ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Programme: B.Sc. Honours in Organic Chemistry (Major)

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Essentials and Applications of Mathematical, Physical andChemical Sciences	3+2	4
		2	Advances in Mathematical, Physical and Chemical Sciences	3+2	4
	II	3	General & Inorganic Chemistry	3	3
			General & Inorganic Chemistry Practical Course	2	1
		4	Fundamentals in Organic Chemistry	3	3
			Fundamentals in Organic Chemistry Practical Course	2	1
II	III	5	Inorganic Chemistry	3	3
			Inorganic Chemistry Practical Course	2	1
		6	Organic Chemistry	3	3
			Organic Chemistry Practical Course	2	1
		7	Physical Chemistry	3	3
			Physical Chemistry Practical Course	2	1
		8	General Chemistry	3	3
			General Chemistry Practical Course	2	1
	IV	9	Spectroscopy	3	3
			Spectroscopy Practical Course	2	1
		10	Physical Chemistry	3	3
			Physical Chemistry Practical Course	2	1
		11	Organic Chemistry	3	3
			Organic Chemistry Practical Course	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
III	V	12	Green Chemistry & Nanotechnology	3	3
			Green Chemistry & Nanotechnology Practical Course	2	1
		13	Analysis of Organic Compounds	3	3
			Analysis of Organic Compounds Practical Course	2	1
		14	Chromatography & Instrumental methods of Analysis	3	3
			Chromatography & Instrumental methods of Analysis Practical Course	2	1
		15	Environmental Chemistry	3	3
			Environmental Chemistry Practical Course	2	1
	VI	Internship			
IV	VII	16	Synthetic Organic Chemistry	3	3
			Synthetic Organic Chemistry Practical Course	2	1
		17	Stereo Chemistry & Natural Products	3	3
			Stereo Chemistry & Natural Products Practical Course	2	1
		18	Modern Organic Synthesis and Natural Products	3	3
			Modern Organic Synthesis and Natural Products Practical Course	2	1
	VIII	19	Chemistry of Natural Products	3	3
			Chemistry of Natural Products Practical Course	2	1
		20	Pharmaceutical & Medicinal Chemistry	3	3
			Pharmaceutical & Medicinal Chemistry Practical Course	2	1
		21	Asymmetric Synthesis and Heterocycles	3	3
			Asymmetric Synthesis and Heterocycles Practical Course	2	1

SEMESTER-I

COURSE 1: ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL ANDCHEMICAL SCIENCES

Theory Credits: 4 5 hrs/week

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of theessential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Learning outcomes:

1. Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.

2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations

3. To Explain the basic principles and concepts underlying a broad range of fundamental areas of chemistry and to Connect their knowledge of chemistry to daily life.

4. Understand the interplay and connections between mathematics, physics, and chemistry in various applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 To explore the history and evolution of the Internet and to gain an understanding of networksecurity concepts, including threats, vulnerabilities, and countermeasures.

UNIT I: ESSENTIALS OF MATHEMATICS:

Complex Numbers: Introduction of the new symbol i – General form of a complex number – Modulus-Amplitude form and conversions

Trigonometric Ratios: Trigonometric Ratios and their relations – Problems on calculation of angles**Vectors:** Definition of vector addition – Cartesian form – Scalar and vector product and problems **Statistical Measures**: Mean, Median, Mode of a data and problems

UNIT II: ESSENTIALS OF PHYSICS:

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance- Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions- Behaviour of atomic and nuclear particles- Wave-particle duality, the uncertainty principle- Theories and understanding of universe

UNIT III: ESSENTIALS OF CHEMISTRY: :

Definition and Scope of Chemistry- Importance of Chemistry in daily life -Branches of chemistry and significance- Periodic Table- Electronic Configuration, chemical changes, classification of matter, Biomolecules- carbohydrates, proteins, fats and vitamins.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY:

Applications of Mathematics in Physics & Chemistry: Calculus , Differential Equations & Complex Analysis

Application of Physics in Industry and Technology: Electronics and Semiconductor Industry, Robotics and Automation, Automotive and Aerospace Industries, Quality Control and Instrumentation, Environmental Monitoring and Sustainable Technologies.

Application of Chemistry in Industry and Technology: Chemical Manufacturing, Pharmaceuticals and Drug Discovery, Materials Science, Food and Beverage Industry.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

Milestones of computer evolution - Internet, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications.

Ethical and social implications: Network and security concepts- Information Assurance Fundamentals, Cryptography-Symmetric and Asymmetric, Malware, Firewalls, Fraud Techniques- Privacy and Data Protection

Recommended books:

1. Functions of one complex variable by John.B.Conway, Springer- Verlag.

2. Elementary Trigonometry by H.S.Hall and S.R.Knight

3.Vector Algebra by A.R.Vasishtha, Krishna Prakashan Media(P)Ltd.

4.Basic Statistics by B.L.Agarwal, New age international Publishers

5. University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman

6. Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker

7. Physics for Scientists and Engineers with Modern Physics" by Raymond A. Serway and John W. Jewett Jr.

8. Physics for Technology and Engineering" by John Bird

9. Chemistry in daily life by Kirpal Singh

10. Chemistry of bio molecules by S. P. Bhutan

11. Fundamentals of Computers by V. Raja Raman

12. Cyber Security Essentials by James Graham, Richard Howard, Ryan Olson

STUDENT ACTIVITIES

UNIT I: ESSENTIALS OF MATHEMATICS:

1: Complex Number Exploration

Provide students with a set of complex numbers in both rectangular and polar forms.

They will plot the complex numbers on the complex plane and identify their properties2:

Trigonometric Ratios Problem Solving

Give students a set of problems that require the calculation of trigonometric ratios and theirrelations.

Students will solve the problems using the appropriate trigonometric functions (sine, cosine,tangent, etc.) and trigonometric identities.

3: Vector Operations and Applications

Provide students with a set of vectors in Cartesian form.

Students will perform vector addition and subtraction operations to find the resultant vectors.They will also calculate the scalar and vector products of given vectors.

4: Statistical Measures and Data Analysis

Give students a dataset containing numerical values.

Students will calculate the mean, median, and mode of the data, as well as other statisticalmeasures if appropriate (e.g., range, standard deviation).
They will interpret the results and analyze the central tendencies and distribution of the data.

UNIT II: ESSENTIALS OF PHYSICS:

1. Concept Mapping

Divide students into groups and assign each group one of the topics.

Students will create a concept map illustrating the key concepts, relationships, and applications related to their assigned topic.

Encourage students to use visual elements, arrows, and labels to represent connections and interdependencies between concepts.

2. Laboratory Experiment

Select a laboratory experiment related to one of the topics, such as motion of objects orelectric and magnetic fields.
Provide the necessary materials, instructions, and safety guidelines for conducting the experiment.
Students will work in small groups to carry out the experiment, collect data, and analyze theresults.

After the experiment, students will write a lab report summarizing their findings, observations, and conclusions.

UNIT III: ESSENTIALS OF CHEMISTRY

1: Chemistry in Daily Life Presentation

Divide students into groups and assign each group a specific aspect of daily life where chemistry plays a significant role, such as food and nutrition, household products, medicine,or environmental issues. Students will research and create a presentation (e.g., PowerPoint, poster, or video) thatshowcases the importance of chemistry in their assigned aspect.

2: Periodic Table Exploration

Provide students with a copy of the periodic table.

Students will explore the periodic table and its significance in organizing elements based ontheir properties.

They will identify and analyze trends in atomic structure, such as electronic configuration,atomic size, and ionization energy.

3: Chemical Changes and Classification of Matter

Provide students with various substances and chemical reactions, such as mixing acids andbases or observing a combustion reaction.

Students will observe and describe the chemical changes that occur, including changes incolor, temperature, or the formation of new substances.

4: Biomolecules Investigation

Assign each student or group a specific biomolecule category, such as carbohydrates,proteins, fats, or vitamins.

Students will research and gather information about their assigned biomolecule category,including its structure, functions, sources, and importance in the human body.

They can create informative posters or presentations to present their findings to the class.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

1: Interdisciplinary Case Studies

Divide students into small groups and provide them with interdisciplinary case studies thatinvolve the interdisciplinary application of mathematics, physics, and chemistry.

Each case study should present a real-world problem or scenario that requires the integrationof concepts from all three disciplines.

2: Design and Innovation Project

Challenge students to design and develop a practical solution or innovation that integrates mathematics, physics, and chemistry principles.

Students can choose a specific problem or area of interest, such as renewable energy,environmental conservation, or materials science.

3: Laboratory Experiments

Assign students laboratory experiments that demonstrate the practical applications of mathematics, physics, and chemistry.

Examples include investigating the relationship between concentration and reaction rate, analyzing the behavior of electrical circuits, or measuring the properties of materials.

.4: Mathematical Modeling

Present students with real-world problems that require mathematical modeling and analysis.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

1. Identifying the attributes of network (Topology, service provider, IP address and bandwidth of

2. your college network) and prepare a report covering network architecture.

3. Identify the types of malwares and required firewalls to provide security.

4. Latest Fraud techniques used by hackers**.**

SEMESTER-I

COURSE 2: ADVANCES IN MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

Theory Credits: 4 5 hrs/week

Course Objective:

The objective of this course is to provide students with an in-depth understanding of the recentadvances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Learning outcomes:

1. Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.

2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations.

3. Understand the different sources of renewable energy and their generation processes and advances in nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.

3. Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of nanosensors. Explore the effects of chemical pollutants on ecosystems and human health.

4. Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 Understand and convert between different number systems, such as binary, octal, decimal, and hexadecimal. Differentiate between analog and digital signals and understand their characteristics.Gain knowledge of different types of transmission media, such as wired (e.g., copper cables, fiber optics) and wireless (e.g., radio waves, microwave, satellite)..

UNIT I: ADVANCES IN BASICS MATHEMATICS

Straight Lines: Different forms – Reduction of general equation into various forms – Point ofintersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function –Problems on product ruleand quotient rule

Integration: Integration as a reverse process of differentiation – Basic methods of integration

Matrices: Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose ofa matrix and determinants

UNIT II: ADVANCES IN PHYSICS:

Renewable energy: Generation, energy storage, and energy-efficient materials and devices. **Recent advances in the field of nanotechnology**: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

UNIT III: ADVANCES IN CHEMISTRY:

Computer aided drug design and delivery, nano sensors, Chemical Biology, impact of chemicalpollutants on ecosystems and human health, Dye removal - Catalysis method

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS &CHEMISTRY

Mathematical Modelling applications in physics and chemistry

Application of Renewable energy: Grid Integration and Smart Grids,

Application of nanotechnology: Nanomedicine,

Application of biophysics: Biophysical Imaging, Biomechanics, Neurophysics,

Application of medical physics: Radiation Therapy, Nuclear medicine

Solid waste management, Environmental remediation- Green Technology, Water treatment.

UNIT V: Advanced Applications of computer Science

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

Recommended books:

1. Coordinate Geometry by S.L.Lony, Arihant Publications
2. Calculus by Thomas and Finny, Pearson Publications
3. Matrices by A.R.Vasishtha and A.K.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
5. "Energy Storage: A Nontechnical Guide" by Richard Baxter
6. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Raghvendra A. Bohara
7. "Biophysics: An Introduction" by Rodney Cotterill
8. "Medical Physics: Imaging" by James G. Webster
9. "Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas
10. Nano materials and applications by M.N.Borah

11. Environmental Chemistry by Anil.K.D.E.

12. Digital Logic Design by Morris Mano

13. Data Communication & Networking by Bahrouz Forouzan.

STUDENT ACTIVITIES

UNIT I: ADVANCES IN BASIC MATHEMATICS

1: Straight Lines Exploration

Provide students with a set of equations representing straight lines in different forms, suchas slope-intercept form, point-slope form, or general form.

Students will explore the properties and characteristics of straight lines, including theirslopes, intercepts, and point of intersection.

2: Limits and Differentiation Problem Solving

Students will apply the concept of limits to solve various problems using standard limits.

Encourage students to interpret the results and make connections to real-world applications,such as analyzing rates of change or optimizing functions.

3: Integration Exploration

Students will explore the concept of integration as a reverse process of differentiation andapply basic methods of integration, such as the product rule, substitution method, or integration by parts.

Students can discuss the significance of integration in various fields, such as physics andchemistry

4: Matrices Manipulation

Students will perform operations on matrices, including scalar multiplication, matrixmultiplication, and matrix transpose.

Students can apply their knowledge of matrices to real-world applications, such as solvingsystems of equations or representing transformations in geometry.

UNIT II: ADVANCES IN PHYSICS:

1: Case Studies

Provide students with real-world case studies related to renewable energy, nanotechnology,biophysics, medical physics, or shape memory materials.

Students will analyze the case studies, identify the challenges or problems presented, andpropose innovative solutions based on the recent advances in the respective field.

They will consider factors such as energy generation, energy storage, efficiency, sustainability, materials design, biomedical applications, or technological advancements.

2: Experimental Design

Assign students to design and conduct experiments related to one of the topics: renewableenergy, nanotechnology, biophysics, medical physics, or shape memory materials.

They will identify a specific research question or problem to investigate and design anexperiment accordingly.

Students will collect and analyze data, interpret the results, and draw conclusions based ontheir findings.

They will discuss the implications of their experimental results in the context of recentadvances in the field.

3: Group Discussion and Debate

Organize a group discussion or debate session where students will discuss the ethical, social, and environmental implications of the recent advances in renewable energy, nanotechnology, biophysics, medical physics, and shape memory materials.

Assign students specific roles, such as proponent, opponent, or moderator, and provide them with key points and arguments to support their positions.

UNIT III: ADVANCES IN CHEMISTRY:

1. Experimental Design and Simulation

In small groups, students will design experiments or simulations related to the assigned topic.

For example, in the context of computer-aided drug design, students could design a virtual screening experiment to identify potential drug candidates for a specific disease target.

For nano sensors, students could design an experiment to demonstrate the sensitivity and selectivity of nano sensors in detecting specific analytes.
Chemical biology-related activities could involve designing experiments to study enzyme-substrate interactions or molecular interactions in biological systems.
Students will perform their experiments or simulations, collect data, analyze the results, and draw conclusions based on their findings.

2. Case Studies and Discussion

Provide students with real-world case studies related to the impact of chemical pollutants on ecosystems and human health.
Students will analyze the case studies, identify the sources and effects of chemical pollutants, and propose mitigation strategies to minimize their impact.

Encourage discussions on the ethical and environmental considerations when dealing with chemical pollutants.
For the dye removal using the catalysis method, students can explore case studies where catalytic processes are used to degrade or remove dyes from wastewater.

Students will discuss the principles of catalysis, the advantages and limitations of thecatalysis method, and its applications in environmental remediation.
3: Group Project

Assign students to work in groups to develop a project related to one of the topics.

The project could involve designing a computer-aided drug delivery system, developing anano sensor for a specific application, or proposing strategies to mitigate the impact of chemical pollutants on ecosystems.
Students will develop a detailed project plan, conduct experiments or simulations, analyzedata, and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

1: Mathematical Modelling Experiment

Provide students with a mathematical modelling experiment related to one of the topics. For example, in the context of renewable energy, students can develop a mathematical model to optimize the placement and configuration of solar panels in a solar farm.
Students will work in teams to design and conduct the experiment, collect data, and analyzethe results using mathematical models and statistical techniques.
They will discuss the accuracy and limitations of their model, propose improvements, and interpret the implications of their findings in the context of renewable energy or the specific application area.
2: Case Studies and Group Discussions

Assign students to analyze case studies related to the applications of mathematical modellingin nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.
Students will discuss the mathematical models and computational methods used in the case studies, analyze the outcomes, and evaluate the effectiveness of the modelling approach.
Encourage group discussions on the challenges, ethical considerations, and potential advancements in the field.

Students will present their findings and engage in critical discussions on the advantages and limitations of mathematical modelling in solving complex problems in these areas.

3. Group Project

Assign students to work in groups to develop a group project that integrates mathematical modelling with one of the application areas: renewable energy, nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.

The project could involve developing a mathematical model to optimize the delivery of radiation therapy in medical physics or designing a mathematical model to optimize waste management practices.
Students will plan and execute their project, apply mathematical modelling techniques,analyze the results, and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT V: Advanced Applications of computer Science

Students must be able to convert numbers from other number system to binary number systems

1. Identify the networking media used for your college network
   Identify all the networking devices used in your college premises.

SEMESTER-II

COURSE 3: INORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to;

1. Understand the basic concepts of p-block elements

2. Understand the concept of d & f -

Block elements UNIT –I

CHEMISTRY P-BLOCK ELEMENTS-I

Group- 13: Synthesis and structure of diborane, boron-nitrogen compounds ($B_3N_3H_6$ and BN) Group - 14: Preparation and applications of silanes and silicones.

Group - 15: Preparation and reactions of hydrazine, hydroxylamine.

UNIT-II:

P-BLOCK ELEMENTS -II

Group - 16: Classifications of oxides of sulphur based on (i) Chemical behaviour and (ii) Oxygen content. (iii) oxyacids of sulphur(structures only) Group-17: Inter halogen compounds and pseudo halogens.

UNIT-III:

ORGANOMETALLIC CHEMISTRY

Definition - classification of Organometallic compounds - nomenclature, preparation, properties and applications of alkyls of Li and Mg.

UNIT-IV:

CHEMISTRY OF d-BLOCK ELEMENTS:

Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states, Colour formation.

UNIT-V:

CHEMISTRY OF f-BLOCK ELEMENTS:

Chemistry of lanthanides - electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties. Chemistry of actinides - electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides, Comparsion of lanthanides and actinides .

List of Reference Books

1. Inorganic Chemistry by J.E.Huheey
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. A textbook of qualitative inorganic analysis by A.I. Vogel
4. Concise Inorganic Chemistry by J.D.Lee

SEMESTER-II
COURSE 3: INORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Practical-II-Mixture Salt Analysis

(At the end of Semester-I)

Qualitative inorganic analysis

Analysis of Mixture salt containing Two anions and Two cations from the following

Anions: Carbonate, sulphate, chloride, bromide, acetate, nitrate, borate, phosphate.

cations: Lead, copper, iron, aluminum, zinc, manganese, nickel, calcium, strontium, barium, potassium and ammonium.

SEMESTER-II

COURSE 4: ORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of alkanes, alkenes and alkynes

2.Understand the concept of Benzene.

UNIT-I:

STRUCTURAL THEORY IN ORGANIC CHEMISTRY

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H_2O,NH_3& $AlCl_3$).

Inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes, carbanions..

Types of Organic reactions : Addition - electrophilic, nucleophilic and free radical. Substitution - electrophilic, nucleophilic and free radical. Elimination- Examples.

UNIT-II:

ACYCLIC HYDROCARBONS

Alkenes - Preparation of alkenes. Properties: Addition of hydrogen - heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H_2O, HOX, H_2SO_4 with mechanism and addition of HBr in the presence of peroxide (anti - Markonikov's addition). Dienes - Types of dienes, reactions of conjugated dienes - 1,2 and 1,4 addition of HBr to 1,3 - butadiene and Diel's - Alder reaction.

UNIT-III:

Alkynes - Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, Properties; Acidity of acetylenic hydrogen (formation of Metal acetylides). Preparation of higher acetylenes, Metal ammonia reductions, Physical properties. Chemical reactivity - electrophilic addition of X_2, HX, H_2O (Tautomerism), Oxidation with $KMnO_4$, OsO_4, reduction and Polymerisation reaction of acetylene.

UNIT-IV

ALICYCLIC HYDROCARBONS (CYCLOALKANES)

Nomenclature, Preparation by Freunds method, Wislicenus method. Properties - reactivity of cyclopropane and cyclobutane by comparing with alkanes, Stability of cycloalkanes - Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane.

UNIT-V:

BENZENE AND ITS REACTIVITY

Concept of aromaticity - aromaticity (definition), Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation)

Reactions - General mechanism of electrophilic substitution, mechanism of nitration, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution - Definition of ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens

(Explanation by taking minimum of one example from each type)

List of Reference Books

1. Organic Chemistry by Morrisson and Boyd

2. A Text Book of Organic chemistry by I L Finar Vol I

SEMESTER-II
COURSE 4: ORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Organic Functional Group Reactions

(At the end of Semester)

Reactions of the following functional groups present in organic compounds (at least **4**)
Alcohols ,phenols, aldehydes, ketones,c arboxylic Acids and Amines

SEMESTER-III

COURSE 5: INORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of Metals,Conductors,insulators

2. understand the concept of Coordination Compounds.

UNIT-I:

THEORIES OF BONDING IN METALS:

Metallic properties and its limitations, Valence bond theory, Free electron theory, Explanation of thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors and insulators.

UNIT – II

METAL CARBONYLS :

Introduction 18 e Rule EAN rule, classification of metal carbonyls, structures and shapes of metal carbonyls of V, Cr, Mn, Fe, Co and Ni.

UNIT – III

COORDINATION CHEMISTRY:

IUPAC nomenclature - bonding theories - Review of Werner's theory and Sidgwick's concept of coordination - Valence bond theory - geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory - splitting of d-orbitals in octahedral, factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds - structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

UNIT-IV

SPECTRAL AND MAGNETIC PROPERTIES OF METAL COMPLEXES:

Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility-Gouy method.

UNIT-V:

STABILITY OF METAL COMPLEXES:

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

List of Reference Books

1. Concise coordination chemistry by Gopalan and Ramalingam
2. Coordination Chemistry by Basalo and Johnson
3. Concise Inorganic Chemistry by J.D.Lee
4. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan

SEMESTER-III

COURSE 5: INORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Practical-Titrimetric Analysis

(At the end of Semester)

1. Determination of Fe(II) using KMno4 with oxalic acid as primary standard
2. Determination of Cu(II) using $Na_2S_2O_3$ with $K_2Cr_20_7$ as primary standard

SEMESTER-III

COURSE 6: ORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1. Understand the basic concepts of Hydroxy Compounds

2. Understand the basic concepts of carbonyl and carboxylic Acids

UNIT – I

HALOGEN COMPOUNDS:

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aryl alkyl, allyl, vinyl, benzyl halides.

Nucleophilic aliphatic substitution reaction- classification into SN^1 and SN^2 – reaction mechanism with examples – Ethyl chloride, t-butyl chloride and optically active alkyl halide 2-bromobutane.

UNIT-II

HYDROXY COMPOUNDS

Nomenclature and classification of hydroxy compounds.

Alcohols: Preparation with hydroboration reaction, Grignard synthesis of alcohols. Phenols: Preparation i) from diazonium salt, ii) from aryl sulphonates, iii) from cumene. Physical properties- Hydrogen bonding (intermolecular and intramolecular). Effect of hydrogen bonding on boiling point and solubility in water.

Identification of alcohols by oxidation with $KMnO_4$, Ceric ammonium nitrate, Luca's reagent and phenols by reaction with $FeCl_3$.

Chemical properties:

a) Dehydration of alcohols.

b) Oxidation of alcohols by CrO_3, $KMnO_4$.

C) Special reaction of phenols: Riemer-Tiemann reaction Pinacol-Pinacolone rearrangement.

UNIT-III

CARBONYL COMPOUNDS

Nomenclature of aliphatic and aromatic carbonyl compounds, structure of the carbonyl group. Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties: Reactivity of carbonyl group in aldehydes and ketones.

Nucleophilic addition reaction with a) $NaHSO_3$, b) HCN, c) RMgX, d) NH_2OH, e)$PhNHNH_2$, f) 2,4 DNPH, g. Base catalysed reactions: a) Aldol, b) Cannizzaro's reaction, c) Perkin reaction, d) Benzoin condensation, e) Haloform reaction, f) Knoevenagel reaction. Oxidation of aldehydes- Baeyer-Villiger oxidation of ketones.Reduction: Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, reduction with $LiAlH_4$ and $NaBH_4$. Analysis of aldehydes and ketones with a) 2,4-DNPH test, b) Tollen's test, c) Fehling test, d) Schiff's test e) Haloform test (with equation)

UNIT-IV

CARBOXYLIC ACIDS

Nomenclature, classification and structure of carboxylic acids. Methods of preparation by a) Hydrolysis of nitriles, amides b) Hydrolysis of esters by acids and bases with mechanism c) Carbonation of Grignard reagents.

Special methods of preparation of aromatic acids by a) Oxidation of side chain. b) Hydrolysis by benzotrichlorides. c) Kolbe reaction. **Physical properties**: Hydrogen bonding, dimeric association, acidity-strength of acids with examples of trimethyl acetic acid and trichloroacetic acid. Relative differences in the acidities of aromatic and aliphatic acids. **Chemical properties**: Reactions involving H, OH and COOH groups-salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, Arndt-Eistert synthesis, halogenation by Hell- Volhard- Zelinsky reaction.

UNIT-V:
ACTIVE METHYLENE COMPOUNDS

ACETOACETIC ESTER: keto-enol tautomerism, preparation by Claisen condensation, Acid hydrolysis and ketonic hydrolysis. Preparation of a) monocarboxylic acids b) Dicarboxylic acids. c) Reaction with urea

MALONIC ESTER: preparation from acetic acid. **Synthetic applications**: Preparation of a) monocarboxylic acids (propionic acid and n-butyric acid). b) Dicarboxylic acids (succinic acid and adipic acid) c) α,β-unsaturated carboxylic acids (crotonic acid).

d) Reaction with urea.

List of Reference Books

1) A Text Book of Organic Chemistry by Bahl and Arun bahl
2) A Text Book of Organic chemistry by I L Finar Vol I
3) Organic chemistry by Bruice
4) Organic chemistry by Clayden

SEMESTER-III

COURSE 6: ORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Practical- Organic Qualitative Analysis

(At the end of Semester)

Systematic qualitative analysis of organic compounds

phenols,carbonyl compounds like Aldehyde,and ketone,carboxylic acid, amine,carbohydrate,amide and Urea

SEMESTER-III

COURSE 7: PHYSICAL CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of Solids,Liquids,and Gases.

2. understand the concept of Solutions.

UNIT-I

SOLID STATE:

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Definition of lattice point, space lattice, unit cell. X-ray diffraction and crystal structure. Bragg's law. Defects in crystals. Stoichiometric and non-stoichiometric defects.

UNIT-II

GASEOUS STATE

Introductin and derivation of Ideal Gas Equation. Vander Waal's equation of state. P-V Isotherms of real gases, Andrew's isotherms of carbon dioxide. Critical phenomena. The vander Waal's equation and the critical state. Law of corresponding states.Relationship between critical constants and vander Waal's constants. Joule Thomson effect.

UNIT-III:

LIQUID STATE

Structural differences between solids, liquids and gases. Liquid crystals, the mesomorphic state. Classification of liquid crystals into Smectic and Nematic. Differences between liquid crystal and solid/liquid. Application of liquid crystals as LCD devices.

UNIT-IV

SOLUTIONS

Liquid-liquid - ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions. Azeotropes-HCl-H_2O, ethanol-water systems and fractional distillation. Partially miscible liquids-phenol-water. Effect of impurity on consulate temperature. Immiscible liquids and steam distillation.

Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

UNIT-V

IONIC EQUILIBRIUM AND HSAB

Ionic Proodcut,common ion effect ,solubility and solubility product.

Definition of acid and basis with examples,pearson concept,HSAB Principle & it's importance definition of buffer solution .Henderson –Hassel batch Equation

List of Reference Books

1. Principles of physical chemistry by Prutton and Marron

2. Solid State Chemistry and its applications by Anthony R. West

3. Text book of physical chemistry by K L Kapoor

4. Text book of physical chemistry by S Glasstone

5. Advanced physical chemistry by Bahl and Tuli

SEMESTER-III
COURSE 7: PHYSICAL CHEMISTRY

Practical Credits: 1 2 hrs/week

Preparations of solutions

(i) 1M HCl 1M CH_3COOH 1M H_2SO_4, 1M NaOH & calibration of volumetric apparatus and statistical analysis of the data

(ii) preparation of reagents:

Starch Solutions,schiff's reagent , Tollen's Reagent,Fehlings Reagent,phenolphalein indicators

(iii) Determination of rate constant for acid catalysed ester hydrolysis.

SEMESTER-III

COURSE 8: GENERAL CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of Colloids, emulsions, and Gels.

2.Understand the concept of VBT and LCAO Method.

UNIT-I

COLLOIDS:

Definition of colloids. Solids in liquids(sols), preparation, properties - kinetic, optical, electrical. Stability of colloids, Hardy-Schulze law, protective colloid.

Liquids in liquids (emulsions) preparation, properties, uses. Liquids in solids (gels) preparation, uses.

UNIT-II

ADSORPTION:

Physical adsorption, chemisorption. Freundlisch, Langmuir adsorption isotherms. Applications of adsorption, difference between physical adsorption and chemical adsorption

UNIT-III

CHEMICAL BONDING:

Valence bond theory, hybridization, VB theory as applied to ClF_3, $Ni(CO)_4$, Molecular orbital theory - LCAO method, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules (N_2, O_2, CO and NO).

UNIT-IV

STEREOCHEMISTRY OF CARBON COMPOUNDS-I:

Molecular representations- Wedge, Fischer, Newman and Saw-Horse formulae.

Optical isomerism: Optical activity- wave nature of light, plane polarised light, optical rotation and specific rotation.

UNIT-V

STEREOCHEMISTRY OF CARBON COMPOUNDS-II

Chiral molecules- definition and criteria(Symmetry elements)- Definition of enantiomers and diastereomers – Explanation of optical isomerism with examples Glyceraldehyde, Lactic acid, Alanine, Tartaric acid, 2,3-dibromopentane.

D,L and R,S configuration methods and E,Z- configuration with examples.

List of Reference Books

1. Text book of physical chemistry by K L Kapoor
2. Text book of physical chemistry by S Glasstone
3. Stereochemistry of Organic compounds by E L Eliel
4. Advanced Organic Chemistry by F A Carey and R J Sundberg
5. Stereochemistry by P.S.Kalsi
6. Stereochemistry of Organic compounds by D. Nasipuri
7. Advanced physical chemistry by Bahl and Tuli

SEMESTER-III

COURSE 8: GENERAL CHEMISTRY

Practical Credits: 1 2 hrs/week

Practical- General Chemistry Lab

(i) Determination of surface tension of liquid

(ii) Determination of viscosity of liquid

(iii) Determination of molecular status and partion coefficient of benzoic acid in benzene and water

(iv) Adsorption of acetic acid on animal charcoal , verification of Freundlisch isotherm

SEMESTER-IV

COURSE 9: SPECTROSCOPY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of Beer-Lambert's Law.

2.understand the concept of Spectroscopy.

UNIT-I

GENERAL FEATURES OF ABSORPTION

- Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of 1. Chromium in $K_2Cr_2O_7$ 2. Manganese in Manganous sulphate

UNIT-II

ELECTRONIC SPECTROSCOPY:

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Energy levels of molecular orbitals (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore and auxochrome.

UNIT-III

INFRA RED SPECTROSCOPY:

Different Regions in Infrared radiations. Modes of vibrations in diatomic and polyatomic molecules. Characteristic absorption bands of various functional groups. Interpretation of spectra-Alkanes, Aromatic, Alcohols carbonyls, and amines with one example to each.

Functional group and finger print Region

UNIT-IV

PROTON MAGNETIC RESONANCE SPECTROSCOPY (^{1}H-NMR)

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants.

UNIT-V

APPLICATIONS OF NMR

Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

Applications of UV-Visible and IR-Spectroscopy

List of Reference Books

1. Spectroscopy by William Kemp

2. Spectroscopy by Pavia

3. Organic Spectroscopy by J. R. Dyer

4 .Elementary organic spectroscopy by Y.R. Sharma

5. Spectroscopy by P.S.Kalsi

SEMESTER-IV
COURSE 9: SPECTROSCOPY

Practical Credits: 1 2 hrs/week

Practical- IR-Spectral Analysis

IR spectral analysis of the following functional groups with examples

(a) Hydroxyl Groups

(b) Carbonyl Groups

(c) Amino Groups

(d) Aromatic Groups

SEMESTER-IV

COURSE 10: PHYSICAL CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of Electrodes.

2.understand the concept of Colligative Properties.

UNIT-I

DILUTE SOLUTIONS

Colligative properties. Raoult's law, relative lowering of vapour pressure, its relation to molecular weight of non-volatile solute. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. osmotic pressure, experimental determination. Theory of dilute solutions. Determination of molecular weight of non-volatile solute from osmotic pressure. Abnormal Colligative properties- Van't Hoff factor.

UNIT-II

ELECTROCHEMISTRY-I :

Specific conductance, equivalent conductance. Variation of equivalent conductance with dilution. Migration of ions, Kohlrausch's law. Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Definition of transport number, determination by Hittorfs method. Application of conductivity measurements- conductometric titrations.

UNIT-III

ELECTROCHEMISTRY-II

Single electrode potential, sign convention, Reversible and irreversible cells Nernst Equation- Reference electrode, Standard Hydrogen electrode, calomel electrode, Indicator electrode, metal – metal ion electrode, Inert electrode, Determination of EMF of cell, Applications of EMF measurements - Potentiometric titrations.

UNIT-IV

PHASE RULE:

Concept of phase, components, degrees of freedom. Thermodynamic Derivation of Gibbs phase rule. Phase equilibrium of one component system - water system. Phase equilibrium of two- component system, solid-liquid equilibrium. Simple eutectic diagram of Pb-Ag system, simple eutectic diagram, desilverisation of lead., NaCl-Water system, Freezing mixtures.

UNIT-V

PHOTOCHEMISTRY

Difference between thermal and photochemical processes. Laws of photochemistry- Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield-Photochemical reaction mechanism- hydrogen- chlorine, hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Photosensitized

List of Reference Books

1. Modern Electrochemistry by J.O. M. Bockris and A.K.N.Reddy

2. Advanced Physical Chemistry by Atkins

3. Introduction to Electrochemistry by S. Glasstone

SEMESTER-IV

COURSE 10: PHYSICAL CHEMISTRY

Practical Credits: 1 2 hrs/week

Practical- Physical Chemistry LAB

1. Critical solution temperature of phenol-water system
2. Effect of Nacl on CST(phenol water system)
3. Determination of concentration of HCL conductometrically using standard NaOH Solutions
4. Determination of concentration of CH_3COOH conductometrically using standard NaOH Solutions

SEMESTER-IV

COURSE 11: ORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of Amines,Nitrocompounds

2.understand the concept of Carbohydrates,Amino Acids.

UNIT- I

NITRO HYDROCARBONS:

Nomenclature and classification-nitro hydrocarbons, structure -Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity -halogenation, reaction with HONO (Nitrous acid),Nef reaction and Mannich reaction leading to Micheal addition and reduction.

UNIT – II

NITROGEN COMPOUNDS

ALIPHATIC AMINES: Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods –

1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism).

Reduction of Amides and Schmidt reaction. Physical properties and basic character - Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine

UNIT-III

AROMATIC AMINES:

introdution comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophillic substitution of Aromatic amines – Bromination and Nitration. Oxidation of aryl and Tertiary amines, Diazotization.

UNIT-IV

CARBOHYDRATES

Monosaccharides: (+) Glucose (aldo hexose) - Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation) - Proof for the ring size (methylation, hydrolysis and oxidation reactions) - Pyranose structure (Haworth formula and chair conformational formula).

(-) Fructose (ketohexose) - Evidence of 2 - ketohexose structure (formation of pentaacetate, formation of cyanohydrin its hydrolysis and reduction by HI). Cyclic structure for fructose (Furanose structure and Haworth formula) - osazone formation from glucose and fructose – Definition of anomers with examples.

Interconversion of Monosaccharides: Aldopentose to Aldohexose (Arabinose to

D- Glucose, D-Mannose) (Kiliani - Fischer method). Epimers, Epimerisation - Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose (D-Glucose to

D- Arabinose) by Ruff degradation. Aldohexose to Ketohexose

[(+) Glucose to (-) Fructose] and Ketohexose to Aldohexose (Fructose to Glucose)

UNIT- V

AMINO ACIDS

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic

and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage).

List of Reference Books

1. Organic Chemistry by G.Mare loudan, Purdue Univ
2. A Text Book of Organic Chemistry by Bahl and Arun bahl
3. A Text Book of Organic chemistry by I L Finar Vol I

SEMESTER-IV

COURSE 11: ORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Practical- Organic Chemistry Lab

(A) Give a brief introduction on

(1) Re-crystallisation(ii) sublimation © distillation (d) M.P & B.P

(B) Single step preparations

1. Preparation of P-Nitro acetanilide

2. Preparation of Aspirin

SEMESTER-V

COURSE 12: GREEN CHEMISTRY AND NANOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the importance of Green chemistry and Green synthesis.
2. Engage in Microwave assisted organic synthesis.
3. Demonstrate skills using the alternative green solvents in synthesis.
4. Demonstrate and explain enzymatic catalysis .
5. Analyse alternative sources of energy and carry out green synthesis.
6. Carry out the chemical method of nanomaterial synthesis.

UNIT-I Green Chemistry: I rs

Introduction-Definition of green Chemistry,Need for green chemistry, Goals of Green chemistry Basic principles of green chemistry. Green synthesis- Evaluation of the type of thereaction i) Rearrangements (100% atom economic),ii)Addition reaction(100% atom economic). Organic reactions by Sonication method: apparatus required and examples of sono chemical reactions (Heck, Hundsdiecker and Wittig reactions).

UNIT- II Green Chemistry : Part- II rs A)

Selection of solvent:

i) Aqueous phase reactions ii) Reactions in ionic liquids, Heck reaction,Suzuki reactions,epoxidation.

iii)Solid supported synthesis

B) Supercritical CO_2:Preparation, properties and applications,(decaffeination, drycleaning)

C) Green energy and sustainability.

UNIT-III Microwave and Ultrasound assisted green synthesis: rs

Apparatus required, examples of MAOS (synthesis of fused anthroquinones, Leukart reductive amination of ketones)-Advantages and disadvantages of MAOS. Aldol condensation –Cannizzaro reaction - Diels-Alder reactions- Strecker's synthesis

UNIT-IV Green catalysis and Green synthesis rs

Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis-biocatalysis: Enzymes, microbes Phase transfer catalysis (micellar/surfactant)

1. Green synthesis of the following compounds : adipic acid, catechol, disodium imino diacetate (alternative Strecker's synthesis)

2. Microwave assisted reaction in water –Hoffmann elimination – methyl benzoate to benzoic acid – oxidation of toluene and alcohols–microwave assisted reactions in organicsolvents. Diels-Alder reactions and decarboxylation reaction.

3. Ultrasound assisted reactions–sonochemical Simmons–Smith reaction(ultrasonic alternative to iodine)

UNIT – V Nanotechnology in Green chemistry rs Basic concepts of Nanoscience and Nanotechnology – Bottom-up approach and Top down approaches with examples – Synthesis of Nano materials – Classification of Nanomaterials – Properties and Application of Nanomaterials. Chemical and Physical properties of

Nanoparticles – Physical synthesis of nanoparticles – Inert gas condensation - aerosol method - Chemical Synthesis of nanoparticles – precipitation and co-precipitation method,sol-gel method.

List of Reference books:

1. Green Chemistry Theory and Practical. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry(London)
5. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., JohnWiley
6. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.MSrivastava, Narosa Publications
7. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, CRC Press(2008).
8. Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials, Vladimir A. Basiuk, Elena V. Basiuk Springer (2015)
9. Web related references suggested by teacher.

SEMESTER-V

COURSE 12: GREEN CHEMISTRY AND NANOTECHNOLOGY

Practical Credits: 1 2 hrs/week

Laboratory course Syllabus:

1. Identification of various equipment in the laboratory.
2. Acetylation of 1^0 amine by green method: Preparation of acetanilide
3. Rearrangement reaction in green conditions: Benzil - Benzilic acid rearrangement
4. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
5. Green oxidation reaction: Synthesis of adipic acid
6. Preparation and characterization of biodiesel from vegetable oil/ waste cooking oil
   7.Preparation and characterization of Nanoparticles of gold using tea leaves.
8. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
9. Photoreduction of Benzophenone to Benzopinacol in the presence of sunlight.

List of Reference books:

1)Green Chemistry Theory and Practical. P.T.Anatas and J.C. Warner

2)Green Chemistry V.K. Ahluwalia Narosa, New Delhi.

3) Real world cases in Green Chemistry M.C. Cann and M.E. Connelly

4) Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry(London)

5) Web related references suggested by teacher.

SEMESTER-V

COURSE 13: ANALYSIS OF ORGANIC COMPOUNDS

Theory Credits: 3 3 hrs/week

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1) Identify the importance of mass spectrometry in the structural elucidation of organic compounds.
2) Acquire the knowledge on structural elucidation of organic compounds.
3) Understand various chromatography methods in the separation and identification oforganic compounds.
4) Demonstrate the knowledge gained in solvent extraction for the separate the organic compounds.

Unit-I: Nuclear Magnetic Resonance (NMR) spectroscopy

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position ofsignals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants. Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2tribromo ethane, ethyl acetate, toluene and acetophenone.

Unit II Mass Spectrometry rs

A brief introduction to analysis of organic compounds
Basic principles, Instrumentation - Mass spectrometer, electron Ionization (Electron Impactionization, EI), Molecular ions, metastable ions, Isotope abundance. Basic fragmentation types. Fragmentation patterns in Toluene, 2-Butanol, Butaldehyde, Propionicacid.

Unit-III : Structural elucidation of organic ompounds using IR,NMR & mass spectraldata- ours

2,2,3,3-Tetramethyl butane,Butane-2,3-dione,Propionicacid and methyl propionate.Phenyl acetylene, acetophenone, cinnamic acid and p-nitroaniline.

Unit-IV: Separation techniques-1 ours

Solvent extraction-Principle and theory, Batch extraction technique, application of batch extraction in the separation of organic compounds from mixture- acid & neutral, base &neutral.

Chromatography – Principle and theory, classification, types of adsorbents, eluents, Rfvaluesand factors affecting Rfvalues. Thin layer chromatography - principle, experimental procedure, advantages and applications.

Unit-5:Separation techniques - 2 ours

Paper chromatography- Principle, experimental procedure, ascending, descending, radial andtwo dimensional, applications.

Column chromatography - Principle, classification, experimental procedure and applications.HPLC-

Principle, Instrumentation – block diagram and applications.

List of Reference books:

1) Organic Spectroscopy by William Kemp,Third Edition, Palgrave USA.
2) Introduction to Spectroscopy by Pavia, Lamp man, Kriz and Vyvyan, Fifth edition,

Cengage.
3) Organic Spectroscopy: Principles and Applications by Jag Mohan, Second edition,Alpha Science.
4) Spectroscopy of Organic Compounds by P.S.Kalsi, Seventh edition, New Age International.
5) Spectroscopic Methods in Organic Chemistry by Ian Fleming and Dudley Williams, Seventh edition, Springer.
6) Fundamentals of Analytical Chemistry by F.James Holler, Stanley R Crouch, DonaldM.West and Douglas A.Skoog, Ninth edition, Cengage.
7) Analytical Chemistry by Gary D.Christian, PurnenduK.Dasgupta and KevinA.Schug, Seventh edition, Wiley.
8) Quantitative analysis by R.A.DayJr.andA.L.Underwood, Sixth edition, Pearson.9)Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.

SEMESTER-V

COURSE 13: ANALYSIS OF ORGANIC COMPOUNDS

Practical Credits: 1 2 hrs/week

Prepare acetanilide using the green synthesis.

1) Demonstrate the preparation of an azo dye.
2) Acquire skills in the separation of organic compounds in the given mixture usingsolvent extraction

VI. Laboratory course Syllabus:

1) Identification of various equipment in the laboratory.
2) Acetylating of 1^0amine by green method : Preparation of acetanilide
3) Rearrangement reaction in green conditions :Benzil-Benzilic acid rearrangement
4) Radical coupling reaction : Preparation of 1,1-bis-2-naphthol
5) Green oxidation reaction: Synthesis of adipic acid
6) Preparation and characterization of biodiesel from vegetable oil/waste cooking oil.
7) Photo reduction of Benzophenone to Benzopinacol in the presence of sunlight.
8) Separation of organic compounds in a mixture(acidic compound + neutral compound)using solvent extraction.
9) Separation of organic compounds in a mixture (basic compound+ neutral compound)using solvent extraction.

VII. List of Reference books :

1) Vogel A.I.Practical Organic Chemistry, Longman Group Ltd.
2) Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
3) Ahluwalia V. K. and Aggarwal R. Comprehensive Practical Organic Chemistry,University press.MannF.G and Saunders B.C, Practical Organic Chemistry, Pearson Education.

SEMESTER-V

COURSE 14: CHROMATOGRAPHY AND INSTRUMENTAL METHODS OF ANALYSIS

Theory Credits: 3 3 hrs/week

Learning Outcomes:

1) Students after successful completion of the course will be able to:
2) Identify the importance of chromatography in the separation and identification of compounds in a mixture
3) Acquire a critical knowledge on various chromatographic techniques.
4) Demonstrate skills related to analysis of water using different techniques.
5) Understand the principles of spectrochemistry in the determination of metal ions.
6) Comprehend the applications of atomic spectroscopy.

I. Syllabus:

Unit-1: Chromatography-Introduction and classification

Principle, Classification of chromatographic methods, Nature of adsorbents, eluents,Rfvalues, factors affecting Rfvalues.

UNIT-2: TLC and paper chromatography

Thin layer chromatography: Principle, Experimental procedure, preparation of plates, adsorbents and solvents, development of chromatogram, detection of spots, applications andadvantages.

Paper Chromatography: Principle, Experimental procedure, choice of paper and solvents,various modes of development- ascending, descending, radial and two dimensional, applications.

UNIT-3: Column chromatography

Column chromatography: Principle, classification, Experimental procedure, stationary andmobile phases, development of the Chromatogram, applications.

HPLC: Basic principles, instrumentation–block diagram and applications.

UNIT-4: Spectrophotometry

Principle, Instrumentation : Single beam and double beam spectrometer, Beer-Lambert'slaw-Derivation and deviations from Beer-Lambert's law, applications of Beer-Lambert's lawQuantitative determination of Fe^{+2}, $Mn^{+2}$and Pb^{+2}.

UNIT-5: Polarimetry and Refractometry

Polarimetry and Refractometry: Polarimetry: Nature of polarized light, polarimeter, samplecells, operation of the polarimeter, optical purity. Refractometry; The refractive index, Refractometer.

List of Reference books:

1) Fundamental so Analytical Chemistry by F.James Holler, Stanley R Crouch, Donald M.West and Douglas A.Skoog, Ninth edition, Cengage.
2) Analytical Chemistry by Gary D.Christian, PurnenduK.Dasgupta and Kevin A.Schug, Seventh edition, Wiley.
3) Quantitative analysis byR.A.DayJr .and A.L.Underwood,Sixthedition,Pearson.
4) Text book of Vogel's Quantitative Chemical Analysis, Sixth edition/Pearson.
5) Instrumental methods of Chemical Analysis by Dr.B.K.Sharma 1981

SEMESTER-V

COURSE 14: CHROMATOGRAPHY AND INSTRUMENTAL METHODS OF ANALYSIS

Practical Credits: 1 2 hrs/week

II. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1) Perform the separation of a given dye mixture using TLC
2) Learn the preparation of TLC plates
3) Demonstrate the separation of mixture of amino acids using paper chromatography
4)Acquire skills in using column chromatography for the separation of dye mixture.

III. Laboratory course Syllabus:

1) Separation of a given dye mixture (methyl orange and methylene blue) using TLC(using alumina as adsorbent).
2) Separation of mixture of methyl orange and methylene blue by column chromatography.
3) Separation of given mixture of amino acids (glycine and phenyl alanine) usingascending paper chromatography.
4) Separation of food dyes using Column Chromatography
5) Separation of triglycerides using TLC
6) Verification of Beer lambert's law. (Using potassium permanganate solution) using colorimeter / spectrophotometer.

IV. List of Reference books:

2) Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
3) VogelA.I .Practical Organic Chemistry, Longman Group Ltd.
4) Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
5) Ahluwalia V. K. and Agarwal R. Comprehensive Practical Organic Chemistry,University press.
6) MannF.Gand Saunders B.C, Practical Organic Chemistry, Pearson Education.

SEMESTER-V

COURSE 15: ENVIRONMENTAL CHEMISTRY

Theory Credits: 3 3 hrs/week

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1)Understand the environment functions and how it is affected by human activities.
2)Acquire chemical knowledge to ensure sustainable use of the world's resources and
3)ecosystems services.

4) Engage in simple and advanced analytical tools used to measure the different typesof pollution.
5) Explain the energy crisis and different aspects of sustainability.
6) Analyze key ethical challenges concerning biodiversity and understand the moral principles, goals
7) and virtues important for guiding decisions that affect Earth's plant and animal life.

UNIT-I

Environmental chemistry

Definition – Concept of Environmental chemistry-Scope and importance of environment in now a days – Nomenclature of environmental chemistry – Segments of environment–Effectsof human activities on environment – Natural resources–Renewable Resources–Solar and Biomass Energy and Nonrenewable resources – Thermal power and atomic energy – Reactions of atmospheric oxygen and Hydrological cycle.

UNIT-II

Air Pollution

Definition – Sources of air pollution – Classification of air pollution – Ambient air quality standards- Climate change – Global warming – Pollution from combustion systems- Acid rain – Photochemical smog – Green house effect – Formation and depletion of ozone – Bhopal gas disaster–Instrumental techniques to monitor pollution – Controlling methods ofair pollution.

UNIT-III

Water pollution

Unique physical and chemical properties of water – Water quality standards and parameters –

Turbidity- pH Dissolved oxygen – BOD, COD, Suspended solids, total dissolvedsolids,alkalinity– Hardnessofwater–Methodstoconverttemporaryhardwaterintosoft water – Methods to convert permanent hard water into soft water – eutrophication and its effects –Industrial waste water treatment.

UNIT-IV

Chemical Toxicology

Toxic chemicals in the environment – effects of toxic chemicals – cyanide and its toxiceffects – pesticides and its biochemical effects – toxicity of lead, mercury, arsenic and cadmium-Solid waste management.

UNIT-V
Ecosystem and biodiversity

Ecosystem : Concepts–structure–Functionsandtypesofecosystem–Abioticandbioticcomponents – Energyflow and Energy dynamics of ecosystem– Food chains – Food web– Tropic levels– Biogeochemical cycles (carbon, nitrogen and phosphorus)**Bio diversity:**

Definition – level and types of biodiversity – concept- significance – magnitude and distribution of biodiversity–trends-biogeographical classification of india – biodiversity atnational, global and regional level.

List of Reference books:

1. Fundamentals of ecology by M.C.Dash
2. A Text book of Environmental chemistry byW. Moore and F.A. Moore
3. Environmental Chemistry by Samir k.Banerji
4. Water pollution, Lalude, MC Graw Hill
5. Environmental Chemistry, Anil Kumar De, Wiley Eastern ltd.
6. Environmental analysis, SMKhopkar (IIT Bombay)
7. Environmental Chemistry by BK Sharma & H Kaur, Goel publishing house.
8. Fundamentals of Environmental Chemistry, Manahan, Stanley. E 9.Applications of Environmental Chemistry, Eugene R. Wiener
10. Web related references suggested by teacher.

SEMESTER-V

COURSE 15: ENVIRONMENTAL CHEMISTRY

Practical Credits: 1 2 hrs/week

1. **Laboratory course Syllabus**:

1. Identification of various equipment in the laboratory.
2. Determination of carbonate and bicarbonate in water samples by double titrationmethod.

3.Determination of hardness of water using EDTA

a) Permanent hardness b) Temporary hardness

4. Determination of Chlorides in water samples by Mohr's method.
5. Determination of pH, turbidity and total solids in water sample.
6. Determination of Ca^{+2} and Mg^{+2} in soil sample by flame photometry.
7. Determination of pH in soil samples using pHmetry.

List of Reference books:

1. A Text Book of Quantitative Inorganic Analysis(3^{rd}Edition) –A.I.Vogel
2. Water pollution, Lalude, MC Graw Hill
3. Environmental analysis, SMKhopkar (IIT Bombay)
4. Web related references suggested by teacher.

SEMESTER-VII
COURSE 16: SYNTHETIC ORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1) Identify the importance of reagents used in the synthesis of organic compounds.
2) Acquire knowledge on basic concepts in different types of pericyclic reactions.
3) Understand the importance of retro synthesis inorganic chemistry.
4) Comprehend the applications of different reactions in synthetic organic chemistry.

Unit-1:Pericyclic reactions ours

Definition and classification of pericyclic reactions: Phases, nodes and symmetry properties of molecular orbital's in ethylene,1,3-butadiene,1,3,5-hexatriene,alkylationandallylradical. Thermal and photochemical reactions. Electro cyclic reactions: Definition and examples, definitions of con and disrotation,Woodward-Hoffmann selection rules.(Correlation diagramsexcluded) Cyclo addition reactions: Definition and examples, definitions of supra facial and antar facial addition, Woodward-Hoffmann selection rules. (Correlation diagrams excluded)

Unit-2 : Organic photochemistry ours

Jablonski diagram-singlet and triplet States Photochemistry of Carbonyl compounds n–π*and π–π*transitions, Norrish type-1and type-2reactions Paterno–Buchi reaction.

Unit-3 : Retrosynthesis ours

Important terms in Retro synthesis with examples-Disconnection, Target molecule, FGI, Synthon, Retrosynthetic analysis, chemo selectivity, region selectivity. Importance of Orderof events in organic synthesis. Retrosynthetic analysis of the compounds: a) cyclohexene b)4-Nitro toluene c) Paracetamol.

Unit-4 : Synthetic Reactions ours

Shapiro reaction, Stork - enamine reaction(only alkylation),Wittig reaction, Robinson annulation, Bailys-Hillman reaction, Heck reaction, Suzuki coupling. Synthesis of aldehydesand ketones using1, 3-Dithiane.

Unit-5 : Reagents in Organic Chemistry ours

Oxidizing agents:PCC,PDC,SeO_2 (Riley oxidation), NBS.

Reducing agents : $LiAlH_4$(with mechanism), LTBA, Metal-solvent reduction (Birchreduction),

Catalytic reduction.

List of Reference books:

1) Pericyclic reactions by Ian Fleming, Second edition,Oxford University press.
2) Pericyclic Reactions- A Text book: Reactions, Applications and Theory byS.Sankararaman, WILEY-VCH.
3) Reaction Mechanism in Organic Chemistry by S.M. Mukherji and S.P.Singh, Revisededition, Trinity Press.
4) Pericyclic reactions – A Mechanistic study by S.M.Mukherji, Macmillan India.
5) Organic synthesis :The disconnection approach by Stuart Warren, John Wiley&Sons.
6) Organic chemistry by Jonathan Clayden, Nick Greeves and Stuart Warren, Secondedition, Oxford university press.
7) Reactions, Reagents and Rearrangements by S.N. Sanyal, Bharati Bhawan Publishers &Distributors

SEMESTER-VII
COURSE 16: SYNTHETIC ORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Laboratory course syllabus:

1) Green procedure for organic qualitative analysis: Detection of N,S and halogens
2) Separation of given mixture of amino acids (glycine and phenyl alanine) usingascending paper chromatography.
3) Separation of a given dye mixture (methyl orange and methylene blue) using TLC(using alumina as adsorbent).
4) Separation of mixture of methyl orange and methylene blue by column chromatography
5) Separation of food dyes using Column Chromatography 6)Separation of triglycerides using TLC

II. List of Reference books :

1) VogelA.I.Practical Organic Chemistry, Longman Group Ltd.
2) Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
3) Ahluwalia V. K. and Aggarwal R. Comprehensive Practical Organic Chemistry,University press.
4) MannF.G and Saunders B.C, Practical Organic Chemistry, Pearson Education.

SEMESTER-VII

COURSE 17: ORGANIC CHEMISTRY: STEREO CHEMISTRY AND NATURAL PRODUCTS

Theory Credits: 3 3 hrs/week

Course Learning outcomes:

On successful completion of this course, student shall be able to:

1) Understand and apply the substitution and elimination reaction mechanisms at aliphaticand aromatic substrates for various reactions leading to research 2)Write the stereo chemical forms for different organic molecules.

3) Understand the conformations of acyclic, monocyclic and fused ring systems and applyingit to organic compounds.
4) Explain formation of various heterocyclic compounds and their synthesis and importance.
5) Describe the importance of natural products in medicinal chemistry

Unit – I Reaction Mechanism ours

AliphaticNucleophilic Substitution and Nucleophilic Aromatic substitution: Stereo chemistry of $SN_2$and SN_1 mechanisms, Neighboring Group Participation (Anchimeric assistance), NGP byO, S, N : Aromatic Nucleophilic substitution SN2 (Ar) (Addition – Elimination), SN1(Ar) and benzyne mechanisms (Elimination - Addition); evidence for the structure of benzyne.

Von Richter Sommelet-Hauser rearrangements.

Elimination Reactions:
Type of elimination reactions, mechanisms, Stereochemistry and Orientation, Hofmann and Saytzeff rules, Syn elimination versus anti-elimination, competition between elimination and substitution, dehydration, dehydrogenation, dehalogenation, decarboxylative eliminations and pyrolytic eliminations

Unit-II: Stereo Chemistry-I: ours
Concept and Recognition of Molecular Symmetry and Chirality. Definition and classificationof Stereoisomers, Enantiomer, Diastereomer, Homomer, Epimer, Anomer, Configuration and Conformation, Configurational nomenclature: D,L and R,S nomenclature. Molecular representation of organic molecules: Fischer,Newman and Sawhorse projections and their inter-conversions. Geometrical Isomerism. Cis-trans, E, Z-and Syn and anti nomenclature, Methods of determining configuration of Geometrical isomers using physical, spectral and chemical methods, Stability, Cis-trans interconversion.

Unit-III: Stereo Chemistry-II: ours
Conformation and factors influencing on stability of Conformations; Conformational analysis of cyclic molecules - cyclobutane, cyclohexane – mono and disubstituted cyclohexanes and carbon heteroatom bonds having C–O&C–N. Prochirality and Prostereoisomerism:-Homotopic ligands and faces; enantiotopic ligands and faces; diastereotopic ligands and faces; nomenclature of enantiotopic ligands and faces(Pro-R, Pro-S, Re, Si carbonyl compounds and Alkenes)

Stereoisomerism in molecules without chiral Center Axial chiralityAllenes, Alkylidene cycloalkanes, spiranes. Atropisomerism: Biphenyl derivatives, nomenclature. Planar chirality:Ansa compounds, paracyclophanes, trans- cyclooctene and Helicity.

UNIT–IV Heterocyclic compounds ours

Importance of heterocyclic compounds as drugs. Nomenclature of heterocyclic systemsbased on ring size, number and nature of hetero atoms. Chemistry of heterocyclic compounds, synthesis and reactivity of the following systems: Quinoline, Isoquinoline, Indole, Pyrazole, Imidazole, Oxazole, Isoxazole, Pyridazine, pyrimidine and Pyrazine.

UNIT- V Chemistry of some typical natural products

Isolation, classification, structure elucidation, synthesis of:

Alkaloids: Atropine, Nicotine, and Quinine.

Terpenoids: α-Terpeneol, α-Pinene and Camphor.

List of Textbooks:

1) Advanced organic chemistry-Reaction, mechanism and structure, Jerry March, John Wiley.
2) Advanced organic chemistry, F.A.Carey and R.J.Sundberg, Springer, NewYork.
3) A guide book to Mechanism in organic chemistry, Peter Sykes, Longman.
4) Organic chemistry, I.L.Finar, Vol.I, Fifth edi . ELBS.
5) Organic chemistry, Hendrickson,Cram and Hammond (McGraw–Hill).

Reference books:

1) Structure and mechanism in organic chemistry, C.K.Ingold, Cornell University Press.
2) Principles of organic synthesis, R.O.C.Norman and J.M.Coxon, Blakie Academic &Professional.
3) ReactionMechanisminOrganicChemistry,S.M.MukherjiandS.P.Singh,Macmillan.
4) Basic Principles of Organic Chemistry by J.B.Roberts and M. Caserio.
5) Stereochemistry of Organic compounds by Ernest L.Eliel, Samuel H.Wilen 6)Chemistry ofnatural products byS.V.Bhat ,B.A.Nagasampangi.
7) Stereochemistry of Organic compounds by D.Nasipuri.

SEMESTER-VII

COURSE 17: ORGANIC CHEMISTRY: STEREO CHEMISTRY AND NATURAL PRODUCTS

Practical Credits: 1 2 hrs/week

Syllabus.

Systematic qualitative analysis of an organic mixture containing two compounds;
Identification of method of separation and the functional group(s) present in each of them and preparation of one solid derivative for the conformation of each of the functional group(s).Purification of derivatives- The student has to do Recrystallization to final derivatives(s) and submit the sample. If the sample is impure liquid must carry out distillationprocess.

SEMESTER-VII

COURSE 18: ORGANIC CHEMISTRY: MODERN ORGANIC SYNTHESIS AND NATURAL PRODUCTS

Theory Credits: 3 3 hrs/week

Course Learning outcomes:

On successful completion of this course, student shall be able to:

1) Understand various types of reaction intermediates and the bonding present in variousorganic compounds.
2) Explain how to protect various functional groups in organic synthesis.
3) Describe the mode of addition reactions by electrophile and nucleophiles.
4) Discuss mechanisms of named reactions and their applications in organic synthesis.
5) Know about the importance of flavones, flavonoids and harmones.

UNIT – I
Reactive intermediates, Reactive Species and Protecting groups:

Reactive intermediates : Generation, Structure, Stability, Detection and Reactivity of Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes and Arynes.

Reactive Species: Generation and reactivity of Electrophiles, Nucleophiles, Dienophiles,Ylids, Enophiles.

Protecting groups: Protection of carbonyl, Hydroxyl, carboxylic acid and amine groups.

UNIT-II Addition Reactions
Addition to Carbon – Carbon Multiple Bonds: Mechanistic and stereo chemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, region and chemo selectivity, orientation and reactivity, Hydrogenation of double andtriple bonds, hydrogenation of aromatic rings, Hydroboration.

Addition to Carbon - Hetero Multiple Bonds: Steric course of addition reactions to C=O and C=N, , Knoevenagel, Claisen- Schmidt, Dieckman and Stobbe condensations,Wittig, Grignard, Mannich and Michael reaction.

UNIT-III Molecular Rearrangements
Types of molecular rearrangements, migratory aptitude;

Rearrangements to electron deficient carbon: Wagner-Meerwein, Dienone–Phenol, ArndtEistertsynthesis;

Rearrangements to electron deficient nitrogen: Beckmann, Hofmann, Schmidt rearrangements;

Rearrangements to electron deficient oxygen: Baeyer-villiger, Benzil-Benzilic acid and Favorskii rearrangements.

UNIT–IV: Steroid harmones
Nomenclature, basic skeleton, Diel's hydrocarbon and it's stereochemistry. Isolation,structure determination and synthesis of androsterone, testosterone, oestrone and progesterone.

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UNIT–V: Flavonoids and Isoflavonoids:

Nomenclature and general methods of structure determination, Isolation, structure elucidation and synthesis of Kaempferol, Quercetin, Cyanidin, Genestein, Butein and Daidzein. Biosynthesis of flavonoids and Isoflavonoids.

List of Text books :

1) Advanced Organic Chemistry: Reactions Mechanisms and Structure by JerryMarch, Mc.GrawHill and Kogakush.
2) Organic Chemistry Vol.I(SixthEd)andVol.II(Fifth Ed.) by ILFinar ELBS.
3) Organic Chemistry (fifthEd) by Morrison and Boyd, PHI, India.
4) Organic Chemistry (fifthedition) by Francis A.Carey Tata Mc Graw Hillpublishing Company Limited, New Delhi.
5) Chemistry of natural products by S.V.Bhat, B.A.Nagasampangi

Reference Books:

1) Reaction Mechanism in Organic Chemistry by Mukherjee Singh.
2) A guide book to mechanism in Organic Chemistry by Peter Sykes, ELBS.
3) Chemistry of Natural products by R.S.Kalsi, Kalyani Publishers.1983.

SEMESTER-VII

COURSE 18: ORGANIC CHEMISTRY: MODERN ORGANIC SYNTHESIS AND NATURAL PRODUCTS

Practical Credits: 1 2 hrs/week

Syllabus:

Preparation, recrystallization, and determination of melting point & yield of the following compounds:

1) Aspirin
2) Nerolin
3) Chalcone
4) p-Nitro acetanilide
5) 2,4,6- Tribromoaniline
7) m-Dinitrobenzene
8) Phthalimide
9) Diels-Alder adduct.

SEMESTER-VIII
COURSE 19: CHEMISTRY OF NATURAL PRODUCTS

Theory Credits: 3 3 hrs/week

Course learning Outcomes

By the end of the course students will be able to:

Understand isolation, purification and characterization of simple chemical constituents fromthe natural source

1. Learn the different types of alkaloids and their chemistry
2. To know the classification of terpenoids, isoprene rule, structures and their natural sources.
3. Learn advanced methods of structural elucidation of compounds of natural origin
4. Understand isolation, purification, chemical constituents from the natural source 5. Toknow the structure characterization and synthesis of steroids

Syllabus:

Unit I:

Alkaloids **[ours]**

Introduction, general methods for the elucidation of the structure, breaking into small fragments,determination of structure of fragments.Type of linkage, functional nature of oxygen,zwitter ion method to know number of –OH groups,C=O group,-COOH group –OCH3 (Ziesel's method).Detection of N atom,Detection of –N-CH3 group. Herzig–Meyer method to recognize heterogeneous system.Hofmann exhaustive methylation.

Emde'sdegradation,Von-Braundegradation,reductivedegradation,Alkali fusion,oxidation,dehydrogenation**.**

Unit - II: Structure and synthesis [ours]

1. Phenyl ethyl amine group alkaloids (adrenaline)
2. Piperedine group alkaloids(piperine)
3. Pyridine group alkaloids(coniine)

Unit- III

Terpenoids

Isoprene rule, special isoprene rule, classification.General methods of the determination of structure. Nature of Oxygen, number of alkyl groups (Kuhn-roth method). Unsaturation detection, reduction (NOCl), dehydrogenation , oxidative degradation,ozonolysis, H_2O_2, Baeyer's reagent, NaOX, HNO_3, dehydration–$ZnCl_2$, H_2SO_4 .

Catalytic hydrogenation,Grignard reaction, Reformatsky reaction.

Unit-IV Structure and synthesis

Mono terpenoids (acyclic)-Citral–structure and synthesis.Monocyclic mono terpenoids:α -

Terpeniol, Menthol, Limonine –Structure and Synthesis

Unit-V

Steroids

Occurrence, nomenclature, basic skeleton, Diel'shydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol (Synthesis not required), Bio Synthesis of Steroids**.** Chemistry and synthesis of oestrone, progesterone, androsterone, testosterone.

Suggested Text Books:

1. Some Modern methods of Organic Synthesis W. Carithers, Cambridge University Press, Cambridge.
2. Organic Chemistry: Stereochemistry and the Chemistry of Natural Products.-I.L. Finar,Pearson Education, Asia
3. Organic Chemistry, Morrison and Boyd, Pearson, 7th Edition
4. Organic Chemistry, Solmons and Fryhle, Willy Student Edition
5. Organic Chemistry a Lab Manual, Piva, Lampman, Engel. Cengage Learning India

References:

1.The terpenoids by Simonsen

2) The steroids by Shoppee

3) Chemistry of Carbon compounds by Rodd

SEMESTER-VIII

COURSE 19: CHEMISTRY OF NATURAL PRODUCTS

Practical Credits: 1 2 hrs/week

III. Practical Syllabus

1. Separation of natural products using column chromatography
2. Identification of alkaloids in any three plant extracts
3. Identification of terpenes in any three plant extracts
4. Identification of diterpinoids in any three plant extracts
5. Identification of Steroids in any three plant extracts 6. Identification of phenolic groups inthree plant extracts

IV. References:

1) The terpenoids by Simonsen

2) The steroids by Shoppee

3) Chemistry of Carbon compounds by Rodd

SEMESTER-VIII

COURSE 20: PHARMACEUTICAL AND MEDICINAL CHEMISTRY

Theory Credits: 3 3 hrs/week

Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1)Know the Terminology in Pharmaceutical chemistry.

2) Describe the classification of Pharmaceutical chemistry
3) Learn the procedure for Synthesis and therapeutic activity of the compounds. 4)Acquire knowledge on Pharmacodynamics and Anesthetics Drugs 5)Gain knowledge on HIV-AIDS and Drugs.

UNIT-I Pharmaceutical chemistry

Terminology: Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics (ADME, Receptors - brief treatment), Metabolites and Anti metabolites.Nomenclature: Chemical name, Generic name and trade names with examples.

UNIT-II Classification of Drugs

Classification based on structures and therapeutic activity with one example each, Administration of drugs. Absorption of drugs - factors affecting absorption of drugs, routes of administration - local, enema, oral and external, parental routes - advantages anddisadvantages.

UNIT-III Synthesis and therapeutic activity of the compounds:

a.Chemotheraputic Drugs : l.Sulpha drugs (Sulpha methoxazole) 2.Antibiotics - βLactam Antibiotics, Macrolide Antibiotics, 3. Anti malarial Drugs(chloroquine)

b.Psychotherapeutic Drugs: 1.Anti pyrectics (Paracetamol) 2.Hypnotics, 3.Tranquilizers (Diazepam) 4.Levodopa

UNIT-IV Pharmacodynamics and Anesthetics Drugs:

1) Antiasthma Drugs (Salbutamol)
2) Antianginals (Glyceryl trinitrate)
3) Diuretics (Furosemide)
4) Anesthetics - general - ether, chloroform, ethyl chloride, halothane, nitrous oxide,local - esters - cocaine, benzococaine.

UNIT-V HIV-AIDS:

Immunity - CD-4cells, CD-8cells, Retro virus, Replication in human body, Investigation available, prevention of AIDS, Drugs available - examples with structures: PIS: Indinavir (crixivan), Nelfinavir (Viracept), AZT- Zidovudine.

List of text Books:

1) Synthetic Drugs by O.D.Tyagi& M.Yadav3.Medicinal Chemistry by Ashutoshkar
2) Medicinal Chemistry by P.Parimoo
3) Pharmacology& Pharmacotherapeutics R.SSatoshkar&S.D.Bhandenkar 4)Reference Books:
5) Medicinal Chemistry by Dr. B.V.Ramana

6) Synthetic Drugs by O.D.Tyagi& M.Yadav3.Medicinal Chemistry by Ashutoshkar
7) Medicinal Chemistry by P.Parimoo
8) Pharmacology& Pharmacotherapeutics R.SSatoshkar&S.D.Bhandenkar
9) Medicinal Chemistry by Kadametal P-I & P.II 10)European Pharmacopoeia.

SEMESTER-VIII

COURSE 20: PHARMACEUTICAL AND MEDICINAL CHEMISTRY

Practical Credits: 1 2 hrs/week

Laboratory course Syllabus

1) Synthesis of Sulphanilamide
2) Synthesis of 7- Hydroxy -4- methyl coumarin
3) Synthesis of Chlorobutanol
4) Synthesis of Tolbutamide 07
5) Assay of Chlorpheniramine Maleate
6) Assay of Benzyl Penicillin 2
7) Synthesis of Aspirin Assisted by Microwave Oven
8) Drawing structure and Reaction using Chemdraw

List of Reference books:

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Text book of practical organic chemistry- A.I.Vogel.

SEMESTER-VIII

COURSE 21: ASYMMETRIC SYNTHESIS AND HETEROCYCLES

Theory Credits: 3 3 hrs/week

At the end of the course , the students will be able to;

1. **Understand the basic concepts of Chiral molecules,enantiomers**
2. **Understand the concept of heterocycles**

UNIT – I :

ASYMMETRIC SYNTHESIS-I

(A) Introduction and terminology

Topicity in molecules : Homotopic, stereoheterotopic (enantiotopic and diastereotopic), **Prochirality nomenclature**: Substitution and addition criteria. Pro-R, Pro-S, Re and Si faces.**Stereoselective reactions:** Enantioselectivity and diastereoselectivity.

Optical purity: Enantiomeric excess and diastereomeric excess.

Unit-II

ASYMMETRIC SYNTHESIS-II:

(B) Strategies in Asymmetric Synthesis

i. Chiral substrate controlled asymmetric synthesis: Nucleophilic additions to chiral carbonyl compounds. 1, 2- asymmetric induction, Cram's rule and Felkin-Anh model.

ii. Chiral auxiliary controlled asymmetric synthesis: α-Alkylation of chiral enolates, imines. Use of chiral auxiliaries in Diels-Alder reaction.

iii. Chiral reagent controlled asymmetric synthesis: Asymmetric reductions usingBINAL-H. Asymmetric hydroboration using IPC_2BH and $IPCBH_2$.

iv. Chiral catalyst controlled asymmetric synthesis: Sharpless and Jacobsen asymmetric epoxidations. Asymmetric hydrogenations using chiral Wilkinson biphosphine and Noyori catalyst. Enzyme mediated enantioselective synthesis.

UNIT – III:

HETEROCYCLES

fivemembered heterocycles : Synthesis and reactions including applications of Pyrazole, Imidazole, Oxazole, Thiazole, Isoxazole, Isothiazole.

UNIT – IV :

BENZOFUSED HETEROCYCLES

Benzofused five membered heterocycles : Synthesis and reactions including applications of Benzimidazole, Benzoxazole and Benzothiazole

UNIT-V:

Benzofused six membered heterocycles : Synthesis and reactions including applications of Quinoline and Isoquinoline,indole

Books Suggested

1. Heterocyclic chemistry Vol. 1-3, RR Gupta, M.Kumar and V. Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry, J.A. Joule, K. Mills and G.F.Smith, Chapman and Hall.
4. Heterocyclic chemistry – T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic chemistry, G.R. Newkome and W.W. Paudler, Wiley – InterScience

6. An introduction to the Heterocyclic Compounds. R.M. Acheson, Jonn Wiley.
7. Comprehensive Heterocyclic chemistry, A.R. Katritzky and C.W. Rees, Eds. Pergamon Press.
8. Principles of Modern Heterocyclic chemistry, L.A. Paquette.
9. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
10. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
11. Stereoselective Synthesis: A practical approach, M. Nogradi, VCH.
12. Introduction to Flavonoids, T.A. Geissman.
13. New Trends in Natural Products Chemistry, Atta-ur-Rahman and M.I. Choudhary,Harwood Academic Publisher.
14. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, ELBS.
15. Chemistry of Natural Products P.S. Kalsi, Kalyani Publishers.
16. Biosynthesis of steroids, terpenes and acetogenins, J.H. Richards & J.R. Hendrieson.
17. The biosynthesis of secondary metabolites, R.D. Herbert, Chapman & Hall.
18. 18.Chemistry of Organic Natural Products, O.P. Agarwal, Vols, 1&2, Goel Pubs.
19. Natural Products Chemistry K.B.G. Torssell, John Wiley, 1983.

SEMESTER-VIII

COURSE 21: ASYMMETRIC SYNTHESIS AND HETEROCYCLES

Practical Credits: 1 2 hrs/week

PRACTICAL- PROJECT WORK

To attain presentation skills on the filed of research work done in organic chemistry.