computational chemistry.

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Textbooks:

2. Sathyaprakash, G.D.Tuli, S.K.Basu and R.D.Madan Advanced Inorganic Chemistry Vol II, S.Chand and Company, NewDelhi

References :

1. J.A Lee, Scientific Endeavor, Addison Wesley Longman.
2. Calvin W Tayler and Frank Barron, Scientific Creativity: Its Recognition and Development.
3. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd.
5. G. D. Christian, Analytical Chemistry, JohnWiley and Sons.6th edn,2007
6. V. S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books

Pvt. Ltd. New Delhi, 2009

7. T. Pradeep**,** *A Textbook of Nanoscience and Nanotechnology,* McGraw Hill, New Delhi, 2012.
8. T. Pradeep, Nano, The Essentials,Mc Graw- Hill Education,2007
9. C. N. R. Rao and A.Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry, 2005.
10. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry,Cengage Learning 9th edn, Cengage learning ,2014.
11. E.G. Lewars, Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics, 2nd Edn. , Springer, 2011.

F. Jensen, Introduction to computational chemistry, 2nd Edn., John Wiley & Sons, 2007

Semester VI (Core) Paper XI

Name of the Course: **Natural products and Heterocyclic Compounds**

Course Code: CH6B11TB

Total Lecture Hours: 54 **Credits : 3**

Duration: One Semester

Aim of the course: To give an outline of bio-organic chemistry and chemistry of natural products:

Course Overview and Context: Carbohydrates, Amino acids, Proteins, Nucleic Acids and Enzymes, Terpenes, Alkaloids, Vitamins and Lipids, Heterocyclic compounds, Steroids and Hormones.

Syllabus Content:

Module I Carbohydrates (12 hrs)

Classification - constitution of glucose and fructose. Reactions of glucose and fructose - osazone formation. Mutarotation and its mechanism. Cyclic structure. Pyranose and furanose forms. Determination of ring size. Haworth projection formula, configuration of monosaccharides ,epimerisation, chain lengthening and chain shortening of aldoses. Inter conversion of aldoses and ketoses.

Disaccharides - reactions and structure of sucrose. Ring structure

Structure and properties of starch and cellulose. (elementary idea) .Industrial applications of cellulose.

Module II. Amino acids, Proteins, Nucleic Acids and Enzymes (12 hrs)

Amino acids- classification, Zwitter ion. Peptide- solution phase peptide synthesis.

Classification of proteins based on physical and chemical properties and on physiological functions. Primary secondary and tertiary structure of proteins, helical and sheet structures (elementary treatment only). Denaturation of proteins.

Nucleic acids. Types of nucleic acids -RNA and DNA, polynucleotide chain components - biological functions. Green Fluorescent Proteins (elementary idea)

Enzymes: Chemical nature and properties of enzymes. Nomenclature and classification of enzymes. Mechanism of enzyme action. Substrate specificity of enzymes. Enzyme inhibition.

Module III. Terpenes, Alkaloids, Vitamins and Lipids (12Hrs)

Natural Products - Terpenoids - isoprene rule. Structure elucidation of citral and geraniol. Natural rubber –structure, vulcanisation

Alkaloids - general methods of isolation –classification – structure elucidation of conine,

piperine and nicotine.

Vitamins – classification- structure (elementary idea) of vitamin A, C and B1.B2 ,B6 .

Lipids – biological functions – oils and fats – common fatty acids- extraction and refining- hydrogenation – rancidity- identification of oils and fats – saponification value, acid value,iodine value and RM value.

Module IV. Heterocyclic compounds (12Hrs)

Aromaticity of heterocyclic compounds. Preparation, properties and uses of furan, pyrrole and thiophene. Synthesis and reactions of pyridine and piperidine - comparative study of basicity of pyrrole, pyridine and piperidine with amines.

Synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup. Bischler and Napieralskii and Fisher indole synthesis.

Module V. Steroids and Hormones (6Hrs)

Introduction – Diels hydrocarbon- Structure and functions of cholesterol, Elementary idea of HDL, LDL, Vitamin D.

Hormones (structure not required)- Introduction, steroid hormones, peptide hormones, amine hormones, artificial hormones (general idea)

Competencies of the course:

C1**.** Enabled the students to understand the chemistry of carbohydrates

C2. Learned in detail the chemistry of heterocyclic compounds.

C3. Understood the structure and functions of amino acids, proteins, enzymes, and nucleic acids.

C4. Fundamentals of terpenoids and alkaloids were discussed.

C5. To have an elementary idea of Green Fluorescent Proteins

C6. To study about the role of vitamins and lipids.

C7. Importance of steroids and hormones in the biological system were discussed

C8. Role of nucleic acid in protein synthesis was noted.

C9. Types of nucleic acids were discussed.

C10. Structure of nucleic acids were studied

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Textbooks:

1.Y.R.Sharma, New Course in Chemistry, Kalyani Publishers, 2011

References:

1. I. L. Finar, Organic Chemistry - Volume I & II - Pearson Education(Chapters 18)
2. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-35)
3. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-33)
4. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-34,35)
5. en.wikipedia.org/wiki/Green_fluorescent_protein
6. www.scholarpedia.org/article/fluorescent_protein

Semester VI (Core)- Paper XII

Name of the Course: **Physical Chemistry**

Duration: One Semester

Course Code : CH6B12TB **Credits-3**

Total Lecture Hours: 54

Aim of the course: To provide an insight into various physical chemistry concepts like solutions, colloids, acids and bases, electrochemical phenomena and photochemistry.

Course Overview and Context: Detailed study of Phase equilibria, Kinetics, Acids and Bases, Electrical Conductance, Electromotive force, Photochemistry at graduate level**.**

Syllabus Content:

Module I: Phase equilibria (9 hrs)

The phase rule, equilibrium between phases – conditions. One component system – water system, sulphur system. Two component systems – solid-liquid equilibrium – simple eutectic, lead- silver system, formation of compounds with congruent melting point: ferric chloride-water system, formation of compounds with incongruent melting point: sodium sulphate-water system. Three component systems having one partially miscible pair: acetic acid-water-chloroform system.

Module II: Kinetics (9 hrs)

Rate of reaction, rate equation, order and molecularity of reactions, Integrated rate expressions for first and second order reactions. Zero order reactions, pseudoorder reactions, half life.

Theories of chemical kinetics: effect of temperature on the rate of reaction, Arrhenius equation, concept of activation energy Collision theory, transition state theory. Thermodynamic parameters for activation – Eyring equation (no derivation needed), enthalpy and entropy of activation. Theory of unimolecular reactions – Lindemann theory. Examples of complex reactions, opposing reactions, consecutive reactions and parallel reactions.

Catalysis: Homogeneous catalysis, enzyme catalysis – Michaelis-Menten equation (no derivation needed). Heterogeneous catalysis – surface catalysis, uni and bi molecular reactions on surface. Elementary idea about autocatalysis.

Numerical problems based on kinetic studies.

Module III. Acids and Bases (6 hours)

Introduction-concepts of acids and bases, relative strength of acid-base pairs, Ostwald's dilution law. Ionic product of water – pH. Buffer solutions – mechanism of buffer

action, Henderson equation, Acid-base indicators, theories, determination of pH by indicators. Numerical problems based on pH, pOH and Henderson's equation.

Module IV Electrical Conductance (12 Hours)

Introduction- Ohms law, specific conductance, molar conductance and equivalent conductance, variation of molar conductivity with concentration. Kohlrausch's law-applications.

Arrhenius theory of ionization, migration of ions, relative speed of ions, transport number-determination-Hittorf's method, Moving boundary method.

Theory of strong electrolytes: Debye-Hückel theory –the concept of ionic atmosphere, Asymmetry and electrophoretic effect, Debye- Hückel-Onsager equation (no derivation). Activity, mean ionic activity and mean ionic activity coefficients of electrolytes. Ionic strength of a solution, Debye-Hückel limiting law (no derivation)

Applications of conductance measurements–Determinations of degree of dissociation of weak electrolytes, solubility of sparingly soluble salts, conductometric titrations- advantages and disadvantages.

Numerical problems based on conductance measurements.

Module V: Electromotive force (12 Hours)

Introduction - Galvanic cells, Representation of cells – emf of cell, electrode potential – Reversible electrodes – different types, electrochemical series. Thermodynamics of reversible cells and reversible electrodes , Determination of ΔG, ΔH and ΔS of cell reaction. Emf and equilibrium constant of cell reaction, effect of electrolyte concentration on electrode potential and emf (Nerst equation).

Concentration cells – electrode concentration cell and electrolyte concentration cells. Types of electrolyte concentration cells – with transference and without transference, liquid junction potential. Over voltage.

Applications of emf measurements – determination of solubility product, determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode. Potentiometric titrations- advantages and disadvantages.

Numerical problems based on emf measurements.

Module :VI Photochemistry (6 hrs)

Interaction of radiation with matter: Laws of photochemistry- Grothus-Draper law, Stark-Einstein law, Quantum yield, primary and secondary processes. examples of different types of photochemical reactions. Basic concepts of photosensitized reactions – photosynthesis, dissociation of hydrogen molecule, isomerization of 2-butene Jablonsky diagram, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing).

Competencies of the course:

C1. To study the various aspects of binary liquid mixtures, CST, Colligative properties and colloids.

C2.To study acid- base concepts, theories and applications

C3.To study the basics, concepts, methods and applications of conductance measurements

C4.To study the various aspects of the cell its construction and working , thermodynamics and applications of emf measurements.

C5.To create basic awareness about photochemical and photo physical process.

C6.To derive the phase rule

C7. To derive the rate equations for zero, first and second order reactions

C8. To interpret the phase diagrams of one and two component systems

C9. To understand the theories of chemical kinetics

C10. To get an elementary idea of catalysis including enzyme catalysis.

Learning Resources:

1**.** Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.

4. Reference books available in the library.

5. Research Seminars and lectures

6. Prescribed text books

7. Science magazines.

Text Book:

1. T.M.Gokulachandran and Joby Thomas, "Solution Chemistry", Manjusha Publications

2015.

2. Y.R.Sharma, A new course in Chemistry (Solution Chemistry) **,** Kalyani Publishers 2011.

References :

1. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry,, Vishal Pub. Co. Jalandhar,
2. K. L. Kapoor, A Textbook of Physical chemistry, Volume 2, Macmillan India Ltd, 3rd edn1999
3. I.N. Levine, Physical Chemistry, Tata Mc Graw Hill, 2007
4. Text Book of Physical Chemistry- Bahl and Bahl,S chand,1998
5. F A Alberty and R J Silby, Physical Chemistry, John Wiley ,2006,1st edn
6. P. W. Atkins,The elements of Physical chemistry, 8th edn, Oxford University Press ,2006
7. K. K. Sharma, L R Sharma, A text book of Physical Chemistry, Vikas Publishing house

Semester VI (Core) - Paper- XIII

Name of the Course: **Chemical Thermodynamics**
Duration: One Semester

Course Code: : CH6B13TB **Credits-3**

Total Lecture Hours: 54

Aim of the course: To provide an insight into the thermodynamics , physical properties of solutions and colloids

Course Overview and Context: To study about First law, second law, third law of thermodynamics, chemical equilibrium, solutions and colloids.

Syllabus Content:

Module 1: First law of thermodynamics **(15 hrs)**

Introduction, definition of thermodynamic terms, intensive and extensive properties, path and state functions, exact and inexact differentials, zeroth law of thermodynamics

First law of thermodynamics, reversible and irreversible processes, internal energy and

enthalpy, heat capacity, Cp and Cv relation in ideal gas systems, change in thermodynamic properties of an ideal gas during (i) isothermal/adiabatic, reversible/irreversible processes. Joule-Thomson experiment, Joule-Thomson coefficient JT, inversion temperature.

Module 1I: Second and Third Law thermodynamics: (9 hrs)

Limitations of first law, statements of second law, Carnot's cycle – efficiency of heat engines, Carnot theorem. Entropy – entropy change for reversible/irreversible processes, spontaneous and non spontaneous processes .Change in entropy of an ideal gas with pressure, volume and temperature. Third law of thermodynamics- Statement and significance

Module III: Gibbs energy, Partial molar properties and chemical equilibrium (12hrs)

Helmholtz energy and Gibbs energy – variation of Gibbs energy with T and P. Criteria for reversible and irreversible processes. Gibbs-Helmholtz equation. Clausius- Clapeyron quation, applications. Partial molar properties – chemical potential, Gibbs-Duhem equation, chemical potential in a system of ideal gases.

Chemical equilibrium: conditions for chemical equilibrium, relation between Kc, Kx and Kp , van't Hoff reaction isotherm. Temperature dependence of Kp –van't Hoff equation.

Module IV : Solutions (12 hrs)

Introduction-- Binary liquid solutions – Raoult's law- ideal and non-ideal solutions- ΔG_{mix}, ΔV_{mix}, and ΔS_{mix} for ideal solutions. Vapour pressure-composition and boiling point-composition curves of ideal and non-ideal binary liquid solutions.. Critical solution temperature (CST) – the lever rule.

Solubility of gases in liquids – Henry's law. Distribution of a solute between two solvents – Nernst distribution law. colligative properties of dilute solutions – vapour pressure lowering, Boiling point elevation and freezing point depression (thermodynamic derivation).Molar mass determination-related problems- Osmotic pressure –laws of osmotic pressure - Reverse osmosis – purification of sea water. Abnormal molecular masses – van' Hoff factor – degree of association and degree of dissociation.

Module V: Colloids (6 hrs)

classifications- method of preparation-purification- Optical, kinetic and electrical properties of sols- protective colloids- Emulsions-different types- Gels- applications of colloids

Competencies of the course:

C1.To study the laws of thermodynamics

C2. To derive Gibbs-Helmholtz, Clausius-Clapeyron, Gibbs-Duhem equations

C3. To derive the relation between Kp, Kc and Kx

C4. To compare ideal and non-ideal solutions

C5. To study about colligative properties of dilute solutions

C6. To know the impact of osmotic pressure on osmosis

C7. To discuss the applications of osmosis

C8. To understand the different types of colloidal systems

C9. To know the electrical and optical properties of colloids

C10. To highlight the applications of colloids

Learning Resources:

1**.** Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.

4. Reference books available in the library.

5. Research Seminars and lectures

6. Prescribed text books

7. Science magazines.

Text Book: Y.R.Sharma, A new course in Chemsitry – Equilibrium and Kinetics, Kalyani Publishers, 2011

References :

1. R. P. Rastogi, R. R. Misra, An Introduction to Chemical Thermodynamics, 6th edn., Vikas Pub. Pvt. Ltd. (2003).
2. P. Atkins and J Paula, The elements of Physical chemistry, 6th edn., Oxford University Press,1998
3. K. K. Sharma, L. K. Sharma,.A Textbook of Physical Chemistry, 4th revised edn,Vikas publishing House, 1999.
4. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry,, Vishal Pub. Co. Jalandhar.
5. J. Rajaram and J. C. Kuriakose, Thermodynamics, Shoban Lal Nagin Chand & Co

(1986).

6. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 3, Macmillan India Ltd., 1981.
7. D. A. D. A. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach Viva Books Pvt. Ltd. 1998.

Semester VI (Core) Paper- XIV A
Choice Based Course

Name of the Course: **Environmental Chemistry**

Duration: One Semester

Course Code: CH6B14TB **Credits-4**

Total Lecture Hours: 54

Aim of the course: The aim of the course is to enable students to study the concept and techniques in monitoring, analysing and solving environmental issues and to develop programmes to inculcate environmental awareness among the common mass.

Course Overview and Context: Environmental management and impact assessment, Air pollution, Water pollution, Soil Pollution, Environmental Analytical techniques, Effluent and waste management.

Syllabus Content:

Module 1: Environmental management and impact assessment (8 hrs)

Basic principles, concepts and scope of environmental planning, Environmental pollution – concepts and definition. Impact assessment- aim, concepts and methods, Environmental management system – ISO-14001.

Module II: Air pollution (10 Hrs)

Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution -acid rain, ozone layer depletion. Indoor air pollution. Air pollution

accidents – Bhopal and Chernobyl incidents. Air quality standards. Sampling and analysis of pollutants – CO, SO_2, H_2S, hydrocarbons, SPM. Noise pollution – Classification and Hazards.

Module III: Water pollution (8 Hrs)

Types, effects and sources of water pollution. Pollution of fresh water, ground water and ocean. Measurement of water quality parameters – TDS, salinity, COD, BOD, DO, coliform, pH, acidity, CO_2, alkalinity, hardness, NO_3^-, NO_2^-, NH_3, phosphate, fluoride, chloride, cyanide, sulphide, sulphate and metals- As, Cd, Fe, Pb, Hg. WQI - Water quality Index. Water quality parameters and standards.

Module IV: Soil Pollution (8 Hrs)

Composition, reactions in soil,. Wastes and pollutants in soil. Sampling procedures and analysis of soil- cation exchange capacity, lime status, lime requirement, gypsum requirement, pH, N, P, K, S, Ca, Mg.

Management of solid waste.

Module V: Environmental Analytical techniques (8hrs)

Sampling – Collection and preservation of water, sediment and biological samples. General Errors, Accuracy and Precision.

Filtration and Storage- Criteria of an ideal filtering medium- Glass fibre, membrane and Nucleopore filters. Storage for analysis of water for major elements, nutrients, dissolved phosphate, total phosphorous, nitrogen compounds silicates, and trace metals.

Chromatographic methods: Paper thin layer gas liquid and high performance liquid chromatograph Basic principles and application to marine samples.

Spectroanalytical methods: Photometry and Spectrophotometry, Fluorimetry, Flame photometry, Atomic absorption spectrophotometry, Flameless AAS and Inductively coupled plasma emission spectrometry (ES and MS)- Basic principles, instrumentation and

applications in the analyses of marine samples.

Module VI: Effluent and waste management (12 Hrs)

Effluent – definition and characteristics. Methods for water and waste water treatment and systems (physical, chemical, and biological). Air pollution emission control devises – principle methods. Plants, animals and microorganisms for controlling pollution and treatment of effluents. Waste management – definition, characterization, sources, classification.

Waste treatment and disposing methods, - recycling and reuse. Methods for management for hazardous and toxic wastes. Principle and strategies of green chemistry –Illustrate with examples.

Competencies of the course:

C1. To discuss about environmental management and impact assessment

C2. To study the Toxic effects of pollutants

C3.To assess the impact of Air, water, and soil pollution

C4. To know the different methods of Effluent and waste management

C5. To understand various environmental analytical techniques

C6. To identify the various strategies of green chemistry.

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Textbook:

1. Anu Gopinath and Chandradasan – Environmental Chemistry Vishal Publishers, Jalandhar, 3rd Edition , 2014.

References :

1. A. K. De, Environmental Chemistry, New age International Ltd3rd edn,1994

2. G.T.T yler, Living in the Environment, Tomson Brooke/Cole-international edn 2011

3. N. Manivasakam, Physico-chemical examination of water, sewage and industrial effluents, Pragathi Prakashan,1984

4. D. Clarson, Soil and water analytical methods, ISBN:81-901483-0-3.

5. R. K. Khitoliya, Environmental Pollution – Management and Control for sustainable development, S.Chand & Company Ltd2004

6. B. B. Kebbekus and S. Mitra, Enveronmental chemical analysis, Blacke Academic & Professional1997

7. S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand & Company Ltd7th edn,2007

8. R. A. Malaviya, Environmental Pollution and its control under international law,1987

9. Pramod Singh, Environmental pollution management1985

10. G. K. Ghosh, Environmental pollution – A scientific study2008

11. Nelson L. Nemerow, Industrial water pollution , 1971

12. James W. Moore and S.Ramamoorthy, Organic chemicals in natural waters,1984

13. Hutzinger, Aquatic pollutants, 2013

14. F. Kreith Handbook of Solid waste management, Mc Graw Hill Inc,2nd edn,2002

15. Standard methods for examination of water and waste water, APHA,2013

16. Peter O' Neil, Environmental Chemistry, Blackie Academic and Professional, London,3rd edn,1998

17. S P Mishra and S N Pandey, Essential Environmental Studies, Ane Books Pvt. Ltd, New

Delhi3rd edn

18. V K Ahluwalia,Environmental Chemistry, Ane Books Pvt Ltd, New Delhi,2013

19.A text book of qualitative Inorganic Analysis including Elementary Instrumental analysis by Vogel (1978). Published by the English Language book society.

20. APHA. Standard methods for the examination of water and waste water analysis(1998).20th edition, Washington DC.

21. Methods of seawater analysis by Grosshoff (1983) .Verlag Chemie, Weinneim.

Semester VI (Core)- Paper XIV B

Choice Based Course

Name of the Course: **Chemistry in Every Day Life**

Course code : : CH6B14TB **Credits : 4**

Duration: One Semester

Total Lecture Hours: 54 hrs

Aim of the course: This course provides a basic understanding of chemistry in every aspects of our life.

Course Overview and Context: Chemistry is an integral part of everyday life. Whether it is the food we eat, the clothes we wear , the drugs we consume or the cosmetics we apply- there is chemistry in it. This course gives a general information of the chemistry behind these will create an awareness as to what is good and what is bad and to be discarded.

Syllabus Content:

Module I: Food additives and Flavours **(12 Hrs)**

Functional food additives, adulteration , food laws. Food colours - permitted and non – permitted- Toxicology. Flavours – natural and synthetic- Toxicology .Other functional additives- Soft drinks- formulation Health drinks.

Module II : Soaps and detergents (12 Hrs)

Soaps – Introduction , detergent action of soap. Toilet soap, bathing bars, washing soaps, liquid soap manufacture- additives, fillers and flavours.

Detergents- Introduction, detergent action, types of detergents-cationic, anionic, amphiphilic detergents. Common detergent chemicals. Additives, Environmental hazards.

Module IV: Cosmetics (12 Hrs)

Cosmetics- Introduction, classification – bathing oils, face creams, toilet powder, skin products, dental cosmetics, hair dyes, shaving cream, shampoo, general formulation of each type. Toxicology of cosmetics.

Module V : Plastics and Dyes (9 Hrs)

Plastics in everyday life. Brief idea of polymerization-Thermoplastic and thermosetting polymers. Use of PET, HDPE, PVC, LDPE, PP, ABS. Recycling of plastics. Biodegradable plastics. Environmental hazards of plastics. Natural and synthetic dyes (basic idea only).

Module VI: Chemistry and Agriculture (9 Hrs)

Fertilizers- natural, synthetic, mixed, NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Bio fertilizers. Plant growth hormones.

Pesticides- Classification-insecticides, herbicides, fungicides. environmental hazards. Bio pesticides.

Competencies of the course:

C1: Enabled the students to understand about food, additives, flavours and their toxicological effects.

C2: Soaps and their chemical nature were discussed.

C3: Detergents, classification of detergents and their pollution aspectes were discussed.

C4: Cosmetics and their harmful effects were discussed.

C5: Plastics and dyes etc were discussed with their environmental hazards.

C6: Chemical nature of fertilizers were discussed.

C7: Pesticides, classification of pesticides and environmental hazards of pesticides were discussed in detail.

Learning Resources:

1. Internet.

2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

References:

1. T.P. Coultate, Food- The Chemistry of its components. Royal Society of Chemistry, London(Paper back)
2. Shashi Chowls,Engineering Chemistry, Danpat Rai Publication.
3. B.K. Sharma. Industrial Chemistry
4. CNR Rao- Understanding chemistry, Universities Press.
5. Puri and Sharma. Advanced Organic Chemistry.
6. Brown, Insect control by chemicals
7. A. K. De, Environmental Chemistry, New age International Ltd.
8. S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand & Company Ltd.
9. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillian Publishing Company, New York, 1990.
10. Buchel, K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983
11. P.C Pall, K. Goel, R.K Gupta, Insecticides,pesticides and agrobased industries.
12. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi.
13. I.I Singh, V.K Kapoor, Organic Pharmaceutical Chemistry

Semester VI (Core) Paper XIV C

Choice Based Course

Name of the Course: **Food Science**

Course code : CH6B14TB **Credits : 4**

Duration: One Semester

Total Lecture Hours: 54 hrs

Aim of the course: To get a basic understanding of the different aspects of food science

Course Overview and Context: This course provides an overview of food adulteration, food poison and food additives. This paper also focusses on the chemistry behind beverages and edible oils.

Syllabus Content:

Module I : Food Adulteration (18hrs)

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, mlk, butter etc. with clay stones, water and toxic chemicals – Common adulterants. Ghee adulterants and their detection. Detection of adultered Foods by simple analytical techniques.

Module II : Food Poisons (9hrs)

Food poisons - natural poisons (alkaloids - nephrotoxic) - pesticdes. (DDT, BHC, Malathion) - Chemical poisons - First aid for poison consumed victims.

Module III: Food Additives (18hrs)

Food additives - artificial sweeteners - Saccharin - Cyclomate and aspartate. Food flavours - esters, aldehydes and heterocyclic compounds. Food colours - restricted use - spurious colours – Emulsifying agents - preservatives ,leavening agents. Baking powder yeast - taste makers – MSG, vinegar.

Module IV : Edible Oils (9hrs)

Fats, oils - Sources of oils - Production of refined vegetable oils - Preservation. Saturated and unsaturated fatty acids – Iodine value - Role of MUFA and PUFA in preventing heart diseases - determination of iodine - value .

Competencies of the course:

C1: Enabled the students to understand the chemistry of food adulteration and adulterants

C2: Helped the students to know the methods of analyzing the adulterants

C3: The chemistry of food poisoning was studied in detail.

C4. Acquired knowledge about food additives

C5: Acquired knowledge about various edible oils and the processing techniques

Learning Resources:

1. Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.

4. Reference books available in the library.

5. Research seminars and lectures

6. Prescribed text books

7. Science magazines.

References:

1. Swaminathan M., Food Science and Experimental oods, Ganesh and Company.

2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S. Chand & Co. Publishers

3. Thankamma Jacob, Text Books of applied chemistry for Home Science and allied Sciences, Macmillan.

4. B. Sreelakshmi, Food Science, New Age

SYLLABI OF PRACTICALS -CORE

SEMESTERS-I & II - CORE COURSE PRACTICAL - Paper I

CH2B01PB - Volumetric Analysis

Duration: Two Hrs/week **Credits : 2**
Total hrs: 72

Aim of the course: To gain practical knowledge about various types of titrations and indicators. To prepare standard solutions and solutions of different concentrations from a standard solution.

Course Overview and Context: Weighing and preparation of standard solutions**.** Acid - base titrations**,** Redox titrations – Permanganometry- Dichrometry- Iodimetry and Iodometry- Complexometric titrations.

Syllabus Content:

Module I: Laboratory safety, first aid and treatment of fires. Importance of lab safety – burns – eye accidents – cuts – gas poisoning – electric shocks – poisons – treatment of fires – precautions and preventive measures.

Module II: Introduction to weighing methods, preparation of standard solutions.

Module III: Acid - base titrations
1. Strong acid – strong base,
2. Strong acid – weak base
3. Weak acid – strong base titrations
4. Estimation of $NaHCO_3$ and Na_2CO_3 in a mixture

Module IV: Redox titrations
a) Permanganometry – 1. Estimation of oxalic Acid
2. Estimation of Calcium
3. Estimation of Ferrous Iron

b) Dichrometry –
1. Estimation of Fe^{2+} - external and internal indicators.
2. Estimation of Fe^{3+} - reduction with Stannous chloride.

c) Iodimetry and Iodometry –
1. standardisation of sodium thiosulphate using potassium iodate, Electrolytic copper and potassium dichromate
2. Estimation of As_2O_3 and arsenite
3. Estimation of copper sulphate.

d) Complexometric titrations
1. Estimation of Zinc
2. Estimation of Magnesium.
3. Estimation of Calcium.

Textbooks: Anu Gopinath, Chandaradasan, Dominic Thomas, Theoritical and Inorganic Chemistry and Volumetric Analysis II, Vishal Publishing company , Jalandhar, IV edition, 2014

SEMESTERS-III & IV - CORE COURSE PRACTICAL - Paper II

CH4B02PB : Organic Chemistry Practical -I

Duration: Two Hrs/week **Credits : 2**

Total hrs: 72

Aim of the course: Identification of functional groups present in organic compounds

Course Overview and Context: To analyze and confirm the functional groups after detecting the hetero atoms, saturation/unsaturation, aromatic/aliphatic and preparation of solid derivatives.

The physical constants of the given compounds was also determined.

Syllabus Content:

1. Tests for elements: Nitrogen, Halogens and sulphur
2. Tests for unsaturation.
3. Tests for aromatic character.
4. Study of the reactions of the functional groups
5. Systematic analysis of the following organic compounds containing one functional group and characterization with a derivative.-

- alcohol
- aldehyde
- ketone
- carboxylic acids
- 1,2 dicarboxylic acid
- ester
- primary and secondary amines
- reducing and non-reducing sugars
- phenol
- amide
- nitro
- halogen compounds
- Diamide
- Anilide
- polynuclear hydrocarbons

6. Determination of Physical constants of solids and liquids

(Minimum 10 compounds to be analyzed)

Textbooks:

1. Joe Murikallel, J.L.Rajan, Jose Willington, Chemical Analysis, Bethany Printers, Kottayam. 2010

SEMESTERS V &VI (Core Practicals - Paper III)

Name of the Course: Inorganic Chemistry Practical

Course Code: CH6BO3PB

Duration: Three Hrs/week **Credits : 2**

Total hrs: 108

Aim of the course: Analysis of inorganic mixture containing cations along with interfering and non-interfering anions

Course Overview and Context:. Analysis of common cations and anions including interfering anions.

Syllabus Content:

1. Study of the reactions of the following radicals with a view to their identification and confirmation.

Pb^{2+}, Cu^{2+}, Bi^{2+}, Cd^{2+}, As^{3+}, Sn^{2+}, Sb^{3+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, Li^{+}, Na^{+}, K^{+}, NH_4^{+}.

CO_3^{2-}, S^{2-}, SO_4^{2-} , NO_3^{-}, F, Cl, Br, BO_3^{2}-, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, CH_3COO^{-}, PO_4^{3-} , AsO_3^{3-}, AsO_4^{3-} and CrO_4^{2-}

Elimination of interfering anions such as F, BO_3^{2}-, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, PO_4^{3-} , AsO_3^{3-} AsO_4^{3-} and CrO_4^{2-}

2. Systematic qualitative analysis of mixtures containing two acid and two basic radicals from the above list with and without interfering radical by Semi-micro method only.

(Minimum of ten mixtures to be analysed)

Textbooks:

2. Joe Murikallel, J.L.Rajan, Jose Willington, Chemical Analysis, Bethany Printers, Kottayam. 2010

References

1. F. G Mann and B.C. Saunders, 'Practical Organic Chemistry' Fourth Edition, Pearson Education.

2. A.I.Vogel, 'Vogel's Textbook of Practical Organic Chemistry' Pearson Education .

3.V.K. Ahluwalia and S. Dhingra ' Comprehensive Practical Organic Chemistry',Universities Press.

SEMESTERS V &VI (Core Practicals - Paper IV)

Name of the Course: **Organic Chemistry Practical -II**

Course Code: CH6BO4PB

Duration: Two Hrs/week **Credits : 2**

Total hrs: 72

Aim of the course: to impart knowledge about basic analytical techniques and organic preparations

Course Overview and Context: Solvent extraction, Crystallisation, Distillation. Chromatography, dilution techniques and preparations involving oxidation, hydrolysis, nitration, halogenations acylation and esterification.

Syllabus Content:

A. Basic Laboratory Skills

a. Solvent extraction – phenol from water - methyl benzoate from water - using ether- Record the yield recovery (demonstration only).

b. Crystallisation – Any four compounds using ethyl acetate, ethanol, and water - Record the yield recovery.

c. Chromatography:

1. TLC - Separation and identification- Determination of Rf value of *o*-and *p*- nitroanilines.
2. Column Chromatography – purification of *o*-nitro aniline. (*non –evaluative*)

d. Distillation of the following organic compounds and recording the yield.

Aniline-water/Phenol/water/Ethyl acetate-water/Ethyl benzoate-water etc

B. Preparations

I. *Organic preparations involving.*-

1. Oxidation (benzaldehyde to benzoic acid).
2. Hydrolysis (methyl salicylate or ethyl benzoate to the acid).
3. Nitration (*m*-dinitrobenzene and picric acid).
4. Halogenation (*p*-bromoacetanilide from acetanilide).
5. Acylation (Benzoylation of aniline, phenol, β -naphthol).
6. Esterification (benzoic acid).
7. Iodoform from acetone or ethyl methyl ketone.
8. Side chain oxidation (benzyl chloride to benzoic acid).

(Any five experiments)

C. Technique of quantitative dilution.

1. Preparation of 100 mL 0.2 M H2SO4 from commercial acid
2. Preparation of 250 mL 0.025 M thiosulphate from .1 M thiosulphate
3. Preparation of sucrose solutions of different concentrations by dilution

Textbooks:

1. Joe Murikallel, J.L.Rajan, Jose Willington, Chemical Analysis, Bethany Printers, Kottayam. 2010

References

1. F. G Mann and B.C. Saunders, 'Practical Organic Chemistry' Fourth Edition, Pearson Education.
2. A.I.Vogel, 'Vogel's Textbook of Practical Organic Chemistry' Pearson Education .
3. V. K. Ahluwalia and S. Dhingra ' Comprehensive Practical Organic Chemistry', Universities Press.

SEMESTERS V &VI (Core Practicals - Paper V)

Name of the Course: **Physical Chemistry Practical**

Course Code: CH6BO5PB

Duration: Three Hrs/week **Credits : 2**

Total hrs: 108

Aim of the course: To study about the role of concentrations and temperature on various physical properties of solids and liquids

Course Overview and Context:. Experimental determination of properties such as viscosity, conductance, EMF, surface tension, rates of reaction, partition coefficient and transition temperature of various liquids and solids respectively.

Syllabus Content:

1. Viscosity – percentage composition of a mixture.
2. Heat of solution – KNO_3, NH_4Cl
3. Heat of neutralization
4. Determination of equivalent conductance of an electrolyte
5. Conductometric titration – strong acid *vs.* strong base, weak acid-strong base
6. Determination of partition coefficient of non-volatile solute between two immiscible solvents. E.g. I_2 between CCl_4 and water.
7. Transition temperature of salt hydrates. (Sodium thiosulphate, sodium acetate)
8. Critical solution temperature. Phenol-water system
9. Determination of molecular weight by Rast's Method (using naphthalene, camphor or biphenyl as solvent and acetanilide, p-dichlorobenzene etc. as solute.)
10. Kinetics of simple reactions eg. Acid hydrolysis of methyl acetate.
11. Potentiometric titration – Fe^{2+} *vs.* $Cr_2O_7^{2-}$, I^- *vs.* MnO^{4-},strong acid- strong base, weak acid-strong base.
12. Determination of Surface tension of various liquids

(minimum of 10 experiments to be done)

Textbooks:

1. Joe Murikallel, J.L.Rajan, Jose Willington, Chemical Analysis, Bethany Printers, Kottayam. 2010

References

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

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Semester V (Core Practicals - Paper VI)

Name of the Course: PROJECT

Course Code: CH6BO6PB

Duration: Two Hrs/week in Vth Semester **Credits : 2**

Total hrs: 36

Aim of the course: To initiate the students into research work in chemistry as well as in interdisciplinary areas and project report presentation.

Course Overview and Context: To carry out a group project work of undergraduate standard and submit a report of the project work done.

Project work – Group project work is to be done. A group may consist of 3 to 5 students.

Preparation of project report.

The project report must have the following sections-Introduction, materials and methods, results and discussion, conclusion and bibliography.

The reports shall be prepared and submitted individually. The reports of the projects are to be submitted in duplicate to the department at the end of the sixth semester and the certified reports are to be produced before the external examiners.

Presentation of project work using power point.

(**The details regarding the project evaluation is given under the section dealing with examination**)

Project Evaluation

1. All students have to begin working on the project in the **FIFTH** semester and must submit the report in the **SIXTH** semester.
2. The ratio of ISA to ESA component of the project is 1:4. The mark distribution for assessment of the various components is shown below.

a) <u>Sessional Evaluation: 10 marks</u>

Component	Marks
Punctuality	2
Experimentation	2
Data collection	2
Compilation	2
Group involvement	2

b) <u>External Evaluation of Dissertation</u>: 40 marks

Component	Marks
Innovation of topic	5
Objective	3
Review	3

Materials & Methods	4
Result &Discussion / Applications	5
Presentation and viva	20

Semester VI (Core Practicals - Paper VII)

Name of the Course: **Gravimetric Analysis**

Course Code: CH6B07PB

Duration: Two hrs/week in VIth semester **Credits : 1**

Total hrs: 36

Aim of the course: Gravimetric estimation of the concentration of the cations and anions in solution
Course Overview and Context:. Estimation of cations like Ba^{2+}, Mg^{2+}, Ni^{2+}, Cu^{2+}, Fe^{3+} and anions SO_4^{2-}
Syllabus Content:

1. Estimation of Barium as $BaSO_4$

2. Estimation of sulphate as $BaSO_4$

3. Estimation of magnesium as oxinate

4. Estimation of iron as Fe_2O_3

5. Estimation of Nickel as dimethyl glyoxime complex

6. Estimation of copper as CuCNS

Textbooks:

1. Joe Murikallel, J.L.Rajan, Jose Willington, Chemical Analysis, Bethany Printers, Kottayam. 2010

References

1. A.I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': (Third Ed.) (ELBS)

2. J. Bassett, R.C.Denney, G.H. Heffery and J Mendham,. 'Vogel's Textbook of quantitative Inorganic Analysis' (revised), ELBS.

SYLLABI OF COURSES

[COMPLEMENTARY]

Semester I (Complementary)- Paper I

(Common for Botany, Zoology and Family and Community Science**)**

Name of the Course: Basic Theoretical and Analytical Chemistry

Duration: 2 hrs/week **Total Lecture Hours: 36**

Course Code: CH1C01TB **Credits: 2**

Aim of the course: To provide awareness about the basic concepts and principles of theoretical and quantitative practical chemistry

Course Overview and Context: Atomic structure, acids and bases, theory of indicators, principles of precipitation, analytical techniques, titrimetry, separation and purification techniques are dealt in this course.

Syllabus Content:

Module I. Atomic Structure (8 hrs)

Dual nature of atom, de Broglie equation, Heisenberg Uncertainty principle, Bohr model of atom, concept of orbital. Quantum numbers and its significance. Electronic configuration of atoms- Aufbau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle.

Module II Chemical Equilibrium (6 hrs)

Acids and Bases – Arrhenius, Lowry-Bronsted and Lewi's Concept, Ostwald's dilution law, ionic product of water- pH, strength of acids and bases. Buffer solutions- Henderson equation. Acid- base indicators, solubility product, common ion effect.

Module III. Analytical Chemistry –Basic principles (10 hrs)

Units, significant digits, rounding, statistical treatment of analytical data. Accuracy, precision- types of errors. Methods of elimination of errors.

Concentration terms- molality, molarity, normality, weight percentage, ppm.

Titrimetric method of analysis: General principle, requirement for titrimetric analysis. Primary and secondary standards, criteria for primary standards, preparation of standard solutions. Types of titrations–acidimetry, alkalimetry, complexometry, permanganometry, dichrometry. Iodometry and Iodimetry, Limitations of volumetric analysis. Gravimetric method of analysis.

Module IV. Separation and purification techniques (12 hrs)

General Principle and techniques of - Filtration, Recrystallisation, sublimation, distillation, fractional distillation, steam distillation, distillation under reduced pressure, solvent

extraction.

Chromatography, principle of differential migration, classification of chromatographic techniques. Basic principle and uses of thin layer chromatography (TLC), Paper chromatography (PC). Rf value. Column chromatography, Gas chromatography (GC), high performance liquid chromatography (HPLC), Ion exchange chromatography (IEC).

Competencies of the course:

C1. Discussion on atomic structure,

C2 . Usefulness of titrimetry in analytical procedures

C3. To understand the theory of precipitation

C4. Chromatographic Procedures were discussed

C5. Preparation of solutions of different concentration.

C6. To understand the theory of indicators

Learning Resources:

1. Internet.
2. Various online platforms offering science courses.
3. Journals related to chemistry.
4. Reference books available in the library.
5. Research seminars and lectures
6. Prescribed text books
7. Science magazines.

Text book:

1. G. D. Gem Mathew, Jose K Xavier, Complementary chemistry, 3rd edition, Vishal publishing company, 2011

References:

1. Manas Chanda, Atomic Structure and Molecular Spectroscopy ,2nd edn,Tata Mc Graw Hill Pub.Co,New Delhi,1979
2. P. L. Soni ,Text book of Inorganic Chemistry ,21st edn,S.chand&co,New Delhi,1999
3. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rd edn.

Vishal Pub. Co., 2008

4. C. N. R. Rao, University General Chemistry, Macmillan publisher's India Ltd,2009
5. R. A. Day Junior, A.L. Underwood, Quantitative Analysis, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988(Chapters 2,3,4,6,8,11)
6. V J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas ,vogel's Text Book of Quantitative Chemical Analysis, 6th edn,. Pearson Education (2003)(Chapters 3,4,10)
7. R. Gopalan, S Sundaram,K Rangarajan,Elements of Analytical Chemistry,3rd edn, S. Chand and Co., New Delhi.2007

Semester II (Complementary)- Paper II

(Common for Botany, Zoology and Family and Community Science**)**

Name of the Course: Advanced Inorganic, Organic and Environmental Chemistry

Duration: 2 hrs/week **Total Lecture Hours: 36**

Course Code: CH2C02TB **Credits: 2**

Aim of the course: To promote understanding facts and concepts in inorganic, organic and environmental chemistry.

Course Overview and Context: This course deals with nuclear chemistry, agricultural chemistry, different types of pesticides, pollution, green chemistry, renewable and non-renewable energy.

Syllabus Content:

Module I. Nuclear Chemistry **(8 Hrs)**

Radioactivity- natural radioactivity, artificial radioactivity, disintegration rates, half life period and disintegration constant. Nuclear Reactions - nuclear fission and nuclear fusion, nuclear reactors. Applications of radioisotopes - carbon dating, rock dating, in medicine, in agriculture, and in industry.

Module II. Chemistry and Agriculture **(10 Hrs)**

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

Pesticides-classifications with simple examples.

Insecticides – stomach poisons, contact insecticides, fumigants. Method of preparation and use of DDT.

Herbicides- structure and function of 2, 4,-D

Fungicides- inorganic and organic- Bordeaux mixture, diothio carbamates

Excessive use of pesticides – environmental hazards, eutrophication.

Module III. Green Chemistry (4 hrs)

Principle of green chemistry: Basic concepts, atom economy, twelve principles of green chemistry, Principles of green organic synthesis, green solvents.

Module IV Environmental Chemistry (14 hrs)

Basic principles. Conservation of energy – Renewable and non renewable energy sources-nuclear energy, solar energy, hydrogen, non conventional energy sources. Environmental pollution – concepts and definition. Air pollution- Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution - acid rain, ozone layer depletion, Green house effect. Types, effects and sources of water pollution-Pollution of fresh water, ground water and ocean. Thermal pollution. Sampling and measurement of water quality –odour, colour, EC, turbidity, TDS, salinity, COD, BOD, DO, coliform, pH, acidity, CO_2, alkalinity, hardness,

Competencies of the course:

C1. The concept of renewable and non-renewable energy will be studied

C2.Pollution and its control measures was discussed

C3. Nuclear chemistry and its application was dealt with.

C4. Role of pesticides and insecticides in agriculture was discussed

Learning Resources:

1. Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.

4. Reference books available in the library.

5. Research seminars and lectures

6. Prescribed text books

7. Science magazines.

Textbook: G.D.Gem Mathew, Jose K Xavier, Complementary chemistry, Vishal Publishers, 2014-15

References:

. 1. H. J. Arnikar, Essentials of nuclear chemistry, Revised 4th edition, New Age International Publications, 1995.

2. C.N. R Rao, University General Chemistry, Mac million publisher's India Pvt Ltd,2009

3. G. T. Austin, Shreve's Chemical process Industries. 5th edition, Mc Graw Hill, 1984

4. V. K. Ahluvalia, Green Chemistry, 3rd edn,Ane Books, 2009.

5. A. K. De, Environmental Chemistry, 6th edn, New age International (p) ltd.2006

6. G. T. Miller, Scott Spoolman, Living in the Environment,17th edn, Brooks/Cole cengage learning, 2011

7. S. S.Dara, A Textbook of Environmental chemistry and pollution control,8th edn, S.Chand & Company Ltd. 2005

8. V K Ahluwalia, Environmental Chemistry, 2nd edn, Ane Books Pvt Ltd, New Delhi,2012

Semester III (Complementary)- - Paper III

(Common for Botany, Zoology and Family and Community Science**)**

Name of the Course: **Basic Organic Chemistry**

Duration: 3 hrs/week **Total Lecture Hours: 54**

Course Code CH3C03TB **Credits: 3**

Aim of the course: The aim of the course is to promote understanding the basic facts of organic chemistry.

Course Overview and Context: This unit deals with classification and nomenclature of organic compounds, basic organic reaction mechanisms, polymers, chemistry in everyday life and petrochemicals.

Syllabus Content:

Module I. Classification and nomenclature of organic compounds (12 hrs)

Classification and IUPAC system of nomenclature of common organic compounds.
Functional group chemistry of alcohols, phenols, Aldehydes, ketones, carboxylic acids and its derivatives, amines and hydrocarbons.Isomerism- structural and sterieo isomerism

Module II. Basic organic reaction mechanism (12 Hrs)

Hybridization- sp^3, sp^2 and sp, (ethane, ethene, ethyne). Polarity of bonds. Bond fission- homolytic and heterolytic fission. Reaction intermediates- radicals, carbocations and carbanions. Classification of reagents- electrophiles, nucleophiles.

Types of organic reactions – addition, substitution and elimination reactions.

Substitution reactions: nucleophilic substitution of alkyl halides- SN1 and SN2 mechanisms. Electrophilic substitution in benzene-reaction mechanism.

Addition reactions: electrophilic addition to ethene, propene and ethyne-the Markwonikoff's

rule, Peroxide effect. Elimination reactions: E1 and E2 mechanisms

Module III. Polymers (10 Hrs)

Classification of polymers: Natural, synthetic; linear, cross-linked and network; plastics, elastomers, fibres; homopolymers and copolymers.

Polymerization reactions, typical examples- polyethene, polypropylene, PVC, phenol-formaldehyde and melamine- formaldehyde resins, polyamides (nylons) and polyester.

Natural rubber: structure, vulcanization. Synthetic rubbers- SBR, nitrile rubber, neoprene. Biodegradability of polymers, environmental hazards.

Module IV. Chemistry in everyday life (12 Hrs)

Natural and synthetic dyes and its uses. Cosmetics- Introduction, classification and toxicology of cosmetics.

Soaps – Introduction, detergent action of soap. Toilet soap, bathing bars, washing soaps, liquid soap manufacture. Detergents- Introduction, detergent action, types of detergents- cationic, anionic, amphiphilic detergents. Environmental hazards.

Drugs- types of drugs- analgesics, antipyretics, antihistamines, antacids tranquilizers, sedatives, antibiotics, antifertility drugs (elementary idea only). Industrial application of cellulose.

Module V. Petrochemicals (8 Hrs)

Introduction to crude oil, constitution of crude oil, Distillation of crude oil. Natural gas, Separation of natural gas and different fractions based on relative volatilities, Compositions of different distillates.

Meaning of terms such as – flash point, octane number, cetane number, knocking and antiknocking. Types of hydrocarbon fuels and their characteristics.

Cracking – types of cracking, applications of cracking, isomerization, reforming, alkylation. Synthetic Petrol- Bergius process, Fischer-Tropsch process.

Competencies of the course:

C1.To get an overview of IUPAC nomenclature

C2.Classification and synthesis of various types of polymers were discussed

C3. Application of chemistry in everyday life was discussed

C4.Different types of hydrocarbon fuels and their characteristics, physical properties were studied

C5. Organic reaction mechanisms were discussed.

Semester IV (Complementary)- Paper IV

(Common for Botany, Zoology and Family and Community Science**)**

Name of the Course: **Advanced Organic Chemistry**

Duration: One Semester

Course Code: CH4C04TB **Credits: 3**

Total Lecture Hours: 54

Aim of the course The aim of this course is to promote understanding of facts and concepts in Advanced organic chemistry and to develop interest in the study of biomolecules, food additives and food adultration.

Course Overview and Context: Enzymes , Nucleic acids & vitamins, Amino acids and proteins, Carbohydrates , Lipids Fats &Oils, Food Additives &food adultration

Syllabus Content:

Module I. Enzymes , nucleic acids & vitamins **(12 Hrs)**

Enzymes – General nature, classification, cofactors, characteristics of enzyme action, mechanism of enzyme action (elementary idea only)

Energy rich molecules: Elementary structure of ATP,ADP& AMP

Nucleic acids- Chemical composition, nucleosides, nucleotides. Structure of DNA & RNA. Biological Functions

Structure and biological activity of vitamin A, B and C.

Module II. Amino acids and proteins **(12 Hrs)**

Classification of amino acids, zwitter ion, general chemical properties of - amino acids, separation of amino acids, synthesis of glycine, alanine, phenyl alanine (any one method) .Peptides – peptide bond, polypeptides.

Proteins- amino acids as building block of proteins, classifications, prosthetic group, properties, denaturation. Structure of proteins- primary, secondary and tertiary structure. Metabolism of Protiens.

Module III. Carbohydrates (12 Hrs)

Classification of carbohydrates , preparation and properties of glucose, fructose and sucrose. Haworth configuration of α-D glucose and β-D glucose. Mutarotation. Conversion of glucose to fructose and vice-versa. Structure of starch and cellulose. Industrial applications of cellulose. Carbohydrate metabolism.

Module IV Lipids Fats &Oils (8 Hrs)

Simple lipids and complex lipids- isolation- properties. Analysis of oils and fats- acid value, saponification value, iodine value. Metabolism of fat, Soaps, cleaning action of soaps. Detergents (general idea)

Module V. Food Additives &food adultration (10 Hrs)

Artificial sweeteners – saccharin, cyclamate aspartame (general idea)

Food Flavours (names only) –esters, aldehydes and heterocyclic compounds.

Food colours- Restricted use, spurious colours.

General discussion of emulsifying agents, preservatives, leavening agents, baking powder, yeast.Taste-enhancers- MSG- vinegar

Contamination of wheat, rice, dhal, milk, butter etc. with clay ,sand stone, water and toxic chemicals, heavy metal (Hg, Pb, Cd)contamination of sea food.

Competencies of the course:

C1. Classification and characteristics of enzymes and mechanism of enzyme action.

C2. To differentiate between different types Nucleic acids, ADP, ATP and AMP

C3. To study the biological effects of various types of vitamins

C4. To outline the classification and properties of amino acids.

C5. To understand the structure and functions of proteins,

C6. To determine the classification, properties and structure of carbohydrates .

C7.to understand the f undamentals of oils, lipids &fats

C8. To investigate various types of food additives and food adultration.

Learning Resources:

1**.** Internet.

2. Various online platforms offering science courses.

3. Journals related to chemistry.

4. Reference books available in the library.

5. Research seminars and lectures

6. Prescribed text books

7. Science magazines.

Text Books

1. G. D Gem Mathew Advanced –Biorganic chemistry 2nd edition, 2011, Vishal Publishing CO.

2. Dr. Kochu Baby Manjooran S. Advanced Inorganic, Organic And Bio-Organic chemistryKannatheri Publications**.**

References:

1. I. L. Finar, Organic Chemistry Vol 1&2, 6th edition, Pearson education

2. K**.** S. Tewari, N. K. Vishnoi, A Text Book of Organic chemistry, 3rd edition , Vikas publishing House Pvt. Ltd ,2006.

3. Rastogi,Biochemistry,3rd edn, Tata Mc Graw Hill Publication ,2010

4. Dr. A.C. Deb, Fundamentals of Biochemistry ,8th edn,New Central book Agency Pvt Ltd,2006

5. C. N. R Rao, University General Chemistry, 20th edn,Macmillan publisher's India Ltd 2009

6. B. Sreelakshmi, Food Science, New Age International Pvt Ltd, New Delhi, 2007

SEMESTERS I & II (Complementary) Practicals- Paper 1

Name of the Course: **Volumetric Analysis**

Course Code: CH2C01PB **Total hrs: 72**

Duration: Two Hrs/week **Credits : 2**

Aim of the course: To give practical training for students in quantitative volumetric analysis.

Course Overview and Context: Practical training in acidimetry, alkalimetry, permanganometry, dichrometry, iodometry, iodimetry and gravimetric analysis

Syllabus

Module I: Laboratory safety, first aid and treatment of fires. Importance of lab safety, burns, eye accidents, cuts, gas poisoning, electric shocks, poisons, treatment of fires, precautions and preventive measures.

Module II: Introduction to Weighing methods, preparation of standard solutions.

Module III:

I. Acidimetry and Alkalimetry

1. Strong acid – Strong base,

2. Strong acid – Weak base

3. Weak acid – Strong base titrations

II. Permanganometry

1. Estimation of Oxalic Acid

2. Estimation of Ferrous Iron in Mohr's salt

3. Estimation of Ferrous iron in crystalline ferrous sulphate

III. Dichrometry

1. Estimation of Fe^{2+} - External indicator

2. Estimation of Fe^{2+} - Internal indicator

IV Iodimetry and Iodometry

1. Standardization of sodium thiosulphate using potassium iodate,

2. Standardization of Iodine solution

2. Estimation of $KMNO_4$

V Gravimetric Analysis

1. Determination of water of crystallization in $BaCl_2$ crystals

2. Estimation of Barium as barium sulphate

Textbooks: Dr. Saritha Chandran A. Volumetric Analysis for BSc complementary Course, Gayathri Publishers, II edition 2014

References

1. F. G Mann and B.C. Saunders, 'Practical Organic Chemistry' Fourth Edition, Pearson Education.

2. A.I.Vogel, 'Vogel's Textbook of Practical Organic Chemistry' Pearson, Education .

Bachelor's Programme in Chemistry (CBCSS) Examination

Model Question Paper

I & II SEMESTER- COMPLEMENTARY COURSE (CHEMISTRY)

COURSE CODE: CH2C01PB

COURSE TITLE: VOLUMETRIC ANALYSIS

Time: 3 hours **Total Marks: 40**

1. Estimate volumetrically the mass of ---- in the whole of the given solution, you are

provided with --------M solution of ----------and crystals of ---------

2. Write the procedure for the estimation as required in question (1)

3. Calculate the mass of ---------- you have to weigh out accurately to prepare---------ml of ---------- solution for the question (1)

Submit the answers of (2) and (3) within 10 minutes
Note: write down the bottle number of solution for estimation on page 1.
Get the burette readings and mass of substance attested by one of the examiners.

Scheme of valuation

1. Principle: 2 marks
2. Procedure : 4 marks
3. Calculation of mass for standard solution: 2 marks
4. Presentation of data: 4 marks
5. Calculation : 4 marks
6. Accuracy : 24 marks

SEMESTERs-III & IV Complementary Practicals - Paper II

(Common for Botany, Zoology and Family and Community Science**)**

Name of the Course: **Organic Analysis**

Course Code: CH4CO2PB **Total Hrs: 72**

Duration: Two Hrs/week **Credits : 2**

Aim of the course: To identify the functional group in the given organic compounds and to confirm it through the appropriate reactions.

Course Overview and Context: To analyze and confirm the functional groups after detecting the hetero atoms, saturation/unsaturation, aromatic/aliphatic and preparation of derivatives.

Syllabus Content:

Module I: Simple Tests for elements: Nitrogen, Halogen and Sulphur

Module II: Determination of Physical constants of the organic compounds

Module III: Study of reactions of common functional groups.

Module IV: Qualitative analysis with a view to characterization of functional groups and identification of the following compounds: naphathalene, phenol, benzaldehyde, benzoic acid, phthalic acid, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, and glucose (minimum eight compounds).

Textbooks:

Dr.Saritha Chandran A, Qualitative organic Analysis for complementary course for semester III & IV, Ist edition, Gayathri Publishers, 2013

References:

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

Bachelor's Programme in Chemistry (CBCSS) Examination

Model Question Paper

III & IV SEMESTER- COMPLEMENTARY COURSE (CHEMISTRY)

COURSE CODE: CH4CO2PB

COURSE TITLE: ORGANIC ANALYSIS

Time: 3 hours **Total Marks: 40**

1. Analyze qualitatively the given organic compound. Suggest a suitable derivative and write down the methods of preparation.

Scheme of valuation

1. Detection of elements- 8
2. Saturation/ unsaturation: 2
3. Aliphatic/aromatic: 2

4. Detection of functional groups with chemistry: 8
5. Confirmatory tests with chemistry of reactions: 10
6. Suggestion of derivative and procedure: 4
7. Systematic recording: 6