TUMKUR UNIVERSITY

Syllabus

Program : Bachelor of Science, B.Sc.

Subject : Chemistry

V and VI Semesters

As per Revised-NEP (2024) Curriculum

Effective from the Academic Year 2026-27 for V and VI Semesters

Curriculum

Name of the Degree Program : **B.Sc.**

Subject : **Chemistry**

Discipline Core : **Chemistry**

Year of Implementation : **2026-27 (for V and VI Semesters)**

Course Structure for V and VI Semesters

Semester	Paper Title and Paper Code	Lecture	Practical	Tutorial	Credits	Total Credits
V	Paper-V **CHEDSC501**	3 hr / week	-	-	3	10
	Paper-VI **CHEDSC502**	3 hr / week	-	-	3	
	Practical Paper-V **CHEDSC501P**	-	4 hr / week		2	
	SEC-1 Classical Methods of Analysis **CHESEC501**	1 hr / week	2 hr / week		2	
VI	Paper-VII **CHEDSC601**	3 hr / week	-	-	3	10
	Paper-VIII **CHEDSC602**	3 hr / week	-	-	3	
	Practical Paper-VI **CHEDSC601P**	-	4 hr / week		2	
	SEC-2 Chemistry of Foods **CHESEC601**	1 hr / week	2 hr / week		2	

Examination Structure for V and VI Semesters

Semester	Paper Title and Paper Code	Summative Assessment (SA) (Semester End Examination)		Internal Assessment Marks	Total Marks
		Duration	Marks		
V	Paper-V **CHEDSC501**	3 hr	80	20 (Average of Two Tests 10 M + Average of Two Assignments 10 M)	100
	Paper-VI **CHEDSC502**	3 hr	80	20 (Average of Two Tests 10 M + Average of Two Assignments 10 M)	100
	Practical Paper-V **CHEDSC501P**	3 hr	40	10 (One Test 5M + One Assignment 5 M)	50
	SEC-1 Classical Methods of Analysis **CHESEC501**	1.5 hr	40*	10 (One Test 5M + One Assignment 5 M)	50
VI	Paper-VII **CHEDSC601**	3 hr	80	20 (Average of Two Tests 10 M + Average of Two Assignments 10 M)	100
	Paper-VIII **CHEDSC602**	3 hr	80	20 (Average of Two Tests 10 M + Average of Two Assignments 10 M)	100
	Practical Paper-VI **CHEDSC601P**	3 hr	40	10 (One Test 5M + One Assignment 5 M)	50
	SEC-2 Chemistry of Foods **CHESEC601**	1.5 hr	40*	10 (One Test 5M + One Assignment 5 M)	50

*** Single paper theory examination (which includes questions from both theory and practical components) shall be conducted.**

V Semester

Paper – V 45 Hours

Paper Code: CHEDSC501

Theory: 3 hours/week Credits: 03

Course Objectives

1. To familiarize students with the nomenclature and type of isomerism exhibited by coordination compounds.
2. To provide an overview of bonding, shape, magnetic and spectral properties of transition metal complexes.
3. To make the learners understand the significance of coordination compounds in various fields.
4. To systematically teach the mechanisms of oxidation, reduction and rearrangement reactions.
5. Describe the molecular mechanisms of industrial homogeneous catalysis, specifically Wilkinson's catalyst and the Monsanto process.
6. To outline the principles of quantum mechanics and fundamental quantum mechanical models.

Course Outcomes

Students will be able to

1. Name the coordination compounds and identify the type of isomerism exhibited.
2. Describe the bonding and interpret magnetic properties and electronic spectra of complex compounds.
3. Identify the application of coordination compounds in various fields.
4. Distinguish between oxidation and reduction in organic reactions and explain the mechanisms.
5. Understand operator algebra, time-dependent and time-independent Schrodinger equations.
6. Apply wave mechanics to describe microscopic particles.

Syllabus

Unit-1: 15 Hours

Coordination Chemistry 15 Hours

Introduction, differences between double salts and complex compounds. Definitions - complex ions, ligands, coordination number and oxidation state of central metal. Classification of ligands with examples. Calculation of the oxidation state of the metal in a complex. IUPAC system of nomenclature of coordination compounds.

Valence Bond Theory (VBT): Postulates of VBT and concept of hybridization. Explanation of formation, structure/geometry and magnetic properties of inner (low spin) and outer (high spin) orbital complexes by taking examples such as $[Cr(H_2O)_6]^{3+}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$, $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $[NiCl_4]^{2-}$, $[Ni(CN)_4]^{2-}$ and $[Cu(NH_3)_4]^{2+}$. Limitations of VBT.

Isomerism in Coordination Complexes: Definition and types of isomerism in coordination complexes with coordination numbers 4 and 6.

(i) Structural isomerism - ionization, hydrate, coordination and linkage isomerism with examples.

(ii) Stereo isomerism - Geometrical (cis-trans) isomerism in square planar ($[Ma_2b_2]$ and $[Ma_2bc]$ type) and octahedral complexes ($[Ma_4b_2]$ type). Geometrical isomerism in Cr(III) and Co(III) complexes containing bis(ethylenediamine). Optical isomerism in octahedral complexes with examples $[Co(en)_3]^{3+}$, cis-$[Co(NH_3)_4Cl_2]^+$ and cis-$[Co(en)_2Cl_2]^+$.

Crystal Field Theory: Postulates, crystal field effect. Crystal field splitting in octahedral and tetrahedral complexes, factors affecting the magnitude of 10 Dq or Δo, weak field and strong filed ligands, spectrochemical series, crystal field effects for weak and strong fields (pairing energy versus crystal field splitting energy), Crystal Field Stabilization Energy (CFSE), calculation of CFSE in weak field and strong filed octahedral complexes. Magnitude of CFS in tetrahedral field (Δt) in comparison with octahedral field (Δo). Magnetic properties of low spin and high spin complexes of Fe, Co and Ni – $[Fe(H_2O)_6]^{2+}$ and $[Fe(CN)_6]^{4-}$, $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$, $[NiCl_4]^{2-}$ and $[Ni(CN)_6]^{4-}$). Calculation of magnetic moments (spin only) of these complexes.

Electronic spectra of transition metal complexes having d^1 $[Ti(H_2O)_6]^{3+}$ and d^2 $(V(H_2O)_6]^{3+}$ systems based on CFT. Jahn-Teller distortion – definition, explanation for tetragonal elongation and tetragonal compression with examples. Merits and demerits of CFT.

Unit-2: 15 Hours

Oxidation, Reduction and Rearrangements (with mechanisms) 15 Hours

Oxidation: Oxidation of alcohols and carbonyl compounds with chromium and manganese reagents (Cr_2O_3, PCC, MnO_2, $KMnO_4$), Oppenauer oxidation.

Reduction: Heterogeneous catalytic hydrogenation, Lindlar catalyst, Rosenmund's reduction. Homogeneous catalytic hydrogenation - Wilkinson catalyst, hydride transfer using $LiAlH_4$, $NaBH_4$ (reduction of all possible functional groups), dissolving metal reductions (Birch reduction and Clemmensen reduction).

Rearrangements: Introduction, Wagner-Meerwein, Fries, Wolff, Hofmann, Curtius, Lossen and Schmidt rearrangements. Baeyer-Villiger oxidation, Benzil-benzilic acid, Favorskii rearrangements.

Unit-3: 15 Hours

Quantum Chemistry 15 Hours

Quantum Mechanical Operators: Definition, algebra of operators – addition, subtraction, multiplication, commutative property and commutator operator, linear operator, ∇ and ∇^2 operators, Hamiltonian operator, Eigen functions and Eigen values (numerical problems on algebra of operators and eigen functions), Hermitian operators and their properties expression for different operators.

Schrodinger Wave Equation: Derivation of time independent Schrodinger equation riting different forms of time independent Schrodinger equation.

Postulates of Quantum Mechanics – Statements.

Application of Schrodinger Equation to a Particle-in-a-box: Derivation of expression for energy and normalized wave functions – discussions on quantization of energy levels, zero-point energy, expressions for expectation values of x, x^2, P_x and P_x^2, Heisenberg uncertainty principle, probability distribution functions, nodal properties. Extension of one dimensional box to two and three dimensional boxes: concept of separation of variables, final expressions for Energy and normalized wave functions (derivations not required); degeneracy – definition and explanation by taking the example of particle in a cubical box, numerical problems on one dimensional box.

Rigid rotator model of rotation of diatomic molecule: Relation between Cartesian and polar coordinates, Schrodinger wave equation of rigid rotator in Cartesian and spherical polar coordinates, Separation of variables (mention the method and relevant equations for ɵ and ϕ variables), Final expressions for energy and normalized wave functions; Spherical harmonics-Definition and expression, Discussion of solutions (Energy levels)-quantization, energy level spacing.

Qualitative treatment of hydrogen atom and hydrogen-like ions: Expression for potential energy; Setting up of Schrodinger equation in Cartesian and spherical polar coordinates, separation of variables (mention the method and relevant equations for r, ɵ and ϕ variables), expressions for normalized solutions for r, ɵ and ϕ equations, final expressions for energy and normalized wave functions, discussion of energy levels- quantization, energy level spacing. Average and most probable distances of electron from nucleus (Radial distribution plots for 1s, 2s, 2p, 3s, 3p, 3d orbitals).

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Hooke's Law, Setting up of Schrodinger equation: Writing expressions for potential energy, Schrodinger equation for simple harmonic oscillator, final expressions for energy and normalized wave functions; Discussion of solutions: Energy (quantization, spacing between levels, zero point energy) and wave functions (description of the plots of Ψ vs x and Ψ^2 vs x).

Need for approximation methods in quantum chemistry. A brief introduction to variation method - statement of variation theorem, concept of trial function, different steps involved in variation methods, merits and demerits.

References:

1. Basic Inorganic Chemistry, FA Cotton, G Wilkinson and P L Gaus; John Wiley and Sons. Inc, 6th edition (1999).
2. Advanced Inorganic Chemistry, 6th edition; F. A. Cotton and G. Wilkinson.
3. Inorganic Chemistry, J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley IV edition (1993)
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford University Press, 1994. 2
5. Chemistry of Elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).

6. Concise Inorganic Chemistry, 5th edition; J. D. Lee (1996).
7. Inorganic Chemistry, 3rd Edition; Gary. L. Miessler and Donald. A. Tarr (2007)
8. Industrial Chemistry, E. Stocchi, Vol-I, Ellis Horwood Ltd. UK.
9. Introductory Quantum Chemistry, Chandra, A. K. Tata McGraw-Hill (2001).
10. Fundamentals of Quantum Chemistry, House, J. E. 2nd Ed. Elsevier: USA (2004).
11. Quantum Chemistry, Lowe, J. P. & Peterson, K. Academic Press (2005).
12. Chemistry For Degree Students (Quantum Chemistry, Spectroscopy and Photochemistry) by R. L. Madan, S Chand and company limited, New Delhi.
13. Introduction to Quantum Mechanics by David J Griffiths, Pearson Publications
14. Quantum Chemistry by Donald A McQuarrie, Viva Student Edition.

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V Semester

PAPER – VI 45 Hours

Paper Code: CHEDSC506

Theory: 3 hours/week Credits: 03

Course Objectives

1. To make the students understand the basic principles of metallurgy, Ellingham's diagrams and its applictions.
2. To provide an overview of thermal properties of ferrous and non-ferrous alloys.
3. To present the concepts of molecular symmetry, chirality, and the standard nomenclature systems (R/S, D/L, E/Z) used for geometric and optical isomers.
4. To detail the chemical, physical, and chromatographic techniques used to distinguish between diastereomers and resolve racemic mixtures.
5. To outline the fundamental laws of photochemistry and illustrate radiative and non-radiative relaxation pathways using the Jablonski diagram.
6. To systematically teach the theoretical principles, selection rules, and mathematical models behind rotational, vibrational, and electronic molecular spectroscopy.

Course Outcomes

Upon successful completion of the course students will be able to:

1. Interpret the thermodynamic principles (Ellingham's diagrams) of roasting, smelting and refining.
2. Apply the principles of metallurgy for the extraction of metals from their ores.
3. Correlate the composition and heat treatment of ferrous/non-ferrous alloys with the chemical stages of the Bessemer steel process.
4. Identify axes, planes, and centers of symmetry to differentiate between molecular asymmetry, dissymmetry, and meso-compounds.
5. Assign absolute (using CIP rules) and relative stereochemical configurations to chiral centers
6. Differentiate geometric isomers by their physical/chemical properties and formulate methods to resolve racemic mixtures.
7. Calculate bond lengths, force constants, and vibrational modes of diatomic and triatomic molecules from microwave and IR spectral data.
8. Characterize the degrees of freedom, fundamental frequencies, and group frequencies of polyatomic molecular vibrations.
9. Differentiate Raman scattering and UV-Visible electronic transitions using selection rules, the Franck-Condon principle, and the free electron model.
10. Apply the Jablonski diagram and Lambert-Beer's law to solve numerical problems and evaluate quantum yields in photophysical processes.

Syllabus

Unit-1: 15 hours

General Principles of Metallurgy 10 hours

Chief modes of occurrence of metals. Types of metallurgy and their general principles. Pyrometallurgy – roasting, calcination, smelting, flux. Ellingham diagrams – definition and application in metallurgy for reduction of metal oxides using C, CO and Al as reducing agents, extraction of chromium from chromite ore. Electrometallurgy – extraction of magnesium. Hydrometallurgy – extraction of gold.

Methods of purification of metals: Electrolytic refining, parting process (separating Ag from Au), vapour phase refining - (a) van Arkel-de Boer (Ti) process and (b) Mond's process (Ni), zone refining (ultrapure metals for semiconductor technology).

Powder Metallurgy: Definition, production of metal powders, powder conditioning and compacting, sintering, advantages and applications of powder metallurgy, production of tungsten powder.

Alloys 6 hours

Classification of alloys, Ferrous alloys - manufacture and uses of ferrosilicon, ferrochrome and ferromanganese. Non-ferrous alloys - Copper alloys (bronze, brass), Tin alloys (solder), Gold alloy (Karat gold for jewelry). Manufacture of steel by the Bessemer process. Heat treatment of steel - hardening, tempering, annealing, surface hardening (or case hardening) - nitriding, carburizing and surface treatment (argon treatment). Composition and properties of different types of steels - stainless steel, nickel steel, invar steel, chrome steel, manganese steel.

Unit-2: 15 hours

Stereochemistry 15 hours

Optical Isomerism: Elements of symmetry - axis, plane, and centre of symmetry with relevant examples, asymmetry and dissymmetry in molecules, optical rotation and specific rotation. Projection formulae – Wedge-dot and Fischer.

Configuration – definition, Chirality and stereogenic centers (formula for calculating the number of stereo isomers). Optical isomerism in glyceraldehyde, lactic acid and alanine, mesocompounds – (tartaric acid and 2,3-dichlorobutane as examples) enantiomers, diastereomers (using erythrose and threose as example). Absolute configuration – assigning R and S notation using CIP rules (examples), relative configuration – D and L configuration by taking glyceraldehyde and amino acids as examples; demerits of D, L configuration. Racemic mixture – definition with suitable examples. Resolution – definition, chemical method of resolution and chiral chromatography. Optical activity in compounds without chiral centers (biphenyls and allenes). Enantiomeric excess (definition and formula for calculation). Asymmetric synthesis- stereo specific and stereo selective reactions.

Geometric Isomerism: Definition, conditions for geometric isomerism, cis and trans isomerism in butenedioic acid and 1,2-dichloroethene as examples, assigning E - Z notations to geometrical isomers (examples). Distinguishing geometric isomers - physical methods (melting point, solubility and polarity) and chemical methods (cyclisation and heat of hydrogenation). Geometric isomerism in oximes and alicyclic compounds (1,2- 1,3- and 1,4-dimethyl cyclohexanes)

Unit-3: 16 hours

Molecular Spectroscopy (Physical Approach) 12 hours

Introduction to electromagnetic radiation, interaction with molecules - various transitions in molecules and types of spectra; Born-Oppenheimer approximation.

Rotation Spectroscopy: Derivation of expression for rotational energy and the frequency. Rotational spectra of a diatomic molecule (rigid rotor) - selection rule, expression for the spectral lines in terms of rotational constant, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, effect of isotopic substitution on rotational spectra (CO as an example), Limitations of rotational spectroscopy.

Vibrational Spectroscopy: Classical equation of vibration, computation of force constant, zero-point energy. Vibrational spectra of simple harmonic oscillator, expression for the transition, selection rule, amplitude of diatomic molecular vibrations. An-harmonic oscillator-Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands. Vibrations in polyatomic molecules-degrees of freedom, normal modes of vibration, concept of group frequencies.

Vibration-Rotation Spectroscopy: Diatomic vibrating rotator, P, Q, R branches and their energies.

Raman Spectroscopy: Qualitative treatment of rotational Raman effect; Vibrational Raman spectra-Stokes and anti-Stokes lines, their intensity difference, mutual exclusion principle.

Electronic Spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, calculation of electronic states of polyenes using free electron model.

Photochemistry 3 Hours

Lambert-Beer's law (derivation and numerical problems) and its limitations, Jablonski Diagram, fluorescence and phosphorescence, Laws of photochemistry, quantum yield, examples of low and high quantum yields, photostationary states, photosensitized reactions, chemiluminescence and bioluminescence.

Reference Books

1. A New Concise Inorganic Chemistry, J.D. Lee:, E.L.B.S.
2. Basic Inorganic Chemistry, F.A. Cotton & G. Wilkinson: John Wiley & Sons.
3. Basic Organometallic Chemistry: Concepts, Syntheses and Applications - B. D. Gupta & A. J. Elias, Universities Press, 2013.
4. Organometallic Chemistry: A Unified Approach - R. C. Mehrotra and A. Singh, New Age International Private Limited, 2nd edition, 2019.
5. Organometallic Chemistry - Gary O. Spessard & Gary L. Miessler Oxford University Press 3rd Edition. 2015.
6. Selected Topics in Inorganic Chemistry - Wahid U. Malik, G. D. Tuli, and R. D. Madan S. Chand Publishing, 2010.
7. Principles of Solid State Chemistry - B. R. Puri, L. R. Sharma, and K. C. Pathania, Vishal Publishing Co. 2020.
8. Introduction to Materials Science for Engineers - James F. Shackelford Pearson, 8th Edition, 2015
9. Stereochemistry of Organic Compounds: Principles and Applications - D. Nasipuri New Age International 1991.

10. Stereochemistry: Conformation and Mechanism - P. S. Kalsi New Age International Private Limited, 1990.
11. Basic Stereochemistry of Organic Molecules - Subrata Sengupta, Oxford University Press, 2014.
12. Fundamentals of Molecular Spectroscopy, Banwell, C. N. & McCash, E. M. 4th Ed. Tata McGraw-Hill: New Delhi (2006).
13. Molecular Spectroscopy - P. S. Sindhu, New Age International / Tata McGraw-Hill (1985)
14. Spectroscopy (Atomic and Molecular) - Gurdeep R. Chatwal & Sham K. Anand, Himalaya Publishing House 5th Edition (2024).

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V Semester

Practical Paper – V

4 hours/week

Paper Code: CHEDSC501P

Credits: 02

Course Objectives

1. To introduce the synthesis of coordination compounds
2. To explain the fundamental principles, techniques, practical skills of gravimetric analysis for inorganic substances.
3. To expose to titrimetric methods and principles required to selectively estimate a specific metal ion within a multi-ion mixture.
4. To demonstrate the application of the Beer-Lambert law in spectrophotometric applications for the quantitative analysis of colored substances.
5. To reinforce the principles of molecular spectroscopy and the mechanisms of electromagnetic radiation interaction with matter.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Synthesize specific coordination complexes and analyse their molecular structures and magnetic behaviours.
2. Execute gravimetric procedures safely and accurately to estimate the mass of inorganic analytes in a given sample.
3. Design and perform selective titrimetric estimations to quantify a target metal ion in a complex mixture.
4. Employ spectrophotometric techniques, leveraging the Beer-Lambert law, to determine the concentration of colored analytes.
5. Interpret molecular spectra to calculate critical molecular parameters, including rotational constants, bond lengths, and bond strengths.

List of Experiments

Part A

1. Preparation of tetraammine copper (II)sulphate complex.
2. Preparation of hexamminenickel (II)chloride complex.
3. Preparation of hexamminecobalt(III)chloride complex.
4. Preparation of potassiumtrisoxalatoferrate(III) trihydrate complex.
5. Gravimetric estimation of magnesium as magnesium 8-hydroxy oxinate.
6. Gravimetric estimation of Cu using NH_4SCN in mixture of Cu and Zn solution.
7. Gravimetric estimation of aluminium as aluminium oxinate.
8. Volumetric estimation of iron in copper and iron solution.

Part B

9. Colorimetric estimation of copper in the given copper sulphate solution.
10. Colorimetric estimation of creatinine in a given solution by Jaffe’s method.
11. Colorimetric estimation of Glucose in a given solution by DNS method.
12. Determination of rotational constant and bond length of diatomic molecule by using vibrational spectrum.

References

1. Advanced Physico-chemical Experiments - J. Rose
2. Instrumental Analysis manual - Modern Experiments for Laboratory - G. G. Guilbault and L. G Hargis.
3. A Text Book of Quanntitaive Inorganic Analysis- 5th edidtion- A. I. Vogel.
4. Experimental Inorganic Chemistry - G. Palmer
5. Inorganic synthesis - O. Glemser.
6. Experimental Inorganic/Physical Chemistry - Mounir A. Malati.

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V Semester

Skill Enhancement Course-I (Theory)

SEC Paper – I **15 Hours**

Paper Code: CHESEC501

Theory: 1 hour/week **Credits: 01**

Classical Methods of Analysis

Course Objectives:

1. To learn the scientific and chemical principles/theory of Classical methods of quantitative analysis.
2. To learn gravimetric analysis principles and various techniques.
3. To gain knowledge of theory and principles of acid-base titrations.
4. To understand the applications of gravimetric and acid-base titrations.

Course Outcomes:

After the successful completion of this course, the students will be able to;

1. Acquire experimental skills on quantitative analysis of specific substances in a given sample.
2. Understand the procedure and skill for the estimation of inorganic substances in a given sample by gravimetric method
3. Understand the procedure and skill for the estimation of inorganic substances in a given sample by acid-base titrimetry.

Syllabus

Gravimetric Analysis: General principles, stoichiometry, calculation of results from gravimetric data. Properties of precipitates. Nucleation and crystal growth, factors influencing completion of precipitation. Co-precipitation and post-precipitation, purification and washing of precipitates. Precipitation from homogeneous solution, a few common gravimetric determinations- chloride as silver chloride, sulphate as barium sulphate, aluminium as the oxinate and nickel as dimethyl glyoximate.

Acid-Base Titrations: Principles of titrimetric analysis, titration curves for strong acid-strong base, weak acid-strong base and weak base-strong acid titrations, theory of acid base indicators(stwald's and Quinonoid), colour change: range of indicator, selection of proper indicator.

Applications of Acid-Base Titrations: Determination of nitrogen, sulphur, ammonium salts, nitrates and nitrites, carbonates and bicarbonates, and organic functional groups like carboxylic acid, amine, hydroxyl, air pollutants like SO_2.

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D Christian, 5th edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A Day and A.L. Underwood, 6th edition, 1993prentice Hall, Inc. New Delhi.
4. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham, R.C Denney, J.D Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principals, John H. Kennedy, 2nd Edn, Saunders College Publishing California, 1990.

V Semester

Skill Enhancement Course-I (Practicals)

SEC Paper – I **2 hour/week**

Credits: 01

Classical Methods of Analysis

Course Objectives:

1. To learn the experimental skills on quantitative analysis of specific substances in a given sample.
2. To have a hands on experience on the estimation of inorganic substances in a given samples by gravimetry and acid-base titrimetry.

Course Outcomes:

After the successful completion of this course, the students will be able to;

1. Acquire experimental skills on quantitative analysis of specific substances like various ores by gravimetry.
2. Understand the procedure and skill for the estimation of organic and inorganic acids and bases in various finished products using acid-base titrimetry.

List of Experiments

I. Gravimetric Analysis

1. Barium as Barium Sulphate
2. Iron as oxide
3. Nickel using DMG.

II. Acid - Base Titrations

1. Determination of carbonate and bicarbonate in a mixture by pH-metric titration and comparison with visual acid- base titration.
2. Determination of total acidity of vinegar and wines by acid – base titration.
3. Determination of replaceable hydrogen and relative molecular mass of a week organic acid by titration with NaOH.
4. Determination of total alkalinity of soda ash by visual and pH-metric titrations.
5. Determination of saponification value of edible oils.

References

1. Vogel's Qualitative inorganic analysis – Svelha.
2. Macro and Semimicro inorganic qualitative analysis – A.I. Vogel.
3. Semimicro Qualitative Analysis -F.J. Welcher and R.B. Halin.
4. Semimicro Qualitative Analysis – Ramanujam.

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VI Semester

Paper – VII 45 Hours

Paper Code: CHEDSC601

Theory: 3 hours/week Credits: 03

Course Objectives

1. To understand the basic concepts, definitions, and classification of organometallic compounds and ligands based on hapticity and electron donation.
2. To learn the synthesis, structure, bonding, and important reactions of selected organometallic compounds and metal carbonyls.
3. To develop an understanding of various acid-base theories and their applications in chemical systems.
4. To provide knowledge of nuclear chemistry, radioactivity, nuclear reactions, and their applications in energy production and dating techniques.
5. To familiarize students with the principles, classifications, and applications of fuel cells and applied electrochemistry.
6. To impart knowledge of modern spectroscopic techniques such as UV-Visible, IR, and NMR spectroscopy for structural elucidation of organic compounds.
7. To develop problem-solving skills related to nuclear reactions and spectroscopic interpretations.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Explain the stability of complexes based on the EAN rule, synergic bonding, synthesis, structure, and reactions of important organometallic compounds.
2. Evaluate molecular bonding and synergic back bonding effects in metal carbonyl structures.
3. Apply various acid-base concepts, including Arrhenius, Brønsted-Lowry, Lewis, Lux-Flood, solvent system, and HSAB theories, to explain chemical behavior and reactions.
4. Describe radioactive processes, nuclear structure, nuclear models, fission and fusion reactions, and evaluate their applications in dating techniques and nuclear energy production.
5. Explain the construction, working principles, kinetics, thermodynamics, and applications of different types of fuel cells and assess their environmental and economic significance.
6. Interpret UV-Visible, IR, and NMR spectra for the identification and structural characterization of organic molecules.
7. Solve numerical problems related to radioactive decay, nuclear energy calculations, and Woodward–Fieser rule-based UV spectral predictions.

Syllabus

Unit-1 15 hours

Organometallic Compounds 10 hours

Definition, Classification of ligands based on hapticity with examples, Classification based on the number of electrons contributed by the ligand for the metal-carbon bonding with examples. Nomenclature of simple organometallic compounds. Metal carbonyls – sigma and pi-bonded ligands. EAN rule (18 electron rule) and stability - (applied to carbonyls). Definition, explanation of stability for $Ti(CO)_6$, $V(CO)_6$, $Cr(CO)_6$, $Mn(CO)_5$, $Mn_2(CO)_{10}$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Co_2(CO)_8$, $Ni(CO)_4$. Limitations of the EAN rule. Synthesis and structure of - Zeise's salt, ferrocene and methyl lithium.

Preparation of metal carbonyls (1) $Ni(CO)_4$ – reactions (action of H_2SO_4, substitution and oxidation). (2) $Fe(CO)_5$ – reactions (hydrolysis, action of NH_3, halogens, and NO). (3) $Cr(CO)_6$ – reactions (with amines).

Bonding in metal carbonyls (M-C-O) – Synergic effects of sigma and pi bonds with diagrammatic representation of overlapping of orbitals for formation M–C bonds in metal. Structure of metal carbonyls – $Fe(CO)_5$, $Ni(CO)_4$, $Cr(CO)_6$, $Mn_2(CO)_{10}$, $Co_2(CO)_8$, $Fe_2(CO)_9$ (structure only)

Catalysis by organometallic compounds – (a) Wilkinson's catalyst in alkene hydrogenation (b) Monsanto acetic acid process (explanation with mechanism).

Concept of Acids and Bases 6 hours

Arrhenius concept, Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and leveling solvents. Lewis acid-base concept, Lux-Flood concept, and the solvent system concept. Hard and soft acids and bases (HSAB concept), applications of the HSAB process (predicting complex stability, Ambidentate Ligand Bonding, catalyst poisoning)

Unit-2 15 hours

UV Spectroscopy 5 hours

Introduction, types of electronic transitions, λ_{max} and ε_{max}, chromophores and auxochromes, bathochromic and hypsochromic shifts (effects of substitution, solvents) and conjugation, on intensity of absorption. Instrumentation (double beam spectrophotometer). Woodward-Fieser rules and their importance, calculation of λ_{max} using Woodward-Fieser rules for the following systems: conjugated dienes (alicyclic, homoannular and heteroannular), α, β- unsaturated aldehydes, ketones, carboxylic acids and esters, extended conjugated systems (aldehydes, ketones and dienes). Problems on Woodward-Fieser rules.

IR Spectroscopy: 5 hours

Number of modes of vibrations in linear and nonlinear molecules (stretching and bending), IR group frequencies, fingerprint region and its significance, IR absorption positions of C, O, N, and S containing functional groups (stretching frequencies range for various bonds C-H, C-C, C=C, C=N, C=O, C≡O, C=N, C≡N, C=S, OH, NH, SH). Effect of H-bonding, conjugation, resonance, and ring size on IR absorptions of carbonyl groups.

Application in functional group analysis - hydrocarbons (i.e., alkanes, alkenes, alkynes, aromatics), alcohols, aldehydes, ketones, carboxylic acids, esters, amines (primary and secondary), amides, and nitro compounds.

Nuclear Magnetic Resonance Spectroscopy: 5 hours

Introduction, basic principles, nuclear magnetic spin quantum number, magnetic properties of nuclei, population of energy levels, Larmor precession, relaxation processes, equivalent and non-equivalent protons with examples, chemical shift, factors affecting the chemical shift values, TMS as internal standard, nuclear shielding and de-shielding effect, spin-spin splitting and coupling. NMR spectra of ethyl alcohol, acetone, acetaldehyde, acetic acid, $CHBr_2$=$CHBr_2$, toluene, phenol, p-xylene, quinol, p-cresol (number of types of protons and number of signals).

Unit-3 15 hours

Nuclear and Radiochemistry 7 hours

Nucleus – Structure and size of the nucleus. Nuclear models: Liquid drop model, Shell model and collective model. Nuclear forces, packing fraction, density of nucleus and instability. Mass defect, binding energy, nuclear stability, N/P ratio, calculation of binding energy,

Radioactivity, emissions from radioactive materials, and radioactive series. Radioactive disintegration, Laws of radioactive disintegration – Group displacement law, Rate of radioactive disintegration, half-life period and its significance (numerical problems), average period, units of radioactivity. Radioactive equilibrium, Radioactive series. Detection and Measurement of Radioactivity – Geiger-Muller and Scintillation Counters. Artificial (or induced) radioactivity. Nuclear reactions induced by √-radiations, *α, n, p*, and *D* particles. Nuclear fission and fusion, Calculation of energy released in nuclear fission reactions.

Nuclear reactors: principles, components, types, and safety. Rock dating and carbon dating, numerical problems.

Applied Electrochemistry: 8 hours

Battery Technology Electrochemical Fundamentals, Redox Systems & Potential: Half-cell reactions. Galvanic Series- Standard reduction potentials and optimal electrode pair selection. Cell Construction-Physical architecture, phase boundaries, and electron/ion transport loops.

Cell Components & Materials: Electrodes-Active materials, binders (PVDF/CMC), and conductive additives (Carbon Black). Electrolytes-Liquid organic solvents, lithium salts (LiPF6), and ionic conductivity requirements. Separators & Collectors-Porous polymer membranes (PE/PP); Copper (anode) and Aluminum (cathode) current collectors. Interfacial Dynamics & Aging**.** SEI Layer-Formation mechanism, chemical passivation, and cell aging and stabilization strategies.

Lithium-Ion battery Chemistry: Cathodes-Structure of LFP (olivine), NMC (layered), and NMCA (nickel-rich) materials.Anodes-Graphite intercalation (LiC6) vs. Silicon-based alloy (SiOx)

Next-Generation Technologies: Solid-State Batteries and Sodium-ion Batteries-Working principles and performance comparisons to Li-ion.

Fuel Cells: Fundamentals of fuel cells, their working principles, components, and applications. Fuel Cells Classification: Types of fuel cells, their construction, working, and relative merits and demerits.

References

1. Inorganic Chemistry: Principles of Structure and Reactivity, James E. Huheey, Ellen Keiter & Richard Keiter: Pearson Publication.
2. Inorganic Chemistry, G.L. Miessler & Donald A. Tarr: Pearson Publication.
3. A New Concise Inorganic Chemistry, J.D. Lee: E.L.B.S.
4. Basic Inorganic Chemistry, F.A. Cotton & G. Wilkinson, John Wiley & Sons.
5. Selected Topics in Inorganic Chemistry, Wahid U.Malik, G.D.Tuli, R.D.Madan, S.Chand publications
6. Concise Coordination Chemistry, R.Gopalan, V.Ramalingam: Vikas Publishing House Pvt.Ltd.
7. Spectroscopic Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morril.
8. Introduction to NMR spectroscopy – R. J. Abraham, J. Fisher and P. Loftus.
9. Application of spectroscopy of organic compounds – J. R. Dyer.
10. Spectroscopy of organic compounds, P. S. Kalsi.
11. Organic Spectroscopy, William Kamp.
12. Organic Chemistry, R. T. Morrison and R. N. Boyd.
13. Practical NMR spectroscopy, M. L. Martin, J. J. Delpench and G. J. Martin.
14. Spectroscopic methods in organic Chemistry, D. H. William, I. Flemming.
15. Fundamentals of Molecular spectroscopy, C.N. Banwell.
16. Essentials of nuclear chemistry, 4th edn; H. J. Arniker, NAIL publishers (1995).
17. Nuclear and Radioactive Chemistry; Friedlander, Kennedy and Miller.
18. Electrochemistry by Carl H. Hamann second edition, Wiley publications.
19. Advanced Electrochemistry by Sahanda Chatterji, 2020, Discovery Publishing House Pvt Ltd.
20. Fuel Cells: Principles, Design, and Analysis by Shripad T. Revankar, Pradip Majumdar, CRC press.
21. Electrochemical Power Sources: Primary and Secondary Batteries, M. Arakamudhan, A. K. Shukla, and T. Prem Kumar, Peter Peregrinus Ltd1980
22. Modern Electrochemistry, Volume 2B: Electrodics in Chemistry, Engineering, Biology and Environmental Science, Amulya K. N. Reddy and John O'M. BockrisSpringer Science & Business Media2001
23. Lithium-Ion Batteries: Science and Technologies, Yoshio Nishi, Masaki Yoshio, and Ralph J. Brodd Springer-Verlag, New York, 2009
24. Fuel Cells: Principles and Application. B Vishwanathan and M Aulice, Scibioh, Universities Press, 2006

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VI Semester

Paper – VIII 45 Hours

Paper Code: CHEDSC602

Theory: 3 hours/week Credits: 03

Course Objectives:

1. To introduce the fundamental physiological roles of essential metal ions, the mechanisms of biological pumps, and the chemical principles of heavy metal toxicity.
2. To familiarize students with the Twelve Principles of Green Chemistry, the evaluation of atom economy, and the design of cleaner synthetic pathways for industrial processes.
3. To provide a comprehensive understanding of bioenergetics, mitochondrial electron transport mechanisms, and the primary metabolic pathways responsible for ATP generation.
4. To survey the classification of pharmaceutical agents based on their modes of action and outline the synthetic pathways and therapeutic applications of essential drugs.
5. To cover the structural architecture, classification, and polymerization reactions of macromolecules, alongside experimental techniques for determining polymer molar masses.
6. To delineate the synthesis, characterization, unique nano-scale properties, and emerging biomedical applications of nano-materials.

Course Outcomes:

Upon completion of the course students will be able to:

1. Describe the physiological roles, mechanism of the Na/K pump, and biological functions of essential metal ions.
2. Assess the toxicity of heavy M-ions and the chemical principles of mercury and cadmium poisoning.
3. Apply the Twelve Principles of Green Chemistry to design cleaner processes and calculate the Atom Economy of organic reactions.
4. Compare traditional industrial pathways with green synthetic routes for ibuprofen, paracetamol, adipic acid, and biodiesel.
5. Explain the thermodynamic concepts of bioenergetics, exergonic/endergonic reactions, energy coupling and the role of ATP.
6. Illustrate the mitochondrial electron transport chain components, phosphorylation mechanisms, and the chemiosmotic theory.
7. Outline the steps, enzymes, and net ATP yields for glycolysis, the Krebs cycle, beta-oxidation, and amino acid metabolism.
8. Classify drugs and outline the synthesis and uses of phenytoin, sulphacetamide, diclofenac, and ranitidine.
9. Classify polymers based on structural architecture (linear/branched/crosslinked), composition (homo/copolymers), and tacticity (iso/syndio/atactic).
10. Calculate number-average and mass-average polymer molar masses and describe their experimental determination via viscosity and osmotic pressure.
11. Describe addition, condensation, and Ziegler-Natta polymerization reactions.
12. Evaluate nanomaterial synthesis (top-down/bottom-up), properties, analytical techniques (electron microscopy/XRD) and core engineering applications.

Syllabus

Unit-1 15 hours

Bioinorganic Chemistry 8 hours

Introduction to bio-inorganic chemistry. Role of metal ions in biological systems (Na^+, K^+, Mg^{2+}, Ca^{2+}, $Fe^{3+/2+}$, $Cu^{2+/+}$, and Zn^{2+} ions). Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca2+ in blood clotting and structural role in bones. Brief introduction to oxygen transport and storage (haemoglobin-myoglobin system). Toxicity of metal ions ($Hg^{2+}$and Cd^{2+}). Metalloenzymes - carbonic anhydrase, superoxide dismutase. (only the key steps involving these enzymes)

Green Chemistry 7 hours

Need for Green Chemistry, Twelve principles and goals of green chemistry, Designing greener processes: prevention/ minimization of hazardous/ toxic chemicals and products; Atom Economy, calculation of atom economy of the rearrangement, cyclization, addition, substitution, and elimination reactions.

Green solvents– water, supercritical carbon dioxide, , ionic liquids, polyethylene glycol, immobilized solvents and solvent less processes. Green synthesis of: Ibuprofen (The BHC Process versus the Boots process), paracetamol, adipic acid (using H_2O_2, biodiesel via trans-esterification

Unit-2 15 hours

Biological Oxidation 10 hours

Bioenergetics – Energy transformation in living systems, free energy concept, exergonic and endergonic reactions, ATP as high energy compound (structure and properties) energy coupling (phosphorylation of glucose as an example), oxidative phosphorylation – mitochondrial electron transport chain – components, schematic representation indicating sites of ATP synthesis, definition, chemiosmotic theory (an outline), substrate level phosphorylation – definition and examples.

Metabolism – Definition of catabolism and anabolism

Carbohydrate metabolism: Glycolysis- (individual reactions and enzymes to be given), ATP yield during glycolysis.

Fates of pyruvate: Anaerobic (lactic acid and alcoholic fermentation) and aerobic oxidation of acetyl-SCoA through Kreb’s cycle – reaction, enzymes, co-enzymes and ATP yield to be given.

Fatty acid metabolism: Activation of fatty acids, mechanism of β-oxidation of fatty acids, Example: Oxidation of palmitic acid and calculation of its ATP yield.

Amino acid metabolism: Transamination, deamination and decarboxylation with examples.

Medicinal Chemistry 5 hours

Definition of drugs, chemotherapy - definition, classification of drugs based on mode of action with examples - antipyretics, analgesics, antibacterial, antimalarial, antibiotics, tranquilizers and hypnotics, synthesis and uses of phenytoin, sulphacetamide, diclofenac, ranitidine and sulfamethoxazole.

Unit-3 15 hours

Chemistry of Macromolecules 10 hours

Introduction to polymers with common exaamples and uses, polydispersity and degree of polymerization. Classification of polymers: homoplymers and copolymers, linear, branched and cross linked polymers, isotactic polymers, syndiotactic polymers, and atactic polymers

Molar masses of polymers: molecular weight distribution, number average molar masses and Mass average molar masses (formula and simple numerical problems). Determination of molar masses of macromolecules: Viscosity method and Osmotic pressure method.

Polymerization reactions with examples: Addition, condensation and Ziegler-Natta polymerizaiton. Techniques of polymerization- Bulk, solution and emulsion.

Chemistry of Nanomaterials 5 hours

Introduction, Classification of nanomaterials (3D, 2D, 1D and 0D).

Properties of Nanomaterials: Unique physical and chemical properties due to nanoscale quantum confinement. Effects of size and shape on material behavior - mechanical, thermal, electronic and optical properties.

Synthesis: Top-down and bottom-up approaches. Preparation Methods: sol-gel processing, chemical vapor deposition, and mechanical milling and green methods**.**

Applications of nanomaterials: Use in drug delivery systems, sensors, and energy storage.

References:

1. Inorganic Chemistry: Principles of Structure and Reactivity – James E. Huheey, Ellen A. Keiter, & Richard L. Keiter, Pearson India, 2006
2. Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life – Wolfgang Kaim, Brigitte Schwederski, & Axel Klein, Wiley, 2013
3. Principles of Bioinorganic Chemistry – Stephen J. Lippard & Jeremy M. Berg, University Science Books, 1994
4. Bioinorganic Chemistry – Asim K. Das, Books and Allied (P) Ltd. 2013
5. New Trends in Green Chemistry, Ahluwalia, V.K. & Kidwai, M.R. Anamalaya Publishers (2005).
6. Green Chemistry - Theory and Practical, Anastas, P.T. & Warner, J.K.Oxford University Press (1998).
7. Introduction to Green Chemistry, Matlack, A.S. Marcel Dekker (2001).
8. Real-World Cases in Green Chemistry, Cann, M.C. &Connely, M.E. American Chemical Society, Washington (2000)
9. Lehninger’s Principles of Biochemistry, D.L. Nelson, M.M. Cox, W.H. Freeman and Co., 7th Edn. (2017).
10. Biochemistry,Berg, J.M., Tymoczko, J.L. & Stryer, L. W.H. Freeman, 2002
11. Textbook of Organic Medicinal and Pharmaceutical Chemistry, Wilson and Gisvold's Ed. John M. Beale Jr. and John H. Block, Wolters Kluwer / Lippincott Williams & Wilkins, 2010
12. Textbook of Medicinal Chemistry (Vol. I & II) – V. Alagarsamy, Elsevier India, 2022-23

13. Medicinal Chemistry – Ashutosh Kar, New Age International (P) Ltd 2023
14. Essentials of Medicinal Chemistry – Rama Rao Nadendla, PharmaMed Press, 2018
15. Introduction to Polymer Chemistry – Charles E. Carraher Jr.CRC Press, 2017
16. Polymer Chemistry – Paul C. Hiemenz & Timothy P. Lodge, CRC Press, 2020
17. Polymer Science – V. R. Gowariker, N. V. Viswanathan, & Jayadev Sreedhar, New Age International (P) Limited, 2019
18. A Textbook of Polymer Chemistry – M. S. Bhatnagar, S. Chand & Company Ltd, 2012
19. Introduction to Nanotechnology – Charles P. Poole Jr. & Frank J. Owens, John Wiley & Sons, 2003
20. Textbook of Nanoscience and Nanotechnology – B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, & James Murday, Springer India / Universities Press, 2013.

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VI Semester

Practical Paper – VI

4 hours/week

Paper Code: CHEDSC601P

Credits: 02

Course Objectives

The objectives of this course are to:

1. Train students in the systematic, step-by-step qualitative analysis of unknown organic compounds.
2. Familiarize students with the core principles of functional group detection, physical constant determination, and derivative preparation.
3. Develop hands-on laboratory skills for organic synthesis (preparations) via acetylation and benzoylation reactions.
4. Introduce the biochemical application of quantitative analytical techniques through volumetric estimation of amino acids.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Systematically identify unknown organic compounds using elemental, solubility, and functional group tests.
2. Confirm compound identities by determining physical constants and preparing crystalline derivatives.
3. Synthesize and purify organic molecules (like Aspirin and Hippuric acid) via acetylation and benzoylation.
4. Quantify amino acids (Glycine) using formal volumetric titration methods.

List of Experiments

Part A

1. **Systematic scheme for the identification of the organic compound is outlined below.**
   a. Preliminary Test
   b. Solubility Test
   c. Detection of nitrogen, sulphur and halogens.
   d. Detection of functional group.
   e. Determination of physical constant and Identification of the compound.
   f. Confirmatory Test.
   g. Derivatives preparation.

(Carbohydrates, carboxylic acids, phenolic acids, amines, amides, nitrobenzenes, aryl halides, urea, anilides, aldehydes and ketones,)

Part -B

1. Preparation of aspirin by salicylic acid and acetyl chloride.
2. Preparation of hippuric acid by using glycine and benzoyl chloride.
3. Estimation of glycine by Sorenson's formal titrimetric method.
4. Conductometric titration of barium chloride and sodium sulphate.
5. Conductometric titration of a mixture of strong acid, salt and sodium hydroxide.
6. Conductometric titration of a mixture of HCl and CH_3COOH versus NaOH.
7. Determination of the partial molal volume of NaCl-H_2O / KCl-H_2O system in aqueous solution.

References:

1. A Text book of Practical Organic Chemistry – A.I. Vogel Vol. I
2. Practical Organic Chemistry – Mann & Saunders.
3. Manual of Organic Chemistry – Dey and Seetharaman.
4. An Introduction to Practical Organic Chemistry – Robert, Vingrove etc.
5. Semimicro Qualitative Organic Analysis by Cheronis, Entrikin and Holdnet.

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V Semester

Skill Enhancement Course-II (Theory)

SEC Paper – II **15 Hours**

Paper Code: CHESEC601

Theory: 1 hour/week **Credits: 01**

Chemistry of Foods

Course Objectives:

1. To make students to understand the of importance food chemistry, classification nutritional value, calorific value and properties of food.
2. To impart the information about the food preservation techniques and processing.
3. To know about the permitted food additives, their role and permitted levels.

Course Outcomes:

After the successful completion of this course, the students will be able to;

1. Have knowledge of food and its classification and nutritional values.
2. Knowledge of food preservation and processing techniques.
3. Know about the food additives and their role and levels

Syllabus

Chemistry of Foods 16 h

Introduction to food, classification, chemical composition and nutritional value of common food stuffs, properties of foods and calorific value of food.

Food preservation and processing: Food deterioration, methods of preservation and processing by heat, cold, chill storage, deep freezing, drying, concentration, fermentation and radiation. Food quality: Sensory evaluation, objective methods, non-nutritional constituents and food safety.

Permitted food additives and their role: Antioxidants, colouring agents, flavours, emulsifiérs, curating agents, non-nutritive sweeteners, flour improvers, leavening agents, stabilizers, thickeners and preservatives.

Proteins and amino acids: Amino acids - classification, structure, physical & chemical properties. Structure of di and tri-peptides, properties of peptides. Food proteins- classification, protein structure, properties of proteins, denaturation, protein gels, proteolytic enzymes.

Reference:

1. Food Chemistry by L.W. Aurand and A.E. woods the AVI Publising Inc.
2. Food Chemistry by L.H. Meyer, Affliated East- West press Ltd, New Delhi.
3. Foods - Facts and Principles by N. Shakuntala Manay, M. Shdakshara Swamy.
4. Principles of Food Chemistry by John M. deMan.

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V Semester

Skill Enhancement Course-II (Practicals)

SEC Paper – I **2 hour/week**

Credits: 01

Chemistry of Foods

Course objectives:

1. To make students to understand the knowledge of importance food chemistry and analysis, various significant parameters of food quality.
2. To impart the information about the foods physical and chemical properties studies.

Course Outcomes:

After the successful completion of this course, the students will be able to

1. Understand the knowledge of analysis aspects, such as moisture content, viscosity, oxidative rancidity.
2. Experimental skills for the analysis of important parameters; like sample collection, preservation and assessing the quality of the food.

List of Experiments

1. Determination of Water Activity of different foods
2. Quantitative Determination of Protein in Foods by the Biuret Method
3. Determination of total dissolved solids
4. Determination of Water soluble vitamin c:
5. Methods of determination of fat soluble vitamin A
6. Estimation of iron in apple juice by phenanthroline method.
7. Determination of iodine value of oil.

References

1. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).
2. Findlays Practical Physical Chemisty revised by P. B. Levitt, Longman's London (1966).
3. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966)
4. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
5. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
6. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
7. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
8. Mechanisms of Molecular Migration, Vols I & II, B.S. Thyagarajan, Pergamon Press, Oxford, 1979.
9. Comprehensive Organic Chemistry, D. Barton and W. D. Wallis, Pergamon Press, Oxford, 1983.
10. Organic Chemistry Vol. II, I. L. Finar 6 th Edn. Longman, 1992.
11. Organic Reaction Mechanisms, 3 rd Edn., V. K. Ahluwalia and R. K. Prashar, Narosa, New Delhi, 2005.
12. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
13. Principles of Food Chemistry by John M. deMan.
14. Principles of Food Science, Part I, Food Chemistry edited by Owen R. Fennama , Mareal Dekker, Inc., New York.

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Examination Pattern

Core Papers (V and VI Semesters)

Theory: 3 Credits : 100 Marks

[Summative Assessment (SA) : 80 Marks + Internal Assessment (IA) : 20 Marks]

Duration of End Semester Examination : 3 hours

Practicals: 2 Credits : 50 Marks

[Summative Assessment (SA) : 40 Marks + Internal Assessment (IA) : 10 Marks]

Duration of End Semester Examination : 3 hours

Assessment	Maximum Marks		Total
	THEORY	PRACTICALS	
Internal Assessment (IA)	**20** Average of two Tests (10) + Average of two Assignments (10)	**10** One Test (5) One Assignment (5)	**30**
Summative Assessment (SA)	80	40	**120**
Total Marks	**100**	**50**	**150**

Skill Enhancement Papers (V and VI Semesters)

Theory : 1 Credit **Practical : 1 Credit**

[Summative Assessment (SA) : 40 Marks + Internal Assessment (IA) : 10 Marks]

Duration of End Semester Examination : 1.5 hours

Assessment	Maximum Marks	TOTAL
	THEORY	
Internal Assessment (IA)	**10** One Test (5) + One Assignment (5)	**50**
Summative Assessment (SA)	40*	

*** Single paper theory examination (which includes questions from both theory and practical components) shall be conducted.**

Blue Print of Question Papers for Examination and Evaluation

Core Papers (V and VI Semesters)

Theory

Duration: 3 Hours	**The question paper shall consist of two parts: Part A and Part B**	**Max Marks: 80**
Part A	Answer any 10 out of 12 questions [Q 1 to Q 12] **(three questions from each unit)**	10 × 2 = 20
Part B	Answer any 6 out of 8 questions [Q 13 to Q 20] **(two questions from each unit)**	6 × 10 = 60
(i) Equal weightage of marks shall be given to all the units in Part A and Part B. (ii) In part B, each main question shall have only three sub-divisions (a), (b) and (c) with (4+4+2) or (4+3+3) marks respectively.		

Practical

Duration: 3 Hours	**Max. Marks: 40**
Performance	**30 marks** Two experiments: One from part-A and one from part-B
Viva	**5 marks**
Record	**5 marks** (minimum 8 experiments to be recorded)

Skill Enhancement Papers (V and VI Semesters)

Duration 1.5 Hours	**The question paper shall consist of two parts: Part A and Part B**	**Max. Marks: 40**
Part A Theory	Answer any 4 out of 5 questions [Q 1 to Q 5]	4 × 2 = 8
	Answer any 3 out of 5 questions [Q 6 to Q 10]	3 × 4 = 12
Part B Practical	Answer any 4 out of 6 questions [Q 11 to Q 16]	4 × 5 = 20
(i) Equal weightage of marks shall be given to all the units in **Part A** and **Part B**. (ii) In **part B**, each main question shall have only two subdivisions (a) and (b) with (3+2) marks respectively.		

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