SYBSc Autonomous NEP 2024-25

SEMESTER-III

Major

CHE-23101: Paper 1: Physical and Organic Chemistry

(4 Credits, 60 Lectures)

Sr. No.	Chapter No.	Lectures
1.	Chemical Kinetics	14
2.	Surface Chemistry	10
3.	Free Energy	06
4.	Aromatic Compounds	15
5.	Alkyl halides, Alcohols and Ethers	15
	Total	60

Course Outcomes:

CO 1:Students will be able to calculate the rate constant of the chemical reactions.

CO 2:Students should be able to predict the order of chemical reactions and determine them experimentally.

CO 3:Students should understand the concept of adsorption and where it can be used for different applications.

CO4:Students should understand the application of free energy to chemical Reactions.

CO5: Electrophilic substitution reactions of aromatic compounds.

CO6: Various Methods of synthesis of aromatic compounds.

CO7: Type of substitution and elimination reactions with stereochemistry of product.

CO8: Synthesis and reactions of alkyl halides, alcohols and ethers.

Chapter 1: Chemical Kinetics [14L]

Introduction to kinetics, the rates of chemical reactions – definition of rates, rate laws and rate constants, reaction order and molecularity, determination of rate law, factors affecting reaction rates, integrated rate laws – zeroth-order reactions, first-order reactions, second-order reactions

(with equal and unequal initial concentration of reactants), half-life period, methods for determination of order of a reactions, Arrhenius equation- temperature dependence of reaction rates, interpretation of Arrhenius parameters, reaction dynamics-collision theory and transition-state theory of bimolecular reactions, comparison of the two theories, Problems.

Learning Outcomes:

1. **Students will be able to apply the chemical kinetics to chemical reactions and to solve the related problems.**
2. **Students should be able to understand the concept of order of reaction, activation energy and reaction dynamics.**

Chapter 2: Surface Chemistry [10L]

Introduction to surface chemistry - some basic terms related to surface chemistry adsorption, adsorption materials, factors affecting adsorption, characteristics of adsorption, types of adsorption, classification of adsorption isotherms, Langmuir adsorption isotherm, Freundlich's adsorption isotherm, BET theory (only introduction), application of adsorption, problems.

Learning Outcomes:

1. Students should understand the phenomenon of adsorption.
2. Students should be able to apply the adsorption process for various chemical reactions and different applications in daily life.

Chapter 3: Free Energy [06]

Introduction, Helmholtz free energy, variation of Helmholtz free energy with volume and temperature, Helmholtz free change energy for chemical reaction, Gibb's free energy, Variation of Gibb's free energy with pressure and temperature, Gibb's free energy change for chemical reaction, Free energy change for physical transitions, Free energy change for an ideal gas; standard free energy change, Gibb's-Helmholtz equation, Properties and significance of Gibb's free change.

Learning Outcomes:

1. Students will be able to apply the free energy and predict the chemical reactions.
2. Students should be able to understand the concept of free energies and apply it to chemical reactions.

References:

1. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.
2. B S Bahl, G D Tuli, Arun Bahl, Essentials of Physical Chemistry.
3. Physical chemistry by Atkins.
4. Principles of Physical Chemistry By Puri, Sharma, And Pathania.

5. Physical Chemistry by K.L Kapoor (Vol. 1)

Chapter 4: Aromatic Compounds [15 L]

Introduction and IUPAC nomenclature, preparation and Reactions of benzene and its derivatives (phenol, aryl halides and aromatic amines)

1) Benzene: Preparation methods - decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: Electrophilic substitution: halogenation, Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene), nucleophilic substitution-benzyne intermediate

2) Phenols: Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation, sulphonation and Friedel-Craft's reaction (alkylation and acylation), Reimer-Tiemann Reaction, Gattermann Reaction.

3) Aryl Halides: Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer and Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Learning Outcomes: After completing this course students will be able to learn:

1. About different methods of synthesis of aromatic compounds
2. Various reactions of substituted aromatic compounds.

Chapter 5: Alkyl halides, Alcohols and Ethers (Up to 5 Carbons) [15L]

1) Alkyl Halides (up to 5 Carbons): Introduction and IUPAC nomenclature Preparation: from alkenes and alcohols. Reactions: Types of Nucleophilic Substitution (SN_1 , SN_2 and SN_i) reactions, hydrolysis, nitrile & isonitrile formation, Williamson's ether synthesis, Elimination vs. substitution.

2) Alcohols: Introduction and IUPAC nomenclature, Preparation: Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, Reactions: with sodium, HX (Lucas test),esterification, oxidation (with alc. $KMnO_4$, acidic dichromate, conc. HNO_3)

3) Ethers (aliphatic and aromatic): Introduction and IUPAC nomenclature Preparation: Williamson's ether synthesis Reactions: Cleavage of ethers with HI

Learning Outcomes: After completing this course students will be able to learn:

1. Various methods of synthesis and reactions of alkyl halides, alcohols and ethers.
2. Mechanism with stereochemistry of nucleophilic substitution reactions and elimination reactions.
3. Comparative study of nucleophilic substitution reactions and elimination reactions.

CHE-23102: Paper 2: Inorganic Chemistry (2 Credits, 30 Lectures)

Chapter 1: Chemistry of p-block elements [12L]

Position of elements in the periodic table, electronic configuration of elements, Anomalous behaviour of first member of each group. Trends in the properties of the elements with respect to following points - size of atoms and ions, ionization potential, electronegativity, oxidation state, reactivity. Bonding and shapes of following molecules – B2H6, CO2, PCl5, H2SO4, ClF3 (Ref. 1: 359 - 633)

Learning Outcomes: A student should be able –

1. To write electronic configuration of any element.
2. To give reasons for anomalous behavior of the first element of IIIA to VII A groups with other elements in the same group.
3. To know the exact position p-block elements in the long form of the periodic table.
4. To know the bonding and shapes of following molecules - B2H6, CO2, PCl_5, SF_6, H_2SO_4, ClF_3.

Chapter 2: Molecular Orbital Theory of Covalent Bonding [10 L]

Introduction to Molecular Orbital Method (MOT) and postulates of MO theory, LCAO approximation, s-s combination of orbitals, s-p combination of orbitals, pp combination of orbitals, p-d combination of orbitals, d-d combination of orbitals, nonbonding combination of orbitals, Rules for linear combination of atomic orbitals, example of molecular orbital treatment for homonuclear diatomic molecules: Explain following molecules with respect to MO energy level diagram, bond order and magnetism: H2 + molecule ion, H_2 molecule, He^{2+} molecule ion, He_2 molecule, Li_2 molecule, Be_2 molecule, B_2 molecule, C_2 molecule, N_2 molecule, O_2 molecule, O^{2-} and O_2^{2-} ion, F_2 molecule, Heteronuclear diatomic molecules: NO, CO, HF. (Ref.-1:89-112 ; Ref-4: 278-292 ; Ref-5: 33-38).

Learning Outcomes: After studying the Molecular Orbital Theory student will be able to

1. Define terms related to molecular orbital theory (AO, MO, sigma bond, pi bond, bond order, magnetic property of molecules, etc).
2. Explain and apply LCAO principle for the formation of MO's from AO's. 3. Explain formation of different types of MO's from AO's.
4. Distinguish between atomic and molecular orbitals, bonding, anti-bonding and nonbonding molecular orbitals.
5. Draw and explain MO energy level diagrams for homo and hetero diatomic molecules. Explain bond order and magnetic property of molecules.
6. Explain formation and stability of molecules on the basis of bond order.
7. Apply MOT to explain bonding in diatomic molecules other than explained in the Syllabus.

References:

1. Concise Inorganic Chemistry, J. D. Lee, 5th Ed (1996) Blackwell Science.

2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008.

3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson. 4. Principles of Inorganic Chemistry, Brian W. Pfennig, Wiley (2015).

5. Inorganic Chemistry, Catherine Housecroft, Alan G. Sharpe, Pearson Prentis Hall, 2008.

CHE-23103-Chemistry Practical-I (2 Credits, 60 hours)

Course Outcomes:

CO 1: Students should be able to perform experiments related to chemical kinetics.

CO 2: Students should relate with different types of Volumetric analysis.

CO 3: Understand systematic methods of identification of substance by Chemical methods.

CO 4: Systematic working skill in the laboratory will be imparted to student.

Section A: Physical Chemistry (Compulsory)

1) To Study the Acid catalyzed hydrolysis of an ester (methyl Acetate) and determine the rate constant (k). (first order reaction)
2) To compare the relative strength of HCl and H_2SO_4 or HNO_3 by studying the kinetics of hydrolysis of methyl acetate.
3) Energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.
4) To verify the Freundlich and Langmuir adsorption isotherm for adsorption of acetic acid on activated charcoal.

Section B: Inorganic Chemistry (Compulsory)

1) Estimation of Aspirin from a given tablet and find errors in quantitative analysis. (Neutralisation titration)
2) Determination of Hardness of water from a given sample using E.D.T.A. (Complexometric titration)

3) Determination of the strength of given H_2O_2 solution with $KMnO_4$ Solution. (Redox titration)
4) Estimation of Mn by Volhard's method.(Precipitation titration)

Section C: Organic Chemistry (Compulsory)

1**. Organic Qualitative Analysis:**

Determination of type and Separation of Two Components from a given binary mixture of Organic compounds containing mono-functional groups (Ex. - carboxylic acid, phenols, amines, amide, nitro, etc.)

(separation of given mixture and physical constant determination of individual components) (Four mixtures: solid-solid type)

2. Organic Preparations (Any two)

1. Preparation of benzoic acid from ethyl benzoate (Identification and confirmatory Test of –COOH group, M.P and purity by TLC)
2. Acetylation of primary amine (Green approach)
3. Base catalyzed Aldol condensation (Green approach)

Section D: Industrial Visit (compulsory)

References:

1. Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication.
2. Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjali publication.
3. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
4. Text book of Practical Organic Chemistry, Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G. Prentice-Hall, 5th edition.

Major

CHE23401-VSEC-Sem-III Industrial Analytical Techniques (2 Credits, 30 Lectures)

Sr. No.	Chapters	Lectures
1.	Errors in Quantitative Analysis	04
2.	Volumetric analysis	14
3.	Conductometry	06
4.	Colorimetry	06
5.	Column Chromatography	06
	Total	30

Course Outcomes:

CO1: Students should understand the perspectives of Analytical Chemistry.

CO2: Students should be able to identify the type of volumetric analysis And how it is performed.

CO3: Students should understand the working of colorimetry and its components and use it for the applications.

CO4: Students should explain/define different terms in column chromatography such as stationary phase, mobile phase, elution, adsorption, ion exchange resin, adsorbate.

Chapter 1: Errors in Quantitative Analysis [04 L]

Introduction to errors, limitations of analytical methods, classifications of errors, accuracy, precision, minimization of errors, significant figures and computation, methods of expressing accuracy and precision: mean and standard deviations, reliability of results and numerical.

Learning Outcome:

1. Students should understand the basic concepts of errors and accuracy in experiments performed for analysis.

2. Students should be able to calculate the deviations and reliability of the results.

Chapter 2: Volumetric Analysis [14 L]

Introduction to volumetric analysis, classification of reactions in volumetric analysis, standard solutions, equivalents, normalities, and oxidation numbers, preparation of standard solutions, primary and secondary standards. Types of Volumetric Analysis methods:

1.Neutralization titrations: Theory of indicators, neutralization curves for strong acid strong base, weak acid strong base, weak base strong acid. Preparation of approximate 0.1 M HCl and standardization against anhydrous sodium carbonate, determination of Na_2CO_3 content in washing soda. **2.Complexometric Titrations:** Definition of complexing agent and complexometric titration, EDTA-as complexing agent (structure of EDTA and metal ion EDTA complex), Types of EDTA titration (direct and back titration), pH adjustment and amount of indicator in EDTA titration, metal ion indicators (general properties, solochrome black –T, Patton and Reeder's indicator only), standard EDTA solution, determination of Ca(II) and Mg(II), total hardness of water. 3. Redox Titrations: Definition of oxidizing agent, reducing agent, redox titration, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agents, 1,10- phenanthroline as indicator in reduction titration, diphenylamine as oxidation indicator, $KMnO_4$ as self-indicator, Standard $KMnO_4$ solution and standardization with sodium oxalate, Determination of H_2O_2. 4. Precipitation titrations: precipitation reactions, determination of end point (formation of coloured ppt., formation of soluble coloured compound, adsorption indicator), standard $AgNO_3$ solution, standardization of $AgNO_3$ solution– potassium chromate indicator- Mohr's titration, determination of chloride and bromide, determination of iodide. Problems based on analysis.

Learning Outcomes:

1. **Students will be able to do the calculations of normality, molarity, and oxidation number.**
2. **Students will understand the relation between molarity and normality.**
3. **Students should be able to explain the different types of volumetric analysis**
4. **Students will be able to solve the related problems.**

Chapter 3: Conductometry [6 L]

Introduction, Electrolytic Conductance, Resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, variation of equivalent and specific conductance with concentrations, Kohlrausch's law and its applications, conductivity cell, conductivity meter, Wheatstone Bridge, determination of cell constant, conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base) and Numericals.

Learning Outcomes:

1.Discuss / explain Kohlrausch's law and its Applications, Conductivity Cell, Conductivity Meter, Wheatstone Bridge.

2.Explain / discuss conductometric titrations.

Chapter 4: Colorimetry [6L]

Introduction, interaction of electromagnetic radiation with matter, essential terms: radiant power, transmittance, absorbance, molar, Lambert's Law, Beer's Law, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter: Principle, Construction and components, Working. Applications–unknown conc. By calibration curve method, Determination of unknown concentration of Cu(II) by EDTA method, Numericals.

Learning Outcomes:

1. Explain / define different terms in Colorimetry such as radiant power, transmittance, absorbance, molar, Lambert's Law, Beer's Law, molar absorptivity.
2. Apply colorimetric methods of analysis to real problems in analytical laboratories.

Chapter 5: Column Chromatography [6 L]

Introduction, Principle of Column Chromatography, Ion Exchange Chromatography: Ion exchange resins, action of ion exchange resin (Ion exchange equilibria, Ion exchange capacity), Experimental technique, Application: i) Separation of Metal ions / non-metal ions on Ion Exchange Chromatography (Zn(II) and Mg(II), $Cl^-$and Br^-), ii) Purification of water, Adsorption Chromatography – Liquid solid chromatography: Introduction, the technique of conventional chromatography, column packing materials, Selection of solvent for adsorption chromatography, Adsorption column preparation and loading, Application–Purification of anthracene, Size Exclusion Chromatography

Learning Outcomes:

1. Explain / define different terms in column chromatography such as stationary phase, mobile phase, elution, adsorption, ion exchange resin, adsorbate, etc.
2. Explain properties of adsorbents, ion exchange resins, etc.
3. Apply column chromatographic process for analysis in analytical laboratory.

References:

1. Analytical Chemistry by G.D. Christian.
2. Calculation of Analytical Chemistry by Hamilton, Simpson &Ellis 7th Edn.
3. Vogel, Textbook of Quantitative Inorganic Analysis, Including Elementary Instrumental Analysis by A. I. Vogel; J. Bassett .
4. Fundamentals of Analytical Chemistry by F. James Holler; Douglas Skoog; Stanley Crouch.

Minor

CHE23201 Course Code: Chemistry of Life (2 Credits, 30 Lectures)

Course Outcomes (COs)

CO1: Classify nutrients, toxins, and adulterants. Compare and contrast its features. Justify the advantages and disadvantages of food additives.
CO2: Define basic concepts of perfumes, formulation and its physiological effects.
CO3: Apply basic concepts to extract perfumery chemicals using various methods. Distinguish between the natural identical and synthetic perfumery compounds.
CO4. Classify food additives and polymers, Explain the principles and procedures involved in the manufacturing process of daily use products.

Unit 1. Role of Chemistry in Everyday Life [04 L]

Food Clothing, paints, lubricants fuels natural products, soaps, detergents and perfumes.

Learning Outcomes: After studying this chapter students will learn

1)Importance of chemistry in various aspects of life.
2)Role of chemistry in detergents, soaps and perfumes etc.

Unit 2. Chemistry of Food [05 L]

Types of Macro and Micronutrients and their sources and significance, Types of Food toxins, Food adulteration in various daily food items.

Learning Outcomes: After studying this chapter students will learn

1) Importance of macro and micronutrients in daily life and their sources.
2)Types of food adulterants and types of toxins present in food items.

Unit 3. Chemistry of Perfumes: Introduction to Perfumes [10 L]

History, classification of perfumes, the concept of aroma, types and physiological effects. Composition, formulation and working mechanism of perfume. Introduction to perfumery chemicals: Natural sources, natural identical and synthetic compounds.

Learning Outcomes: After studying this chapter students will learn

1) History, classification and physiological effects of perfumes
2) Natural and synthetic sources of perfumes
3) Composition and formulation of perfumes

Unit 4. Chemistry of natural products [06 L]

Methods of Isolation, properties & uses of the following: Eugenol, Pinene, Linalool, Citral and Geraniol. Flavours–Sources and properties of Vanilla, Rose, Peppermint, Orange & Lemon.

Learning Outcomes: After studying this chapter students will learn

1) Different methods of isolation of natural products
2) Sources and properties of flavours and their isolation

Unit 5. Chemistry of Fibers and polymers [05 L]

Cotton, natural fibers, silk, wool, rayon, artificial fibers, polyamides, acrylic acid, PVA, PVC.

Learning Outcomes: After studying this chapter students will learn

1) Natural fibers like silk, cotton, wool etc.
2) Synthetic polymers like acrylic acid, PVA, PVC etc.

References:

1)SrilakshmiB (2017): Nutrition Science, 6th Multicolour Ed. New Age International (P) Ltd.

2)Mann J and TruswellS(2017): Essentials of Human Nutrition, 5th Ed. Oxford University Press.

3) Handbook of Food and Nutrition- Dr. M. Swaminathan, Bangalore Press

4) Sadasivan S. and Manikam K. (2007): Biochemical Methods, 3rd Ed. New Age International (P)Ltd.

5)W. A. Poucher, Perfumes, Cosmetics and soaps, Ninth edition, – (Pages 3 to 67 and relevant pages from 68 to 360).

6)P. P. Sharma, Cosmetic Formulation, Manufacturing, and Quality Control. 3rd Edition, 1998) Vandana Publications, Lucknow, (relevant pages from 569 to 573).

7)Giriraj Prasad, Manufacture of Perfumes, Cosmetics & Detergents.

8)D. D. Wasule Perfumes: History & Chemistry Vol-I.

9)Paul Z. Bedoukian, "Perfumery and Flavouring Synthetics" II Edn, elsevier Publishing Co., Amsterdam, London, New York, 1967.

10)H. Panda, Perfumes and Flavours Technology Handbook, Asia Pacific Business Press Inc., 2010, Delhi.

11)Lippard S., Berg J. M. Principles of Bioinorganic Chemistry; University Science Books 1994.

12)Polymer science, V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, New Age International.

CHE 23301 OE1: Introduction to Forensic Science (2 Credits, 30 Lectures)

Course Outcomes (COs)

CO1: Define the scope of forensic science and evidence in criminal laws.
CO2: Discuss the uses of physical and biological evidence in criminal proceedings.
CO3: Distinguish between physical evidence and biological evidence.
CO4: Justify the physical and biological evidence in criminal proceedings.

Chapter 1: Introduction to Forensic Sciences (6L)

Scope of forensic science, evidence in criminal law (act, case studies).

Learning Outcomes:

1. **To get familiarized with different terms in forensic science**
2. **To understand the laws in forensic.**

Chapter 2 : Branches of Forensic Science (12 L)

Forensic law, Forensic biology/ serology, toxicology, ballistics, Forensic psychology, Cyber forensics, question document analysis.

Learning Outcomes:

1. **Students will understand different branches of forensic science**
2. **Students will become familiar with documentation in forensic science.**

Chapter 3: Evidences (12L)

Physical Identification, collection and preservation of sample. physical properties of sample material. Use of physical evidence (Fingerprint) and biological evidence (blood, semen, saliva and DNA) in criminal proceedings.

Trace Evidences

Introduction, principle and analysis of trace evidence (hair, fibre and paints).

Learning Outcomes:

1. Students will know the evidence and its classification.

References:

1. Suzanne Bell, Forensic Chemistry, 1st edition, Pearson Education Ltd.

2. http://www.forensicsciencesimplified.org/..

3. B. B. Nanda and R. K. Tiwari, Forensic Science in India: A Vision for the Twenty-First Century, Select Publishers, New Delhi (2001).

4. M. K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).

5. S. H. James and J. J. Nord, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).

6. Brenner, J. C. (2004). Forensic Science: An Illustrated Dictionary. CRC Press. Eckert, W. G. (1997). Introduction to Forensic Sciences (2nd Edition). CRC Press.

7. S. Nath, R. C. (2013). Forensic Science and Crime Investigation: Abhijeet Publications.

8. Sharma, B. R. (2019). Forensic Science in Criminal Investigation & Trails. Universal Law Publishing Company.

9. Yount, L. (2006). Forensic Science: From Fibers to Fingerprints (Milestones in Discovery and Invention), Chelea House publications.

SEMESTER-IV

CHE-24101: Paper 1: Electroanalytical, Coordination and Organic Chemistry (4 Credits, 60 Lectures)

Sr. No.	Chapter	No. of Lectures
1.	Electrolytic Conductance	08
2.	Colligative Properties	12
2.	Chemistry of Carbonyl compounds: Aldehydes, Ketones and carboxylic acids and derivatives	20
3	Coordination compounds	20
	Total	60

Course Outcomes:

CO1: Students will be able to explain the conductance due to electrolytes And calculate its E.M.F.

CO2: Synthesis and reactions of carbonyl compounds

CO3: Reagents used in reactions of carbonyl compounds

Chapter 1: Electrolytic conductance [08L]

Electrolytic conductance, Specific and equivalent conductance, Variation of equivalent conductance with concentration, Kohlrausch's law and its applications to determine:

a. Equivalent conductance at infinite dilution of a weak electrolyte, b. The ionic product of water, c. Solubility of sparingly soluble salts, Migration of ions and ionic nobilities, absolute velocity of ions, Ionic theory of conductance, Debye-Huckel–Onsager equation and its validity, Activity in solution, fugacity and activity coefficient of strong electrolyte. Problems.

Learning Outcomes:

1. **Meaning of specific resistance, specific conductance, cell constant and their units.**
2. **Cell constant, its theoretical and experimental determination.**
3. **Applications such equivalent conductance of weak electrolyte at zero Concentration, degree of dissociation (α), ionic product of water.**
4. **Validity of Onsager equation.**

References:

1. University General Chemistry. By C.N. R. Rao. Mc Millan

Publication.
2. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH Publication.
3. Physical Chemistry. By G.M. Barrow.

Chapter 3: Colligative Properties [12L]

Introduction, Solution, electrolytes and nonelectrolytes, Meaning of term colligative property, lowering of vapour pressure of solvent in solution, elevation of B.P. of solvent in solution, Landberger's method, freezing point depression, Beckmann's method, Osmosis and Osmotic pressure, Berkeley and Hertley method, Modern osmometer, application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight, Relation between Van't Hoff's factor and degree of dissociation of electrolyte by colligative property, Numericals.

Learning Outcomes:

1. **Students can identify the electrolytes and nonelectrolytes.**
2. **The students can explain the reason for colligative properties.**
3. **Students can solve problems related to colligative properties.**

References:

1. University General Chemistry. By C.N. R. Rao. Mc Millan Publication.
2. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH Publication.
3. Physical Chemistry. By G.M. Barrow.

Chapter 4: Chemistry of Carbonyl compounds: Aldehydes, Ketones and carboxylic acids and derivatives [20L]

Introduction, Structure, IUPAC Nomenclature of carbonyl compounds- Aldehydes, Ketones and carboxylic acids.

1) Aldehydes: Preparations: from primary alcohol, methyl benzenes, acid chlorides, phenols.
2) Ketones: Preparation of ketones from – secondary alcohols, Friedel Craft acylation, nitriles.
3) Reactions of Aldehydes & Ketones: (i) Oxidation (ii) reduction – catalytic reduction, metal hydrides –$LiAlH_4$, $NaBH_4$. Clemmenson's reduction, Wolf Kishner (iii) Addition of cyanides (iv) Addition of derivatives of NH_2-G (v) Addition of alcohols (vi) Cannizzaro reaction (vii) Addition of Grignard reagent (viii) Aldol condensation (ix) Perkins reaction (x) haloform reactions (xi) Iodoform test, (xii) Benzoin condensation.
4) Carboxylic acids: Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell–Vohlard-Zelinsky Reaction. Carboxylic acid derivatives (aliphatic): (up to 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids, Reactions: Reformatsky Reaction, Perkin condensation.

Learning Outcomes: After completion of this chapter, students will be able to learn:

1. Various methods of preparation and reactions of carbonyl compounds.

CHE-24102: Paper 2: Major Specific IKS (2 Credits, 30 Lectures.)

CHE-24103 Chemistry Practical-II (2 Credits, 60 hrs)

Course Outcomes:

CO1: Verify theoretical principles experimentally.

CO2: Develop skill of synthesis of chemical compounds.

CO3: Perform the quantitative chemical analysis of substances and able to explain the principles behind it.

Section A: Physical Chemistry (Compulsory)

1. To determine the cell constant of the given cell using 0.01 M KCl solution and determine dissociation constant of a given monobasic weak acid.
2. To investigate the conductometric titration of any one of the following
   a) Strong acid against strong base b) Strong base against weak acid.
   (standardization of base must be performed with KHP).
3. To determine the critical solution temperature for the Phenol-water system.
4. To determine the unknown concentration of Copper solution using Cu-EDTA complexometric titration by colorimetry.

Section B: Inorganic Chemistry (Compulsory)

1. Preparation of hexaamminenickel (II) chloride. $[Ni(NH_3)_6]Cl_2$
2. Preparation of Potassium dioxalatocuprate (II),$[Cu(C_2O_4)_2]SO_4$.
3. Estimation of Fe(III) from given solution by converting it to Fe(II) using Zn metal and then by titrating with the standard solution of $K_2Cr_2O_7$.
4. Separation and Identification of metal ions by Paper Chromatography.

Section C: Organic Chemistry (Compulsory)

Organic Qualitative Analysis (Two mixtures: solid-liquid type)

Separation of Two Components from a given binary mixture of organic compounds containing mono-functional groups (Ex. - carboxylic acid, phenols, amines, amide, nitro, etc.) and systematic identification of each component qualitatively.

Organic Estimations

i. Determination of molecular weight: Determination of molecular weight Of organic acid by titration against standardized NaOH - a) monobasic acid or b) dibasic acid.

ii. Estimation of amides: Determine the amount of acetamide in given solution by volumetric method. (Standardization of acid must be performed).

iii. Estimation of Ethyl benzoate: To determine the amount of ethyl Benzoate in given solution volumetrically. (Standardization of acid must be performed).

Section D: Industrial Visit (compulsory)

References:

1. Qualitative Inorganic Analysis, Svehla, G. Vogel's Pearson Education.
2. Quantitative Chemical Analysis, Mendham, J. Vogel's Pearson.
3. Text book of Practical Organic Chemistry, Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G. Prentice-Hall, 5th edition.
4. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal.

CHE-24201: Chemistry of Nanomaterials

(2 credits, 30 L)

Course Outcomes:

CO1: Understand basic characteristics of Nanomaterials

CO2: Physical, chemical and biological methods of synthesis of nanoparticles

CO3: Analytical techniques to identify particle size and crystal structure of the Nanomaterials

Chapter 1. Introduction of nanomaterials (2 L)

1.1. Bottom-up approach

1.2. Top-Down approach

Learning Outcomes: After completing this chapter, students will be able to learn:

1. Understand basics of nanomaterials

2. Difference between methods of synthesis of nanomaterials

2. Synthesis of nanomaterials - I Physical methods **(3 L)**

2.1. Ball-milling method

2.2. Melt mixing method

Learning Outcomes: After completing this chapter, students will be able to learn:

1. Physical methods of synthesis of nanomaterials

Chapter 3. Synthesis of Nanomaterials- II Chemical methods **(3 L)**

3.1. Sol-Gel method

3.2. Colloidal Method

Learning Outcomes: After completing this chapter, students will be able to learn:

1. Chemical methods of synthesis of nanoparticles.

Chapter 4. Synthesis of Nanomaterials—III Biological Methods **(3 L)**

4.1. Synthesis Using Microorganisms

4.2. Synthesis Using Plant Extracts

Learning Outcomes: After completing this chapter, students will be able to learn:

1. synthesis of nanoparticles using biological means

Chapter 5. Methods of Analysis **(3 L)**

5.1. Scanning Electron Microscope

5.2. X-ray Diffraction Analysis (XRD)

Learning Outcomes: After completing this chapter, students will be able to learn:

1. Understand different methods of analysis
2. Instrumentation and working of SEM and XRD.

Practical: **(10 L)**

1. Synthesis of ZnO nanoparticles using sol-gel method.
2. Synthesis of Ag nanoparticles using plant extract.
3. Analysis of synthesized nanoparticles and interpretation of results.

CHE 24301 OE1: Food & Health **(2 Credits, 30 Lectures)**

Course Outcomes:

CO1: Label the basic parts of digestive organs and recall their functions. Remember the food regulation laws. Define terminologies related to nutrition

CO2: Classify nutrients, toxins, and adulterants. Compare and contrast its features. Justify the advantages and disadvantages of food additives.

CO3: Apply the principles of ancient and modern food preparation and preservation techniques and its utility in retaining the nutritive value of various types of food.

Chapter 1: Types of Nutrients: (7 L)

Basic concept on Food and Nutrition. Scope of Nutrition, Classification of food. Types of Macro and Micronutrients. Sources and significance. Recommended daily intake. Structure and functions of the digestive system. Process of digestion and absorption of food. Significance of digestive juices in digestion.

Chapter 2: Food Adulterants and Healthy choices: (8 L)

Types of Food toxins. Food adulteration in various daily food items. Healthy alternatives.

Chapter 3: Food preservation methods: (8 L)

Definition, objectives, and principles of food preservation. Different ancient and modern methods of food preservation to retain nutritive value.

Chapter 4: Food analysis and Food regulation laws: (7 L)

Identification and analysis of macro and micronutrients in food. Weight for age, height for age, weight for height, body Mass Index (BMI) Waist - Hip Ratio, (WHR). Skin fold thickness. Simple home testing of food adulterants. National and International Food Adulteration prevention laws. Reading of food labels and ingredients.

References:

1. SrilakshmiB (2017): Nutrition Science,6th MulticolourEd. New Age International (P) Ltd.
2. Mann J and TruswellS(2017) : Essentials of Human Nutrition, 5th Ed. Oxford University Press.
3. Handbook of Food and Nutrition- Dr.M.Swaminathan,Bangalore Press
4. Sadasivan S and ManikamK(2007): Biochemical Methods, 3rd Ed. New Age International (P)Ltd.
5. GopalanC , Rama Sastri BV and Balasubramanian SC(2016): Nutritive value of Indian Foods, Indian Council of Medical Research.
6. Subalakshmi, G and Udipi, SA(2006):Food processing and preservation, 1st Ed. New Age International
(P)Ltd.