PSO-7: Research motivation: Chemistry graduates are expected to be technically well trained with modern devices and Chemistry based software and has powerful knowledge in different disciplines of Chemistry so they can easily involve themselves in theory and laboratory-based research activities.

PSO-8: Teamwork: Graduates are expected to be team players, with productive co-operations involving members from diverse socio-cultural backgrounds.

PSO-9: Digital Literacy: Graduates are expected to be digitally literate for them to enroll and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning.

PSO-10: Social Awareness: As an inhabitant of this green world it is our duty to make our planet clean and suitable for living to all. In this context Chemistry graduates are expected to be more aware about finding green chemical reaction routes for sustainable development. They are expected to maintain good laboratory practices and safety.

FIRST YEAR - SEMESTER I

PAPER – 1

GENERAL CHEMISTRY – I

Learning Objectives	
LO1	To understand the all basic facts and concepts of inorganic and organic chemistry students will learn the atomic structure and basic concepts of organic chemistry like hybridisation conjugation field effects aroma city and reactive intermediates.
LO2	Students will learn the atomic structure through the basic Concept of quantum mechanics
LO3	They will understand the chemical bonding through VBT, MOT and CFT.
LO4	This organic chemistry part contains preparation and properties of aliphatic hydrocarbons.
LO5	The unit has been designed to give an insight into almost all aspects of stereochemistry and to build a solid platform in this specific field

Course Objectives: Students will be empowered with basic to advance knowledge of organic and in organic chemistry.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Recollect the Chemistry of Quantum Numbers.	**PO1**
CO2	Review and apply periodicity of properties	**PO1, PO2**

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CO3	Discuss various types of bonding through VB & MO theories.	PO4, PO6
CO4	Name simple Aliphatic and Aromatic Compounds	PO4, PO5, PO6
CO5	Illustrate and apply electron displacement effects and reaction mechanisms.	PO3, PO8

SEMESTER II
PAPER – 2
GENERAL CHEMISTRY - II

Learning Objectives	
LO1	Describe the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in day-to-day life.
LO2	Employ critical thinking for solving problems using basic chemistry knowledge and concepts.
LO3	Acquire skills in handling scientific instruments, planning and performing laboratory experiments and drawing logical inferences from the chemical experiments
LO4	Create an intellectual curiosity and ability to think in a scientific manner and get sensitized to social and environmental realities
LO5	Develop an interest in pursuing higher studies in Chemistry and related subjects which are relevant to employment and entrepreneurship.

Course Objectives: Students will be empowered with basic to advance knowledge on s- and p-Block Elements, Group Study, Hydrocarbons, Cycloalkanes, Dienes, Quantum Chemistry, Thermochemistry, First Law of Thermodynamics, Derivation of Equations, Related Problems, Reaction Mechanism and Applications wherever necessary are to be taught for II- Semester

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Compare the basic properties of elements and their Compounds of s & p –block elements.	PO1
CO2	Explain the reaction mechanisms of alkanes, alkenes and alkynes and predict the products	PO1, PO2
CO3	Classify dienes and analyze the stability of alkanes, alkenes and cycloalkanes	PO4, PO6
CO4	Recollect the basic concepts of Quantum Theory and Thermodynamics.	PO4, PO5, PO6
CO5	Calculate the thermodynamic parameters using thermo chemical equations and data	PO3, PO8

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SEMESTER – III

PAPER – 3

GENERAL CHEMISTRY – III

Learning Objectives	
LO1	To know the basic concepts of semi -micro concepts
LO2	To study the fundamental Reactions involved in Carbon family, Nitrogen family and Oxygen family
LO3	To learn about Aromaticity Its Simple Applications
LO4	Helps to understand about the Aliphatic Nucleophilic Substitutions Aromatic Nucleophilic Substitutions
LO5	To learn in detail about the first and second laws of Chemical Thermodynamics and the related terms; to get idea about thermo-chemistry and thermodynamic relationships and system of variable compositions

Course Objectives: Basic concepts regarding the Principles of Inorganic Analysis and Applications of Qualitative Analysis, Types of Solvents, p- Block Elements, Group Study, Aromaticity, Electrophilic and Nucleophilic Substitution Reactions, Elimination Reactions, Reaction Mechanism, Second Law of Thermodynamics, Derivation of Equations, Related Problems and Applications wherever necessary are to be taught for III semester.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Compare the basic properties of elements and their Compounds of s & p –block elements.	**PO1**
CO2	Explain the reaction mechanisms of alkanes, alkenes and alkynes and predict the products	**PO1, PO2**
CO3	Classify dienes and analyze the stability of alkanes, alkenes and cycloalkanes	**PO4, PO6**
CO4	Recollect the basic concepts of Quantum Theory and Thermodynamics.	**PO4, PO5, PO6**
CO5	Calculate the thermodynamic parameters using thermo chemical equations and data	**PO3, PO8**

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SKILL BASED SUBJECT
PAPER – 1
WATER TREATMENT AND ANALYSIS

Learning Objectives	
LO1	To know the basic concepts of Purification of Water for drinking purpose
LO2	To study about determination of Hardness of water
LO3	To learn about Effluent Treatment of Water from Paper Industry, Petrochemicals, Fertilizer industry and Power station
LO4	Helps to understand about Water in Industry – Pollution of Water by Fertilisers, Detergents, Pesticides and Industrial wastes
LO5	To learn in detail about Methods of removing Radioactivity from Water.

Course Objectives: To impart knowledge about the various methods of Water Analysis and Treatment of Water.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To Explain significant standards and regulations in the water industry	PO1
CO2	To Demonstrate knowledge of chemicals and methods used for coagulation and flocculation	PO1, PO2
CO3	Indicate knowledge and application of different filtration methods	PO4, PO6
CO4	To Indicate knowledge and application of different types of disinfectants	PO4, PO5, PO6
CO5	To Explain common biological wastewater treatment processes	PO3, PO8

NON-MAJOR ELECTIVE
PAPER – 1
MEDICINAL CHEMISTRY

Learning Objectives	
LO1	To Explain significant standards and regulations in the water industry
LO2	To Demonstrate knowledge of chemicals and methods used for coagulation and flocculation
LO3	Indicate knowledge and application of different filtration methods
LO4	To Indicate knowledge and application of different types of disinfectants
LO5	To Explain common biological wastewater treatment processes

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Course Objectives: Upon completion of the course the student shall be able to To learn the basic idea of Drugs and Names of Common Drugs, Blood, Blood Pressure, Diabetes, AIDS, Vitamins, Indian Medicinal Plants and First Aid.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Helps in correlating between pharmacology of a disease and its mitigation or cure...	**PO1**
CO2	To understand the drug metabolic pathways, adverse effect and therapeutic value of drugs	**PO1, PO2**
CO3	To know the structural activity relationship of different class of drugs.	**PO4, PO6**
CO4	Well acquainted with the synthesis of some important class of drugs.	**PO4, PO5, PO6**
CO5	To understand the chemistry of drugs with respect to their pharmacological activity	**PO3, PO8**

SEMESTER – IV

PAPER – 4

GENERAL CHEMISTRY – IV

Learning Objectives	
LO1	To know the basic concepts of Position of Noble Gases in the Periodic Table
LO2	To learn about Monocarboxylic acids ,Dicarboxylic acids and Amines
LO3	To learn in detail about Alcohols and Phenols
LO4	Helps to understand about Free energy and Work function, Gibbs-Helmholtz equation
LO5	To learn in detail about the first and second laws of Chemical Thermodynamics and the related terms; to get idea about thermo-chemistry and thermodynamic relationships and system of variable compositions.

Course Objectives: Noble gases, Carboxylic Acids, Amines, Alcohols, Phenols, Naphthols, Important Name Reactions, Mechanism, Thermodynamics, Derivation of Equations, Partial Molar Properties, Chemical Potential, Related Problems and Applications are to be taught for IV semester.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of position of noble gases in the periodic table	**PO1**

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CO2	To understand the basic concept of carboxylic acids	**PO1, PO2**
CO3	To learn about the basic concepts Alcohols and Phenols	**PO4, PO6**
CO4	To gain vast knowledge Free energy and Work function, Gibbs-Helmholtz equation	**PO4, PO5, PO6**
CO5	To learn the basic concepts of first and second laws of Chemical Thermodynamics and the related terms; to get idea about thermo-chemistry and thermodynamic relationships and system of variable compositions.	**PO3, PO8**

SKILL BASED SUBJECT
PAPER – 2
FOOD CHEMISTRY

Learning Objectives	
LO1	To know the basic concepts of Position of Noble Gases in the Periodic Table
LO2	To learn about Monocarboxylic acids ,Dicarboxylic acids and Amines
LO3	To learn in detail about Alcohols and Phenols
LO4	Helps to understand about Free energy and Work function, Gibbs-Helmholtz equation
LO5	To learn in detail about the first and second laws of Chemical Thermodynamics and the related terms; to get idea about thermo-chemistry and thermodynamic relationships and system of variable compositions.

Course Objectives: To impart knowledge about Different Foods, Their Nutritive Values and Food Preservation

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Cereals , Pulses, Medicinal value of Cereals and Pulses.	**PO1**
CO2	To understand the basic concept of Vegetables and Fruits	**PO1, PO2**
CO3	To learn about the basic concepts of Fruit Beverages	**PO4, PO6**
CO4	To gain vast knowledge Food Preservatives	**PO4, PO5, PO6**
CO5	To learn the basic concepts of Packaging of Foods	**PO3, PO8**

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NON – MAJOR ELECTIVE
PAPER – 2
CHEMISTRY IN EVERY DAY LIFE

Learning Objectives	
LO1	To know the basic concepts of General Survey of Chemicals used in everyday life.
LO2	To learn about Food and Nutrition
LO3	To learn in detail about Food Preservatives
LO4	Helps to understand about Plastics , Natural Rubber , Antipyretics,
LO5	To learn in detail about the Fertilizers Uses and Hazards

Course Objectives:

To know the basics of Chemistry in our life

To know about the Food Colours, Plastics, Drugs etc.,

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of General Survey of Chemicals used in everyday life	**PO1**
CO2	To understand the basic concept of Food and Nutrition	**PO1, PO2**
CO3	To learn about the basic concepts of Food Preservatives	**PO4, PO6**
CO4	To gain vast knowledge of Plastics , Natural Rubber , Antipyretics	**PO4, PO5, PO6**
CO5	To learn the basic concepts of Fertilizers Uses and Hazards	**PO3, PO8**

SEMESTER – V
PAPER – 5
INORGANIC CHEMISTRY – I

Learning Objectives	
LO1	To know the basic concepts of Interhalogen compounds
LO2	To learn about Coordination compounds
LO3	To learn in detail about Calculation of CFSE In Octahedral and Tetrahedral Complexes.
LO4	Helps to understand about Applications of Coordination Compounds in Qualitative and Quantitative Analysis
LO5	To learn in detail about the Application of XRD to Crystal studies

Course Objectives:

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To study about the Halogens and Related compounds.

- To give students a firm grounding in Co-ordination chemistry and Solid state Chemistry

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Interhalogen compounds	**PO1**
CO2	To understand the basic concept of Coordination compounds	**PO1, PO2**
CO3	To learn about the basic concepts of Calculation of CFSE In Octahedral and Tetrahedral Complexes.	**PO4, PO6**
CO4	To gain vast knowledge of Applications of Coordination Compounds in Qualitative and Quantitative Analysis	**PO4, PO5, PO6**
CO5	To learn the basic concepts of Application of XRD to Crystal studies	**PO3, PO8**

PAPER – 6

ORGANIC CHEMISTRY – I

Learning Objectives	
LO1	To know the basic concepts of Structural elucidation of Glucose and Fructose
LO2	To learn about Stereoisomerism
LO3	To learn in detail about Conformational analysis of Ethane and n-Butane.
LO4	Helps to understand about Reagents and their Applications in Organic Chemistry
LO5	To learn in detail about the Preparation and properties of Pyridine and Piperidine

Course Objectives:

- To effectively impart knowledge about Carbohydrates, Stereochemistry, Conformational Analysis, Nitroalkanes and Heterocyclic chemistry.
- To make the students more inquisitive in learning the Mechanistic details in Organic Chemistry through the teaching of the named reactions.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Structural elucidation of Glucose and Fructose	**PO1**
CO2	To understand the basic concept of Stereoisomerism	**PO1, PO2**
CO3	To learn about the basic concepts of Conformational analysis of Ethane and n-Butane	**PO4, PO6**
CO4	To gain vast knowledge of Reagents and their Applications in Organic Chemistry	**PO4, PO5, PO6**

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CO5	To learn the basic concepts of Preparation and properties of Pyridine and Piperidine	PO3, PO8

PAPER- 7
PHYSICAL CHEMISTRY – I

Learning Objectives	
LO1	To know the basic concepts of Nernst distribution law – Definition - Thermodynamic derivation – Applications
LO2	To learn about Applications of phase rule
LO3	To learn in detail about Colligative properties and Chemical Equilibrium
LO4	To gain vast knowledge on chemical equilibrium and electrochemistry.
LO5	To learn in detail about the Concept of pH & Buffer solutions

Course Objectives:
To impart knowledge about the Solutions, Phase Rule and its Applications, Colligative properties, Chemical Equilibrium, Phase Rule and its Applications, Electrochemistry and its Applications

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Nernst distribution law – Definition - Thermodynamic derivation – Applications	PO1
CO2	To understand the basic concept of Applications of phase rule	PO1, PO2
CO3	To learn about the basic concepts of Colligative properties and Chemical Equilibrium	PO4, PO6
CO4	To gain vast knowledge of chemical equilibrium and electrochemistry.	PO4, PO5, PO6
CO5	To learn the basic concepts of pH & Buffer solutions	PO3, PO8

ELECTIVE
PAPER – 1
A. ANALYTICAL CHEMISTRY – 1

Learning Objectives	
LO1	To know the basic concepts of Data analysis – Types of errors
LO2	To learn about Purification of organic compounds
LO3	To learn in detail about Different Spectroscopic Techniques and their Application
LO4	To gain vast knowledge on Principles of IR Spectroscopy
LO5	To learn in detail about the Raman Spectroscopy

Course Objective:

- To impart knowledge about Data Analysis, Purification of organic compounds, Different Spectroscopic Techniques and their Application

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	

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CO1	To learn the basic concepts of Data analysis – Types of errors	**PO1**
CO2	To understand the basic concept of Purification of organic compounds	**PO1, PO2**
CO3	To learn about the basic concepts of Different Spectroscopic Techniques and their Application	**PO4, PO6**
CO4	To gain vast knowledge of Principles of IR Spectroscopy	**PO4, PO5, PO6**
CO5	To learn the basic concepts of Raman Spectroscopy	**PO3, PO8**

PAPER – 1
B. BASICS OF COMPUTER PROGRAMMING IN C AND ITS APPLICATIONS IN CHEMISTRY

Learning Objectives	
LO1	To know the basic concepts of Basic Computer Organisation
LO2	To learn about Computer Languages
LO3	To learn in detail about Control Structures
LO4	To gain vast knowledge on applications in solving problems in Chemistry
LO5	To learn in detail about Calculation of pH, Solubility Product

Course Objective:

- To introduce the basics of computers.
- To learn C language and its applications in solving problems in Chemistry

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Basic Computer Organisation	**PO1**
CO2	To understand the basic concept of Computer Languages	**PO1, PO2**
CO3	To learn about the basic concepts of Control Structures	**PO4, PO6**
CO4	To gain vast knowledge of applications in solving problems in Chemistry	**PO4, PO5, PO6**
CO5	To learn the basic concepts Calculation of pH, Solubility Product	**PO3, PO8**

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PAPER – 1
C. ORGANIC SYNTHESIS

Learning Objectives	
LO1	To know the basic concepts of disconnection approach
LO2	To learn about protecting groups
LO3	To learn in detail about one group c-c disconnections
LO4	To gain vast knowledge on two group c-c disconnections
LO5	To learn in detail about ring synthesis

Course Objective:

To know the Basics of Retrosynthesis.

- To impart knowledge about the Ring Synthesis

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of disconnection approach	**PO1**
CO2	To understand the basic concept of protecting groups	**PO1, PO2**
CO3	To learn about the basic concepts of one group c-c disconnections	**PO4, PO6**
CO4	To gain vast knowledge of two group c-c disconnections	**PO4, PO5, PO6**
CO5	To learn the basic concepts ring synthesis	**PO3, PO8**

ELECTIVE
PAPER – 2
A. PHARMACEUTICAL CHEMISTRY

Learning Objectives	
LO1	To know the basic concepts of Various Diseases and Their Treatment
LO2	To learn about Importance of Indian Medicinal Plants and Different Types of Drugs
LO3	To learn in detail about Antibacterials ,Antiseptics and Disinfectants Vitamins
LO4	To gain vast knowledge on Drugs affecting CNS
LO5	To learn in detail about Biological functions – Disorders of Hyposecretion and Hypersecretion of Hormones.

Course Objective:

To effectively impart knowledge about Various Diseases and Their Treatment, Importance of Indian Medicinal Plants and Different Types of Drugs. Preparation, Synthesis and Structural Determination are not required for the Compounds mentioned

Course Outcomes

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Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Various Diseases and Their Treatment	PO1
CO2	To understand the basic concepts of Importance of Indian Medicinal Plants and Different Types of Drugs	PO1, PO2
CO3	To learn about the basic concepts Antibacterials, Antiseptics and Disinfectants Vitamins	PO4, PO6
CO4	To gain vast knowledge of Drugs affecting CNS	PO4, PO5, PO6
CO5	To learn the basic concepts Biological functions – Disorders of Hyposecretion and Hypersecretion of Hormones	PO3, PO8

ELECTIVE
PAPER – 2
B. POLYMER CHEMISTRY

Learning Objectives	
LO1	To know the basic concepts of Introduction to Polymers
LO2	To learn about Importance of Polymerization Techniques
LO3	To learn in detail about Thermoplastic and Thermosetting Resins
LO4	To gain vast knowledge on Chemistry of Commercial Polymers
LO5	To learn in detail about Advances in Polymers

Course Objective:
To impart Knowledge about the Types of Polymers, Polymerization Techniques, Commercial Polymers and their Applications.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Introduction to Polymers	PO1
CO2	To understand the basic concepts of Polymerization Techniques	PO1, PO2
CO3	To learn about the basic concepts Thermoplastic and Thermosetting Resins	PO4, PO6
CO4	To gain vast knowledge of Chemistry of Commercial Polymers	PO4, PO5, PO6
CO5	To learn the basic concepts Advances in Polymers	PO3, PO8

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ELECTIVE
PAPER – 2
C. GREEN CHEMISTRY

Learning Objectives	
LO1	To know the basic concepts of Need for Green Chemistry
LO2	To learn about Importance of Selection of Solvents
LO3	To learn in detail about Green Techniques
LO4	To gain vast knowledge on Green Catalysis
LO5	To learn in detail about Green Reactions

Course Objective:
To impart knowledge about Green Solvents, Green Techniques, Green Catalysts and Green Reactions

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Need for Green Chemistry	**PO1**
CO2	To understand the basic concepts of Selection of Solvents	**PO1, PO2**
CO3	To learn about the basic concepts Green Techniques	**PO4, PO6**
CO4	To gain vast knowledge of Green Catalysis	**PO4, PO5, PO6**
CO5	To learn the basic concepts Green Reactions	**PO3, PO8**

SKILL BASED SUBJECT
PAPER – 3
APPLIED CHEMISTRY

Learning Objectives	
LO1	To know the basic concepts of Petrochemicals,
LO2	To learn about Paper Technology
LO3	To learn in detail about Sugar Industry
LO4	To gain vast knowledge on Explosives
LO5	To learn in detail about Photography and Diary Chemistry

Course Objective:
To impart Knowledge about Petrochemicals, Paper Technology, Sugar Industry, Explosives, Photography and Diary Chemistry,

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Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Petrochemicals	**PO1**
CO2	To understand the basic concepts of Paper Technology	**PO1, PO2**
CO3	To learn about the basic concepts of Sugar Industry	**PO4, PO6**
CO4	To gain vast knowledge of Explosives	**PO4, PO5, PO6**
CO5	To learn the basic concepts Photography and Diary Chemistry	**PO3, PO8**

SEMESTER – VI
PAPER – 8
INORGANIC CHEMISTRY – II

Learning Objectives	
LO1	To know the basic concepts of Petrochemicals, NUCLEAR CHEMISTRY
LO2	To learn about Natural Radioactivity
LO3	To learn in detail about General metallurgy and Metallurgical processes
LO4	To gain vast knowledge on General Characteristics of f- Block elements
LO5	To learn in detail about Organometallic Compounds and Bio-inorganic Chemistry

Course Objective:
To impart knowledge about Nuclear chemistry, Radioactivity, Metallurgy, Chemistry of f- Block Elements, Organometallic Compounds and Bio-inorganic Chemistry.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Nuclear Chemistry	**PO1**
CO2	To understand the basic concepts of Natural Radioactivity	**PO1, PO2**
CO3	To learn about the basic concepts of General metallurgy and Metallurgical processes	**PO4, PO6**
CO4	To gain vast knowledge of General Characteristics of f- Block elements	**PO4, PO5, PO6**
CO5	To learn the basic concepts Organometallic Compounds and Bio-inorganic Chemistry	**PO3, PO8**

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PAPER - 9
ORGANIC CHEMISTRY – II

Learning Objectives	
LO1	To know the basic concepts of Mechanisms of Molecular Rearrangements
LO2	To learn about Amino acids and Polypeptides
LO3	To learn in detail about Bio-organic chemistry through the introduction of topics such as Proteins, Nucleic acids
LO4	To gain vast knowledge on Chemistry of Natural Products such as Terpenes, Alkaloids
LO5	To learn in detail about Synthetic Applications of Acetoacetic Ester, Benzene Diazonium Chloride, Grignard Reagents and Diazomethane

Course Objective:

- To kindle interest in students in learning Bio-organic chemistry through the introduction of topics such as Proteins, Nucleic acids, Terpenes, Alkaloids etc.

- To generate Keen Interest and Thinking in Understanding the Mechanisms of Molecular Rearrangements and Synthetic Applications of Acetoacetic Ester, Benzene Diazonium Chloride, Grignard Reagents and Diazomethane.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Mechanisms of Molecular Rearrangements	**PO1**
CO2	To understand the basic concepts of Amino acids and Polypeptides	**PO1, PO2**
CO3	To learn about the basic concepts of Bio-organic chemistry through the introduction of topics such as Proteins, Nucleic acids	**PO4, PO6**
CO4	To gain vast knowledge of Chemistry of Natural Products such as Terpenes, Alkaloids	**PO4, PO5, PO6**
CO5	To learn the basic concepts of Synthetic Applications of Acetoacetic Ester, Benzene Diazonium Chloride, Grignard Reagents and Diazomethane	**PO3, PO8**

PAPER- 10
PHYSICAL CHEMISTRY – II

Learning Objectives	
LO1	To know the basic concepts of Electrochemistry
LO2	To learn about Lead Storage Battery - Fuel Cells (H2-O2 Cell)
LO3	To learn in detail about Chemical Kinetics

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LO4	To gain vast knowledge on Surface Chemistry
LO5	To learn in detail about Photochemistry

Course Objective:

To impart Knowledge about Electrochemistry, Surface Chemistry, Photochemistry, Chemical Kinetics and Theories of reaction rates

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Electrochemistry	**PO1**
CO2	To understand the basic concepts of Lead Storage Battery - Fuel Cells (H2-O2 Cell)	**PO1, PO2**
CO3	To learn about the basic concepts of Chemical Kinetics	**PO4, PO6**
CO4	To gain vast knowledge of Surface Chemistry	**PO4, PO5, PO6**
CO5	To learn the basic concepts of Photochemistry	**PO3, PO8**

ELECTIVE
PAPER – 3
A. ANALYTICAL CHEMISTRY – II

Learning Objectives	
LO1	To know the basic concept of Principles and Techniques of Chromatography
LO2	To learn about Principles and Applications of High Pressure Liquid Chromatography and Gas Chromatography
LO3	To learn in detail about Basic Instrumentation of NMR Spectroscopy
LO4	To gain vast knowledge on Basic principles of Mass Spectrum
LO5	To learn in detail about Basic Instrumentation of ESR Spectroscopy

Course Objective:

To impart knowledge about Different Chromatographic and Spectroscopic Techniques

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Principles and Techniques of Chromatography	**PO1**
CO2	To understand the basic concepts of Principles and Applications of High Pressure Liquid Chromatography and Gas Chromatography	**PO1, PO2**

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CO3	To learn about the basic concepts of Basic Instrumentation of NMR Spectroscopy	PO4, PO6
CO4	To gain vast knowledge of Basic principles of Mass Spectrum	PO4, PO5, PO6
CO5	To learn the basic concepts of Basic Instrumentation of ESR Spectroscopy	PO3, PO8

ELECTIVE PAPER – 2
B. TEXTILE CHEMISTRY

Learning Objectives	
LO1	To know the basic concept of Production, Properties and Applications of Natural Fibres
LO2	To learn about Production, Properties and Applications of Synthetic Fibres,
LO3	To learn in detail about Raw Cotton and Grey Cloth, Wool and Silk
LO4	To gain vast knowledge on Colour and Constitution, Classification of Dyes
LO5	To learn in detail about Concept of Dyeing in Textile Industry

Course Objective:

To impart knowledge about the Production, Properties and Applications of Natural and Synthetic Fibres, Colour and Constitution, Classification of Dyes and Concept of Dyeing in Textile Industry

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Production, Properties and Applications of Natural Fibres	PO1
CO2	To understand the basic concepts of Production, Properties and Applications of Synthetic Fibres,	PO1, PO2
CO3	To learn about the basic concepts of Raw Cotton and Grey Cloth, Wool and Silk	PO4, PO6
CO4	To gain vast knowledge of Colour and Constitution, Classification of Dyes	PO4, PO5, PO6
CO5	To learn the basic concepts of Concept of Dyeing in Textile Industry	PO3, PO8

ELECTIVE
PAPER – 3
C. NANO CHEMISTRY

Learning Objectives	
LO1	To know the basic concept of Basics of Nanochemistry
LO2	To learn about Introduction – Types of Nanoparticles
LO3	To learn in detail about Techniques to Synthesise Nanoparticles
LO4	To gain vast knowledge on Preparation, Properties and Applications of Nanomaterials
LO5	To learn in detail about Instrumental Techniques used in Characterisation of Nanomaterials

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Course Objective:

To introduce the Basics of Nanotechnology.

- To learn the Instrumental Techniques used in Characterisation of Nanomaterials

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Basics of Nanochemistry	**PO1**
CO2	To understand the basic concepts of Introduction – Types of Nanoparticles	**PO1, PO2**
CO3	To learn about the basic concepts of Techniques to Synthesise Nanoparticles	**PO4, PO6**
CO4	To gain vast knowledge of Preparation, Properties and Applications of Nanomaterials	**PO4, PO5, PO6**
CO5	To learn the basic concepts of Instrumental Techniques used in Characterisation of Nanomaterials	**PO3, PO8**

SKILL BASED SUBJECT
PAPER – 4
AGRICULTURE AND LEATHER CHEMISTRY

Learning Objectives	
LO1	To know the basic concept of Soil Fertility
LO2	To learn about Fertilisers and Manures
LO3	To learn in detail about Insecticides and Fungicides
LO4	To gain vast knowledge on Manufacture of Leather
LO5	To learn in detail about Treatment of Tannery effluents

Course Objective:

To learn about Soil fertility and Productivity, Soil Chemistry, Insecticides, Leather Industry and Treatment of Tannery Effluents.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To learn the basic concepts of Soil Fertility	**PO1**
CO2	To understand the basic concepts of Fertilisers and Manures	**PO1, PO2**
CO3	To learn about the basic concepts of Insecticides and Fungicides	**PO4, PO6**
CO4	To gain vast knowledge of Manufacture of Leather	**PO4, PO5, PO6**
CO5	To learn the basic concepts of Treatment of Tannery effluents	**PO3, PO8**

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MSC-CHEMISTRY

Programme Outcomes

PO-1: Disciplinary knowledge and skill: The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, use of chemical simulation software and related computational work.

PO-2: Skilled communicator: The course also helps them to understand the causes of environmental pollution and thereby applying environmental friendly policies instead of environmentally hazard ones in every aspect. The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

PO-3: Critical thinker and problem solver: The course curriculum also includes components that can be helpful to graduate students to develop critical thinking and to design, carry out, record and analyze the results of chemical reactions. Students will be able to think and apply evidence based comparative chemistry approach to explain chemical synthesis and analysis.

PO-4: Sense of inquiry: It is expected that the course curriculum will develop an inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation.

PO-5: Team player: The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.

PO-6: Skilled project manager: The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

PO-7: Digitally literate: The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, use of chemical simulation software and related computational work.

PO-8: Ethical awareness: The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.A graduate student requires understanding and developing ethical awareness or reasoning which is adequately provided through the course curriculum. Students can also create an awareness of the impact of chemistry on the environment, society, and also make development outside the scientific community.

PO-9: Environmental Awareness: As an inhabitant of this green planet a Chemistry graduate student should have many social responsibilities. The course curriculum is designed to teach a Chemistry graduate student to follow the green routes for the synthesis of chemical compounds and also find out new greener routes for sustainable development. The course also helps them to understand the causes of environmental pollution and thereby applying environmental friendly policies instead of environmentally hazard ones in every aspect.

PO-10: Lifelong learner: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available e-techniques, e-books and e-journals for personal academic growth.

PO-11: Analytical skill development and job opportunity: The course curriculum is designed in such a way that Chemistry graduate students can handle many Chemistry based software, decent instruments and advanced technologies to synthesize, characterize and analyze the chemical compounds very skillfully which a wonderful

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practice in the graduate level will bring a good opportunity to the students for getting job in industries besides academic and administrative works.

Programme Specific Outcomes

PSO-1: Core competency: The chemistry graduates are expected to gain knowledge of the fundamental concepts of chemistry and applied chemistry through theory and practical. These fundamental concepts would be reflected in the latest understanding of the field to keep continues its progression.

PSO-2: Communication skills: Chemistry graduates are expected to possess minimum standards of communication skills to read and understand documents so that they can solve their problems very methodically, independently and with logical argument. Graduates are expected to build good communication skill so that they can easily share their idea finding/concepts to others

PSO-3: Critical thinking: Chemistry graduates are expected to achieve critical thinking ability to design, carry out, record and analyze the results of chemical reactions. They can have that much potential and confidence that they can overcome many difficulties with the help of their sharp scientific knowledge and logical approaches.

PSO-4: Psychological skills: Chemistry graduates are expected to possess basic psychological skills so that they can deal with individuals and students of various socio-cultural, economic and educational levels. Psychological skills are very important for proper mind setting during performing, observing and giving conclusion of a particular reaction. It is also important for self-compassion, self-reflection, interpersonal relationships, and emotional management.

PSO-5: Problem-solving: Graduates are expected to be well trained with problem-solving philosophical approaches that are pertinent across the disciplines.

PSO-6: Analytical skill development and job opportunity: Chemistry graduates are expected to possess sufficient knowledge how to synthesize a chemical compound and perform necessary characterization and analysis in support of the formation of the product by using modern analytical tools and advanced technologies. Because of this course curriculum chemistry graduates have lot of opportunity to get job not only in academic and administrative field but also in industry.

PSO-7: Research motivation: Chemistry graduates are expected to be technically well trained with modern devices and Chemistry based software and has powerful knowledge in different disciplines of Chemistry so they can easily involve themselves in theory and laboratory-based research activities.

PSO-8: Teamwork: Graduates are expected to be team players, with productive co-operations involving members from diverse socio-cultural backgrounds.

PSO-9: Digital Literacy: Graduates are expected to be digitally literate for them to enroll and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning.

PSO-10: Social Awareness: As an inhabitant of this green world it is our duty to make our planet clean and suitable for living to all. In this context Chemistry graduates are expected to be more aware about finding green chemical reaction routes for sustainable development. They are expected to maintain good laboratory practices and safety.

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FIRST YEAR - SEMESTER I

PAPER – 1
ORGANIC CHEMISTRY – I

Learning Objectives	
LO1	To understand the all basic facts and concepts of organic chemistry students will learn the R,S Notations and basic concepts of organic chemistry like E and Z Nomenclature and Asymmetric synthesis.
LO2	Reactive intermediates and reactions involving free radicals Structure, reactivity, formation, stability and reactions involving carbocations, carbanions, free radicals, carbenes and nitrenes
LO3	They will understand the chemical reaction of aliphatic Nucleophilic and electrophilic substitution(Sn1,Sn2,Sni)
LO4	This organic chemistry part contains Aromaticity,heterocylic compound to learning annulenes.
LO5	The unit has been designed to give an insight into almost all aspects of aromatic substitution reaction,common reaction reimer tiemann reaction ary halidesreaction ziegler alklationreaction.

Course Objectives

1) To learn the basic aspects of stereochemistry
2) To gain knowledge about the reactive intermediate and reactions involving free radicals
3) To study the mechanisms of Aliphatic Nucleophilic and electrophilic substitutions
4) To learn the concepts of Aromaticity, Anti aromaticity and Homo aromaticity of Benzenoid and Non- benzenoid compounds.To accrue skill of predicting the mechanisms of Aromatic substitution reactions

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Describe the concept of Stereochemistry	PO1
CO2	Compare the stabilities of various reactive intermediates.	PO1, PO2
CO3	Analyse and propose reasonable mechanism for Substitutions in Aliphatic molecules	PO4,
CO4	Analyze the mechanisms of Aromatic Substitution reactions	PO4, PO5, PO6
CO5	Compare the stabilities of molecules based on aromaticity	PO3,

SEMESTER I
PAPER – 2
INORGANIC CHEMISTRY - I

Learning Objectives	
LO1	Describe the basic concepts, fundamental polymeric inorganic compounds(Chains,Rings,Polymers,Cages,Clusters) and the scientific theories related to various scientific phenomena and their relevancies in day-to-day life.
LO2	Employ critical thinking for solving problems using Coordination chemistry knowledge and concepts
LO3	Acquire skills in handling scientific instruments, planning and derivation of terms for P2,P3,d1 and d2. Orgel and Tanabe reaction.

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LO4	Substitution reaction of octahedral complexes,twist mechanisms for isomerisation,Create an intellectual curiosity and ability to think in a scientific manner and get sensitized to social and environmental realities
LO5	Substitution reaction of square planar complexes(Pt(II) Develop an interest in pursuing higher studies Marcus Hush theory and related subjects which are relevant to employment and outer sphere mechanism

Course Objectives:

1) To know about the structure and bonding of inorganic compounds and the inorganic polymers.
2) To study the concept of coordination chemistry and stability of the complexes
3) To gain knowledge of metal-ligand orbital overlap, molecular orbital theory and energy level diagrams etc.,
4) To learn about the mechanism of substitution reactions of octahedral complexes.
5) To acquire skill of using substitution reactions of square planar complexes and electron transfer reactions for complexes.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Gain knowledge about the structure and bonding of Inorganic compounds and explain Isopolyacids and hetropolyacids of Vanadium, Chromium, Molybdenum and Tungsten.	**PO1**
CO2	Illustrates the chemistry of metal clusters and discuss polyhedral boranes, carboranes and metallocarboranes	**PO1, PO2**
CO3	Explain the stability constant of co-ordination complexes and stereo chemistry for co-ordination complexes	**PO4, PO6**
CO4	Apply the molecular orbital theory and energy level diagrams, concept of weak and strong field ligands, Jahn-Teller distortion etc	**PO4, PO5, PO6**
CO5	Illustrate the Substitution reactions of square planar complexes and electron transfer reactions	**PO3, PO8**

SEMESTER – I
PAPER – 3
PHYSICAL CHEMISTRY – I

Learning Objectives	
LO1	To know the basic concepts of Chemical Kinetics,Thermodynamic derivation of ARRT-comparison of ARRT with collision theory (A , $\Delta S^{\#}$, E_a and $\Delta H^{\#}$) Thermodynamic derivation of ARRT-comparison of ARRT with collision theory (A , $\Delta S^{\#}$, E_a and $\Delta H^{\#}$)
LO2	Chemical KineticsApplication of ARRT to solution kinetics-effects of solvents, double sphere model, effect of ionic strength on ionic reactions – influence of pressure on reaction rates in solution-significance ofvolume of activation-substituent effects – Hammett and Taft equations.
LO3	Adsorption–physisorption and chemisorptions – Langumuir, BET & Gibbs adsorption isotherms- surface area determination – Heat of adsorption, determination.
LO4	Wave function as bases for irreducible representation. Transition moment integral – spectroscopic selection rules to IR, Raman (H_2O, NH_3, trans-N_2F_2) and electronic spectroscopy (HCHO). Hybridization schemes of orbitals – (sp, sp^2 and sp^3 for ethylene and butadiene.

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LO5	Microwave Spectroscopy-Rotation of molecules and selection rules, Diatomic molecules; Rigid and non-rigid rotator, Rotational constant and centrifugal distortion. Techniques and instrumentation. Vibrational spectroscopy-diatomic molecules

Course Objectives

1) To understand the theories of chemical kinetics in reaction mechanisms.
2) To apply the kinetic concepts in homogenous and heterogeneous catalyzed reactions.
3) To study about Surface Chemistry, surface tension and catalysis.
4) To identify the symmetry of elements, symmetry operations and apply the fundamentals of group theory in electronic spectroscopy
5) To appreciate the principals involved in the Rotational and vibrational spectroscopic techniques.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Apply group theory for molecules like water, ethylene, butadiene.	**PO1**
CO2	Relate microscopic properties of molecules with macroscopic thermodynamic observables	**PO1, PO2**
CO3	Derive the rate equation from mechanistic data and calculation	**PO4, PO6**
CO4	Gain knowledge about the Surface Chemistry and its mechanisms.	**PO4, PO5, PO6**
CO5	Imbibe basic aspects of spectroscopy and apply to poly atomic molecule	**PO3, PO8**

SEMESTER-I
CORE ELECTIVE-1
POLYMER CHEMISTRY

Learning Objectives	
LO1	To provide a thorough understanding of the basic concept of polymers,Addition and condensation polymerisation,to preparation and properties structure and application.
LO2	To gain knowledge about the different polymerization mechanisms(Ziegler Natta Catalyst and ionic and Free radical polymerisation)
LO3	To learn the molecular weight determination and characterization of polymers,Tm,Tg,DSC.
LO4	To exploit the polymer processing techniques for various applications.Injection Moulding ,Compression Moulding Extrusion Moulding.
LO5	To study the importance of advanced polymers,Heat resistant polymer,Dental polymer,Artificial organs, Polymeric mechanism.

Course Objectives

1) To provide a thorough understanding of the basic concept of polymers
2) To gain knowledge about the different polymerization mechanisms

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3) To learn the molecular weight determination and characterization of polymers.
4) To exploit the polymer processing techniques for various applications.
5) To study the importance of advanced polymers

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Understand the basic concept of polymers and the chemistry of organic and inorganic polymers	PO1
CO2	Understand the kinetics and mechanism of various polymerization techniques.	PO1, PO2
CO3	Choose an appropriate analytical method to characterize polymers.	PO4, PO6
CO4	Select an appropriate moulding technique to process a particular polymer.	PO4, PO5, PO6
CO5	Realize the importance of advanced polymers.	PO3, PO8

SEMESTER-I
OPEN ELECTIVE-I
FOOD CHEMISTRY

Learning Objectives	
LO1	Fermentation-Definition, types of fermentation-Fermented foods sauerkraut, cucumber pickles, olive pickles-Oriental fermented foods–soy sauce, tofu-Traditional fermented foods–idli, dosa,
LO2	Quality evaluation of raw and processed water - methods of water treatment-BIS quality standards (for bottled water: mineral water, natural spring water).
LO3	Synthetic Beverages technology of carbonated beverages-Low-calorie and dry beverages-Isotonic and sports drinks-Role of various ingredients of soft drinks-Carbonation of soft drinks.
LO4	Food poisoning -Sources, causes and remedy-Causes and remedies for acidity, gastritis indigestion and constipation.
LO5	Food Spoilage-definition–Prevention-Food Preservatives-definition-classification- food preservation- Methods of preservation

Course Objectives

1) To understand the principles of food fermentation technology.
2) To study about packaged drinking water.
3) To study importance of beverages and its types.
4) To study about food adulteration
5) To understand about food preservation and packaging.

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Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Students will be able to acquire knowledge of fermented food.	PO1
CO2	Acquire knowledge about packaged drinking water.	PO1, PO2
CO3	Illustrate the importance of beverages and its types.	PO4, PO6
CO4	Acquire knowledge about food adulteration.	PO4, PO5, PO6
CO5	Illustrate the importance of food preservative	PO3, PO8

SEMESTER – II

PAPER – IV

ORGANIC CHEMISTRY – II

Learning Objectives	
LO1	Conformations of some simple 1,2 – disubstituted ethane derivatives - Gauche effect. Conformation and stereochemistry of cis and trans-decalin and 9 - methyldecalin.
LO2	Electrophilic, nucleophilic and free radical mechanisms of addition to carbon-carbon multiple bonds – isolated and conjugated multiple bonds. Hydration, hydroxylation, hydroboration.Mannich, Reformatsky, Grignard and Robinson Annulation.
LO3	E1, E2 and E1cB mechanism - E1, E2 and E1cB spectrum - Orientation of the double bond - Hofmann and Saytzeff rules - Bredt's rule. Competition between elimination and substitution.Chugaev and Cope eliminations.
LO4	Mechanism – study of the following oxidation reactions–oxidation of alcohols- use of DMSO in combination with DCC and acetic anhydride in oxidising alcohols -oxidation of methylene to carbonyl, oxidation of aryl methanes – Etard reaction – Formation of C = C bonds by dehydrogenation, dehydrogenation by Quinones, $Hg(OAc)_2$ and $Pb(OAc)_4$
LO5	Acids and Bases, HSAB, the equilibrium constant, thermodynamic and kinetic control of organic reactions, Hammond postulate, Curtin – Hammett principle, Hammett equation – Application to organic reactions.

Course Objectives:

1) To learn about the conformations and reactivity of the substituted six membered ring systems
2) To understand the mechanisms of addition and elimination reactions.
3) To learn the name reactions with their mechanisms
4) To learn the synthetic utilities of various oxidation and reduction reactions.
5) To acquire knowledge on the various concepts of reaction kinetics and the HSAB principle.

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Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Compare the stability and reactivity of different conformers of Cyclohexane derivatives	PO1

CO2	Solve problems based on additions to Carbon – Carbon and Carbon – Hetero atom multiple bonds.	**PO1, PO2**
CO3	Propose mechanisms and predict the products with proper stereochemistry for various elimination reactions.	**PO4, PO6**
CO4	Have a thorough knowledge of using proper reagents for specific Oxidation and Reduction reactions.	**PO4, PO5, PO6**
CO5	Apply HSAB principle to Organic reactions and have sufficient knowledge on reaction kinetics and mechanism.	**PO3, PO8**

SEMESTER – II

PAPER – V

INORGANIC CHEMISTRY – II

Learning Objectives	
LO1	Ionic bonding, Lattice energy, born equation and its derivation, Limiting radius ratio rules, Radius ratio for trigonal, tetrahedral, octahedral and cubic sites. Crystal defects: Stoichiometric defects-Schottky and Frenkel defects – colour centres in alkali halide crystals
LO2	Nuclear properties: nuclear spin and moments, origin of nuclear forces, nuclear models: liquid drop model and nuclear shell model. Modes of radioactive decay: Orbital electron capture, nuclear isomerism, internal conversion.
LO3	Electronic spectra and magnetic properties of lanthanide complexes- Lanthanide complexes as shift reagents-Difference between 4f and 5f orbitals-Comparative account of coordination chemistry of lanthanides and actinides with special reference to electronic spectra and magnetic properties.
LO4	Conditions of the excited states to be useful as redox reactants-photosubstitution, photooxidation and photoreduction- Photochemical reactions involving Ruthenium (II) bipyridyl complex. Application to photovoltaics-water photolysis- carbondioxide reduction.
LO5	Porphyrin ring system – Metalloporphyrins – hemoglobin and myoglobin – structures and work functions – synthetic oxygen carries – cytochromes – structure and work function in respiration – chlorophyll – structure – photosynthetic sequence .

Course Objectives:

1) To make the students knowledgeable in solid state chemistry.
2) To study about stellar energy, nuclear reactions etc and to equip the students for their future career in nuclear industry.
3) To learn the chemistry of lanthanides and actinides
4) To understand the inorganic photochemistry.
5) To gain knowledge about the bioinorganic complexes.

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Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To make the students knowledgeable in solid state chemistry.	**PO1**

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CO2	To study about stellar energy, nuclear reactions etc and to equip the students for their future career in nuclear industry.	PO1, PO2
CO3	To learn the chemistry of lanthanides and actinides	PO4, PO6
CO4	To understand the inorganic photochemistry.	PO4, PO5, PO6
CO5	To gain knowledge about the bioinorganic complexes.	PO3, PO8

SEMESTER – II
PAPER – VI
PHYSICAL CHEMISTRY – II

Learning Objectives	
LO1	To know the foundations and the physical and mathematical basis of quantum mechanics and to apply the concepts of quantum mechanics to solve problems in microscopic systems.
LO2	Approximation methods – Variation method-application to one dimensional box, H_2, H_2^+ and Helium atom -Perturbation method - application to one dimensional box .
LO3	Fluorescence-relation to structure- Phosphorescence- conditions for Phosphorescence emission (spin-orbit coupling)- Photosensitization.
LO4	Diagrams for ternary mixtures-Phase rule-methods of reading and rules relating to triangular diagrams-three component system having a pair of partially miscible system-acetic acid-chloroform and water system
LO5	Acid - Base catalysis - mechanism of acid - base catalyzed reactions - Bronsted catalysis law. Catalysis by enzymes - Kinetics of enzyme catalyzed reaction - Michaelis

Course Objectives

1) To know the foundations and the physical and mathematical basis of quantum mechanics and to apply the concepts of quantum mechanics to solve problems in microscopic systems.
2) To understand the quantum mechanical approach to the atomic and molecular electronic structure and to know the limitations of quantum chemistry in the evaluation of macroscopic properties
3) To know the mechanisms of photo chemical reaction
4) To know the construction of phase diagram for one, Two and three component systems
5) To understand the catalysis of reactions.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Identify the application of quantum chemistry in MO and VB theories and construct hybridizationschemes.	PO1
CO2	Derive the equation for one dimensional and two-dimensional boxes.	PO1, PO2
	Identify the photo chemical reactions	PO4, PO6

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CO4	Construct the phase diagram for the Three components system.	PO4, PO5, PO6
CO5	Illustrate the use of catalysis in reactions.	PO3, PO8

SEMESTER-II
CORE ELECTIVE-2
NANO CHEMISTRY

Learning Objectives	
LO1	Introduction, length scale of different structures, definition of Nanoscience and nanotechnology - Electronic structure of various nanostructures - Classification of Nanomaterials. Biological nanostructures, polypeptide nanowires and protein nanoparticles.
LO2	Fullerenes and Carbon nanotubes. Micro and Mesoporous Materials: Core-shell structures.Nanotubes of several metal oxides –Functionalization of CNTs and Graphene.
LO3	Chemical precipitation and co-precipitation, Sol-Gel synthesis; Microemulsions synthesis, Hydrothermal, Solvothermal synthesis methods, Microwave assisted synthesis
LO4	X-ray diffraction (XRD), SEM, EDAX, TEM, FTIR, UV-Visible spectrophotometer, Laser Raman Spectroscopy, Differential Scanning Calorimeter (DSC),
LO5	Nanoparticles for degradation of solvents and organic compounds – Nanotechnology in Textiles, Cosmetics, Defence, Agriculture, and Food industry, Bio-Medical Engineering

Course Objectives

1) To understand the scientific background, classification and properties of nanomaterials.
2) To gain knowledge about special nonmaterial's and to identify the bonding in nanostructure.
3) To acquire knowledge about various methods of synthesis of nanomaterials .
4) To learn characterization techniques used for nanosystems.
5) To study various industrial applications of nanotechnology.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	To understand the scientific background, classification and properties of nanomaterials	PO1
CO2	To gain knowledge about special nonmaterial's and to identify the bonding in nanostructure	PO1, PO2
CO3	To acquire knowledge about various methods of synthesis of nanomaterials	PO4, PO6
CO4	To learn characterization techniques used for nanosystems	PO4, PO5, PO6
CO5	To study various industrial applications of nanotechnology	PO3, PO8

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SEMESTER – III
PAPER – VII
ORGANIC CHEMISTRY – III

Learning Objectives	
LO1	Ultraviolet spectroscopy: Types of electronic transitions - chromophores and auxochromes - factors influencing the positions and intensity of absorption bands - absorption spectra of dienes, polyenes and unsaturated carbonyl compounds – Woodward - Fieser rules
LO2	Chemical shift and coupling constant - factors influencing proton chemical shift and vicinal proton - proton coupling constant- ^1H NMR spectra of simple organic molecules such as CH_3CH_2Cl and CH_3CHO.
LO3	Mc Lafferty rearrangement - Mass spectra of hydrocarbons, alcohols, phenols, aldehydes and ketones. Spectroscopic identification of organic compounds using data of UV, IR and NMR spectroscopy and mass spectrometry.
LO4	Photochemical reactions of olefins – Cis-trans isomerism, Dimerization reactions, photochemistry of butadiene. Photochemistry of aromatic compounds and photooxidation. Di-Pi methane rearrangement.
LO5	Pericyclic Reactions: Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1, 3, 5- hexatriene. Classification of pericyclic reactions.

Course Objectives

1) To understand the concepts of UV and IR spectroscopic techniques and to apply these techniques in the structural analysis of organic compounds.
2) To learn about the ^{1}HNMR and ^{13}C NMR apply it for the structural elucidation of the compound
3) To study the mass spectroscopic technique.
4) To understand the concept of Photochemical Reactions.
5) To study the concept of Pericyclic Reactions.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Visualize the importance of UV-Visible and IR spectroscopy.	PO1
CO2	Acquire knowledge of vibrational transition and identify functional groups	PO1, PO2
CO3	Apply the concept of Mass spectroscopy to different compounds	PO4, PO6
CO4	Elucidate the structure of organic compounds using NMR	PO4, PO5, PO6
CO5	Solve photochemical and pericyclic problems	PO3, PO8

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SEMESTER – III
PAPER – VIII
INORGANIC CHEMISTRY – III

Learning Objectives	
LO1	NMR Spectroscopy: ^{31}P, ^{19}F and ^{15}N NMR introduction applications in structural problem,evaluation of rate constants monitoring the course of reaction,NMR of fluxional molecules NMR of paramagnetic molecules,contact shifts and shift reagents.
LO2	Mossbauer spectroscopy: Mossbauer effect resonance absorption Doppler effect Doppler velocity,Experimental technique of measuring resonance absorption ,isomer shift – magnetic hyperfine splitting application of Mossbauer spectroscopy in the study of iron and tin complexes.
LO3	ESR Spectroscopy: Principles,presentation of the spectrum Hyperfine splitting: hyperfine splitting in isotropic systems involving one nucleus and more than one nucleus, hyperfine splitting caused by quadrupole nuclei. g value and the factors affecting g values
LO4	Synthesis, structure and bonding in metal carbonyls, nitrosyls, dioxygen complexes and dinitrogen complexes.Application of EAN and 18 electron rules- Synthesis, properties, structure and bonding in Ferrocene, Arene, olefin, acetylene and allyl complexes
LO5	Carboxypeptidase A: structure, function,carbonic anhydrase – inhibition and poisoning ,corin ring system – vitamin B12 and B12 coenzymes – *in-vivo* and *in-vitro* nitrogen fixation.

Course Objectives

1) To analyze and interpret the IR and NMR spectra of Inorganic compounds and coordination complexes.
2) To study the Mossbauer and Photoelectron spectroscopy for metal complexes
3) To gain knowledge about the principle and applications of ESR and NQR
4) To provide the students a thorough understanding of the relationship between the structures, chemical bonds and chemical properties in organo metallic chemistry.
5) To learn about the role of metals in different enzymes

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	
CO1	Illustrate the different types of reaction of organo metallic compounds and discuss the various catalysis processes in organo metallic chemistry.	PO1
CO2	Analyze and interpret the IR, Raman and NMR spectra of Inorganic compounds and coordination complexes	PO1, PO2
CO3	Apply Mossbauer and photo electron spectroscopic data for the structural classification of inorganic compounds.	PO4, PO6
CO4	Describe the principle and applications of ESR and NQR for inorganic molecules.	PO4, PO5, PO6
CO5	Explain about the structure and functions of metalo enzymes and role of trace elements in biological systems	PO3, PO8

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SEMESTER – III
PAPER – IX
PHYSICAL CHEMISTRY – III

Learning Objectives	
LO1	Partial molar properties–chemical potential, relationship between partial molar quantities and thermodynamic functions
LO2	Statistical mechanics – calculation of thermodynamic probability of system – Assembly, ensembles, phase space-definition of micro and macro states - different methods of counting macro and micro states – distinguishable and indistinguishable particles-classical statistics - derivation of Maxwell Boltzmann distribution law
LO3	Non-equilibrium thermodynamics, Steady-State-phenomenological laws and Onsager"s reciprocalrelations.
LO4	Interaction between spin and magnetic field - Gyromagnetic ratio - FT NMR.
LO5	ESR-Principle-Position of ESR absorptions - g value - Hyperfine splitting -Zero field splitting.

Course Objectives

1) To know the applications of classical thermodynamics in the evaluation properties.
2) To learn the concepts of statistical thermodynamics for the study of equilibrium reactions and reaction intermediates
3) To derive equations for enthalpy, internal energy, Gibb's energy, entropy in terms partition function.
4) To learn the concepts of surface phenomena
5) To know the applications of Raman and NMR spectroscopy.

Course Outcomes		
Course Outcomes	At the completion of this course, the students will be able to	
CO1	Calculate the thermodynamic and kinetic properties	PO1
CO2	Relate microscopic properties of molecules with macroscopic thermodynamic observables	PO1, PO2
CO3	Derive the rate equation from mechanistic data	PO4, PO6
CO4	Utilise the Raman and NMR spectroscopy	PO4, PO5, PO6
CO5	Apply the ESR and Mossbauer spectroscopy for various compounds.	PO3, PO8

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SEMESTER – III
PAPER – X
SCIENTIFIC RESEARCH METHODOLOGY

Learning Objectives	
LO1	Source of chemical information – primary, secondary, tertiary sources-literature survey-Indexes and abstracts in science and technology – Applied science and technology index, chemical abstracts, chemical titles, current chemical reactions, current contents and science citation index
LO2	CA volume indexes-general subject index, chemical substance index-formula index, index of ring systems, author index, patent index. CA collective indexes: collective index (CI), decennial index (DI).
LO3	Choosing a Research Problem and Scientific Writing
LO4	Data analysis - Report. Errors in chemical analysis – classification of errors – determination of accuracy of methods – improving accuracy of analysis
LO5	Plagiarism and intellectual property rights - Online browsing of research articles–online submission of research papers in various Journals (ACS, RSC, Elsevier, Springer etc.)– Instructions to the authors – Impact factors. Writing project proposal to funding agencies (UGC, DST etc.

Course Objectives

1) To understand the importance of research and literature sources.
2) To gain knowledge about the Chemical Abstract search in Chemical research.
3) Acquire knowledge on choosing a research problem and science writing.
4) Adequate knowledge on assessing the quality of analytical data.
5) Working knowledge on Computer aided literature search..

Course Outcomes		
Course Outcomes	At the completion of this course, the students will be able to	
CO1	The students will be able to acquire knowledge of Literature survey	PO1
CO2	Acquire knowledge about thesis writing.	PO1, PO2
CO3	Acquire knowledge about Research work.	PO4, PO6
CO4	Identify the importance of errors involved chemical analysis.	PO4, PO5, PO6
CO5	Illustrate the importance of online browsing of literature.	PO3, PO8

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SEMESTER – III
OPEN ELECTIVE-II
DAIRY CHEMISTRY

Learning Objectives	
LO1	Present status of milk & milk products in India and abroad; market milk-Composition of milk of various species
LO2	Milk lipids-terminology and definitions -Milk proteins: Physical properties of milk proteins-Electrical properties and hydration.
LO3	Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream.
LO4	Definition, composition, classification, methods of manufacture, cheddar, Swiss, cottage and processed cheese, evaluation, defects in cheese.
LO5	Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream and technology aspects of softy manufacture.

Course Objectives

1.To make the students learn about dairy chemistry.
2.To understand the importance of milk-lipids, proteins, carbohydrates and vitamins.
3.To understand the importance of condensed milk and cream.
4.To learn the importance of butter and cheese.
5. To understand the importance of the ice-cream and milk product.

Course Outcomes		
Course Outcomes	At the completion of this course, the students will be able to	
CO1	Identify the importance of dairy chemistry.	**PO1**
CO2	The students will be able to understand the nutrients of milk.	**PO1, PO2**
CO3	Acquire knowledge of milk nutrients.	**PO4, PO6**
CO4	Appreciate the importance of butter and cheese.	**PO4, PO5, PO6**
CO5	Acquire knowledge of ice – creams and milk product	**PO3, PO8**

SEMESTER – IV
PAPER – X
ORGANIC CHEMISTRY – IV

Learning Objectives	
LO1	Synthesis of simple organic molecules using acetylation and alkylation of enamines
LO2	Chemistry of enolates and enamines, Kinetic and Thermodynamic enolates, Lithium and boron enolates in Aldol and Michael reactions

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LO3	DNA & RNA polynucleotide chain - components - biological functions – structure and role of (genetic code) DNA and RNA (nucleotides only)
LO4	Introduction - classification - isoprene rule - structural determination of terpenoids -Citral, geraniol - linalool - farnesol - α-pinene and camphor
LO5	A detailed study with suitable examples of the mechanism of the following rearrangements.

Course Objectives

1) Develop problem solving skills requiring application of chemical reaction.
2) To understand the different reagents and their applications.
3) To learn the importance of Proteins and nucleic acid
4) To learn the chemistry of terpenes and alkaloids and their importance.
5) To study about the mechanisms of different rearrangements

Course Outcomes		
Course Outcomes	The student will be able to	
CO1	Develop problem solving skills requiring application of chemical reaction.	PO1
CO2	Use important reagents in the modern synthetic methods	PO1, PO2
CO3	Acquire knowledge of terpenes and alkaloids.	PO4,
CO4	Elucidate the structure of proteins and nucleic acids.	PO4, PO5,
CO5	Solve problems related to rearrangements	PO3,

SEMESTER – IV
PAPER – XI
PHYSICAL CHEMISTRY – IV

Learning Objectives	
LO1	Debye-Huckel-Onsager theory and its derivation –Debye –Falkanhagen and Wein's effects – extension to Debye-Huckel Onsager theory. Activity of ions in solutions-mean ionic activity coefficients-experimental determination – Debye-Huckel limiting law-modification
LO2	Electrical double layer theory of multiple layers at electrode- (Guoy Chapman, Stern and Helmholtz model) – double layer capacity – Electrokinetic phenomena, zeta potential and electro osmotic velocity, zeta potential and streaming potential – determination of zeta potential and interpretation of zeta potential values
LO3	Electronic spectra - Electronic spectra of diatomic molecules - Born - Oppenheimer approximation- vibrational coarse structure- Franck – Condon Principle-, Dissociation energy and dissociation products
LO4	Experimental set up -Cyclic voltammogram of Fe^{2+} in H_2SO_4 - Anodic peak current - Cathodic peak current -Electrochemically reversible couple - Cathodic peak potential - Electrochemically irreversible couple - Outline of applications.
LO5	Principle - pumping He-Ne laser Carbon dioxide laser, semiconductor laser holography recording and reconstruction-applications laser induced fusion process.

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Course Objectives

1) To understand the behavior of electrolytes in solution and to familiarize the structure of the electrode surface and the applications of electrode processes.
2) To differentiate electrode kinetics from other types of kinetic studies
3) To know the applications of electro analytical Techniques
4) To understand the electronic spectroscopy
5) To know the applications of Laser devices

Course Outcomes		
Course Outcomes	The student will be able to	
CO1	To analyse the fundamental concepts of atoms and molecules and their arrangements indifferent energy levels by statistical approach.	**PO1**
CO2	To apply the mathematical concepts in chemical systems at molecular level.	**PO1, PO2**
CO3	To predict the application of electrical energy in chemical phenomena.	**PO4,**
CO4	To understand the laser devices and applications	**PO4,**

SEMESTER – IV
CORE ELECTIVE-III
ADVANCED ANALYTICAL TECHNIQUES

Learning Objectives	
LO1	Photo Luminescent Spectroscopy and Laser Raman Spectroscopy - Fluorescence spectroscopy Atomic Spectroscopy – Sources of Atomic and Emission Absorption Spectra.
LO2	Principle, Instrumentation applications of Scanning Electron Microscopy: SEM and FESEM - Transmission Electron Microscopy (TEM) – HRTEM- Scanning Tunneling Microscopy (STM), Atomic Force Microscopy AFM
LO3	Super Critical Fluid Chromatography (SFC): Characteristics of super critical fluids, Comparison of SFC with HPLC & GLC, Applications of SFC.
LO4	Controlled current micro-electrode techniques.Bulk Electrolysis MethodBioelectrochemistry: Bioelectrodics, Electrical conductance in biological organism: Enzymes as electrodess
LO5	Principle, instrumentation and applications of thermogravimetry analysis (TGA), Differential Thermal Analysis (DTA), TGA & DTA curves of $CuSO_4.5H_2O$, $MgC_2O_4.H_2O$ & $Ca(OOCCH_3)_2.H_2O$

Course Objectives

1) Know various methods involved in analytical techniques
2) Learn qualitative and quantitative measurements in the spectroscopy analysis.
3) Learn the separation process using various chromatographic technique.
4) Acquire knowledge in electro-analytical techniques.

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5) Gain knowledge about TGA, DSC, DMA and TMA.

Course Outcomes		
Course Outcomes	At the end of this course, the students will be able	
CO1	Apply HPLC, GC and SFC chromatographic techniques to identify the components.	PO1
CO2	Relate the concepts of SEM, FESM, TEM, HRTEM, HTM, AFM to identify the ultra-structure of molecules.	PO1, PO2
CO3	Infer the principle, instrumentation of coulometry, chronopotentiometry and bioelectrodes.	PO4,
CO4	Classify thermo analytical techniques and to assess the thermal stability of a chemical compound	PO4, PO5,
CO5	Perceive the principle, instrumentation and applications of thermoanalytical techniques	PO3,

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