# FACULTY OF APPLIED SCIENCES

# SYLLABUS

# FOR

# Pre-Ph.D. Course in Chemistry

(Under Choice based Credit System)

**Examinations: 2025 Onwards**

## Department of Chemistry

## I. K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

## KAPURTHALA

Note:

**(i) Subject to change in the syllabi at any time. Please visit the University website time to time.**

# I. K. Gujral Punjab Technical University

## VISION

To be an institution of excellence in the domain of higher technical education that serves as the fountainhead for nurturing the future leaders of technology and techno- innovation responsible for the techno-economic, social, cultural and environmental prosperity of the people of the State of Punjab, the Nation and the World.

## MISSION

To provide seamless education through the pioneering use of technology, in partnership with industry and society with a view to promote research, discovery and entrepreneurship and
To prepare its students to be responsible citizens of the world and the leaders of technology and techno-innovation of the 21st Century by developing in them the desirable knowledge, skill and attitudes base for the world of work and by instilling in them a culture for seamlessness in all facets of life.

## OBJECTIVES

- To offer globally-relevant, industry-linked, research-focused, technology- enabled seamless education at the graduate, postgraduate and research levels in various areas of engineering & technology and applied sciences keeping in mind that the manpower so spawned is excellent in quality, is relevant to the global technological needs, is motivated to give its best and is committed to the growth of the Nation;
- To foster the creation of new and relevant technologies and to transfer them to industry for effective utilization;
- To participate in the planning and solving of engineering and managerial problems of relevance to global industry and to society at large by conducting basic and applied research in the areas of technologies. To develop and conduct continuing education programmes for practicing engineers and managers with a view to update their fundamental knowledge base and problem-solving capabilities in the various areas of core competence of the University;

- To develop strong collaborative and cooperative links with private and public sector industries and government user departments through various avenues such as undertaking of consultancy projects, conducting of collaborative applied research projects, manpower development programmes in cutting-edge areas of technology, etc;
- To develop comprehensive linkages with premier academic and research institutions within the country and abroad for mutual benefit;
- To provide leadership in laboratory planning and in the development of instructional resource material in the conventional as well as in the audio- visual, the video and computer-based modes;
- To develop programmes for faculty growth and development both for its own faculty as well as for the faculty of other engineering and technology institutions;
- To anticipate the global technological needs and to plan and prepare to cater to them;
- To interact and participate with the community/society at large with a view to inculcate in them a feel for scientific and technological thought and endeavour; and
- To actively participate in the technological development of the State of Punjab through the undertaking of community development programmes including training and education programmes catering to the needs of the unorganized sector as well as that of the economically and socially weaker sections of society.

## ACADEMIC PHILOSOPHY

The philosophy of the education to be imparted at the University is to awaken the **"deepest potential"** of its students as holistic human beings by nurturing qualities of self-confidence, courage, integrity, maturity, versatility of mind as well as a capacity to face the challenges of tomorrow so as to enable them to serve humanity and its highest values in the best possible way.

# Department of Chemistry

## VISION

The Chemistry department at IKGPTU campus will address the challenging and important questions in the physical and life sciences of current era using its multi-disciplinary vision, its culture of synergistic collaboration and translational science, and its excellence in the physical, medical and engineering sciences. Department continues to explore the new fields and frontiers and, with them, fundamentally new and innovative ways to address the increasingly complex scientific, health, energy and environmental problems of our time.

## MISSION

- Inspiring and educating undergraduate, postgraduate and research students in chemistry and molecular-driven sciences in the core concepts of chemistry and the scientific methodology.
- To explore the new frontier area of organometallic catalysis in synthetic chemistry.
- Developing more-economic and greener strategies for chemical synthesis and production
- Understanding how molecules and materials behave, interact and transform at macroscopic, molecular, atomic and electronic levels, and exploring the contribution of geometric and electronic structure to function.
- Informing the public about the excitement of science, its impact on everyday life, and the crucial role it plays in human health, energy and environmental stewardship
- Building centralized, state-of-the-science facilities designed to promote collaborative synergies among faculty, staff and students and across disciplinary boundaries.
- Sharing the excitement of new chemical knowledge across IKGPTU and to other institutions, educators, and the global community through scientific communications and outreach.

**PROGRAM OUTCOMES:**

| | |
|---|---|
| PO1 | To provide in-depth knowledge in an area of specialization, including the current status of the area and what remains to be understood. |
| PO2 | To teach about the importance of literature review, accessing scientific databases, laboratory safety and code of conduct with the view of preparing them for taking up research problems |
| PO3 | To evaluate scientific work critically, by applying, analyzing, synthesizing, and evaluating scientific knowledge |
| PO4 | To communicate scientific concepts, methods, results, and conclusions effectively to the society at large through presentation. |
| PO5 | To develop skills in applicable professional areas, such as pedagogy, teamwork and leadership, through teaching, workshops, interactions with alumni and internships. |

**PROGRAM SPECIFIC OUTCOMES**:

| | |
|---|---|
| PSO1 | To inculcate the research scholars with applied and advanced knowledge associated with subject. |
| PSO2 | To introduce the students with the latest development in the concerned specialization. |
| PSO3 | To impart skill in the handling and operation of instruments and other analytical techniques for solving their research problems. |
| PSO4 | Ability to integrate knowledge and techniques from other scientific disciplines into chemistry research, promoting a holistic approach to problem-solving. |
| PSO5 | Capacity for innovative thinking and problem-solving in tackling complex scientific challenges and developing novel solutions. |
| PSO6 | To integrate the interdisciplinary programme in the concerned area of specialization. |

## TITLE OF THE COURSE: Pre-Ph.D. Course in Chemistry

## SCHEME OF THE COURSE:

| Sr. No. | Code | Nature of Course | Theory Papers | Hours | L-T-P | Credits | Marks Distribution | | Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Internal | External | |
| 1. | | Mandatory | Research Methodology | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 2. | | Mandatory | Research Publication Ethics | 45 | 2-0-0 | 2 | 30 | 70 | 100 |
| 3. | PPDS101-25<br><br>PPDS102-25<br><br>PPDS103-25<br>PPDS104-25<br><br>PPDS105-25 | Core (discipline specified) | Electroanalytical Techniques<br>Or<br>Supramolecular Chemistry<br>Or<br>Green Chemistry<br>Or<br>Advanced Organic Chemistry<br>Or<br>Medicinal Chemistry | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 4 | | Interdisciplinary | Research Seminar | | | 4 | - | - | - |
| | | | **Total** | | **(L-10, T-0, P-0 )** | **14** | **90** | **210** | **300** |

**SYLLABUS OF THE COURSE**

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|---|---|---|---|---|
| **Subject Code:** | **PPDS101-25** | | | |
| **Subject Title:** | **Electroanalytical Techniques** | | | |
| **Contact Hours:** | **L:3** | **T:1** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The objective of teaching electroanalytical techniques is to equip students with the knowledge and skills to understand and apply electrochemical principles to analyze chemical species, enabling them to quantify and characterize substances in a variety of samples across various scientific fields, including chemistry, biology, and environmental science, with high sensitivity and selectivity. | | | |

| Unit | Contents | Contact Hours |
|---|---|---|
| I | **Potentiometry**: Standard and Formal potentials, Types of electrodes – Glass membrane and Ion-selective electrodes – mechanism of electrode response and evaluation of selectivity coefficient, Applications of Ion-selective electrodes. Methods – manual titrimeters and automated titrators, Direct potentiometry and potentiometric titrations including differential methods, acid–base titrations in non-aqueous systems, Titrations involving polarised electrodes. Bipotentiometry – Principle, instrumentation, and applications. | 10 |
| II | **Voltammetry:** Introduction, Principle, excitation signals in voltammetry, basic instrumentation based on operational amplifiers, voltammetric electrodes.<br><br>Cyclic Voltammetry: Instrumentation, Determination of analytes using cyclic voltammetry, Applications.<br><br>Pulse voltammetry: Introduction, Normal Pulse Voltammetry, Reverse pulse voltammetry, Differential pulse voltammetry, Square wave voltammetry.<br><br>Stripping voltammetry: Cathodic and Anodic stripping voltammetry, Electrodeposition step, Voltammetric completion of the analysis, adsorptive striping methods,<br><br>Voltammetry with microelectrodes. Practical applications in analytical chemistry and research. | 13 |

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|---|---|---|
| III | **Sensors:** Introduction- Sensitivity, Detection Limit, Response Time Life Time. Amperometric and voltammetric sensors. Modified electrodes and their advantages over conventional electrodes in sensing variety of metals and biomolecules. Nanomaterials in electrode modification–C60, single wall and multi wall carbon nanotubes. Preparation and characterization of modified surfaces. Applications of sensors in determining cases of doping. | 13 |
| IV | **Potentiometric and Cyclic voltametric studies of coordination compounds:**<br>Compounds containing one or more redox centers, coupled chemical reactions, EE and EEE mechanisms, stability constant of complexes. Complexation Modulated Redox Behavior of Transition Metal Systems: Complexation effect on redox potential, Design and development of novel redox systems such as Iron 1,10-phenanthroline system, Cobalt 1,10-phenantroline (Phen) system, Effect of Phen ligand on Fe(III)–Co(II) redox reaction, Phen modulated redox potentials for simultaneous iron oxidation state analysis. | 9 |

**Books Recommended**


1. Bard, A.J. and Faulkner, L.R., "Electrochemical Methods-Fundamentals and Applications", John Wiley, 2000.
2. Modern Techniques in Electroanalysis" by Petr Vanýsek, Wiley–Blackwell.
3. Skoog, West, Holler and Crouch, "Fundamentals of Analytical Chemistry" Cengage Learning.
4. Advanced Potentiometry by Néher-Neumann, Erzsébet, Springer Netherlands, 2009, http://dx.doi.org/10.1007/978-1-4020-9525-2.
5. Electro-analytical chemistry, edited by H.W. Nurnberg.
6. Techniques in Electroanalytical Chemistry; American Chemical Society, 2022. DOI: 10.1021/acsinfocus.7e5021
7. Potentiometric Sensing by Elena Zdrachek and Eric Bakker, Anal. Chem. 2021, 93, 1, 72–102.
8. Recent trends in potentiometric sensor arrays—A review, A. Bratov, N. Abramova, A. Ipatov, Analytica Chimica Acta, 2010, 678, 2, 149-159.
9. Recent Advances in Voltammetry - Batchelor ‐ McAuley - 2015 - Chemistry Open - Wiley Online Library.
10. Recent Advances in Microfabrication, Design and Applications of Amperometric Sensors and Biosensors - https://doi.org/10.1149/1945-7111/abe8b6.
11. A Practical Beginner's Guide to Cyclic Voltammetry by Jillian L. Dempsey, J. Chem. Educ. 2018, 95, 2, 197–206.
12. Rizvi, M.A. Complexation modulated redox behavior of transition metal systems (review) Russ J Gen Chem 85, 959–973 (2015), https://doi.org/10.1134/S1070363215040337.

**Course Outcomes and Mapping**

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

**CO1** Explain, at an advanced level, the theories and causes behind concepts such as the electrical double layer, polarisation, convection, migration, diffusion, capacitance/ impedance, electrocatalysis and their significance.

**CO2** Describe the structure and function of different instrument components, e.g. reference electrodes, ion-selective electrodes, different electrode materials that are used in ammeters, electrochemical flow cells etc.

**CO3** Produce, characterize and apply chemically modified electrodes.

**CO4** Provide oral and written accounts and discussions of conclusions that are based on experimental results.

**CO5** Search for and evaluate scientifically relevant information.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|---|---|---|---|---|---|---|
| CO1 | 5 | 4 | - | 5 | 4 | - |
| CO2 | 5 | 4 | 5 | - | 3 | 3 |
| CO3 | 5 | 5 | 5 | - | 5 | 5 |
| CO4 | 4 | 5 | 3 | 5 | 4 | 5 |
| CO5 | 4 | 5 | - | 5 | 5 | 5 |

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|---|---|---|---|---|
| **Subject Code:** | **PPDS102-25** | | | |
| **Subject Title:** | **Supramolecular Chemistry** | | | |
| **Contact Hours:** | **L:3** | **T:1** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | • To discuss the principles of supramolecular and host-guest chemistry.<br>• To illustrate the type of supramolecular systems available for the binding of cations and anions.<br>• To highlight the role of host-guest chemistry in catalysis and enzyme mimic.<br>• To understand the various photo-physical mechanism. | | | |

| Unit | Contents | Contact Hours |
|---|---|---|
| I | **Introduction**<br>What is supramolecular chemistry? Selectivity, Complementarity, Cooperativity and Chelate effect; Binding constant; Kinetic and Thermodynamic Selectivity; Supramolecular interactions: Ionic and dipolar interactions, Hydrogen bonding, Halogen bonding, Van der Waal's interactions; Hydrophobic and Solvation effect; Supramolecular Design.<br>Biological supramolecular systems: Ionophores, Phorphyrin and other Tetrapyrolic macrocycles, neurotransmitters, DNA. | 11 |
| II | **Molecular recognition, self-organization, self-assembly and preorganization**<br>Introduction about molecular recognition, self-organization, self-assembly and preorganization (template reactions) with examples; Biological self-assembly; Self-assembled capsules (molecular containers, metal-directed capsules, hydrogen bonded capsules); mechanically interlocked molecules (rotaxanes, catenanes and knots). | 10 |
| III | **Macrocyclic ligands, solid state supramolecular chemistry and catalysis**<br>Crown ethers and cryptands synthesis; calixarenes synthesis and conformation; cyclodextrins and their complexes; Metal organic framework: Synthetic strategies, zero dimensional, one dimensional and two dimensional superstructures, Application of MOF two dimensional structures, Covalent organic framework: Chemical structure, configuration and chemical bonding in COFs. Methods of synthesis: Solvothermal, Microwave-assisted, Mechanochemical, Photochemical and Room temperature synthesis. Supramolecular catalysis and enzyme mimics. | 13 |
| IV | **Fluorescence mechanism and supramolecular complexes quantification**<br>Photoinduced electron transfer (PET), Photoinduced charge transfer (PCT), | 11 |

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| | Excited state intramolecular proton transfer (ESIPT), energy transfer: Fluorescence resonance energy transfer (FRET), Through bond energy transfer (TBET) Other Mechanisms: chelation enhanced fluorescence (CHEF), aggregation-induced emission (AIE), aggregation-caused quenching (ACQ).<br>Quantifying Supramolecular Complexation: Benesi-Hildebrand Binding Constants, Stern-Volmer Constants, Job's Plots, Limits of Detection. | |

**Books Recommended**


1. J. W. steed, J. L. Atwood, Supramolecular Chemistry, Second edition, 2009.
2. Jean-Marie Lehn, Supramolecular Chemistry, 1995, Wiley.
3. K. Ariga, T. Kunitake, Supramolecular chemistry fundamental and applications, 2006, Springer.
4. Teresa L. Mako, Joan M. Racicot, and Mindy Levine, Supramolecular Luminescent Sensors, Chem. Rev. 2019, 119, 322-477.
5. S. Ge, K. Wei, W. Peng, R. Huang, E. Akinlabi, H. Xia, M. W. Shahzad, X. Zhang, B. B. Xu and J. Jiang, A comprehensive review of covalent organic frameworks (COFs) and their derivatives in environmental pollution control, Chem. Soc. Rev., 2024, 53, 11259.


**Course Outcomes and Mapping**

At the end of the course, the student will be

**CO1** Able to describe the fundamental principles of supramolecular and host-guest chemistry.
**CO2** Well versed with supramolecular approached to complex cations and anions.
**CO3** Learn the molecular recognition and self-assembly processes.
**CO4** Acquire the knowledge of various photo-physical processes occurring in supramolecules.
**CO5** Able to understand the chemistry and applications of metal organic frameworks, supramolecular catalyst and enzyme mimics.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|---|---|---|---|---|---|---|
| CO1 | 5 | 2 | 3 | 4 | 4 | 4 |
| CO2 | 4 | 2 | 2 | 4 | 4 | 3 |
| CO3 | 4 | 2 | 2 | 4 | 4 | 3 |
| CO4 | 5 | 2 | 3 | 4 | 4 | 4 |
| CO5 | 5 | 3 | 5 | 5 | 4 | 4 |

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|---|---|---|---|---|
| **Subject Code:** | **PPDS103-25** | | | |
| **Subject Title:** | **Green Chemistry** | | | |
| **Contact Hours:** | **L:3** | **T:1** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | • To develop a comprehensive understanding of the principles and concepts of green chemistry.<br>• To gain insights into the importance of sustainability in chemical research and industry.<br>• To design chemical reactions that are efficient, minimize waste, and reduce environmental impact.<br>• To foster critical thinking and innovation in developing sustainable solutions to chemical challenges. | | | |

| Unit | Contents | Contact Hours |
|---|---|---|
| I | **Principles, concepts and environmentally benign solvents**<br>**Green chemistry:** Introduction, Green chemistry Principles and their importance.<br>**Waste Minimisation and Atom Economy:** Sustainable development and green chemistry, atom economy, atom economic reactions: Rearrangement, addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity.<br>**Waste-problems and Prevention:** Associated problems, Design for degradation.<br>**Environmentally benign solvents:** Organic solvents and volatile organic compounds, solvent free systems, water as a reaction solvent, ionic liquids as solvents (Role, advantages over the conventional solvents with relevant examples and mechanisms). | 12 |
| II | **Catalysis and Green chemistry**<br>Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Cross-coupling reactions for environmentally benign synthesis, Multicomponent Reactions, Ring transformations by heterogeneous catalysis, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Heterogenising the Homogeneous catalysts, Phase transfer catalysis: C–C Bond Formation, Oxidation Using Hydrogen Peroxide and alkyl hydroperoxide oxidations, Bio-catalysis and photo-catalysis with suitable examples. | 10 |
| III | **Catalysis in Novel Reaction Media**<br>Introduction, Alternative Reaction Media and Multiphasic Systems, Two Immiscible Organic Solvents, Aqueous Biphasic Catalysis: Olefin Hydroformylation, Hydrogenation, Carbonylations, Other C–C Bond Forming Reactions, Oxidations; Fluorous Biphasic Catalysis: Olefin | 11 |

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| | Hydroformylation, Other Reactions; Supercritical Carbon Dioxide: Supercritical Fluids, Supercritical Carbon Dioxide, Hydrogenation, Oxidation, Biocatalysis, Biphasic Systems with Supercritical Carbon Dioxide, Thermoregulated Biphasic Catalysis. | |
| IV | **Metal-Free Catalysis:** Importance in Green Chemistry, Advantages over Metal-Based Catalysis. Types of Metal-Free Catalysts: 1. Organocatalysts: Proline, thiourea, DMAP, Mechanisms: Enamine, iminium ion, and hydrogen bonding catalysis, Applications: Asymmetric synthesis, C–C bond formation *etc.* 2. Organic Dyes and Photocatalysis: Eosin Y, rose bengal, and fluorescein, Photocatalytic processes and applications in organic synthesis. 3. Carbon-Based Catalysts: Graphene, graphene oxide, and carbon nitride (g-$C_3N_4$), Applications in heterogeneous catalysis and pollutant degradation 4. Radical and Brønsted Acid/Base Catalysis: Radical-based organic transformations, Role of organic acids and bases.<br>Challenges and Future Prospects: Limitations of Metal-Free Catalysis, Scope of reactions and substrate compatibility. | 12 |

**Books Recommended**


1. Concepts of Nanochemistry; Ludovico Cademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Wiley-VCH, 2011.
2. Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and Ackmez Mudhoo, CRC Press, 2010.
3. Edited by Alvise Perosa and Maurizio Selva, Hand Book of Green chemistry Volume 8: Green Nanoscience, wiley-VCH, 2013.
4. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
5. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4$^{th}$ Edition, Oxford University Press, USA.
6. Green Chemistry and Catalysis, Roger A. Shelton, Isabel Arends, Ulf Hanefeld, Wiley-VCH, 2007.


**Course Outcomes and Mapping**

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

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|---|---|
| **CO1** | Develop the ability to integrate green chemistry concepts into experimental design and research projects. |
| **CO2** | Understand the significance of safety and health considerations in chemical research, particularly in the context of green chemistry. |
| **CO3** | Develop proficiency in using green metrics and assessment tools to evaluate the environmental impact of chemical processes. |
| **CO4** | Take advanced studies and research at the PhD level, with a strong foundation in sustainable chemistry practices. |

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 4 | 4 |
| CO2 | 2 | 2 | 3 | 2 | 3 | 2 |
| CO3 | 5 | 3 | 4 | 4 | 5 | 4 |
| CO4 | 5 | 4 | 5 | 4 | 4 | 5 |

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|---|---|---|---|---|
| **Subject Code:** | **PPDS104-25** | | | |
| **Subject Title:** | **Advanced Organic Chemistry** | | | |
| **Contact Hours:** | **L:3** | **T:1** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | Advanced Organic Chemistry is designed to provide students with an in-depth understanding of the principles, mechanisms, and applications of cycloaddition and organometallic chemistry. These objectives aim to enhance theoretical knowledge, experimental skills, and problem-solving abilities related to cycloaddition and organometallic chemistry | | | |

| Unit | Contents | Contact Hours |
|---|---|---|
| I | **Pericyclic Reactions**<br>Molecular orbital symmetry, Frontier orbital of ethylene, 1, 3- butadiene, 1, 3, 5- hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann diagrams. FMO and PMO approach. Electrocyclic reactions, 4n, 4n+2 and allyl systems. Cycloadddition – antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements–suprafacial and antarafacial shifts of Hydrogen, sigmatropic shifts involoving carbon moieties, 3, 3- and – sigmatropic rearrangements. Claisen, Cope and aza-Cope rearreangements, ene reaction. | 11 |
| II | **Metal Salt Catalysis**<br>(a). Fundamental reaction steps of transition metal catalysed reaction. oxidative-addition reactions, elimination reactions, cleavage of C-H bonds, migration reaction, insertion reaction.<br>(b). Homo/heterogeneous catalysis by transition metal complexes. Hydrogenation reaction, alkene isomerization, hydrosilylation, hydroformylation of unsaturated compounds, carbonylation reactions, C-C cross coupling and related reaction, reaction of conjugated dienes, reaction of alkynes, alkene and alkyne metathesis<br>(c). C-H activation using metal salts, Suzuki reaction, Heck reaction, Negishi coupling, Stille reaction, Sonogashira coupling reactions. | 11 |
| III | **Cycloaddition reaction in Organic Synthesis**<br>Cycloaddition reactions:- Brief introduction, types of cycloaddition reactions, electron rich and electron deficient diene and dienophiles, intra and inter-molecular Diels Alder reaction (Lewis acid catalysed and uncatalysed), brief introduction to diene and heterodiene and their cycloaddition reaction [2+2] and [4+2] with dienophiles, regiochemistry and stereochemistry in Diels alder reaction, povarov reaction, aza-Diels Alder | 11 |

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|---|---|---|
| | reactions, normal and inverse electron demand cycloaddition reactions, heterodienophiles, Hetero Diels alder reactions (general introduction), 1,3-dipolar cycloaddition reactions (general introduction) | |
| IV | **Multicomponent cycloaddition reactions,** brief introduction to transition metal salts catalysed reactions, brief introduction to (m+o) cycloaddition reaction with emphasis on [4+3], [5+2],[3+3] and ( (m+n+o) type reactions with emphasis on [2+2+2],[3+2+2], [5+2+1] types of reactions. | 12 |

**Books Recommended**


1. Advanced Inorganic Chemistry F.A Cotton 6th edition, chapter 21 and 22, p. 1167-1294.
2. Cycloaddition reactions in organic synthesis by W. Carruthers in the Tetrahedron Organic Chemistry Series, edited by J. E. Baldwin and P. D. Magnus, Pergamon Press, Oxford, **1990**.
3. S.M. *Mukherji* and S. P. *Singh*, Reaction Mechanism in *Organic* Chemistry.
4. Inorganic Chemistry:Principles of Structure and Reactivity by James E. Huheey, Ellen A. Keiter, Richard L. Keiter
5. Some Modern Methods of Organic Synthesis by W Carruthers, Cambridge University Press.
6. Smith M B, March J March's Organic Chemistry 5th ed (2001)(2103s), Wiley, New York.


**Course Outcomes and Mapping**

At the end of the course, the student will be

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|---|---|
| **CO1** | Students will learn the mechanistic details of cycloaddition reactions, |
| **CO2** | Students will be able to classify and explain different types of cycloaddition reactions, |
| **CO3** | Students will connect the theoretical understanding of cycloaddition reactions to practical applications |
| **CO4** | Students will critically analyse reaction conditions, predict outcomes for novel cycloaddition scenarios, and engage with literature to explore advanced examples and recent developments in cycloaddition chemistry. |
| **CO5** | Students will gain the ability to predict and rationalize the regioselectivity and Stereoselectivity and analyze the effects of substituents influencing the positioning of atoms in the product. |

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|---|---|---|---|---|---|---|
| CO1 | 5 | 5 | 5 | 5 | 5 | 5 |
| CO2 | 3 | 5 | 4 | 4 | 2 | 2 |
| CO3 | 5 | 5 | 5 | 5 | 5 | 5 |

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|---|---|---|---|---|---|---|
| CO4 | 4 | 4 | 4 | 2 | 2 | 2 |
| CO5 | 5 | 5 | 4 | 4 | 2 | 2 |

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|---|---|---|---|---|
| **Subject Code:** | **PPDS105-25** | | | |
| **Subject Title:** | **Medicinal Chemistry** | | | |
| **Contact Hours:** | **L:3** | **T:1** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to familiarize students with advanced medicinal Chemistry. Emphasis will be made on the SAR of various drugs such as Antimicrobial, antiviral and CNS Active Drugs and their mode of actions. The commercial synthesis of representative of such drugs will also be discussed. | | | |

| Unit | Contents | Contact Hours |
|---|---|---|
| I | **CNS Active Drugs**: **CNS Depressants: Hypnotics and sedatives**<br>Barbiturates, Non-barbiturates, Amides and Imides, Glutethimide, Benzodiazepines, Aldehydes and derivatives, Methaqualone and other miscellaneous agents.<br>**Anticonvulsants**: Barbiturates, Hydanatoins, Oxazolidinediones. Succinimides, Bezodiazepines, Thenacemide, Glutethimide.<br>**CNS-stimulants & Psychoactive drugs**: Analeptics, Purines, Psychomotor stimulants, Sympathomimetics, Monamine oxidase inhibitors, Tricyclic antidepressants, Miscellaneous psychomotor stimulants. Hallucinogens **(Psychodelics, Psychomimetics)**: Indolethylamines, R-phenylethylamines, Butyrophenones and other miscellaneous drugs.other miscellaneous drugs. | 12 |
| II | **Commercial Synthetic routes**<br>Thioridazine, Haloperidol, Chloropromazine, Phenytoin, Phenobarital, Carbamazipine valproic acid, Methaquolane, Nitrazepam, Oxazepam, Diazepam, Cholridazepoxide. | 10 |
| III | **Antibacterial and Antiviral Agents**<br>History of Antibacterial Drugs, Types, Classifications, Structural Activity Relationship, Fluoroquinolones, Mechanism of Action Of Antibacterial, ß-lactams, Bacterial Resistance against Anti-bacterial Drugs,<br>Target for Anti HIV Drugs. Anti HIV Agents: HIV-Protease inhibitors, Amprenavir, Foseprenavir, Alazanavir etc. Anti-HIV Nucleosides: Lamivudine, Retrovir, Videx, Hivid, Zlarit, Viread, Carbovir, Delavirdine, Ziduvidine, Etavirenz, Calanolide, Capravine, Nevirapine. DNA Polymerase inhibitors: Acyclovir, Ganciclovir, Penciclovir, Famicilovir, Valaciclovir, Valomaciclovir, Codofvir. | 11 |
| IV | **Antineoplastic agents** | 12 |

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|---|---|---|
| | Alkylating agents (Nitrogen mustards, Aziridines, Sulfonic acid Esters, Epoxides, Nitrosoureas, Triazenes, Phosphamides, Mitomycin, Comparative activity of alkalyting agents).<br>**Antimetaboilities**: Antifolates (Methotrexate), Mercaptopurine, Thioguanine, Flourouracil, Floxuridine, Cytarabine, Azathioprine, Antitumor, antibiotics, Dactinomycin, Daunorubricin, Aclacinomycin, Mithramycin, Bleomycin,<br>**Miscellaneous compounds**: Cisplatin, Taxol, Gunazole, Pipobromin.<br>**Antitumor alkaloids**: Vincristine, Vinblastine.<br>**Hormones agonist and antiagonists**: Steroids, Tamoxifen, Mitotane, Dromastanolone propionate, Testalactone, Megestrol acetate Immunotherapy. | |

**Books Recommended**


1. Wilson and Gisvolds Textbook of Organic Medicinal and Pharmaceuticals Chemistry, 8th edition, edited by R.F. Deorge, J.B. Lippincott Company, Philadelphia, 1982.
2. Pharmaceutical Chemicals in Perspective. B.G. Reuben and H.A. Wittcoff, John Wiley & Sons, New York, 1989.
3. W.O. Foye, T.L. Lamke, D.A. Williams, Principles of Medicinal Chemistry, 5th edition, Lippencott Williams and Wilkins, 2002.


**Course Outcomes and Mapping**

At the end of the course, the student will be

**CO1** Understand the need of Medicinal Chemistry in curing various ailments.

**CO2** Study the concept of CNS Active Drugs and antimicrobial drugs.

**CO3** Students will gain an understanding of the **mechanism of action** of drugs at molecular, cellular, and systemic levels and the relationship between **chemical structure** and biological activity (SAR - Structure-Activity Relationship).

**CO4** Students will understand the synthetic pathways and reactions used in the preparation of key drug molecules.

**CO5** Students will explore the integration of medicinal chemistry with Biochemistry, molecular biology, and pharmacology.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|---|---|---|---|---|---|---|
| CO1 | 5 | 5 | 3 | 3 | 3 | 3 |
| CO2 | 5 | 5 | 3 | 3 | 3 | 3 |
| CO3 | 5 | 5 | 4 | 4 | 3 | 4 |
| CO4 | 5 | 5 | 4 | 5 | 3 | 5 |
| CO5 | 5 | 5 | 5 | 4 | 5 | 4 |