



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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SCHOOL OF SCIENCE AND HUMANITIES

DEPARTMENT OF CHEMISTRY

1.1.3 Courses having Focus on Employability/ Entrepreneurship/

Skill Development

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SCYA 5101	ORGANIC SYNTHESIS AND RETROSYNTHETIC METHODS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the strategies involved in designing a chemical reaction.
- To recognize the importance of oxidizing and reducing agents in functional group conversion reactions.
- To comprehend the name reactions of alkyl halide and functional groups with their mechanism.
- To learn the significant organic name reactions applied in industries with their mechanism.
- To highlight on importance of molecular rearrangement in organic chemistry.

UNIT 1 ORGANIC SYNTHESIS

12 Hrs.

Synthetic analysis and planning: Retrosynthetic analysis – Synthetic equivalent – Synthons, Rethon – control of stereochemistry – Linear, convergent and divergent syntheses – Use of protecting groups in hydroxyl and carbonyl compounds: different protection and deprotection methods.

UNIT 2 REAGENTS IN ORGANIC CHEMISTRY

12 Hrs.

Oxidation reagents: Potassium permanganate, HIO_4 , OsO_4 , MnO_2 – Alcohol to carbonyls: Cr (VI) oxidants, PCC, 1,3-dithiane – Swern oxidation, Silver carbonate, Prevost and Woodward oxidation, Oxidation of allylic – C-H bonds: DDQ, SeO_2 . Reducing reagents: LAH, NaBH_4 , DIBAL, Electrophilic metal hydrides: BH_3 , AlH_3 . Functional group transformations: Use of organo-lithium compounds – Lithium diisopropyl amide (LDA), RMgX and Tri-N-butyltinhydride, Phase transfer catalysts – Crown ethers and Merrifield resin, Baker yeast.

UNIT 3 NAMED REACTIONS

12 Hrs .

Appel reaction – Corey-Chaykovsky reaction; Stork; Arbuzov reaction - Horner-Wadsworth Emmons reaction - Mannich reaction- Robinson annulation - Stork enamine reaction - Michael addition - Nef reaction - Barton reaction - Henry reaction - Stetter reaction - Sharpless asymmetric epoxidation Grubb's metathesis reaction –Vilsmeier- Haack reaction- Bischler-Napieralski reaction.

UNIT 4 METAL CATALYSED NAMED REACTIONS

12 Hrs .

Mukaiyama reaction - Suzuki Coupling – Stille coupling –Negishi coupling- Hiyama Coupling - Kumada coupling - Fukuyama coupling - Heck reaction- Trost-Tsuji coupling - Sonogashira reaction- Wacker reaction - Buckwald Hetwig reaction – Pauson - Khand reaction - Kulivikovich reaction - Miyaura borylation reaction.

UNIT 5 MOLECULAR REARRANGEMENT

12 Hrs .

General mechanistic considerations: Types of rearrangement by nature of migration – Intra and Inter molecular rearrangement – Cross over experiment. C-C Migration: Pinacol-Pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorski rearrangements. C-N migration: Neber, Arndt-Eistert synthesis, Beckmann, Hofman, Curtius, Schmidt rearrangements. C-O migration: Bayer-Villiger, Shapiro reaction. Miscellaneous: Fries, Cope, Sommelet Hauser, Stevens, Von-Richter rearrangement.

Max. 60 Hours

COURSE OUTCOMES

On completion of the course the student will be able to

- CO1: Construct a single step retrosynthetic pathway for organic reaction
 CO2: Interpret the products in organic chemical reactions involving oxidizing and reducing reagents.
 CO3: Construct and predict the reaction mechanism for name reactions outlined.
 CO4: Formulate chemical reactions and mechanism for name reactions outlined.
 CO5: Design chemical reaction based on molecular rearrangements outlined
 CO6: Design and predict the products in organic reactions.

TEXT / REFERENCE BOOKS

1. March J., and Smith M., Advanced Organic Chemistry, 5th Edition, John-Wiley and Son, 2001.
2. Gould E. S., Mechanism and Structure in Organic Chemistry Holt, Rinehart and Winston Inc., 1959.
3. Carey A. Francis, and Sundberg J Richard., Part A and Part B Advanced Organic chemistry, 5th edition, Springer, 2007.
4. Jonathan Clayden, Nick Greeves and Stuart Warren., Organic Chemistry, 2nd Edition, Oxford Publishers, 2012.
5. Finar I. L., Organic Chemistry, 6th Edition, Pearson Education Asia, 2004.
6. House H.O., Modern Synthetic Reactions, W.A. Benjamin Inc, 1972.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions each carrying 5 marks without choice

30 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

70 marks

(Out of 100 marks, maximum of 10% problems may be asked)

 Employability

SCYA 5104	ANALYTICAL CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To learn the basic analytical principles of AAS
- To gain knowledge about working principle of separation techniques
- To understand the basic concepts of TGA/DSC
- To know the basic principles involved in electroanalytical techniques
- To study the concepts of various spectrometric analytical techniques

UNIT 1 ATOMIC ABSORPTION SPECTROSCOPY

12 Hrs.

Atomic absorption spectroscopy: Principle, instrumentation, the nebuliser - burner system, graphite tube furnace, resonance line source, monochromators, detectors, and spectral and chemical interferences - determination of calcium and magnesium in water and determination of tin in canned fruit juices. Flame Spectrometry: Principle, instrumentation and interferences determination of alkali metals.

UNIT 2 SEPARATION TECHNIQUES

12 Hrs.

Chromatographic separation: Gas chromatography: Principle – instrumentation – Detectors: Flame ionisation detector – Photo ionisation detector and ECD – Application of GC using mass spectrometry – Liquid Chromatography: Types – Application of LC using mass spectrometry - HPLC: Principle – Instrumentation – Advantages of HPLC. Electrophoresis: Principle – Instrumentation – Capillary electrophoresis and detector, Gel electrophoresis.

UNIT 3 THERMAL METHODS OF ANALYSIS

12Hrs.

Introduction to thermal analysis: TG and DTG – Static thermogravimetry and dynamic thermogravimetry: Instrumentation – Thermogram – Factors affecting thermograms – Application of thermogravimetry – Reaction kinetics: Kinetics by single and multiple heating rates. Differential thermal analysis: DTA theories – DTA curves – Factors affecting DTA curves – Instrumentation – Applications of DTA – Simultaneous determination in thermal analysis. Correlation of DTA and TGA data with examples – Thermal decomposition of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ – DSC: Introduction – Principle – Instrumentation and Application of DSC.

UNIT 4 ELECTROANALYTICAL METHODS

12Hrs.

Electrogravimetry: Principle, instrumentation, deposition and separation. Electrolysis at constant current and estimation of copper. Coulometry: Principle, controlled potential coulometry and separation of nickel and cobalt, coulometric titration, instrumentation - Estimation of Sb(III). Potentiometry: Principle, potentiometric titration, equivalence point potential for (i) Fe^{2+} - Ce^{4+} system (ii) Fe^{2+} - MnO_4^- / H^+ system, determination of concentration of the species at the equivalence point. Ion selective electrodes, solid state ion selective detectors, Biochemical electrodes.

UNIT 5 SPECTROMETRY

12 Hrs.

Spectrophotometry: Beer Lambert's law - significance of molar extinction coefficient, photoelectric photometer, spectrophotometric titration, determination of Fe (III) with EDTA and determination of Fe (III) in the presence of aluminium.

Turbidimetry: Principle, instrumentation - determination of sulphate and phosphate

Fluorimetry: Principle, relationship between excitation spectra and fluorescence spectra, factors affecting fluorescence emission, instrumentation - determination of quinine in tonic water and determination of codeine and morphine in a mixture.

Max. 60 Hours

COURSE OUTCOME:

- CO1: Explain the principle, instrumentation and working of AAS and Flame photometry.
 CO2: Understand the basic concepts of Chromatographic techniques.
 CO3: Analysis and interpretation of TGA/DSC curves
 CO4: Understand the basic principles and interpretations of electroanalytical techniques.
 CO5: Apply the principles of Beer's law for the determination of ions.
 CO6: Understand the basic concepts of analytical techniques.

TEXT / REFERENCE BOOKS

1. J. M. Hollas, Modern Spectroscopy, John Wiley & sons, 4th Edition, 2004.
2. H. H. Willard, L. L. Merritt, J. A. Dean and A. F. Settle, Instrumental methods of analysis, 6th Edition, Van Nostrand, 1984.
3. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, Wadsworth Publishing Co. Inc., 9th Edition, 2012.
4. R. D. Braun, Introduction to Instrumental Analysis, McGraw-Hill, 1987.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Exam Duration : 3 Hrs.

30 Marks

70 marks

Employability

SCYA 5105	FUNDAMENTALS OF QUANTUM CHEMISTRY AND GROUP THEORY	L	T	P	Credits	Total Marks
		3	0	0		

COURSE OBJECTIVES:

- To have a good foundation in understanding the physical and mathematical aspects of quantum mechanics
- To understand the basic concepts of postulates of quantum mechanics
- To study the fundamental principles of quantum chemistry, Schrodinger wave equation and its applications
- To learn the approximation methods to Helium and Hydrogen molecule ion
- To study the elements of group theory and the applications of group theory

UNIT 1 BASICS OF QUANTUM MECHANICS

12 Hrs.

Black-body radiation – Planck's law of radiation – Photoelectric effect – Compton effect – wave particle duality – de-Broglie's hypothesis – Heisenberg's uncertainty principle – Bohr's theory and its limitations – Classical waves and wave equation for electrons. Operators – Linear operators, Commutator algebra – Evaluation of commutators, Hermitian operators and its properties – Eigen value and Eigen function – Momentum – Hamiltonian operator – Postulates of quantum mechanics.

UNIT 2 APPLICATION OF QUANTUM MECHANICS

12 Hrs.

Derivation of Schrodinger wave equation – Orthogonality and normalization of wave functions – Characteristics of wave function. Application of SWE to free particle, particle in one dimensional box and three dimensional box – Simple harmonic oscillator – Rigid rotor – ladder operator – Angular momentum operator. Schrodinger equation for hydrogen – Significance of quantum numbers – shapes of atomic orbitals – spin angular momentum.

UNIT 3 APPROXIMATION METHODS

12 Hrs.

Need for approximation methods – Approximation methods - perturbation and variation methods and their application to Helium atom – Born - Oppenheimer approximation – Hydrogen molecule ion – Huckel- π -electron theory and its applications to ethylene and butadiene.

UNIT 4 GROUP THEORY

12 Hrs.

Group and Subgroup – Symmetry elements and operations – Determination of point groups of representative molecules/complexes - Symmetry point groups – Vector and matrix algebra – Matrix representation of Symmetry operations – Reducible and irreducible representations – Great orthogonality theorem – Characters – Construction of a character tables– C_{2v} , C_{3v} , C_{2h} , D_{2h} .

UNIT 5 APPLICATION OF GROUP THEORY

12 Hrs.

Determination of representation of vibrational modes in non- linear molecules such as H_2O , CH_4 and NH_3 – symmetry of Hybrid orbitals in non- linear molecule (BF_3 , CH_4 , NH_3) – Symmetry selection rules of infra-red and Raman spectra – application of group theory for the electronic spectra of ethylene and formaldehyde.

Max. 60 Hours

COURSE OUTCOME:

On successful completion of the course, student will be able to

- CO1:** Understand the various laws of radiation and principle that explain the basics of quantum mechanics
CO2: Apply the quantum mechanical treatment to derive the various quantum mechanical operators
CO3: Derive the wave function and energy of particle in 1D and three-dimensional box, Simple harmonic oscillator, Rigid rotor and hydrogen atom
CO4: Explain the Born - Oppenheimer approximation and apply the Perturbation and variation methods to Helium atom
CO5: Construct the character table of C_{2v} , C_{3v} , C_{2h} point groups and explain the Great Orthogonality theorem
CO6: Determine the representation of vibrational modes and symmetry of hybrid orbitals in non- linear molecules

TEXT / REFERENCE BOOKS

1. A. K. Chandra, Introductory Quantum Chemistry, Tata Mc Graw Hill Publishing Co., 4th Edition 1994.
2. R. K. Prasad, Quantum Chemistry, New Age International Publishers, Revised 3rd Edition, 2006.
3. H. L. Strauss, Quantum Mechanics, Prentice Hall, 1972.
4. P. W. Atkins and R. S. Friedman, Molecular Quantum Mechanics, Oxford University Press, 5th Edition, 2010.
5. H. Eyring, J. Walter and G. E. Kimball, Quantum Chemistry, John Wiley & Sons, 1944
6. F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 3rd Edition, 1999.
7. K. V. Raman, Group Theory and its Applications to Chemistry, Tata McGraw-Hill, 3rd Edition, 1990.
8. V. Ramakrishnan and Gopinath, Group Theory in Chemistry, Vishal Publications, 2nd Edition 2013.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Exam Duration : 3 Hrs.

30 Marks

70 marks

 Employability

SCYA5204	Computational Chemistry	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basic concept of computational chemistry built for a simple system.
- To comprehend the concept of Variation theory for Density-Functional theory (DFT)
- To realize the basic construction method of “Density-Functional theory” using quantum mechanics.
- To build up the subject related concepts to approach contemporary methods.
- To get familiar with the recent approaches of molecular dynamic methods.

Unit-1: Introduction to Computational Chemistry

12 Hrs

The promise of computational chemistry, potential energy surfaces, computational strategies-coordinate systems, geometry optimization, local and global minima, conformational analysis, transition state optimization, saddle point, vibrational frequencies. *Case study: Predict the local and global minima of benzene molecule using structural and energy values.*

Unit-2: Computational Chemistry methods

12 Hrs

Molecular Mechanics-Force field methods, Semi-empirical methods, Variational method, Roothaan-Hall equations, self-consistent field approach, electron spin and Pauli principle and Slater determinants.

Unit-3: The Quantum Theory

12 Hrs

The Perturbation theory. *Ab initio* methods- Basis sets, Slater and Gaussian functions, polarization and diffuse functions, split-valence sets, correlation-consistent sets, Born-Oppenheimer approximation.

Unit-4: The Hartree–Fock method and beyond

12 Hrs

Hartree-Fock theory, electron correlation problem, Koopmans theorem. **Density Functional Theory (DFT) and methods.**

Unit-5: Molecular Dynamics Simulations

12 Hrs

Basic principles-Equations of motion, **force calculations, integration schemes, boundary conditions, phase space and distribution functions**, time step and time scale considerations, stability, Practical aspects of simulations, *ab initio* molecular dynamics.

COURSE OUTCOMES

Upon completion of the course the students will be able to

CO1: Examine the significance of computational chemistry to chemical systems.

CO2: Interpret the currently available high-performance computational chemistry methods.

CO3: Analyse the solutions for Chemical problems by using computational thinking.

CO4: Evaluate the structural parameters of chemical systems by computational techniques.

CO5: Compare the various theory available in computational chemistry software.

CO6: Implement the programming skills in computational chemistry field.

TEXT / REFERENCE BOOKS

1. Quantum chemistry, Ira N. Levine, Brooklyn, New York.
2. F. Jensen, Introduction to Computational Chemistry, John Wiley & Sons, 2003
3. C. J. Cramer “Essentials of Computational Chemistry”, 2nd ed., Wiley 2004.
4. Foresman, J. B.; Frisch, A.E. Exploring Chemistry with Electronic Structure Methods, 3rd ed.
5. Gaussian, Inc.: Wallingford, CT, 2015. (See also: <http://expchem3.com/>) User manuals of Gaussian09.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration: 3 Hrs.

PART A : 6 Questions each carrying 5 marks without choice

30 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

70 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Employability

SCYA 6203	Computational Chemistry Lab	L	T	P	Credits	Total Marks
		0	0	3	2	100

COURSE OBJECTIVES

- To understand the basic concept about how to built for a simple system in computational chemistry visualization software.
- To understand the concept of energy optimization in Density-Functional theory (DFT)
- To understand and analyse the orbitals of a molecule.
- To understand and analyse the spectroscopic properties for a given molecule.
- To get familiar with the recent approach of other computational theory.

The list of probable experiments is mentioned below, which delineates the experiment to be performed in a semester. Any seven experiments can be selected from the list.

List of Experiments

Exp-1: Construction of the molecular structure of small molecule like H₂, CH₄, CO₂ by Gauss View software.

Exp-2: Design the method for calculating the lowest energy structure of small molecule like H₂, CH₄, CO₂ by Gaussian software.

Exp-3: Execute the orbital analysis of a given structure by Gaussian software.

Exp -4: Interpret the vibrational frequency spectrum of small molecule like H₂, CH₄, CO₂ by Gaussian software calculation.

Exp -5: Implement the geometry optimization process of a given small molecule like H₂, CH₄, CO₂ by other computational theory by Gaussian software.

Exp -6: Construct the structure of organic molecule by Gaussian software and evaluate its properties by geometry optimization process.

Exp -7: Construct the structure of transition metal complex by Gaussian software and evaluate its properties by geometry optimization process.

Exp -8: Investigate the absorption spectra for fullerenes by Gaussian software.

Exp -9: Construct the structure of polymer material by Gaussian software and evaluate its properties by geometry optimization process.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1: Construct the molecular structure of chemical compounds.

CO2: Develop the skill for geometry optimization process.

CO3: Identify the molecular orbital diagram of molecules computationally.

CO4: Interpret the vibrational spectra of chemical systems computationally.

CO5: Investigate the absorption spectra for solar cell materials.

CO6: Implement the knowledge of Gaussian software for real world problems.

TEXT/REFERENCE BOOKS

1. Warren J Hehre, Laboratory book of computational organic chemistry, wave function, 1998.

2. Tim Clark, A Handbook of Computational Chemistry: A Practical Guide to Chemical Structure and Energy Calculations, Wiley Black Well, 1985.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 50

Exam Duration: 3 Hrs

CAE Evaluation of Regular Lab class 25 Marks

50 Marks

Model practical exam 25 Marks

ESE University Practical exam

50 Marks

Employability

SCYA 5301	ORGANIC REACTION MECHANISM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To learn the various types of bonding and conjugation in organic compounds
- To apply the concept of Huckel rule to determine the aromaticity of compounds
- To know the concept of stability and reactivity of reactive intermediates
- To understand the mechanism of nucleophilic and electrophilic substitution reactions
- To appreciate the concept of substitution, addition and elimination reactions and their reaction mechanism

UNIT 1 NATURE OF BONDING IN ORGANIC MOLECULES

12 Hrs.

Nature of Bonding in Organic Molecules, Delocalized chemical bonding – Conjugation, cross-conjugation, hyperconjugation and hydrogen bonding. Aromaticity. Benzenoid and nonbenzenoid compounds. Huckel and Craig rules. Application of Huckel's rule for annulenes, heteroannulenes, fullerenes, cyclopropenium cation, cyclopentadienyl anion, cycloheptadienyl cation, Homo-and antiaromaticity, Ψ -aromaticity Energy levels of π molecular orbitals, FMO approach.

UNIT 2 REACTION MECHANISM – REACTIVE INTERMEDIATES

12 Hrs.

Field effects (inductive, electromeric effects), mesomerism, resonance, steric effects. Types of reactions and mechanism. Generation, structure, stability and reactivity of carbocations, carbanions and free radicals. Structure of carbenes, nitrenes and benzynes.

UNIT 3 ELECTROPHILIC AND NUCLEOPHILIC ALIPHATIC SUBSTITUTION REACTIONS

12 Hrs.

Aliphatic Nucleophilic substitution: Types of nucleophiles – attacking nucleophile, ambident nucleophiles, hard and soft Nucleophiles. SN^1 , SN^2 and SN^i mechanisms. Neighbouring group participation, anchimeric assistance. Nucleophilic substitution at allylic, aliphatic trigonal and vinylic carbon. Nucleophilicity and solvent effects, Competition between nucleophilicity and basicity, leaving group effects, steric substituent effects on substitution.

Aliphatic Electrophilic substitution: Mechanisms - SE^2 and SE^i , SE^1 , Substitution by double bond shifts. Effect of substrates, leaving group and solvent polarity on the reactivity.

UNIT 4 ELECTROPHILIC AND NUCLEOPHILIC AROMATIC SUBSTITUTION REACTIONS

12 Hrs.

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity, Ortho/para ratio, ipso attack, orientation in naphthalene ring systems. Diazonium coupling, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution: Mechanisms: $SNAr$, SN^1 and Benzyne mechanisms. - Reactivity, Effect of structure, leaving group and attacking nucleophile. Typical reactions: O and S-nucleophiles, Bucherer reaction and Rosenmund reduction and Smiles rearrangements.

UNIT 5 ADDITION AND ELIMINATION REACTIONS

12 Hrs.

Addition to C-C Multiple Bond: Mechanism of addition of HX (X=Halo, OH) to alkenes and alkynes – Micheal addition Addition to Carbon-Hetero Atoms Multiple Bonds –Nucleophilic addition of carbonyl compounds. Addition - Elimination Reactions of Ketones and Aldehydes, Reactivity of carbonyl compounds towards Addition. Elimination Reactions: The E1, E1cB and E2 mechanism, Syn elimination, Orientation Effects in Elimination. Reactions - Pyrolytic eliminations, Chugaev reaction.

Max. 60 Hours

COURSE OUTCOME:

On successful completion of the course, student will be able to

C01- Understand the various types of bonding and conjugation in organic molecules and concept of aromaticity, anti-aromaticity and non-aromaticity

C02- Apply the Huckel rule for benzenoid and non-benzenoid compounds

C03- Learn the stability and reactivity of carbocations, carbanions and free radicals and concept of NGP, Field effects.

C04- Explain the mechanism of aliphatic nucleophilic and electrophilic substitutions such as SN^1 , SN^2 and SN^i mechanism and SE^2 and SE^i , SE^1 , Substitution by double bond shifts

C05- Discuss the mechanism of aromatic nucleophilic and electrophilic substitutions such as arenium ion mechanism, orientation, reactivity and $SNAr$, SN^1 and Benzyne mechanisms

C06- Illustrate the addition to C-C multiple bond, Carbon-Hetero atoms multiple bonds with suitable examples and explain the mechanism of Elimination reactions such as E1, E1cB and E2 mechanism

TEXT / REFERENCE BOOKS

1. J. March and M. Smith, Advanced Organic Chemistry, John-Wiley and Sons, 7th Edition, 2013.
2. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry Part-A and B, Kluwer Academic/Plenum Publishers, 5th Edition, 2007.
3. R. Morrison and R. Boyd, Organic Chemistry, Allyn & Bacon, 2nd Edition, 1967.
4. R. K. Bansal, Organic Reaction Mechanism, New Age International Pvt. Ltd. Publishers, 4th Edition, 2014.
5. S. H. Pine, Organic Chemistry, McGraw Hill International Edition, 5th Edition, 1987.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions each carrying 5 marks without choice

30 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

70 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Employability

SCYA 7301	APPLICATIONS OF SPECTROSCOPY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the principles of Molecular Spectroscopy.
- To apply the principles of UV-Visible, IR, NMR and Mass spectroscopy
- To know the application of spectroscopy to study the structure of molecules
- To elucidate the structures of simple organic molecules using the given spectral data.
- To interpret spectra of various spectroscopic techniques.

UNIT 1 ELECTRONIC SPECTROSCOPY

12 Hrs.

Electronic transitions (185-800 nm) – Beer-Lambert law – Effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Electronic spectra of inorganic and coordination compounds: Charge transfer and d-d transitions, electronic spectra of transition metal halides and oxo compounds.

UNIT 2 IR SPECTROSCOPY

12 Hrs.

Principle, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies. Study of isomerism: linkage isomerism in coordination compounds-cyano and isocyanato-thiocyanato- and isothiocyanato complexes.

UNIT 3 ¹H NMR AND ¹³C SPECTROSCOPY

12 Hrs.

General introduction and definition – Chemical shift, spin-spin interaction, shielding and deshielding mechanism and measurement, chemical shift values and correlation for protons bonded to carbon complex spin-spin interaction between two, three, four and five nuclei (first order spectra), spin system-Pople notation, virtual coupling. Hindered rotation, Karplus curve – variation of coupling constant with dihedral angle. Fourier transform technique. Further tools for simplification (chemical and instrumental) and elucidation of structures by NMR. Carbon-13 NMR Spectroscopy – General considerations, chemical shift - coupling constants. nuclear overhauser effect (NOE).

UNIT 4 MASS SPECTROMETRY

12 Hrs.

Principle of Mass spectra - Representation of Mass spectrum, Molecular ion – types of ions in mass spectra. Effect of isotopes on mass spectra – Determination of molecular formula – McLafferty rearrangement- ortho effect- Meta stable ions – Doubly charged ion – Nitrogen rule – General fragmentation modes – Mass spectra of hydrocarbons – Alkanes, cycloalkanes, alkene, alkynes, aromatic hydrocarbons, alcohols and thiophenols.

UNIT 5 ESR AND MÖSSBAUER SPECTROSCOPY

12 Hrs.

ESR Hyperfine splitting: hyperfine splitting in isotropic systems involving one nucleus and more than one nucleus, hyperfine splitting caused by quadrupole nuclei. Anisotropic systems: anisotropy in g-value, factors causing anisotropy. **EPR spectra of systems with more than one unpaired electrons: zero-field splitting, causes of ZFS, ZFS and EPR transitions, EPR spectrum of triplet naphthalene and highspin Mn(II) complexes.**

Principles of Mössbauer spectroscopy: Doppler shift, recoil energy, experimental technique- sources, absorber, calibration. Applications of Mossbauer spectroscopy: isomer shift, quadrupole splitting, magnetic interactions; magnetic and quadrupole splitting in ferromagnetic ⁵⁷Fe compounds, Mossbauer spectra of high and low-spin Fe(II) and Fe(III) compounds, site symmetry of metal centers in iron complexes, differentiation of nonequivalent metal centers in polynuclear complexes, discovering oxidation states-Sn, Sn(II), Sn(IV) compounds. Problems pertaining to known and unknown simple organic and Inorganic compounds by using UV, IR, Mass and NMR spectroscopy.

max. 60 Hours

Course Outcomes

On successful completion of the course, student will be able to

- CO1: Identification Of $\lambda_{\max}$ Value Of Inorganic and Organic Compounds.
- CO2: Explains – how to identify the functional group of molecules using IR Spectral data.
- CO3: Demonstrate the processes responsible for NMR chemical shifts and splitting patterns
- CO4: Identification and Ionization of Mass spectra of a given organic molecule using Mc-Lafferty rearrangement.
- CO5: To demonstrate application of ESR hyperfine splitting and Mossbauer spectroscopy.
- CO6: Evaluating experimental tools to obtain information to confirm or reject a reaction mechanism

TEXT / REFERENCE BOOKS

1. Banwell C. N and McCash E. M., Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw Hill, New Delhi, 2000.
2. Silverstein R. M and Webster F. X., Spectroscopic Identification of Organic Compounds, 6th Edition, John Wiley & Sons, New York, 2003.
3. Levine I. N., Molecular Spectroscopy, John Wiley & Sons, New York, 1974.
4. Williams D. H and Fleming I., Spectroscopic Methods in Organic Chemistry, 4th Edition, Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. Kemp W., Applications of Spectroscopy, English Language Book Society, 1987.
6. J. A. Weil, J. R. Bolton and J. E. Wertz, Electron Paramagnetic Resonance; Wiley Interscience: 1994.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Exam Duration : 3 Hrs.

30 Marks

70 marks

Employability

SCYA 7302	SYNTHETIC ORGANIC CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

Course Objectives

- To learn the methods involved in determining the mechanism of an organic reaction.
- To understand the significance of stereo, enantio, regio and chemo selectivity in chemical reactions.
- To recognize the strategies involved in asymmetric synthesis.
- To impart an insight into specific asymmetric reactions like aldol, hydrogenation, hydroformylation and Reformatsky reaction.
- To emphasize on the importance of organometallic reagents in organic synthesis.

UNIT 1 MECHANISMS AND DETERMINATION METHODS

12 Hrs.

Types of Mechanisms and Reactions - Thermodynamic and Kinetic requirements of a reaction - Representation of Potential Energy Changes in Reactions - General relationship between Thermodynamic stability and Reaction Rates - Kinetic vs thermodynamic control - Methods of Determining Mechanisms: Identification of Products, Determination of the presence of Intermediates, the study of catalysis, Isotopic labeling, Stereochemical Evidence, Kinetic Evidence - Isotope effects.

UNIT 2 STEREO, ENANTIO, REGIO, CHEMO SELECTIVE REACTIONS

12 Hrs.

Introduction: Enantiomeric excess, Diastereomeric excess, Enantioselective Reactions: Hydrogenation, Reduction of ketones, Epoxidation of Allylic alcohols, Dihydroxylation of alkenes – Stereo selective and Stereo specific reactions with suitable examples – Hydroboration - Regioselectivity with examples - The Use of acetylenes – Diastereoselectivity - Cram's Rule - Chemoselectivity in Oxidizing and Reducing agents, dissolving metal reductions, and Catalytic hydrogenation.

UNIT 3 ASYMMETRIC SYNTHESIS – I

12 Hrs.

Introduction to Asymmetric Synthesis – General strategies for asymmetric synthesis - "Chiron" approaches – Acyclic Diastereoselective approaches – Double asymmetric synthesis – Asymmetric Oxidations: Asymmetric Epoxidation of Allylic Alcohols: Sharpless Epoxidation - Selective opening of 2, 3 epoxy alcohols by metallic hydride and organometallic reagents - Asymmetric Diels Alder Reaction: Intramolecular and Retro Diels Alder Reaction.

UNIT 4 ASYMMETRIC SYNTHESIS –II

12 Hrs.

Asymmetric Reformatsky Reactions - Double Asymmetric Cycloaddition – Asymmetric aldol reactions – Aldol reactions – Substrate controlled aldol reactions – Reagent controlled aldol reactions – Chiral catalyst controlled aldol reactions – Double Asymmetric aldol reactions – Asymmetric Transfer Hydrogenation - Asymmetric Hydroformylation.

UNIT 5 REAGENTS IN ORGANIC SYNTHESIS

12 Hrs.

Reagents: Organo-Zinc compounds, Organo-Copper compounds, Organo-lead compounds, Organo- silicon compounds and Organo-cadmium compounds.

Max. 60 Hours

Course Outcomes

On completion of the course the student will be able to

- CO1: Categorize and analyze the mechanism involved in basic organic reactions.
- CO2: Solve the organic reactions with respect to stereo, enantio, regio and chemoselectivity.
- CO3: Propose a strategic reaction pathway in synthesizing a chiral product.
- CO4: Predict the products in asymmetric aldol, hydrogenation reactions
- CO5: Solve the asymmetric hydroformylation and Reformatsky reactions.
- CO6: Choose and predict the organometallic reagents in organic reaction

TEXT / REFERENCE BOOKS

1. Clayden, Greeves, Warren and Wothers., Organic chemistry, 2nd Edition, Oxford University, 2012.
2. J. March's Advanced Organic Chemistry Reaction, Mechanisms and Structure, Wiley 2007.
3. Guo-Qiang Lin, Yue-Ming Li, Albert S.C. Chan., Principles and applications of Asymmetric synthesis, John Wiley 2001.
4. Finar I. L., Organic Chemistry, 6th Edition, Pearson Education Asia, 2004.
5. Carey F. A., and Sundberg R. J., Advanced Organic Chemistry Part-A and B, 5th edn, Springer Publishers 2007.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Exam Duration : 3 Hrs.

30 Marks

70 marks

Employability

SCY 1620	SYNTHETIC ORGANIC CHEMISTRY	L	T	P	C	Max. Marks
		3	1	0	4	100

COURSE OBJECTIVES

- To learn the importance of oxidizing agents in organic reaction.
- To understand the significance of reducing agents in organic chemical reactions.
- To recognize the importance of organometallic compounds in organic reactions.
- To impart an insight into modern methodologies used in synthesis of organic compounds.
- To emphasize on chemical reactions involving the formation of cyclic transition structures.

UNIT 1 ORGANIC REAGENTS- I

12 Hrs.

Introduction to Organic Reagents - Types of Reagents - Oxidation Reagents – DDQ - SeO₂ - KMnO₄ - OsO₄ - Epoxidation of Olefins - Jones Reagent - Oppenauer Oxidation - HIO₄.

UNIT 2 ORGANIC REAGENTS-II

12 Hrs.

Reducing Agents - Hydride ion transfer mechanism - Electron Transfer mechanism – LAH - NaBH₄ - Electrophilic Reducing Agents - Allanes and Boranes. Hydroboration - Dissolving metal reduction - Birch Reduction - Clemmensen Reduction - Wolf-Kishner Reduction - Lindlars Reagent.

UNIT 3 ORGANIC REAGENTS-III

12 Hrs.

Introduction to organo-metallic reagents - Grignard reagent, Gilman's reagent – LDA - 1, 3 dithianes - Wittig Reagent - Peterson olefination.

UNIT 4 GREEN CHEMISTRY

12 Hrs.

Need - principles - planning of green synthesis - examples of green reactions - Importance and experimental conditions required – Green reactions in condensation, oxidation, reduction, rearrangement and addition reactions - Microwave assisted reactions, solid state synthesis and ionic liquid reaction.

UNIT 5 INTRODUCTION TO PERICYCLIC REACTIONS

12 Hrs.

Pericyclic reactions – Introduction, Definition and classification – Electrocyclic, cycloaddition, sigmatropic and cheletropic reactions – Thermal and Photochemical approach – Diels Alder reaction – Frontier Molecular Orbital approach – Woodward-Hoffmann's rules

Max. 60 Hrs.

COURSE OUTCOMES

On successful completion of the course, student will be able to

CO1: Interpret the products in organic chemical reactions involving oxidizing reagents.

CO2: Solve the chemical reactions involving reducing agents.

CO3: Predict the products formed in organic chemical reactions catalyzed by organometallic reagents.

CO4: Analyze the methodologies involved in Green chemistry.

CO5: Propose a strategic plan for basic chemical reactions based on Green chemistry principles.

CO6: Design and predict the reaction mechanism in electrocyclic, cycloaddition, sigmatropic and cheletropic reactions.

TEXT / REFERENCE BOOKS

1. Clayden, Greeves, Warren and Wothers., Organic chemistry, Oxford University, 2001.
2. J. March's Advanced Organic Chemistry Reaction, Mechanisms and Structure, Wiley 2007.
3. Ian Fleming, Pericyclic Reactions, Oxford Science Publications, Cambridge, 1999.
4. Finar I. L., Organic Chemistry, 6th Edition, Pearson Education Asia, 2004.
5. Rashmi Sanghi, M.M. Srivastava, Green chemistry, Environment Friendly Alternatives, Narosa Publishing House, 2007.
6. Carey F. A., and Sundberg R. J., Advanced Organic Chemistry Part-A and B, 4th edn, Kluwer Academic/Plenum Publishers 2000.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

 Employability

SCYA 3002	FUNDAMENTALS OF SPECTROSCOPY	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To study the interaction of radiation with matter and selection rules
- To learn the fundamentals of spectroscopic techniques
- To understand the principle and instrumentation of various spectroscopic techniques
- To interpret the spectra of various spectroscopic techniques
- To apply the concept of spectral data to assign the structure of organic compounds

UNIT 1 INTRODUCTION TO SPECTROSCOPY

9 Hrs.

Interaction of radiation with matter – Electromagnetic spectrum – quantization of energy – Boltzman distribution (formula only) - Electronic, vibrational and rotational energy levels: Relative population – Absorption and emission spectra – Selection rules – line widths – resolution and signal to noise ratio.

UNIT 2 UV-VISIBLE SPECTROSCOPY

9 Hrs.

Electromagnetic spectrum – Energy-Wavelength relationship – Introduction to UV-VIS spectroscopy – Beer-Lamberts Law – Instrumentation – Bands in UV-VIS spectrum – Possible electronic transitions – Types of electronic transitions based on selection rules – Characteristic absorption (λ_{max} and ϵ_{max}) – Factors influencing absorption – Chromophore, Auxochrome, Bathochromic shift, Hypsochromic shift, Hypochromic shift, Hyperchromic shift

UNIT 3 IR AND RAMAN SPECTROSCOPY

9 Hrs.

Introduction to IR spectroscopy – Principle, types of stretching and bending vibrations, vibrational frequencies – Instrumentation – Bands in IR spectrum – Selection rules – Identification of organic molecules from characteristic absorption bands.

Raman spectroscopy – Principle – Raleigh and Raman scattering – Stoke's and antistoke's line – Differences between IR and Raman spectroscopy – Mutual exclusion principle – applications.

UNIT 4 NMR SPECTROSCOPY

9 Hrs.

Principle of nuclear magnetic resonance – Instrumentation – Shielding mechanism - Chemical shift – Multiplicity – Spin-spin coupling and coupling constants – Splitting of signals - Deuterium labeling – Interpreting the NMR spectra of some organic molecules.

UNIT 5 MASS SPECTROMETRY

9 Hrs.

Basic principles of mass spectrometry – Molecular ion peak – Base peak – Isotopic peak – Metastable peak and their uses – Fragmentation – m/z values of various fragments – Nitrogen rule - McLafferty rearrangement - Interpreting the mass spectra of some organic molecules – Instrumentation – Combined application in identifying organic compounds.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

- CO1: Examine the principles of spectroscopy for absorption and emission spectra
- CO2: Analyze the UV-Visible spectral transitions of molecules
- CO3: Examine the principles of IR and Raman spectroscopic techniques
- CO4: Apply the principles of NMR spectroscopy to interpret NMR spectra of organic molecules
- CO5: Analyze the Mass spectra of organic molecules
- CO6: Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCE BOOKS

1. Banwell C. N., Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, 1983.
2. Kalsi P. S., Stereochemistry, 3rd Edition, New Age International Publishers, 1995.
3. Barrow G. M., Introduction to Molecular Spectroscopy, McGraw-Hill, 1962.
4. Willard H. H., Merritt Jr. L. L., Dean J. A., and Settle Jr. A. F., Instrumental methods of analysis, 6th Edition, Van Nostrand, 1981.
5. Kemp W., Applications of Spectroscopy, English Language Book Society, 1987.
6. Skoog D. A., West D. M., Holler f. J., and Crouch S. R., Fundamentals of Analytical Chemistry, 9th Edition, Wadsworth Publishing Co. Inc., 2012

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

Employability

SCYA 3005	CHEMISTRY OF NATURAL PRODUCTS	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To learn about the isolation of alkaloids and structural elucidation of coniine, nicotine, piperine and papaverine.
- To emphasize on the isolation of terpenoids and structural elucidation of citral, menthol, geraniol, camphor and vitamin A.
- To recognize the biological importance of purines and pyrimidines in organic reactions.
- To emphasize on the structural determination of cyanidine chloride and Quercetin .
- To impart an insight into structural details of hormones and Vitamins.

UNIT 1 ALKALOIDS

9Hrs.

Classification, isolation, purification, general methods of structure determination - functions of alkaloids. Structural elucidation of coniine, nicotine, piperine and papaverine.

UNIT 2 TERPENOIDS AND CAROTENOIDS

9 Hrs.

Terpenoids: Introduction, classification, Isoprene rule - General methods of determining structure – Structural elucidation of citral, menthol, geraniol and camphor.

Carotenoids: Introduction, geometrical isomerism, structure determination and synthesis of β -carotene and vitamin A.

UNIT 3 PURINES AND PYRIMIDINES

9 Hrs.

Purines: Introduction, biological importance - Structure and synthesis of Uric acid, Xanthine and Caffeine - Pyrimidines: Introduction, Structure and synthesis of Uracil and Thymine.

UNIT 4 ANTHOCYANINS AND FLAVONES

9 Hrs.

Anthocyanins: Introduction to anthocyanins - Structure and general methods of synthesis of anthocyanins - Cyanidine chloride: structure and determination – Flavones and Isoflavones: Structure and determination of flavone and flavonoids - Quercetin: Structure determination and importance.

UNIT 5 HORMONES AND VITAMINS

9 Hrs.

Hormones: Introduction - Difference between hormones and vitamins. Classification - Structure and functions of steroid hormones: Androsterone - Progesterone - Testosterone - Estrone. Adrenocortical hormones: Cortisone. Vitamins: Structure and importance of Vitamin D - Folic acid - Nicotinamide.

Max.45 Hours

COURSE OUTCOMES

On successful completion of the course, student will be able to

CO1:Elaborate on the methods and structural elucidation of Coniine, Nicotine, Piperine and Papaverine.

CO2:Explain on the structural elucidation of citral, menthol, geraniol, camphor and vitamin A.

CO3:Examine the structure and synthesis of uric acid, Xanthine, caffeine, Uracil and Thymine.

CO4:Discuss on the general methods of synthesis of anthocyanins.

CO5:Explain on the structural elucidation of cyanidine chloride and Quercetin.

CO6:Summarize the structure and functions of hormones and Vitamins..

TEXT / REFERENCE BOOKS

- 1). O. P. Agarwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002.
- 2). L. Finar, Organic Chemistry, Vol-2, 6th ed., Pearson Education Asia. 2004.
- 3). Gurdeep Chatwal and Anand, Chemistry of Natural Products Vol 1 & 2, Himalayan Publishing Co, 2001.
- 4). Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

 Employability

SCYA 6101	PHYSICAL CHEMISTRY LAB – I	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES:

- To know about the practical applications of conductometry.
- To learn concepts of potentiometry and pH metry.
- To apply the basic concept of chemical kinetics and adsorption studies.
- To gain practical knowledge in the synthesis of nanomaterials.

The list of probable experiments is mentioned below, which delineates the experiment to be performed in a semester. Any seven experiments can be selected from the list.

List of Experiments

1. Verification of Ostwald dilution law and determination of dissociation constant of weak acids.
2. Effect of ionic strength on reaction rate.
3. Study of kinetics of second order reaction by conductometric method.
4. Determination of equivalent conductance of a strong electrolyte (NaCl, KCl) at several concentrations and hence verify Debye Huckel Onsager equation.
5. Determination of equivalent conductance of a weak electrolyte (CH_3COOH) at infinite dilution by Kohlrausch's law.
6. Intercalation of sodium into vanadium oxide and potentiometric estimation of extent of intercalation.
7. Comparison of the strength of ferrous ammonium sulphate solution by potentiometric titration and by conventional titrimetric method.
8. Determination of first, second and third dissociation constants of phosphoric acid.
9. Determination of dissociation constants of a weak acid.
10. Verification of the Freundlich and Langmuir adsorption isotherms for adsorption of acetic acid/oxalic acid on activated charcoal.
11. Synthesis of Cd-Te nanoparticles and study quantum confinement

COURSE OUTCOME:

On successful completion of the course, student will be able to

C01- To develop practical skills in conductance measurements.

C02- To develop practical skills in emf measurements.

C03- To understand to determine dissociation constants for mono and multi basic acids.

C04- To understand experimental knowledge on kinetics.

C05- To gain experimental knowledge on surface chemistry.

C06- To gain experimental knowledge on the synthesis of nanoparticles at room temperature.

TEXT / REFERENCE BOOKS:

1. Carl Garland, Joseph Nibler and Schoemaker, Experiments in Physical Chemistry, Mcgraw-Hill College, 7th Edition, 2003.
2. D.V. Jahagirdan, Experiments in Chemistry, Himalaya Publishers House, 2003.
3. Arthur, Halpern and George McBane, Experimental Physical Chemistry, Freeman, 2006.
4. Yadav, Advanced Practical Physical Chemistry, Goel Pub, 1994.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 50

Exam Duration: 6 Hrs

CAE	Evaluation of Regular Lab class	25 Marks	50 Marks
	Model practical exam	25 Marks	
ESE	University Practical exam		50 Marks

Entrepreneurship

SCYA 6102	INORGANIC CHEMISTRY LAB-I	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES:

- To improve the skill in quantitative estimation of metal ions.
- To identify the methodology for the quantitative separation and estimation of mixture of metal ions.
- To improve the skill in preparation of metal complexes in good yield under suitable conditions with appropriate starting materials.

Course Contents

ESTIMATION

Estimation of Cu-Zn

Estimation of Fe-Mg

Estimation of Fe-Ni

Estimation of Cu-Ni

PREPARATION OF COMPLEXES

thiourea copper(I) sulphate

dioxalatodiaquachromate(III)

tris(thiourea)copper(I) chloride

hexamminenickel(II) chloride

bis(acetylacetonato)copper(II) sulphate

COURSE OUTCOME:

On successful completion of the course, student will be able to

- CO1-** Quantitatively estimate metal ions in the presence of other ions by titration and gravimetric methods.
CO2- Identify the qualitative method for the quantitative separation of metal ions from a mixture of metal ions.
CO3- Develop skill in preparation of inorganic metal complexes by the selection of suitable starting materials in good percentage yield.
CO4- Understand the mechanism and structural details of the prepared complexes.
CO5- Characterization of some of the prepared complexes by spectroscopic analysis.
CO6- Assessment of purity of the prepared complexes from the spectroscopic data.

TEXT / REFERENCE BOOKS

1. Jeffery G. H., Bassett J., Mendham J., and Denney R. C., Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearsons Education, 2004.
2. Kolthoff I. M., and Sandell E. B., Text Book of Qualitative Inorganic Analysis, 3rd Edition, The Macmillan Company; 1956.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 50

Exam Duration: 6 Hrs

CAE	Evaluation of Regular Lab class	25 Marks	50 Marks
	Model practical exam	25 Marks	
ESE	University Practical exam		50 Marks

Entrepreneurship

SEMESTER 4										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	INTERNSHIP	S91 APT	Professional Training	0	0	0	5	50	50	-
2	PROJECT	S91APROJ	Project Work (Phase – 1 & 2)	0	0	0	12	50	50	36
Total Credits for Semester: 17										
Total Marks for Semester: 200										

Entrepreneurship

SEMESTER 5										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SCY1311	Inorganic Chemistry-I	3	1	0	4	50	50	55
2	Theory	SCY1312	Organic Chemistry-I	3	1	0	4	50	50	56
3	Theory	SCY1313	Physical Chemistry-I	3	1	0	4	50	50	57
4	Theory	SCH 1314	Processes and Separation In Chemical Industry	3	0	0	3	50	50	58
5	Theory		Elective – 4	3	1	0	4	50	50	-
6	Practical	SCY 4315	Industrial Chemistry Lab	0	0	3	2	50	50	59
7	Practical	SCH 4061	Chemical Process and Separation Lab	0	0	3	2	50	50	60
8	I	S03PT	Professional Training	0	0	0	3	I	100	-
Total Credits for Semester: 26										
Total Marks for Semester: 800										

 Entrepreneurship

SCYA 3009	INDUSTRIAL CHEMISTRY	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES:

To enable a student to understand:

- The generation of energy from various types of fuels and electrochemical power sources.
- The use of chemicals in improvement of agricultural crops.
- Methods employed for purification of water for industries.
- Manufacturing processes of industrially important materials.

UNIT 1 INDUSTRIAL FUELS AND EXPLOSIVES

9 Hrs

Classification of fuels – Solid fuels: Coal: Types, properties and uses – Liquid fuels: Petroleum – Refining of petroleum, fractions and their uses – Fluidized bed catalytic cracking – Knocking and octane number – Gaseous fuels: Natural gas; LPG; Gobar gas: production, composition and uses.

Explosives: Definition and requirements – Classification of explosives – Preparation of gun powder, lead azide, cordite, TNT, RDX, dynamite – Classification of rocket propellants.

UNIT 2 ELECTROCHEMICAL INDUSTRY

9 Hrs

Production of materials like chlorine, caustic soda, sodium chlorate – Batteries: Zinc-carbon cell, alkaline battery, lead-acid battery, NICAD battery – Fuel cells: Hydrogen-oxygen fuel cell – Solar cells: Photovoltaic cell – Paints: Pigment volume concentration, constituents of paints and their functions – Types of varnishes.

UNIT 3 AGROCHEMICALS

9Hrs

Fertilizers: Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts – Insecticides: stomach poisons, contact insecticides, fumigants – Pesticides: Mode of action and synthesis of common pesticides like gammexane, DDT, aldrin, Parathion, Malathion. Herbicides: Manufacture of 2,4-D and 2,4,5-T – Fungicides: Preparation of Bordeaux mixture.

UNIT 4 WATER TREATMENT

9 Hrs

Sources of water – Hardness of water – Water softening methods: Zeolite process, demineralisation process – Desalination: Reverse osmosis and electrodialysis.

Sugar industry: Refining and grading of sugar - Sugar substitute: Saccharin and aspartame.

Leather industry: Curing, preservation and tanning of hides and skins – Treatment of tannery effluents.

Cleansing agents: Preparation of toilet and washing soaps – Cleansing action of soaps.

UNIT 5 CERAMIC INDUSTRY

9 Hrs

Cement: Manufacture by wet process and dry process – Setting and hardening of cement – Water proof cement – White cement.

Glass: Composition and properties of glass – Manufacture of glass – Types of glasses.

Composites: Definition – Metal-matrix composites – Fiber reinforced composites – ceramic matrix composites.

COURSE OUTCOMES

On successful completion of the course, student will be able to

CO1-To understand the classification of fuels and explosives and their requirements.

CO2-To learn the different types of batteries and fuel cells.

CO3- To understand the composition of different types of important fertilizers.

CO4- To study the different softening methods of hard water and its application in different industries.

CO5-To learn the composition of cement and glass and their properties.

TEXT / REFERENCES

1. Norris Shreve, R. and Joseph A. Brink, Jr. Chemical process industries, McGraw-Hill, 4th Ed (1997).
2. Subba Rao, N. S. Biofertilizers in Agriculture, Oxford and IBH Publishing Co. (1982).
3. Jain, P. C. and Jain, M. Engineering Chemistry, 14th Ed.; Dhanpat Rai and Sons, (2016).
4. Sheik Mideen, A. Engineering Chemistry I and II, J B Publications (2015).
5. Kuriakose, J. C. and Rajaram, J. Chemistry in Engineering and Technology Volume 1&2, Tata McnGraw Hill. (1988).
6. Sharma, B. K. Industrial Chemistry, Oxford and IBH Publishing Co. (1981).

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

Entrepreneurship

SCYA 2102	VOLUMETRIC ANALYSIS	L	T	P	Credits	Total Marks
		0	0	3	2	100

COURSE OBJECTIVES

- To bridge the conceptual ideas with practical experiments.
- To promote analytical skills in volumetric analysis.

VOLUMETRIC ANALYSIS:

1. Laboratory safety and Hygiene
2. Preparations of Reagents and Standard Solutions
3. Calibration of volumetric apparatus: Burette, pipette and standard flasks.
4. Determination of Mean, Standard Deviation, Co-efficient of Variations of given sample.
5. Acid – base titrations:
 - a. Estimation of HCl.
 - b. Estimation of oxalic acid.
6. Redox titrations:
 - a. Estimation of Ferrous ammonium sulphates (Permanganometry).
 - b. Estimation of KMnO_4 (Iodometry).
 - c. Estimation of Copper (Iodometry).
7. Complexometric titration:
 - a. Estimation of Calcium using EDTA.
 - b. Estimation of Magnesium using EDTA

COURSE OUTCOMES

On successful completion of the course, student will be able to

CO1: Apply safety protocols in chemistry laboratory

CO 2: Interpret the statistical parameters in quantitative analysis

CO3: Quantitative skills in volumetric analysis..

TEXT / REFERENCE BOOKS

- 1). S. Sundaram and K. Raghavan, Practical Chemistry, S. Viswanathan Co. Pvt., 1996.
- 2). N. S. Ganapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S.Viswanathan Co. Pvt., 2002.
3. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry.5th ed., Pearson Education, 2005.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 50
Duration: 2 Hrs.

Exam

CAE	Evaluation of Regular Lab class	15 Marks	
	Model practical exam	10 Marks	25 Marks
ESE	End Semester Practical exam		25 Marks

Entrepreneurship

SCYA 3001	Analytical Chemistry	L	T	P	Credits	Total marks
		3	1	0	3	100

COURSE OBJECTIVES

- To enable the students learn the principles of separation and purification techniques.
- To understand the principles of various chromatographic techniques.
- To construct the techniques for separation of metal ions using various chromatographic methods.
- To develop the skill of learning various thermal methods.
- To discuss the basic principle of polarimetry and amperometry methods.

UNIT 1 SEPARATION AND PURIFICATION TECHNIQUES

9 Hrs.

Principles involved in the separation of precipitates, solvent extraction and electrophoresis. Purification of solid organic compounds, extraction - use of immiscible solvents, soxhlet extraction, crystallization, use of miscible solvents, fractional crystallization, sublimation. Purification of liquids, experimental techniques of distillation, fractional distillation, vacuum distillation, steam distillation, tests for purity.

UNIT 2 CHROMATOGRAPHY I

9 Hrs.

Principles adsorption, thin layer, partition and paper. Chromatography column chromatography, adsorbents, preparation of column, adsorption, elution, recovery of substance and applications, **TLC - choice of adsorbent and solvent, preparation of chromatogram and applications, Rf value.** Paper chromatography, Solvents used and principles, factors affecting Rf value, separation of amino acid mixtures. Radial paper chromatography.

UNIT 3 CHROMATOGRAPHY II

9 Hrs.

Ion exchange chromatography – principle, resins, action of resins, experimental techniques, applications, separation of Zn-Mg, Co-Ni, Cd-Zn, Chloride, bromide. Gas chromatography and high pressure liquid chromatography – principles, Detectors, experimental techniques, instrumentation and applications.

UNIT 4 THERMAL ANALYSIS

9 Hrs.

Thermal analytical methods - Principle involved in thermogravimetric analysis and differential gravimetric analysis, discussion of various components with block diagram, **characteristics of TGA and DTA, factors affecting TGA and DTA curves, thermometric titrations.**

UNIT 5 POLAROGRAPHY

9 Hrs.

Principle, concentration polarization, dropping mercury electrode, advantages and disadvantages, convection, migration and diffusion currents, ilkovic equation (derivation not required) and significance, experimental assembly, electrodes, capillary solutions, current voltage curve, oxygen wave, influence of temperature and agitation on diffusion layer, polarography as an analytical tool in quantitative and qualitative analysis. Amperometry - basic principles and uses. Polarimetry principle – instrumentation, comparison of strengths of acids, estimation of glucose.

Max.45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to:

- CO1: Apply the principles of separation and purification to the miscible and immiscible liquids
- CO2: Examine the principles of adsorption in paper and thin layer chromatography
- CO3: Apply the principles of chromatography to the GC and HPLC techniques
- CO4: Examine the principles of thermal methods to TGA, DTA and thermometric titration techniques
- CO5: Apply the polarization principles to the polarography and polarimetry techniques
- CO6: Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCE BOOKS

1. Concise Inorganic Chemistry – J.D. Lee – 3rd Edition, Von Nostrand
2. Inorganic Chemistry – P. L. Soni – Sultan Chand
3. Inorganic Chemistry – Pun and Sharma Nagin
4. Inorganic Chemistry – Modan S. Chand
5. Advanced Inorganic Chemistry – Cotton and Wilkinson
6. A Textbook of Inorganic Chemistry – A.K. De – New Age
7. Industrial Chemistry- B.K. Sharma – Goel Publications
8. General and Inorganic Chemistry Part I Sarkar, Books and Allied (P) Ltd
9. General and Inorganic Chemistry Part II Sarkar, Books and Allied (P) Ltd
10. Chemical Methods for Environmental Analysis Ramesh and Anbu, Macmillan

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 Marks each-No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 Marks.
(Out of 100 Marks, maximum of 10% problems may be asked.)

80 Marks

Entrepreneurship

SCYA 5102	COORDINATION CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To know the nature of metal-ligand bonding in coordination compounds and quantification of the bonding parameters.
- Learn the various bonding theories in coordination chemistry and their application in understanding spectra and magnetism.
- Understand Reaction Mechanism in Coordination Chemistry
- To be able to describe the stability of metal complexes by the use of formation constants and to calculate thermodynamic parameters
- To Understand and interpret the spectrum of the metal complexes

UNIT 1 THEORIES OF COORDINATION COMPOUNDS

12 Hrs.

Introduction to Werner's Coordination theory and its postulates, Defects of Werner's theory, Problems based on Werner's theory, Sidgwick's electronic concept of coordination, EAN rule, Defects of Sidgwick's theory, problems based on Sidgwick's theory. Valence bond theory, Spin-only magnetic moment, Hybridization schemes for the bonding frameworks of different geometrical configurations of ligand donor atoms, Defects of the VBT. Problems based on VBT. Isomerism in coordination complexes - Optical isomerism in coordination complexes. Circular dichroism and optical rotatory dispersion. Racemization in coordination complexes: Ray-Dutt twist and Bailor twist mechanisms. HSAB-principle.

UNIT 2 THEORIES OF COORDINATION COMPOUNDS-II

12 Hrs.

Crystal Field Theory and its postulates, shapes of d-orbitals, crystal field splitting of d-orbitals in different geometries like octahedral – Square planar – Square pyramidal – Trigonal bipyramidal-Pentagonal bipyramidal, Square antiprismatic and tetrahedral complexes. Measurement of $10Dq$. Factors affecting the magnitude of $10Dq$. Determination of CFSE, consequences of CF splitting, calculations of crystal field stabilisation energy for d^1 to d^{10} Oh systems – Pairing energy – Low-spin and high-spin complexes and magnetic properties. Effect of ligand field on color of the complexes, Jahn-Teller distortions and its consequences with copper system as example. Limitations of crystal field theory. Ligand field theory, and molecular orbital MO diagrams with and without metal-ligand π bonding in an octahedral and tetrahedral complex.

UNIT 3 SPECTRAL AND MAGNETIC PROPERTIES OF COORDINATION COMPOUNDS

12 Hrs.

Introduction, types of absorption spectra, Quantum numbers, Spin-spin coupling, orbit-orbit coupling, spin-orbit coupling, Ground state term Symbols for d^{1-10} electron systems, selection rules for electronic transitions in complexes, spin selection rule, Laporte selection rule, Micro states, Correlation diagrams – Orgel and Tanabe – Sugano diagrams for Oh complexes, The nephelauxetic effect, Racah parameters, Electronic spectrum of d^{1-10} systems of Oh and Td complexes, Charge transfer spectra of L to M and vice versa, Magnetic properties of metal complexes and spin only formula, determination of magnetic susceptibility – Gouy method, spin and orbital contribution to magnetic moments, The effects of temperature on μ_{eff} , and spin crossover.

UNIT 4 REACTIONS MECHANISMS OF COORDINATION COMPOUNDS

12 Hrs.

Labile and Inert complexes, VBT explanations of lability and Inertness, Ligand substitution reaction, SN^1 – Dissociative mechanism, SN^2 – Associative mechanism, SN^i Conjugate base mechanism anation reaction, electron transfer reactions, Outer-sphere – Tunnelling mechanism, Inner-sphere mechanism, Isomerisation reactions –involving Geometrical and optical isomers. Substitution reaction in square planar complexes, Trans effect series, applications of trans effect.

UNIT 5 STABILITY OF COORDINATION COMPOUNDS

12Hrs.

Thermodynamic stability and kinetic stability, step-wise stability constants and overall stability constants and its relationship, trend in K values, Irving – Williams series, Factors affecting the stability of coordination compounds – Charge and size of central metal ion, Nature of ligand, Basicity and chelating ability of the ligands, steric effect, stereochemical requirements of ligands. Determination of stability constants – solubility method, Ion-exchange method, electrochemical method, spectrophotometric method.

Max. 60 Hours

COURSE OUTCOMES

On completion of the course the student will be able to

CO1: Understand the structure, isomerism and bonding in coordination complexes.

CO2: Deduce the crystal field splitting diagram for different geometries.

CO3: Characterize the electronic spectra of metal complexes based on correlations diagrams.

CO4: Evaluate the mechanistic pathway of metal complexes.

CO5: Determine the stability of metal complexes using conventional methods

CO6: Interpret the spectrum of different metal complexes with different geometries.

TEXT / REFERENCE BOOKS

1. Catherine E.House Croft and Alan G.Sharpe, Inorganic Chemistry, Pearson, 5th Edition, 2012.
2. Gopalan R., Ramalingam V., Concise Coordination Chemistry, Vikas Publishing House Pvt. Ltd., 2017.
3. Huheey J. E., Keiter E. A., and Keiter R. L., Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education, 2006.
4. Atkins P. W., Overton T., Rourke J., Weller M., and Armstrong F., Shriver & Atkins: Inorganic Chemistry, 4th Edition, Oxford University Press, 2006.
5. Cotton F. A., Wilkinson G., Murillo C. A., and Bochmann M., Advanced Inorganic Chemistry, 6th Edition, Wiley, 1999.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions each carrying 5 marks without choice

30 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

70 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Skill Development

SCYA 5103	THERMODYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To construct second law of thermodynamics, concept of entropy and Carnot cycle.
- To determine the methods for fugacity, activity and activity coefficients.
- To understand the partition function for distinguishable and indistinguishable molecules.
- To derive the various statistical approach and free energy functions of mono and diatomic gases.
- To learn the Onsager theory and applications of irreversible thermodynamics to biological and non-linear systems.

UNIT 1 CLASSICAL THERMODYNAMICS - I

12 Hrs.

Need for the second law – Concept of entropy – Carnot cycle – Gibbs function – Gibbs – Helmholtz equation – Clausius – Clapeyron equation – Thermodynamics of systems of variable compositions – Partial molar quantities, partial molar volume – Chemical potential, Gibbs – Duhem equation – Third law of thermodynamics. Ellingham diagram and its significance.

UNIT 2 CLASSICAL THERMODYNAMICS – II

12Hrs.

Thermodynamics of real gases and real solutions: Fugacity: Methods of determination. Dependence on temperature, pressure and composition. Activity and activity coefficient – Determination of activity and activity coefficient of non-electrolytes and electrolytes. Solubility of ionic solids in water – Solubility curves – Ternary system involving water and two soluble ionic solids – Formation of double salts.

UNIT 3 STATISTICAL THERMODYNAMICS – I

12Hrs.

Phase space – Ensembles: Different types of ensembles – Micro canonical, canonical and grand canonical – Distinguishable and indistinguishable molecules – Maxwell-Boltzmann statistic – Partition function and thermodynamic functions – Separation of partition function – Translational, rotational, vibrational and electronic partition functions. Statistical approach to thermodynamic properties - Internal energy, entropy, enthalpy, Helmholtz function, pressure, Gibbs function, residual entropy, equilibrium constant.

UNIT 4 STATISTICAL THERMODYNAMICS - II

12 Hrs.

Quantum Statistics Bose-Einstein statistics – Fermi-Dirac statistics – Free energy function Heat capacity of mono and diatomic gases. Ortho- and para hydrogen and mixture of the two viz., ortho H₂ and para H₂ – Heat capacity of solids – Einstein and Debye models – Sackur-Tetrode equation.

UNIT 5 NON EQUILIBRIUM THERMODYNAMICS

12 Hrs.

Near equilibrium process: General theory – Conservation of mass and energy – Entropy production in open system by (i) heat (ii) matter and (iii) current flow – Onsager theory: Validity and verification – Application of irreversible thermodynamics to biological and non-linear systems.

Max. 60 Hours

COURSE OUTCOME:

On successful completion of the course, student will be able to

CO1: Construct the Second law of thermodynamics for explaining the concept of entropy and to derive Carnot cycle and various Gibbs functions.

CO2: Determine the methods for fugacity, activity and activity coefficient of electrolytes and non-electrolytes.

CO3: Derive the various partition functions in statistical approach.

CO4: Discuss the Bose-Einstein and Fermi-Dirac statistics and heat capacity of solids.

CO5: Explain the conservation of mass and energy and entropy production in open systems.

CO6: Discuss the Onsager theory validity and verification.

TEXT / REFERENCE BOOKS

1. P. R. Rastogi and R. R. Misra, An Introduction to Chemical Thermodynamics, 6th Revised Edition, Vikas Publishing House Ltd., 2009.
2. P. W. Atkins, Physical Chemistry, Oxford University Press, 1978.
3. S. Glasstone, Thermodynamics for Chemists, Affiliated East-West Press, 1974.
4. I. M. Klotz and R. M. Rosenberg, Chemical Thermodynamics: Basic Theory and Methods, 18th Edition, Benjamin/Cummings Pub. Co., 1986.
5. R. P. Rastogi and R. R. Misra, Classical Thermodynamics, Vikas Publishing House Ltd., 1990.
6. J. Rajaram and J. C. Kuriakose, Thermodynamics, 3rd Edition, S. Chand & Co., 1999.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions each carrying 5 marks without choice

30 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

70 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Skill Development

SCYA 5201	CHEMISTRY OF THE MAIN GROUP ELEMENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To study the structure and bonding in polyhedral boranes
- To understand the chemistry of Silicon, Sulphur and Phosphorus compounds
- To discuss the synthesis and reactivity of organometallic reagents and macrocycles.
- To study the preparation and properties of various organyls
- To determine the properties and applications of lanthanides and actinides

UNIT 1 CHEMISTRY OF BORANES

12 Hrs.

Structure and bonding in boranes and boron cage compounds- Closo, nido, arachno and carboranes – Styx notation – Wade's rule – Electron count in polyhedral boranes – Synthesis of polyhedral boranes – Isolobal analogy between main group and transition metal fragments– Boron halides – Phosphine-Boron heterocycles – Borazine.

UNIT 2 NON-TRANSITION METAL CHEMISTRY

12 Hrs.

Silanes, silicon halides, silicates, germanes and stannenes – Phosphorous halides, oxyacids of phosphorous, phosphazenes – Sulphur halides, oxo acids of sulphur – Structural features and reactivity of reactivity of S-N heterocycles.

Interhalogen compounds: Structure and properties of interhalogen compounds [ClF, ICl, ClF₃, BrF₃, IF₃, ClF₅, BrF₅, IF₅] poly halides - pseudohalogens [cyanide, thiocyanate and azide] and Xenon compounds.

UNIT3 ORGANOMETALLIC REAGENTS AND MACROCYCLES

12 Hrs.

Synthesis and reactivity of organo-lithium, beryllium and magnesium compounds.

Macrocyclic Ligands: Calixarenes, cryptands and crown ethers-structure and applications in complexation chemistry.

UNIT 4 ORGANYLS

12 Hrs.

Preparation and reactivity of aluminium organyls – Carbalumination, hydroalumination – Chemistry of Ga(I) and In(I) – Reduction of Al, Ga and In organyls – Germanium, tin and lead organyls.

UNIT 5 LANTHANIDES AND ACTINIDES

12 Hrs.

Lanthanides: Lanthanide series, abundance and natural isotopes - lanthanide contraction, similarity in properties, occurrence, oxidation states - chemical properties of Ln(III) cations - magnetic properties, colour and electronic spectra of lanthanide compounds - separation of lanthanides, solvent extraction, ion exchange method.

Actinides: actinide series, abundance and natural isotopes, occurrence, preparation of actinides - oxidation states - general properties, the later actinide elements, uranium-occurrence, metallurgy; chemical properties of hydrides, oxides, and halides - complexes of lanthanides and actinides - term symbols.

Max. 60 Hours

COURSE OUTCOME:

On successful completion of the course, student will be able,

CO1 - To explain the structure and bonding in polyhedral boranes and borazines and the concept of Styx notation, Wade's rule.

CO2 - To discuss the structural features and reactivity of Silicon, Sulphur, Phosphorous and S-N heterocycles.

CO3 - To determine the synthesis and reactivity of organo lithium, Be and Mg compounds and complexation in calixarines, cryptand and crown ethers.

CO4 - To illustrate the preparation and properties of various organyls and its reduction reactions.

CO5 - To discuss the magnetic and optical properties of lanthanides and actinides.

CO6 - To determine the coordination chemistry of lanthanides and actinides and its applications.

TEXT / REFERENCE BOOKS

1. D. F. Shriver, P. W. Atkins and C.H. Langford, Inorganic Chemistry, Oxford University Press, 1990.
2. J. E. Huheey, E. A. Keiter and R. I. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education, 2004.
3. F. A. Carey, G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, Wiley Interscience, 2003.
4. C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Prentice Hall, 2005.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Exam Duration : 3 Hrs.

30 Marks

70 marks

Skill Development

SCYA 5202	CHEMICAL KINETICS AND CATALYSIS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To elucidate the use of chemical kinetics in understanding reaction mechanisms.
- To understand the kinetics of fast reactions.
- To understand adsorption phenomena.
- To enable the learners to understand the importance and significance of heterogeneous catalysis.
- To learn the kinetics of polymerization and experimental methods of determination of molar masses of polymers.

UNIT 1 ADVANCED CHEMICAL KINETICS

12 Hrs.

Thermodynamic formulation of activated complex theory – Theories of unimolecular reactions: Lindemann mechanism – Hinshelwood mechanism – Temperature dependence of pre-exponential factor. Kinetics of reactions in solution: Effect of solvent on reaction rates (reaction between two ions) – Effect of ionic strength on reaction rates: Primary salt effect and secondary salt effect.

UNIT 2 KINETICS OF FAST REACTIONS

12 Hrs.

Chemical relaxation methods: Temperature and pressure jump methods – Reactions in flow systems: Continuous and Stopped flow methods – Shock tube methods – Laser Flash photolysis – Ultrasonic absorption technique.

UNIT 3 KINETICS OF POLYMERIZATION

12 Hrs.

Kinetics of Free radical mechanism, Cationic mechanism and Anionic mechanism – Molar masses of polymers: Number average molecular mass – Weight average molecular mass. Determination of molecular weight of polymers: Light scattering method – Ultracentrifuge method (Sedimentation velocity method).

UNIT 4 ADSORPTION

12 Hrs.

Adsorption isotherms: Types of adsorption isotherm – Langmuir theory of unimolecular layer adsorption isotherm – The BET theory of multimolecular layer isotherm – Determination of surface area of adsorbents – The Gibbs adsorption isotherm equation – Surfactants: Classification of surfactants – Formation of micelles – Critical micelle concentration (CMC) – Thermodynamics of micellization. Emulsions: Hydrophilic-Lipophilic Balance (HLB).

UNIT 5 CATALYSIS

12 Hrs.

Definition of Catalysis – Types of catalysis: homogeneous and heterogeneous. Catalytic kinetics: Concept of Langmuir-Hinshelwood – Photocatalysis using semiconducting oxides: Definition, basic principles and mechanism of photocatalysis – Application of photocatalysis in water remediation, air cleaning – Heterogeneous catalysis by intercalation compounds: Structural aspects of graphite intercalation compounds, catalytic reaction – Kinetics of enzyme catalysis – Lineweaver-Burk plot for the determination of Michaelis constant.

Max. 60 Hours

COURSE OUTCOME:

On successful completion of the course, student will be able,

- CO1- To study thermodynamic and theoretical aspects of chemical kinetics.
- CO2- To learn the experimental and theoretical aspects of kinetics of fast reaction techniques.
- CO3- To understand the kinetics of polymerization and learn the methods of determination of molecular mass of polymers.
- CO4- To learn about surface chemistry and their kinetics.
- CO5- To understand the importance of surfactants, micelle, and emulsions.
- CO6- To study the importance of heterogeneous catalysis.

TEXT / REFERENCE BOOKS:

- Keith J. Laidler, Chemical Kinetics, Pearson Education India, 3rd Edition, 2003.
- John W. Moore and Ralph G. Pearson, Kinetics and Mechanism, Wiley, 3rd Edition, 1981.
- Julian R.H. Ross, Heterogeneous Catalysis: Fundamentals and Applications, Elsevier, 1st Edition, 2011.
- G.C. Bond, Heterogeneous Catalysis: Principles and Application. Oxford University Press, USA, 1987.
- B. Vishwanathan, S. Sivasankar and A.V. Ramaswamy, Catalysis: Principles and Applications, Narosa Publishing House, New Delhi, 2004.
- C. Kalidas C, Chemical Kinetic Methods, New Age International, 1996.
- F. Wilkinson, Chemical Kinetics and Reaction Mechanism, Van Nostrand Reinhold Co., 2000.
- R. Aveyard and D.A Haydon, An Introduction to the Principles of Surface Chemistry, Cambridge University Press, 1973.
- V.R. Gowarikar, N.V. Vishwanathan and Jayadev Sreedhar, Polymer Science, 2nd Edition, New Age International Publishers, 2006.
- F.W. Billmeyer, Textbook of Polymer Science, John Wiley & Sons, 3rd Edition, 1990.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Exam Duration : 3 Hrs.

30 Marks

70 marks

Skill Development

SCYA 5203	FUNDAMENTALS OF STEREOCHEMISTRY AND ORGANIC PHOTOCHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To suggest synthetic route for simple organic compounds with stereochemistry
- To make the students understand and appreciate the concept of stereochemistry and reaction mechanism
- To know the nature of addition in pericyclic reactions
- To learn the alpha cleavage and gamma hydrogen transfer reactions
- To understand the photochemical organic reactions and rearrangement reactions

UNIT 1 STEREOCHEMISTRY-I

12 Hrs.

Elements of symmetry – Chirality – Representation of organic molecules (Fischer, Sawhorse, Newman and Zig-Zag) and their interconversion – Molecules with more than one chiral centre: Erythro and threo isomers – Optical activity in the absence of chiral carbon – biphenyls, allenes and spiranes – Criteria for optical purity – D and L Notation, Cahn-Ingold-Prelog rules – R and S-notations – Absolute and relative configuration Racemic modifications – Racemisation – Thermal, anion, cation, reversible formation – Resolution of racemic modifications – Epimerisation – Mutarotation.

UNIT 2 STEREOCHEMISTRY-II

12 Hrs.

Stereospecific synthesis – Stereochemistry of compounds containing nitrogen, sulphur and phosphorus – Conformational analysis: In acyclic systems – Simple 1,2 disubstituted ethane derivatives – In cyclic systems (cyclobutane, cyclopentane, cyclohexane and cycloheptane) – Conformation and reactivity in disubstituted cyclohexanes – Cis and trans decalins – Topicity of ligands and faces – Enantiotopic and diastereotopic atoms – Prochiral centre and pseudoasymmetry – Stereoselective reactions – Cram's rule and Felkin-Ahn's modification – Prelog's rule.

UNIT 3 PERICYCLIC REACTIONS

12 Hrs.

Characteristics – Types of pericyclic reactions – electrocyclic, cycloaddition, cheletropic and sigmatropic reactions – Woodward Hoffmann rules; The Mobius and Huckel concept, FMO method and Correlation diagrams – Electrocyclic reactions of conjugated dienes and trienes – Cycloaddition and Cheletropic reactions [2 + 2] and [4 + 2] cycloadditions – Diels Alder and Retro Diels Alder reactions – 1, 3-dipolar cycloaddition – Sigmatropic rearrangements involving hydrogen and carbon migration – Cope and Claisen rearrangements.

UNIT 4 ORGANIC PHOTOCHEMISTRY-I

12 Hrs.

Organic photochemistry – General principles – Frank-Condon principle – Electronic transitions – Jablonski diagram: Inter-system crossing and Energy transfer – Photochemistry of carbonyl compounds: $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions – alpha cleavage or Norrish type I reaction – Gamma hydrogen transfer or Norrish type II reaction - Energy transfer reactions – Sensitizer and Quencher.

UNIT 5 ORGANIC PHOTOCHEMISTRY-II

12 Hrs.

Photoreduction – Paterno-Buchi reactions – di-pi-methane rearrangement – Barton rearrangement – Photo-Fries rearrangement - photochemistry of an α, β -unsaturated ketones – Olefin photochemistry (Cis-Trans isomerism) – Photochemistry of conjugated dienes – Photochemistry of arenes and benzene derivatives – Cycloaddition of benzene to olefins and dienes.

Max. 60 Hours

COURSE OUTCOME:

On successful completion of the course, student will be able to

- CO1-** Understand the various symmetry elements and representation of organic molecules and their interconversion
- CO2-** Apply the D and L notation, R and S notation, absolute and relative configurations to organic molecules
- CO3-** Explain the conformational analysis of acyclic and cyclic systems
- CO4-** Explain the mechanism of various pericyclic reactions such as electrocyclic, cycloaddition, cheletropic and sigmatropic reactions and understand the concept of Woodward Hoffmann rules, The Mobius and Huckel concept and FMO method
- CO5-** Discuss the Frank-Condon principle and Jablonski diagram and apply the α -cleavage or γ -hydrogen transfer mechanism to organic molecules
- CO6-** Illustrate the mechanism of various photochemical reaction and rearrangement with suitable examples.

TEXT / REFERENCE BOOKS

1. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 14th Reprint Edition, 1990.
2. P. S. Kalsi, Stereochemistry: Conformation and Mechanism, New Age International Publishers, 8th Edition, 2015.
3. J. March and M. Smith, Advanced Organic Chemistry, John-Wiley and Sons, 7th Edition, 2013.
4. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry Part-A and B, Kluwer Academic/Plenum Publishers, 5th Edition, 2008.
5. G. B. Gill and M. R. Wills, Pericyclic Reactions, Chapman Hall, 1974.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Exam Duration : 3 Hrs.

30 Marks

70 marks

Skill Development

SCYA 5302	ADVANCED INORGANIC CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To learn about organometallic compounds in terms of structure and bonding including dinitrogen and dioxygen as ligands.
- To understand various synthesis methods of different types of organometallic compounds and to learn their reactivity with mechanism.
- To learn about different reactions involving organometallic compounds as catalysts in chemical synthesis.
- To understand the role of metals and their complexation in the formation of biological compounds like enzymes and their application in medicinal chemistry.
- To learn different types of nuclear reactions with radioactive techniques and to know the applications of radio isotopes in different fields.

UNIT 1 ORGANOMETALLIC COMPOUNDS

12 Hrs.

EAN Rule - Valence electron count (16/18 electron rules) – concept of hapticity. Structure and bonding of mono and heteroleptic metal carbonyls – dinitrogen and dioxygen as ligands in organometallic compounds. Infrared spectra of metal carbonyls – Metal clusters – Low and high nuclearity clusters – clusters having interstitial atoms - Isolobal analogies - Metallocenes and bent metallocenes.

UNIT 2 SYNTHESIS OF ORGANOMETALLIC COMPOUNDS

12 Hrs.

Types of M-C bonds – structure and bonding of metal alkyls, alkenes, allyl, alkynes and arenes - Ligand dissociation and substitution - Oxidative addition - Reductive elimination - Nucleophilic displacement – Insertion - Alkyl migration – 1, 2 insertion - Hydride elimination.

UNIT 3 ORGANOMETALLIC CATALYSTS

12 Hrs.

Terminology in catalysis: Turnover, Turnover number (TON), Turnover frequency (TOF). Homogeneous catalysis – Hydroformylation - Monsanto acetic acid process - Hydrogenation by Wilkinson's catalyst - Wacker (Smidt) process - Olefin metathesis - Heterogeneous catalysts – Ziegler Natta polymerization - Water gas reaction.

UNIT 4 BIOINORGANIC CHEMISTRY

12 Hrs.

Transition metal ions in biology. Active site structure and functions of dioxygen binding heme (hemoglobin and myoglobin) and non-heme (hemocyanin and hemerythrin) proteins. Characterization of coordinated O₂ species in oxy forms of heme and non-heme proteins by resonance Raman spectroscopy. Bohr effect. Electron transfer proteins: Active site structure and functions of cytochromes, and iron-sulphur proteins. Significance of electron transfer proteins in photosynthesis (Z scheme). Coenzyme F430, carboxypeptidase, carbonic anhydrase, vitamin B₁₂, ferritin and transferrin. Mechanism of action of cytochrome P450 and urease. Therapeutic uses of cisplatin, and radioisotopes (Tc, Co and Cu). Basic principles of MRI and application of metal (Mn and Fe) complexes as contrast agents. Toxicity of Cd, Hg and Pb in biology with specific examples.

UNIT 5 NUCLEAR CHEMISTRY

12 Hrs.

Terminology, Concept and formulae of Nuclear chemistry; Radioactivity, Types of particles, Radioactive decay, Radioactive decay constants, equilibrium, Nuclear reactions; Q – Value, Chemical effects of Nuclear Transformations, Fission and Fusion, stability of Nucleus, Radioactive techniques – Tracer technique, Neutron activation analysis, counting technique – G.M. ionization, Proportional counter. Application of Radioisotopes.

Max. 60 Hours

COURSE OUTCOME:

On successful completion of the course, student will be able to

- CO1- Identify organometallic compounds based on EAN rule and to elaborate on the different types of substituted carbonyl compounds.
- CO2- Interpret the structure, reactivity and significance of organometallic compounds with dinitrogen and dioxygen as ligands.
- CO3- Analyze the mechanism involved in various ligand dissociation and substitution reactions of organometallic compounds.
- CO4- Analyze the role of organometallic compounds in various catalysis processes which are of commercial use.
- CO5- Understand the role and importance of metals in forming biomolecules based on complexation and their application in biotransformation.
- CO6- Identify different particles in nuclear fission and fusion reactions and to evaluate the application of different radioactive isotopes.

TEXT / REFERENCE BOOKS

1. C.E. Housecroft and A.G. Sharpe, Inorganic Chemistry, 4th Edition, Pearson, 2012.
2. B. D. Gupta and A. J. Elias, Basic Organometallic Chemistry: Concepts, Synthesis, and Applications, 2nd Edition, Universities Press (India), 2013.
3. J. E. Huheey, E. A. Keiter, R.L. Keiter and O.K. Mehdi, Inorganic Chemistry, Principles of Structure and Reactivity, Pearson, 2006.
4. F. A. Carey, G. Wilkinson G., C.A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, Wiley Interscience, 2003.
5. J. Lippard and J.M. Berg, Principles of Bioinorganic Chemistry, University Science Books, 1994.
6. W. Kaim, B. Schwederski and Axel Klein, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life (An introduction and Guide), 2nd Edition, John Wiley & Sons, 2013.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

Exam Duration : 3 Hrs.

30 Marks

70 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Skill Development

SCYA 5303	ELECTROCHEMISTRY AND SOLID STATE CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To understand theories of inter-ionic interactions and to learn the concept of activity coefficient.
- To study the structure of electrical double layer, and to learn electrochemical kinetics.
- To learn electroanalytical techniques.
- To introduce and give an insight into the fascinating area of solid state chemistry and material science.
- To know the preparative methods of solids.

UNIT 1 IONICS

12 Hrs.

Debye-Hückel theory of interionic attraction – Debye-Huckel limiting law – Debye-Huckel-Onsager theory of electrolytes: Asymmetry effect and Electrophoretic effect – Variation of conductance with applied potential: Wein effect and Debye-Falkenhagen effect – Concept of activity coefficient: Mean activity coefficient – Ionic strength.

UNIT 2 ELECTRODICS AND ELECTROANALYTICAL TECHNIQUES

12 Hrs.

The structure of electrical double layer: Helmholtz, Gouy-Chapman and Stern models – Kinetics of electrode reactions: Derivation of Butler Volmer equation – Tafel equation – Polarography: The Ilkovic equation – Half wave potential – Cyclic voltammetry for redox system – Amperometric titrations – Ion selective electrodes: Glass membrane electrode – Solid membrane electrode – Liquid membrane electrode.

UNIT 3 CRYSTAL STRUCTURE

12 Hrs.

Crystalline and amorphous solids – Crystal systems – Bravais lattices – Miller indices – Limiting radius ratio for trigonal, tetrahedral, octahedral and cubic configurations – Methods of characterizing solids: Principle of Powder x-ray diffraction, electron and neutron diffraction.

UNIT 4 CRYSTAL DEFECTS AND NONSTOICHIOMETRY

12 Hrs.

Types of Defect: Point Defects – Schottky Defect – Frenkel Defect – Thermodynamics of Schottky and Frenkel Defect Formation – Solid Electrolytes: Fast-Ion Conductors – Applications of Solid Electrolytes in Batteries, Fuel cells, Oxygen sensor – Vacancies and Interstitials in Non-Stoichiometric Crystals: Extrinsic and Intrinsic Defects – Superconductivity: High Temperature Superconductors: Cuprate Superconductors – Iron Superconductors.

UNIT 5 PREPARATIVE METHODS OF SOLIDS

12 Hrs.

Wagner reaction mechanism for solid state synthesis for spinel – Chemical precursor method for perovskite – Sol-gel method for silica aerogel synthesis – Self-propagating high temperature synthesis – Ion exchange reactions – Intercalation / deintercalation reactions – Methods of Single Crystal Growth: Hydrothermal method of synthesis – Czochralski method.

Max. 60 Hours

COURSE OUTCOME:

- CO1- To understand the theories and applications of electrochemistry.
- CO2- To learn electrode kinetics and the structure of electrified interfaces.
- CO3- To know the techniques like polarography, cyclic voltammetry, ion selective electrodes, amperometry.
- CO4- To study the basic concept of solid state chemistry.
- CO5- To understand the importance of crystal defects, nonstoichiometry
- CO6- To learn the various preparative methods crystalline solids.

TEXT / REFERENCE BOOKS

1. J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry 1: Ionics, Springer, 2nd Edition, 1998.
2. O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry 2A: Electrodics, Springer, 2nd Edition, 1998.
3. Samuel Glasstone, An Introduction to Electrochemistry, Reed Books, 2007.
4. Allen J. Bard, Larry R. Faulkner, Electrochemical Methods: Fundamentals and Applications, John Wiley & Sons, 2nd Edition, 2001.
5. H.V. Keer, Principles of the Solid State, Wiley Eastern Limited, 1993.
6. D.K. Chakrabarty, Solid State Chemistry, New Age Publishers, 1996.
7. L.E. Smart, E.A. Moore, Solid State Chemistry: An Introduction, CRC Press, 4th Edition, 2012.
8. Sandra E Dann, Reactions and Characterization of Solids, RSC, 2000.
9. A.R. West, Solid State Chemistry and Its Applications, Wiley, 2nd Edition, 2014.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 6 Questions each carrying 5 marks without choice

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

(Out of 100 marks, maximum of 10% problems may be asked)

Exam Duration : 3 Hrs.

30 Marks

70 marks

Skill Development

SCYA 1301	GENERAL CHEMISTRY III	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To learn the chemical reactions and theories of acids and bases, oxidation reduction processes and electron transfer reactions.
- To understand the properties and chemical reactions of s-block elements and their compounds.
- To learn the preparation, nomenclature and structure of halogen compounds, dienes and alkynes.
- To understand stereochemistry of organic compounds from geometric isomerism, conformers and their interconversions.
- To study the solution laws and properties of binary solutions and dilute solutions

UNIT 1 ACIDS AND BASES

9 Hrs.

Types of chemical reactions- Acid-base, oxidation-reduction, electron transfer and double decomposition reactions. Balancing chemical reactions by oxidation number and ion electron method. Theories of acids and bases- Arrhenius theory - Bronsted-Lowry theory - Lewis theory - solvent system - Lux-Flood definition and Usanovich definition, HSAB concept.

UNIT 2 s-BLOCK ELEMENTS

9 Hrs.

Chemical properties of the group metals: reaction with water, air, nitrogen; uses of s-block metals and their compounds. Compounds of s-block metals: oxides, hydroxides, peroxides, superoxides - preparation and properties; oxo salts - carbonates, bicarbonates, nitrates; halides and polyhalides; anomalous behavior of Li, Be and B, extraction of beryllium. Complexes of s-block metals: complexes with crown ethers, biological importance of sodium and potassium.

UNIT 3 ALKENES, DIENES AND CYCLOALKENES

9 Hrs.

Structure and Nomenclature-Methods of Preparation-Dehydration of alcohols, dehydrohalogenation of alkyl halides-Elimination reactions- Hoffmann and Saytzeff rules- dehalogenation-Physical and Chemical Properties-Addition of hydrogen, halogen, hydrohalogenation(Markovnikov's and Anti-Markovnikov's rule)- Epoxidation, Ozonolysis, Polymerization-Dienes-Conjugated, Non-conjugated dienes, cumulative dienes-Structure-1, 3-butadiene-Preparation and properties-Diels Alder reaction.Cycloalkenes- Structure and Nomenclature- Methods of preparation-Physical and chemical properties cyclopentadiene and cyclohexene.

UNIT 4 ALKYNES

9Hrs

Nomenclature- Preparation- Dehydrohalogenation, Dehalogenation, alkylation of acetylene-Physical properties, Chemical properties- Electrophilic addition Addition of halogen, halogen acids- Nucleophilic addition: Addition of HCN, NH₃, acids and alcohols- Oxidation- Hydroboration- Reduction- Metal-ammonia reactions-Formation of sodium or lithium alkynide.

UNIT 5 SOLUTIONS

9Hrs

Types of solutions- Raoult's law and Henry's law. Deviation from Raoult's law and Henry's law-ideal and non-ideal solutions- Binary solutions: fractional distillation-Azeotropic mixture-immiscible liquids-steam distillation-partially miscible liquids-critical solution temperature-phenol-water system-aniline-hexane system-Nicotine-water system. Dilute solutions: Colligative properties, relative lowering of vapour pressure, osmosis, Law and osmotic pressure, Thermodynamic derivation of elevation of boiling point and depression in freezing point. Determination of molecular masses using the above properties.

Max.45 Hrs.

COURSE OUTCOMES

On successful completion of the course, student will be able to

CO1: Examine the mechanism involved in various theories of acids and bases

CO2: Assess the structure and reactivity of s-block elements

CO3: Examine the physical and chemical properties of alkenes, dienes and cycloalkenes

CO4: Apply the electrophilic and nucleophilic addition mechanism to the alkyne reactions

CO5: Apply the laws of solutions to determine the colligative properties for dilute solutions and critical solution temperature for binary solutions

CO6: Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCE BOOKS

1. Kalsi P. S., Stereochemistry, 3rd Edition, New Age International Publishers, 1995.
2. Selected topics in inorganic chemistry, R D Madan, G D Tuli & Wahid U Malik, S.Chand publication, 1976.
3. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
4. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
5. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
6. L. Finar, Organic Chemistry, Vol-1, 6th ed., Pearson Education Asia. 2004.
7. B. R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chandand Co. 23rd edition, 1993.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 Marks each-No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

Skill Development

SCYA 1401	GENERAL CHEMISTRY-IV	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To understand the structure and properties of important boron and carbon compounds
- To learn the trend observed for the nitrogen and oxygen groups and understand the structural importance in forming nitrogen and phosphorous compounds.
- To learn the preparation of Nitrogen and Oxygen group elements
- To appreciate the concept of stereochemistry and optical isomerism
- To learn the properties of colloidal systems, emulsions and macromolecules

UNIT 1 BORON AND CARBON GROUP ELEMENTS

9 Hrs.

Group 13 (Boron group): Extraction of B and Si - types of compounds - reactions involving Boron - Compounds of boron with oxygen - boron sesquioxide – borates – borax; Boron hydrides - reaction with ammonia, hydroboration, structure of boranes – uses of Boron hydrides – Aluminium - amphoteric behaviour - aluminates.

Group 14 (Carbon group): Catenation and heterocatenation - allotropes of carbon - graphite, diamond, fullerenes and carbon nanotubes (structural features and uses); carbides - salt-like carbides, interstitial carbides, covalent carbides; Silicates - ortho-, pyro-, cyclic-, chain-, sheet - three dimensional silicates - properties and structures - silicates in technology - alkali silicates.

UNIT 2 NITROGEN AND OXYGEN GROUP ELEMENTS

9 Hrs.

Group-15 (Nitrogen group): metallic and nonmetallic character - compounds of Nitrogen - N₂H₄, NH₂OH, HN₃ - Phosphorous compounds - halides and oxohalides. Group-16 (Oxygen group): Types of oxides - basic oxides, amphoteric oxides, acidic oxides, neutral oxides. Oxides of sulphur - S₂O, SO₃ - oxyacids of sulphur - thionic acid series - peroxyacid series – oxohalides - thionyl compounds (methods of preparation and properties).

UNIT 3 STEREOCHEMISTRY-I

9 Hrs.

Geometrical Isomerism- Cis and trans, syn and anti, E and Z notations- Cis-trans interconversion- Conformational isomerism: Conformers, dihedral angle, torsional strain- Conformational analysis of ethane and n-butane, conformers of cyclohexane (Chair, boat and skew boat forms), axial-equatorial positions and their interconversions, conformers of mono and disubstituted cyclohexanes - diaxial interactions.

UNIT 4 STEREOCHEMISTRY – II

9 Hrs.

Optical isomerism – Chirality – Measurement of optical activity – Specific rotation – Enantiomerism and Diastereomerism - Wedge, Fischer, Newmann and Sawhorse projection formulae – Difference between Configuration and Conformation - Absolute and Relative configuration - D and L notation - Cahn-Ingold-Prelog's rules – R and S notation – Optical isomerism in compounds containing more than one carbon atom – Isomerism in tartaric acid - Racemic modification – Racemization - Resolution of racemic mixtures – Asymmetric synthesis (definition only) - Walden inversion.

UNIT 5 COLLOIDS AND MACROMOLECULES

9 Hrs

Colloidal systems – classification – preparation – purification of colloids- Properties of colloids: Kinetic, optical and electrical properties. Emulsions: Types of emulsions, preparation, properties and applications, Donnan membrane equilibrium- applications of colloids. Macromolecules- Different types of polymers – classification of polymers. Molecular weight of polymers – number average and weight averages – determination of molecular weight of polymer – osmotic pressure and light scattering methods.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

- CO1: Examine the properties of boron and carbon group elements
 CO2: Analyze the metallic and non-metallic character of nitrogen group elements and nature of oxides of oxygen group elements
 CO3: Apply the concept of conformation analysis to the conformations of acyclic and cyclic compounds
 CO4: Apply the configurational rules for assigning the absolute and relative configuration to organic molecules
 CO5: Examine the properties and industrial applications of colloids and macromolecules
 CO6: Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCE BOOKS

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
2. Selected topics in inorganic chemistry, R D Madan, G D Tuli & Wahid U Malik, S.Chand publication, 1976.
3. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
4. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
5. I. L. Finar, Organic Chemistry, Vol-1, 6th ed., Pearson Education Asia. 2004.
6. Kalsi P. S., Stereochemistry, 3rd Edition, New Age International Publishers, 1995.
7. Eliel E. L., Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
8. B. R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co. 23rd edition, 1993.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

Skill Development