

SCYB5101	ORGANIC REACTIONS AND REAGENTS	L	T	P	EL	Credits	Total Marks
		3	0	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 understand the mechanism of nucleophilic and electrophilic substitution reactions.

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 SUBSTITUTION REACTIONS**12 Hrs.**

Aliphatic Nucleophilic substitution: Types of nucleophiles – attacking nucleophile, ambident nucleophiles, hard and soft Nucleophiles. S_N1 , S_N2 and S_Ni 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 - S_E2 and S_{Ei} , S_{E1} , Substitution by double bond shifts. Effect of substrates, leaving group and solvent polarity on the reactivity.

Aromatic Electrophilic Substitution reactions - 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: S_NAr , S_N1 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 3 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: $E1$, $E1CB$ and $E2$ mechanism, Syn elimination, Orientation Effects in Elimination. Reactions - Pyrolytic eliminations, Chugaev reaction.

UNIT 4 OXIDATION REAGENTS**12 Hrs.**

Oxidation reagents: Potassium permanganate, HIO_4 , OsO_4 , MnO_2 – Alcohol to carbonyls: Cr (VI) oxidants, PCC, PDC, Jones Reagent, 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, Red Aluminium, Electrophilic metal hydrides: BH_3 , AlH_3 .

Functional group transformations: Use of organo-lithium compounds – Lithium diisopropyl amide (LDA) Protecting groups – Protection of hydroxyl, carboxylic acid, amine and carbonyl compounds by protecting groups.

UNIT 5 ORGANO METALLIC REAGENTS**12 Hrs.**

Organo magnesium reagents, organo-lithium, Organo Zinc reagents, Organo cadmium Reagents, Organo Copper reagents, Organo Lead reagents, Organo silicon compounds. Tri-N-butyltinhydride

Max. 60 Hrs.**COURSE OUTCOMES**

On completion of the course the student will be able to

- CO1** - Understand the nature of bonding, conjugation, aromaticity, anti-aromaticity and non-aromaticity in organic molecules
- CO2** - Formulate the mechanism of aliphatic nucleophilic and electrophilic substitution reactions.
- CO3** - Evaluate the mechanism of aromatic nucleophilic and electrophilic substitutions reactions.
- CO4** - Illustrate the mechanism of addition and elimination reactions.
- CO5** - Interpret the products in organic chemical reactions involving oxidizing and reducing reagents.
- CO6** - 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 EXAMINATION 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 with internal choice, each carrying 16 marks
(Out of 100 Marks, maximum of 10% problems may be asked.)

80 Marks

SCYB5103	THERMODYNAMICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To construct second law of thermodynamics, concept of entropy and Carnot cycle.
- To understand the partition function for distinguishable and indistinguishable molecules.
- 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**12 Hrs.**

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**12 Hrs.**

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 Hrs.**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 EXAMINATION 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 with internal choice, each carrying 16 marks
(Out of 100 Marks, maximum of 10% problems may be asked.)**80 Marks**

SCYB5104	ANALYTICAL CHEMISTRY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study the concepts of various spectrometric analytical techniques
- To gain knowledge about working principle of separation & electroanalytical techniques
- To understand the basic concepts of TGA/DSC as thermal methods of analysis

UNIT 1 ABSORPTION SPECTROSCOPY**12 Hrs.**

Atomic absorption spectroscopy - Theory, instrumentation (flame and flameless atomization), Interferences - spectral and chemical - determination of calcium and magnesium in water, estimation of tin in canned food, applications of AAS, Flame Spectrometry - Principle, instrumentation and interferences, determination of alkali metals, applications.

UNIT 2 CHROMATOGRAPHIC TECHNIQUES**12 Hrs.**

General aspects of Chromatography - Gas chromatography: Principle – Types – nature and selection of stationary and mobile phases – solid supports – sampling methods - instrumentation – Detectors: FID – TCD and ECD – qualitative and quantitative applications of GC-MS - Liquid Chromatography: Types – Applications - HPLC: Principle – Theory and equipments – types of pumps and their choice – types of columns – choice of column materials – detectors and applications. Electrophoresis: Principle – Instrumentation – Capillary and Gel electrophoresis.

UNIT 3 THERMAL METHODS OF ANALYSIS**12 Hrs.**

Introduction: TG and DTG – Instrumentation – Thermogram – Factors affecting thermograms – Thermal decomposition study of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ - Applications of thermogravimetry. Differential thermal analysis: Theory – DTA curves – Factors affecting DTA curves – Instrumentation – Applications of DTA - Correlation of DTA and TGA data with examples — DSC: Principle – Instrumentation - Applications of DSC.

UNIT 4 ELECTROANALYTICAL METHODS**12 Hrs.**

Electrogravimetry: Theory – electronegativity – order of deposition – over potential – polarization curves – constant potential and consecutive deposition – selective deposition – constant current deposition and deposition of complex ions - estimation of copper. Coulometry: Principle, Faraday's laws – types of coulometers – coulometric titrations – internal and external generation – coulogravimetry and applications.

Potentiometry: Principle, standard and formal potentials – types of electrodes – Glass membrane and ion-selective electrodes - potentiometric titration based on Fe^{2+} - Ce^{4+} system - Biochemical electrodes.

UNIT 5 SPECTROMETRY**12 Hrs.**

Spectrophotometry: Introduction - Beer Lambert's law - significance of molar extinction coefficient, UV-visible spectrophotometry - photometric titration – Determination Fe(III) involving EDTA as ligand, determination of Fe(III) in the presence of aluminium.

Turbidimetry and Nephelometry: Principle - instrumentation - applications

Fluorimetry: Principles of fluorescence - factors affecting fluorescence emission - instrumentation - applications.

COURSE OUTCOME

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

- 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.
5. J. H. Kennedy, Analytical Chemistry Principles, Saunders College Publishing, New York, II Edition, 1990.

END SEMESTER EXAMINATION 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 with internal choice, each carrying 16 marks
(Out of 100 Marks, maximum of 10% problems may be asked.)

80 Marks

SCYB5204	COMPUTATIONAL CHEMISTRY	L	T	P	EL	Credits	Total Marks
		3	0	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.

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.

Case study: Derivation of Schrodinger equation for H_2 molecule by molecular mechanics and variational method.

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.

Case study: Identify the basis set of H_2 molecule for polarization and diffuse functions.

UNIT 4 THE HARTREE-FOCK METHOD AND BEYOND

12 Hrs.

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

Case study: Determine the basis set of H_2 molecule for Hartree-Fock and DFT theory.

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.

Case study: Determine the behaviour of bulk of H_2O molecule by considering the time step and time scale.

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 EXAMINATION 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 with internal choice, each carrying 16 marks
(Out of 100 Marks, maximum of 10% problems may be asked.)**80 Marks**

SCYB6201	COMPUTATIONAL CHEMISTRY LAB	L	T	P	EL	Credits	Total Marks
		0	0	3	0	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.

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

Exp-2: Design the method of calculating the lowest energy structure by Gaussian software.

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

Exp -4: Describe the vibrational frequency calculation by Gaussian software.

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: Construction and implementation of the geometry optimization process for organic complexes.

Exp -7: Construction and implementation of the geometry optimization process for transition metal complexes.

Exp -8: Investigate the absorption spectra for fullerenes.

Exp -9: Construction and implementation of the geometry optimization process for polymer materials.

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 optimization process.
- CO3** - Identify the orbital diagram computationally.
- CO4** - Interpret the vibrational spectra computationally.
- CO5** - Investigate the absorption spectra for solar cell materials.
- CO6** - Implement the knowledge 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: 6 Hrs.

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

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

CO1- Understand the various types of bonding and conjugation in organic molecules and concept of aromaticity, anti-aromaticity and non-aromaticity

CO2- Apply the Huckel rule for benzenoid and non-benzenoid compounds

CO3- Learn the stability and reactivity of carbocations, carbanions and free radicals and concept of NGP, Field effects.

CO4- 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

CO5- Discuss the mechanism of aromatic nucleophilic and electrophilic substitutions such as arenium ion mechanism, orientation, reactivity and $SNAr$, SN^1 and Benzyne mechanisms

CO6- 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)

LIST OF ELECTIVES OF THIRD SEMESTER

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

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**

S03BPT / S03APT	SUMMER INTERNSHIP / COMMUNITY INTERNSHIP	L	T	P	EL	Credits	Total Marks
		0	0	0	6	2	100

COURSE OBJECTIVES

- To make our student to prepare for industry ready

INTERNSHIP REPORT: 60 Marks

About the industry, Protocol of Industry, Industry safety, R&D lab, ETP etc.,

VIVA-VOCE: 40 Marks

Communication

Presentation using Teaching aids

Language and diction

Interpretation of Technical data

S91BPT/ S91 APT	SUMMER INTERNSHIP/ COMMUNITY INTERNSHIP	L	T	P	EL	Credits	Total Marks
		0	0	0	15	5	100

COURSE OBJECTIVES

- To make our student to prepare for industry ready

INTERNSHIP REPORT: 60 Marks

About the industry, Protocol of Industry, Industry safety, R&D lab, ETP etc.,

VIVA-VOCE: 40 Marks

Communication

Presentation using Teaching aids

Language and diction

Interpretation of Technical data

S03 PROJECT	PROJECT	L	T	P	C	Max. Marks
		0	0	0	4	100

COURSE OBJECTIVES

1. To learn the theoretical and experimental basis of synthetic and analytical methods.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:Able to synthesis and interpretation of the results independently

CO2:To improve the technical presentation skills.

SCYA 3010	SYNTHETIC ORGANIC CHEMISTRY	L	T	P	C	Max. Marks
		3	1	0	3	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**9Hrs.**

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**9 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**9 Hrs.**

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

UNIT 4 SYNTHETIC NAME REACTIONS – II**9Hrs.**

Synthetic reactions :Mannich reaction – Mannich bases – Robinson annulations. The Shapiro reaction, Stork–enamine reaction. Use of dithioacetals – Umpolung, phase transfer catalysis – mechanisms and use of benzyl trialkyl ammonium halides. Wittig reaction.

UNIT 5 MOLECULAR REARRANGEMENTS**9Hrs**

Types of rearrangement (nucleophilic and electrophilic) - Classification as anionotropic, cationotropic, free radical, inter and intramolecular - Mechanism and Stereochemical aspects of Pinacol-pinacolone rearrangement, Beckmann, Hoffmann, Curtius and Benzilic acid rearrangements – Benzidine, Lossen and Schmidt rearrangements Wagner-Meerwein and Fries rearrangement.

Max. 45 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: Outline the mechanisms for the named reactions

CO5: Propose a strategic plan for molecular rearrangements.

CO6: Design and predict the reaction mechanism in electrophilic, nucleophilic 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.)

SCYA 3009	INDUSTRIAL CHEMISTRY	L	T	P	Credits	Total Marks
		3	1	0	3	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.
CO6:Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCES

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

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.)

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 TERPENOID AND CAROTENOID**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.)