

Department of Applied and Interdisciplinary Sciences
Sardar Patel University
B.Sc. Advanced Organic Chemistry (UG) Semester IV
Effective from June 2025

Course Code	Course Title	Course Type	T/P	Credits	Number of Hours per Week
UT04MAAOC01	Heterocyclic Chemistry & Natural Products	Disciplinary Major	T	4	4

Course Objective	To make students familiar with: <ul style="list-style-type: none"> - significance of heterocyclic chemistry and natural products in organic chemistry - synthesis and reactions of various heterocycles and natural products - the biosynthesis, extraction, and structural elucidation of natural products
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Course Content		
Unit	Description	Weightage (%)
1.	Introduction to Heterocyclic Chemistry: Definition and classification of heterocyclic compounds, Nomenclature of basic heterocycles, Aromaticity in heterocycles: Five- and six-membered rings.	25
2.	Chemistry of Important Heterocycles: Five-Membered Heterocycles: Structure, synthesis, and reactions of pyrrole, furan, and thiophene; Six-Membered Heterocycles: Structure, synthesis, and reactions of pyridine, Structure and synthesis of pyrimidine and pyrazine. Fused Heterocycles: Indole, quinoline, isoquinoline: Synthesis and reactions.	25
3.	Introduction to Natural Products: Definition and Classification of natural products such as, alkaloids, terpenoids, flavonoids, and steroids, Importance of natural products in drug development.	25
4.	Alkaloids: Definition, extraction, and general properties, Structure and biological significance of morphine and quinine. Terpenoids: Classification, isoprene rule, and biosynthetic pathways, Structure and uses of limonene, menthol, and camphor.	25

Course Outcomes	After completion of course, students will be able to learn: <ul style="list-style-type: none"> - the basic structure, nomenclature, and classification of heterocyclic compounds and natural products - understanding of aromaticity in heterocyclic systems and its role in their chemical properties and reactivity
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	<ul style="list-style-type: none">- knowledge of various methods of synthesis for common heterocyclic compounds such as pyrrole, furan, thiophene, pyridine, and their derivatives- the classification and significance of natural products, including alkaloids, terpenoids, flavonoids, and steroids- the biosynthesis, extraction, and structural elucidation of natural products
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Reference Books:

1. Heterocyclic Chemistry by John A. Joule and Keith Mills, 3rd edition, CRC Press.
2. An Introduction to the chemistry of Heterocyclic Chemistry by R. M. Acheson, 3rd edition, Wiley India Pvt Ltd.
3. Advanced Organic Chemistry: Part B - Reaction and Synthesis by Francis A. Carey and Richard J. Sundberg, 5th edition, Springer.
4. Natural Products Chemistry and Applications by Sujata V. Bhat and Bhimsen A. Nagasampagi, Narosa Publishing House.
5. Natural Products: Chemistry and Biological Significance by J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorpe, and J. B. Harborne, Prentice Hall.
6. Organic Chemistry of Natural Products, Volume I & II by Gurdeep R. Chatwal, Himalaya Publishing House.
7. Organic Chemistry by Morrison and Boyd, 7th edition, Pearson Education India.
8. A Textbook of Organic Chemistry by Arun Bahl and B. S. Bahl, 22nd edition, S Chand Publishing.

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Course Code	Course Title	Course Type	T/P	Credits	Number of Hours per Week
UT04MAAOC02	Organic Photochemistry & Pericyclic Chemistry	Disciplinary	T	4	4

Course Objective	<p>To make students familiar with:</p> <ul style="list-style-type: none"> - To provide a thorough understanding of the fundamental principles of photochemistry and pericyclic reactions. - To examine the mechanisms and applications of photochemical and pericyclic reactions in organic synthesis. - To develop analytical and problem-solving skills for interpreting reaction pathways and stereochemical outcomes.
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Course Content		
Unit	Description	Weightage (%)
1.	Introduction of photochemistry: Photochemical Reactions, Difference between Photochemical and Thermochemical Reactions, Thermopile, Photoelectric Cell, Laws of Photochemistry, Grothus-Draper Law, Stark-Einstein Law of Photochemical Equivalence, Quantum Yield (or Quantum Efficiency), Calculation of Quantum Yield, Photosensitized Reactions.	25
2.	Photochemistry in Organic reactions: Photophysical Processes, Jablonski Diagram, Fluorescence, Phosphorescence, Chemiluminescence, Norrish Type-I and Type-II, Photoreduction and photooxidation, Paterno-buchi reaction.	25
3.	Pericyclic chemistry-I : Introduction of pericyclic reactions, types of pericyclic reactions, cycloaddition, electrocyclic, sigmatropic and group transfer reactions, Frontier Molecular Orbital (FMO) theory, Woodward-Hoffmann Rules.	25
4.	Pericyclic chemistry-II: Examples and Mechanism of Electrocyclic reactions, Conrotatory vs disrotatory stereochemical outcomes, [2+2],[4+2] cycloaddition reaction, Diels-Alder reaction, sigmatropic rearrangements.	25

Course Outcomes	<p>After completion of course, students will be able to learn:</p> <ul style="list-style-type: none"> - Demonstrate knowledge of photochemical reaction mechanisms and their applications in organic synthesis.
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	<ul style="list-style-type: none">- Apply photochemical principles to environmental and industrial problems, such as pollutant degradation and photopolymerization.- Classify the types of pericyclic reactions based on their mechanisms and stereochemical outcomes.- Applications of pericyclic reactions in industrial chemistry and advanced organic synthesis.
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Reference Books:

1. Clyden J., Greeves N., and Warren S. (2014), Organic Chemistry, 2th Edition, Oxford Univ. Press.
2. Puri, B. R., Sharma, L.R. and Pathania, M. S. (2005), 41st Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar
3. Bahl, B.S., Bahl A. and Tuli, G.D. (2007), Essentials of Physical Chemistry, 25th Edition, S. Chand, New Delhi.
4. March J., Smith M.B., (2007), March's Advanced Organic Chemistry, 6th Edition Wiley-interscience A john wiley & sons, INC, publications.

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Course Code	Course Title	Course Type	T/P	Credits	Number of Hours per Week
UT04MAAOC03	Organic Chemistry Practical - 2	Disciplinary Major	P	4	8

Course Objective	<p>To make students familiar with:</p> <ul style="list-style-type: none"> - Provide hands-on experience in the preparation and purification of organic compounds. - Familiarize students with advanced laboratory techniques such as reflux, crystallization, and extraction. - Develop skills in organic synthesis and reaction mechanism understanding. - Emphasize safety and good laboratory practices while handling chemicals and equipment. - Encourage students to analyze and document experimental results systematically.
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Course Content		
Practical	Description	Weightage (%)
	<p>Practical-I: Separation and Identification of Binary Semi-solid Organic Mixture (A/B/P/N) such as Solid + Solid, Solid + Liquid, Liquid + Liquid. Carboxylic Acids: Salicylic Acid, <i>p</i>-Aminobenzoic acid, <i>p</i>-Chlorobenzoic acid, <i>p</i>-Nitrobenzoic acid. Solid & Liquid Phenols: α-naphthol, β-naphthol, Phenol. Solid & Liquid Bases: <i>o</i>, <i>m</i>, and <i>p</i>-Nitroaniline, <i>p</i>-Toluidine, <i>p</i>-Chloroaniline, Aniline, <i>o</i>-Chloroaniline. Solid & Liquid Neutrals: Naphthalene, Anthracene, Benzanilide, <i>m</i>-dinitrobenzene, Acetone, Methanol, Ethyl acetate, Chloroform, Carbon tetrachloride.</p> <p>Practical-II: Preparation of the following organic compounds.</p> <ol style="list-style-type: none"> i) Synthesis of dibenzalacetone ii) Synthesis of chalcone iii) Synthesis of ethyl 4-aminobenzoate (Benzocain) 	100
Course Outcomes	<p>After completion of the course, students will be able to learn:</p> <ul style="list-style-type: none"> - Demonstrate proficiency in techniques like recrystallization and distillation. 	

	<ul style="list-style-type: none">- Perform synthesis of organic molecules, understanding the mechanisms behind the transformation.- Adhere to laboratory safety protocols and maintain accuracy in measurements and observations.- Develop teamwork and communication skills by working effectively in group experiments and discussions.
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Reference Books:

1. Elementary Practical Organic Chemistry Qualitative Organic Analysis By A. I. Vogel, Pearson publisher.
2. Advanced Practical Organic Chemistry By N. K. Vishnoi, 3rd edition, S Chand.
3. Vogels Textbook of Practical Organic Chemistry By B. S. Furniss, A. J. Hannaford, P W. G. Smith, A. R. Tatchell, 5th edition, Pearson publisher.
4. Comprehensive Practical Organic Chemistry: Qualitative Analysis By V. K. Ahluwalia and Sunita Dhingra, University Press.
5. Systematic Identification of Organic Compounds By Ralph L. Shriner.
6. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis By V. K. Ahluwalia and Renu Aggarwal.

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Course Code	Course Title	Course Type	T/P	Credits	Number of Hours per Week
UT04IDAOC01	Nanoscience and Nanotechnology	Interdisciplinary Minor	T	2	2

Course Objective	<p>To make students familiar with:</p> <ul style="list-style-type: none"> - To introduce students to fundamental concepts and applications of nanoscience and nanotechnology. - To promote understanding of the implications and potential applications of nanotechnology in various fields, including medicine, electronics, and environmental science.
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Course Content		
Unit	Description	Weightage (%)
1.	Introduction to nanoscience and nanotechnology, Importance and relevance of nanotechnology in today's world, Properties of nanomaterials (physical, chemical, and optical properties of nanomaterials), Methods of synthesis of nanomaterials (top-down and bottom-up).	50
2.	Synthesis of nanoparticles (gold and silver), Carbon-based nanomaterials (fullerenes, carbon nanotubes, and graphene), Properties and applications of carbon-based nanomaterials, Applications of nanotechnology (drug delivery, diagnostics, water purification, and pollution control), Future of nanotechnology (nanorobots, nanomedicine, and quantum nanotechnology).	50
Course Outcomes	<p>After completion of the course, students will be able to learn:</p> <ul style="list-style-type: none"> - Explain nanoscience principles, including nanoscale dimensions and quantum effects. - Describe nanomaterials (e.g., nanoparticles, nanotubes) and their unique nanoscale properties. - Understand bottom-up (e.g., self-assembly) and top-down (e.g., lithography) nanomaterial fabrication techniques. - Relate nanomaterial properties (optical, electrical, mechanical, thermal) to their structure. - Identify nanotechnology applications in medicine, electronics, energy, and the environment. 	

	- Recognize the interdisciplinary nature of nanotechnology in solving complex problems.
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Reference Books:

1. Introduction to Nanoscience by G.L. Hornyak, J. Dutta, H.F. Tibbals, and A.K. Rao.
2. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications By Guozhong Cao and Ying Wang.
3. Nanotechnology: Principles and Practices By Sulabha Kulkarni.
4. Introduction to Nanotechnology By Charles P. Poole Jr. and Frank J. Owens.
5. Textbook of Nanoscience and Nanotechnology By B.S. Murty, P. Shankar, B. Raj, B.B. Rath, and J. Murday.

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Sardar Patel University
B.Sc. Advanced Organic Chemistry (UG) Semester IV
Effective from June 2025

Course Code	Course Title	Course Type	T/P	Credits	Number of Hours per Week
UT04IDAOC02	Nanoscience and Nanotechnology Practical	Interdisciplinary Minor	P	2	4

Course Objective	<ul style="list-style-type: none"> - To introduce students to fundamental concepts and applications of nanoscience and nanotechnology. - To provide hands-on experience in synthesizing and characterizing various nanoparticles using simple methods. - To promote understanding of the implications and potential applications of nanotechnology in various fields, including medicine, electronics, and environmental science.
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Course Content		
Practical	Description	Weightage (%)
	<ul style="list-style-type: none"> - Observation of everyday materials at the nanoscale using microscopes (e.g., examining sand, sugar, etc. under a microscope). - Synthesis of copper nanoparticles using a simple reduction method; observe the color change and discuss particle formation. - Synthesis of iron oxide (Fe₂O₃) nanoparticles using co-precipitation method; simple characterization using a magnet. - Characterization of synthesized copper nanoparticles using simple techniques such as UV-Vis spectroscopy. - Explore the antibacterial properties of silver nanoparticles; setting up simple experiments with bacterial cultures (if permitted) or using prepared samples. - Synthesis and characterization of Silver Nanoparticles (AgNPs), Copper Nanoparticles (CuNPs), Zinc Oxide Nanoparticles (ZnO NPs), Iron Oxide Nanoparticles (Fe₂O₃ NPs), Titanium Dioxide Nanoparticles (TiO₂ NPs), Carbon Nanoparticles (CNPs) [Any two synthesis in total]. 	100

Course Outcomes	<ul style="list-style-type: none">- Demonstrate the ability to synthesize nanoparticles using straightforward techniques and understand the underlying principles.- Analyze and characterize synthesized nanoparticles, developing skills in basic laboratory techniques.- Evaluate the applications and societal impacts of nanotechnology, fostering critical thinking about its benefits and challenges.
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Reference Books:

1. Rao, C. N. R., & K. J. Rao. (2018). *Nanotechnology: Principles and Practices*. New Delhi: Wiley India.
2. Nair, P. R. (2020). *Nanomaterials: Synthesis, Characterization, and Applications*. New Delhi: Springer India.
3. Griffiths, P. R., & de Haseth, J. A. (2016). *Fourier Transform Infrared Spectrometry*. New York: Wiley.
4. Khan, Y., & Niazi, J. H. (2019). *Nanotechnology in Medicine: From Bench to Bedside*. Cambridge: Cambridge University Press.

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B.Sc. Advanced Organic Chemistry (UG) Semester IV
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Course Code	Course Title	Course Type	T/P	Credits	Number of Hours per Week
UT04AEAOC01	Marketing and Mass Communication	AEC	T	2	2

Course Objective	<ul style="list-style-type: none"> - To provide students with a comprehensive understanding of marketing principles and their applications in business and consumer contexts. - To equip students with knowledge of mass communication tools and strategies for effective audience engagement and brand promotion.
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Course Content		
Unit	Description	Weightage (%)
1.	Fundamentals of Marketing <ul style="list-style-type: none"> - Introduction to Marketing: Definition, scope, and importance of marketing, Core concepts: needs, wants, demand, value, and satisfaction - Marketing Environment: Micro and macro environmental factors, Market segmentation, targeting and positioning (STP). - Marketing Mix (4Ps): Product, price, place, and promotion - Consumer Behavior: Factors influencing consumer decision-making, Customer journey and purchase behavior models 	50
2.	Basics of Mass Communication <ul style="list-style-type: none"> - Introduction to mass communication: Definition, scope and functions, Difference between interpersonal and mass communication - Media Platforms: Print media, broadcast media (radio and TV), and digital media - Communication Theories - Role of Mass Communication in Marketing 	50

Course Outcomes	<ol style="list-style-type: none"> 1. Understand the fundamentals of marketing and its role in meeting consumer needs. 2. Analyze consumer behavior and apply marketing strategies effectively. 3. Comprehend mass communication principles and their impact on society and business.
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	4. Integrate marketing and mass communication techniques to create impactful advertising and branding campaigns.
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Reference Books:

1. Principles of Marketing by Philips Kotler, Gary Armstrong – A Comprehensive guide to the fundamentals and strategies in marketing.
2. Marketing management by Philip Kotler, Kevin Lane Keller – Advanced concepts and case studies in marketing management.
3. Mass Communication in India by Keval J. Kumar – Focused on media and communication dynamics in india.
4. Mass Communication: Theory and Practice by Uma Narula – An essential introduction to mass communication theories and applications.

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Course Code	Course Title	Course Type	T/P	Credits	Number of Hours per Week
UT04SEAOC01	Maintenance and Testing of Home Appliances	SEC	T	2	2

Course Objective	<p>The paper is designed to:</p> <ul style="list-style-type: none"> - Familiarize students with various types of home appliances and their operational principles, enhancing understanding of how they work. - Develop practical skills in diagnosing, maintaining, and troubleshooting common issues with electrical appliances. - Promote awareness of safety measures and standards associated with the use and maintenance of home appliances.
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Course Content		
Unit	Description	Weightage (%)
1.	<p>Principles of Home Appliances</p> <ul style="list-style-type: none"> - Introduction to Home Appliances: Types and classifications of home appliances (kitchen, cleaning, entertainment). - Basic Electrical Concepts: Voltage, current, resistance, and power; understanding electrical circuits. - Operating Principles: How common appliances work (e.g., refrigerators, microwaves, washing machines); key components and their functions. - Safety Measures: Electrical safety practices; understanding labels and standards (IS, IEC). - Practical Application: Hands-on practice in using and maintaining basic home appliances. 	50
2.	<p>Testing and Troubleshooting</p> <ul style="list-style-type: none"> - Testing Equipment and Methods: Introduction to multimeters, insulation testers, and other testing tools; how to read measurements. - Common Issues: Identifying and diagnosing common appliance problems (e.g., electrical faults, mechanical failures). - Troubleshooting Techniques: Systematic approaches to troubleshooting; documentation and reporting of appliance issues. - Repair Techniques: Basic repair techniques for common issues; understanding when to call a professional. 	50

<p>Course Outcomes</p>	<ul style="list-style-type: none"> - Demonstrate knowledge of the functioning and components of different home appliances, including electrical circuits and safety standards. - Effectively troubleshoot and repair common appliance issues using appropriate testing methods and equipment. - Apply best practices in maintenance and safety while working with electrical appliances, ensuring safe operation and longevity.
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Reference Books:

1. Rao, P. K., & Reddy, M. S. (2017). *Electrical Appliances and Maintenance*. New Delhi: Tata McGraw-Hill Education.
2. Nair, K. A. (2015). *Home Appliances: Maintenance and Troubleshooting*. Chennai: PHI Learning.
3. Smith, T. (2019). *Fundamentals of Home Appliance Repair: A Comprehensive Guide*. New York: McGraw-Hill Education.

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Course Code	Course Title	Course Type	T/P	Credits	Number of Hours per Week
UT04VAAOC01	Environmental Safety	VAC	T	2	2

Course Objective	<p>To make students familiar with:</p> <ul style="list-style-type: none"> - understanding the importance of environmental safety, hazards, preventive measures, and sustainable practices - equipping students with the skills to address and mitigate environmental risks
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Course Content		
Unit	Description	Weightage (%)
1.	<p>Introduction to Environmental Safety:</p> <p>Basic Concepts: Definition and scope of environmental safety, Importance of environmental safety in daily life and industry.</p> <p>Environmental Hazards: Types of hazards: Physical, chemical, biological, and radiological, Sources of environmental pollution: Air, water, soil, and noise, Impact of hazards on human health and ecosystems.</p> <p>Sustainable Practices: Importance of sustainability in environmental safety, Global initiatives: Sustainable Development Goals (SDGs) related to environmental protection.</p>	25
2.	<p>Environmental Laws and Policies:</p> <p>National and International Frameworks: Overview of key environmental laws in India (e.g., Environment Protection Act, Water Act, Air Act), International conventions and treaties (e.g., Kyoto Protocol, Paris Agreement, Montreal Protocol).</p> <p>Environmental Management Systems: ISO 14001: Environmental Management Standards, Role of environmental impact assessments (EIA).</p> <p>Regulatory Agencies and Governance: Role of pollution control boards and environmental agencies, Citizen responsibilities and public participation in environmental governance.</p>	25

Course Outcomes	<p>After completion of course, students will be able to learn:</p> <ul style="list-style-type: none"> - Understand key environmental safety concepts and hazards. - Be familiar with environmental laws, policies, and governance frameworks. - Appreciate the importance of sustainable practices in mitigating environmental risks.
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Reference Books:

1. Environmental Science and Engineering by Suresh K. Dhameja, S K Kataria and Sons Publisher.
2. Environmental Studies: From Crisis to Cure by R. Rajagopalan, 2nd edition, Oxford University Press, 2011.
3. Principles of Environmental Science by William P. Cunningham and Mary Ann Cunningham, McGraw-Hill, 2012.
4. Environmental Safety and Health Engineering by Gayle Woodside, New York : Wiley, 1997.
5. Handbook of Environmental Health and Safety by Herman Koren, 4th edition, Lewis publisher, 2002.
6. Environmental Hazards: Assessing Risk and Reducing Disaster by Keith Smith, Carina J. Fearnley, Deborah Dixon, Deanne K. Bird, Ilan Kelman, 7th edition, Taylor and Francis, 2023.