

MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102



SCHOOL OF LIBERAL ARTS AND SCIENCES

M.Sc. – Organic Chemistry

CURRICULUM AND SYLLABUS
(From 2025-26 Admitted Students)

FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM (FFCBCS)

Vision

To be a globally respected institution with an innovative and entrepreneurial culture that offers transformative education to advance sustainability and societal good.

Mission

- ❖ Develop industry-focused professionals with a global perspective.
- ❖ Offer academic programs that provide transformative learning experience founded on the spirit of curiosity, innovation, and integrity.
- ❖ Create confluence of research, innovation, and ideation to bring about sustainable and socially relevant enterprises.
- ❖ Uphold high standards of professional ethics leading to harmonious relationship with environment and society.

SCHOOL OF LIBERAL ARTS AND SCIENCES

Vision

To be the ideal culmination for the edification of liberal arts and sciences recognized for excellence, innovation, entrepreneurship, environment and social consciousness.

Mission

- ❖ Infuse the essential knowledge of liberal arts and sciences, skills and an inquisitive attitude to conceive creative and appropriate solutions to serve industry and community.
- ❖ Proffer a know-how par excellence with the state-of-the-art research, innovation, and incubation ecosystem to realise the learners' fullest entrepreneurial potential.
- ❖ Endow continued education and research support to working professionals in liberal arts and sciences to augment their domain expertise in the latest technologies
- ❖ Entice the true spirit of environment and societal consciousness in citizens of tomorrow in solving challenges in liberal arts and sciences.

DEPARTMENT OF BIOLOGICAL AND CHEMICAL SCIENCES

Vision

To become a leading center of excellence in the Biological and Chemical Sciences through adapting advanced methods in teaching and research.

Mission

- ❖ Inspire science students of tomorrow to take on the challenges in the scientific field and build sustaining society that is free from Biological and Chemical science apprehensions.
- ❖ Provide students with an education that combines academics with diligent practical training in a dynamic, research-oriented environment to serve Industry and Societal needs.
- ❖ Encourage faculty and staff to achieve bigger goals in their respective fields and exhibit the best of their abilities via continuing education and research.

M.Sc. – Organic Chemistry

PROGRAM EDUCATIONAL OBJECTIVES

After few years of graduation, the graduates of B.Sc., will:

- PEO1.** Practitioners and leaders in their chosen field.
- PEO2.** Employed as a productive and valued professional in industry/teaching/research.
- PEO3.** Engaged in innovation and deployment as a successful entrepreneur.
- PEO4.** Adapt evolving technologies in their profession with social awareness and responsibility.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of M. Sc. will be able to:

- PO1. Knowledge:** To study as well as apply concepts, theories, and practices across the disciplines to gain the foundational knowledge.
- PO2. Problem Analysis:** To identify, analyze and evaluate various experiences and perspectives using foundational disciplinary knowledge for substantiated conclusions.
- PO3. Design/Development of solutions:** To design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4. Modern tool usage:** To create, select, and apply appropriate techniques, resources and modern tools with an understanding of the limitations.
- PO5. Environment and Sustainability:** Understand the issues of environmental contexts and demonstrate the knowledge for sustainable development.
- PO6. Ethics and Society:** Apply the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities under moral dimensions.
- PO7. Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, to manage projects and finance in multidisciplinary settings.
- PO8. Effective Communication:** To develop proficiency and efficiency in communicating by connecting people, ideas, books, media, and technology.
- PO9. Life-long learning:** Recognize the need for and acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAM SPECIFIC OUTCOMES

On successful completion of the M.Sc., **Organic Chemistry** program students will be able to:

- PSO1.** Apply advanced concepts of organic, analytical, physical and inorganic chemistry to solve complex problems to improve human life.
- PSO2.** Design experiments, analyze, synthesize and interpret data to provide solutions to different industrial problems by working in the pure, inter and multi-disciplinary areas of chemical sciences.
- PSO3.** Able to carry out research independently, investigation to solve practical problems and write, present a technical report.

M.Sc. – Organic Chemistry

Basket Wise - Credit Distribution

Sl. No.	Baskets	Credit Contribution
1	SCHOOL CORE	24-30
2	PROGRAM CORE	21-26
3	PROGRAM ELECTIVE	33-42
4	UNIVERSITY ELECTIVE	6-9
TOTAL CREDITS		Min. 90

School Core (24-30 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25BS201001	Environment and the Society	2	-	-	-	2	-
25BS206001	Basics of Computer for Chemist and Biologist	-	-	2	4	2	-
25BS201025	Nano Chemistry	3	-	-	-	3	-
25BS201021	Heterocyclic Chemistry	3	-	-	-	3	-
25EE201001	Research Methodology	3	-	-	-	3	-
25BS201101	Internship	-	-	-	-	2	-
25BS200801	Capstone Project	-	-	-	-	10	-
Mandatory Non-Credit Courses (Min. 4 Credits to be earned) Earned Credits will not be considered for CGPA							
25BS207602	Chemistry of Biomolecules	2	-	-	-	2	-
25BS207601	Ecology	2	-	-	-	2	-
25CB207601	Essentials of Cyber Security *	2	-	-	-	2	-
25AI207601	Statistics with R	2	-	-	-	2	-
25MG207601	Project Management	2	-	-	-	2	-
25MG207602	Essentials of Business Etiquette	2	-	-	-	2	-
25LG207601	Technical Report Writing	2	-	-	-	2	-

Program Core (21-26 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25BS202013	Basics of Organic chemistry	3	-	3	-	4.5	-
25BS202014	Inorganic Chemistry-I	3	-	3	-	4.5	-
25BS202015	Physical Chemistry-I	3	-	3	-	4.5	-
25BS201019	Bioorganic Chemistry	3	-	-	-	3	-
25BS201028	Drug Design	3	-	-	-	3	-
25BS202016	Organic Reaction Mechanism	3	-	3	-	4.5	Basics of Organic chemistry
25BS202020	Organic Synthesis	3	-	3	-	4.5	

Program Elective (33 – 42 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25BS202017	Inorganic Chemistry-II	3	-	3	-	4.5	Inorganic Chemistry-I
25BS202018	Physical Chemistry-II	3	-	3	-	4.5	Physical Chemistry-I
25BS201030	Group Theory and Molecular Spectroscopy	3	-	-	-	3	-
25BS201022	Green Chemistry	3	-	-	-	3	-
25BS201023	Polymer Chemistry	3	-	-	-	3	-
25BS201024	Chemistry of Natural Products	3	-	-	-	3	-
25BS202021	Organic Spectroscopy and its applications	3	-	3	-	4.5	-
25BS201027	Retrosynthesis	3	1	-	-	4	Basics of Organic chemistry
25BS201026	Separation Techniques	3	-	-	-	3	-
25BS203001	Modern methods of Organic Synthesis	2	-	-	4	3	Organic Reaction Mechanism
25BS201004	Advanced Clinical and Pharmaceutical techniques	4	-	-	-	4	-
25BS201029	Instrumental Methods of Analysis	3	-	-	-	3	-
25BS201031	Medicinal Chemistry	3	-	-	-	3	-
25BS201032	Quality control and quality assurance in pharma industry	3	-	-	-	3	-

UNIVERSITY ELECTIVE (6-9 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25AI201701	Business Analytics	3	-	-	-	3	-
25AI201702	Ethics for AI	3	-	-	-	3	-
25CM201701	Cost Management of Engineering Projects	3	-	-	-	3	-
25CE201701	Disaster Management	3	-	-	-	3	-
25SS201701	Value Education	3	-	-	-	3	-
25SS201702	Pedagogy Studies	3	-	-	-	3	-
25LG201701	Personality Development through Essential Life Skills	3	-	-	-	3	-
25ME201701	Entrepreneurship and Innovation Management	3	-	-	-	3	-

Note:

1. If any student has chosen a course or equivalent course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s under University Elective.
2. The student can choose courses from other disciplines offered across the schools of MBU satisfying the pre-requisite other than the above list.

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS201001	ENVIRONMENT AND THE SOCIETY	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on atmospheric science, toxicological science, air, water, soil pollution, environmental reforms in India and the ways of building safe environment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the effect of pollution on the environment and atmosphere.
- CO2.** Analyze the impact of toxic materials on environment.
- CO3.** Understand the types of impurities and their impacts on the environment.
- CO4.** Gain awareness on the Indian laws and policies for the protection of the environment.
- CO5.** Design the ways to build sustainable environment by using modern science and technology.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	2	-	-	-	2
CO2	2	3	-	-	2	-	-	-	2
CO3	3	-	-	-	2	-	-	-	2
CO4	3	-	-	-	-	2	-	-	3
CO5	3	-	-	1	2	-	-	-	2
Course Correlation Mapping	3	3	-	1	2	2	-	-	2

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: ATMOSPHERIC SCIENCE

(06 Periods)

Chemical reactions in the atmosphere, types, production and distribution of Aerosol, Aerosols and radiation, Atmospheric turbidity and related environmental problems, Global climate and photochemical reactions, nuclear accidents, Global warming, Greenhouse effect, Ozone depletion, Acid rain, Factors effecting corrosion.

Module 2: TOXICOLOGICAL SCIENCE

(06 Periods)

Introduction to toxicology and toxicological Science, Toxicants, Dose-Response Relationships, Toxic chemicals in the environment, Biochemical aspects of As, Cd, Pb, Hg, CO, O₃, PAN, Pesticides, MIC and carcinogens in air.

Module 3: ENVIRONMENTAL POLLUTION

(07 Periods)

Air: Impact of air pollutants on the physical, chemical, and biological characteristics of the surrounding atmosphere.

Water: Impact of water pollutants on the physical, chemical, and biological properties of aquatic ecosystems. Definition and importance of potable water; water quality standards.

Soil: Effects of soil contamination on the physical, chemical, and biological properties of soil. Methods of solid waste disposal and their environmental impacts.

Module 4: ENVIRONMENTAL REFORMS IN INDIA

(05 Periods)

Constitutional Provisions and Legal Framework: Environmental provisions in the Indian Constitution (Articles 48A & 51A), Fundamental Rights and Duties and Judicial activism and environmental jurisprudence.

Environmental Acts: Wildlife (Protection) Act, 1972, Water (Prevention and control of pollution) Act, 1974, Forest (Conservation) Act, 1980, Air (Prevention and control of pollution) Act, 1981, Environmental Protection Act, 1986.

National Green Tribunal: Structure, composition and functions.

Module 5: WAYS OF BUILDING SAFE ENVIRONMENT

(06 Periods)

Biodegradable polymers: Definition, properties, classification, mechanism of degradation of biodegradable polymers and their applications.

Biodiesel: Introduction, Synthesis (Tran's esterification method), advantages, disadvantages and applications.

Role of technology: Green computing, green construction, green manufacturing Systems.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a document on the eco-friendly traditional practices for sustainable environment.
2. Discuss the effect of toxic chemicals released from the Tirupathi Industrial area on the Tirupathi.
3. How to maintain the sustainable environment in this modern world?
4. Study and analyze the impact of environmental reforms in India
5. Explain the ways to maintain the industry in an eco-friendly way

6. Discuss the water harvesting system in your institution
7. Present your plan to improve ground water levels in your institutions surround villages
8. Submit a report to maintain the kitchens (Home/hotel/hostel) in green way
9. Prepare a document on the role of technology to maintain the environment in safer way
10. Submit a document on the conversion of waste into money.

RESOURCES

TEXT BOOKS:

1. E. Bharucha, Textbook of environmental studies, University Press, UGC, 2005.
2. M. Basu and S. Xavier, Fundamentals of Environmental Studies, Cambridge University Press, 2016.

REFERENCE BOOKS:

1. R.K. Trivedi, Environment and Natural Resources Conservation, 1994.
2. S. Cuttler, Environmental Risk and Hazards, Prentice Hall of India, New Delhi, 1994.

VIDEO LECTURES:

1. <https://www.digimat.in/nptel/courses/video/105107176/L01.html>
2. <https://nptel.ac.in/courses/105106119>
3. <https://archive.nptel.ac.in/courses/127/106/127106004/>
4. <https://www.digimat.in/nptel/courses/video/123105001/L31.html>

WEB RESOURCES:

1. https://en.wikipedia.org/wiki/Environmental_policy_of_India
2. <https://iclg.com/practice-areas/environment-and-climate-change-laws-and-regulations/india>
3. <https://www.unep.org/news-and-stories/story/5-ways-make-buildings-climate-change-resilient>
4. <https://www.niehs.nih.gov/health/topics/science/toxicology/index.cfm>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS206001	BASICS OF COMPUTER FOR CHEMIST AND BIOLOGIST	-	-	2	4	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on the usage of chemdraw and Chem sketch

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Familiar to use the computers for drawing various chemical structures using chemdraw and Chem sketch
- CO2.** Illustrate chemical and biological concepts
- CO3.** Prepare a technical report on the process of a chemical reaction

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	2
Course Correlation Mapping	3	-	-	-	-	-	-	-	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT (Minimum 10 experiments to be performed)

1. **PAGE LAYOUT-1** (The Drawing Area, The Document Type, Printing, Saving Page Setup Settings)
2. **PAGE LAYOUT-2** (Slide Boundary Guides Viewing Drawings, Tables)
3. **PREFERENCES AND SETTINGS-1** (Setting Preferences, Customizing Toolbars)
4. **PREFERENCES AND SETTINGS-2** (Document and Object Settings, Customizing Hotkeys)
5. **PREFERENCES AND SETTINGS-3** (Working with Color, Document Settings)
6. **BASIC DRAWINGS-1** (Bonds, Atoms, Captions)
7. **BASIC DRAWINGS-2** (Drawing Rings, Chains, Objects, Clean Up Structure)
8. **BASIC DRAWINGS-2** (Checking Structures, Chemical Warnings)

9. **DESIGNING OF MOLECULES-1** (simple two- dimensional representations of organic molecules)
10. **DESIGNING OF MOLECULES-2** (Structure to Name, Name to Structure, drawing chemical reactions)
11. **BIODRAW-1** (BioDraw Templates, BioDraw of simple molecules)
12. **BIODRAW-2** (proteins, amino acids, polymers, 3D structures)

EXPERIENTIAL LEARNING

- 1 Prepare a document on the application of Chemdraw / Chemsketch in Chemistry and biology
- 2 Present a chemical reaction on PPT using Chemdraw / Chemsketch
- 3 Draw a various organic molecules using Chemdraw / Chemsketch
- 4 Draw a simple polymer molecule using Chemdraw / Chemsketch

RESOURCES

TEXT BOOKS:

1. ChemDraw 16.0 User Guide.
2. S. Wilson, Chemistry by Computer: An Overview of the Applications of Computers in Chemistry, Springer, 2011.

REFERENCE BOOKS:

1. <http://media.cambridgesoft.com/support/manuals/16/ChemDrawHelp.pdf>

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=a9r4Ofnc-Ro>
2. <https://www.youtube.com/watch?v=pccebQuLr9k>
3. <https://www.youtube.com/watch?v=a9r4Ofnc-Ro>

WEB RESOURCES:

1. <https://www.lib.ncsu.edu/faq/what-chemdraw-and-how-do-i-access-it>
2. <https://bitesizebio.com/31511/chemdraw-molecule-sketching-for-biochemists/>
3. <https://cen.acs.org/articles/92/i33/Reflections-ChemDraw.html>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS201025	NANO CHEMISTRY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on introduction to nano materials, synthesis of nanomaterials, nano material characterization techniques, nanocomposites and nano materials for special functions.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Assess type, properties and applications of nanomaterials.
- CO2.** Propose synthetic techniques for the preparation of nanomaterials.
- CO3.** Understand the various techniques for nanomaterial characterization.
- CO4.** Give examples of nanocomposite for appropriate applications
- CO5.** Suggest nanomaterials for specific optical, electronic and energy storage applications

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	2	2	-	-	-	-	1	3	-	-
CO3	3	-	-	-	-	-	-	-	1	3	-	2
CO4	3	-	2	-	-	-	-	-	1	3	-	-
CO5	3	-	2	-	-	-	-	-	1	3	-	-
Course Correlation Mapping	3	-	2	2	-	-	-	-	1	3	-	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO NANO MATERIALS (09 Periods)

Introduction to Nanomaterials, classification of Nanomaterials, properties, Reason for the anomalous behavior of Nanomaterials, General and medical applications, Disadvantages.

Module 2: SYNTHESIS OF NANOMATERIALS (09 Periods)

Introduction to Bottom-up and Top-down approaches
Ball milling, Sol Gel, Inert Gas condensation, Physical vapour deposition, Pulsed laser Deposition, Chemical vapour deposition, Hydrothermal Synthesis

Module 3: NANO MATERIAL CHARACTERIZATION TECHNIQUES (09 Periods)

XRD, SEM, TEM, EDAX, AFM, FESEM - Basic Principles, instrumentation and their utility in characterization of nanomaterials

Module 4: NANOCOMPOSITES (09 Periods)

Nanocomposites- Metal Matrix nanocomposites, Ceramics matrix nanocomposites, Polymer matrix nanocomposites, metal chalcogenides, Dendrimers - Preparation, Properties and applications.

Module 5: NANO MATERIALS FOR SPECIAL FUNCTIONS (09 Periods)

Nanomaterials for hydrogen storage cells, Energy-Storing Structural Nanocomposites, Piezoelectric nanomaterials, Bioinspired Nanomaterials for Adaptive Surfaces, Magnetic Nanomaterials for Remote Actuation, Nano-Engineered Membranes for Selective Filtration, Nanozymes with Artificial Enzyme Functionality and Quantum Dot-Based Solar Windows.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Discuss nanomaterial's role in science and technology.
2. Give a presentation on the characterization of nano materials.
3. Summarize any two latest articles on nano materials.
4. Prepare a document on nanodevice fabrication.
5. Relate structure of nanomaterials with their property.
6. Narrate the nano materials in LED, solar cell and laser applications.

RESOURCES

TEXT BOOKS:

1. Charles P. Poole Jr and Frant J. Owens, Introduction to Nanotechnology, Wiley Inter science, 2003.
2. C.N.R. Rao, Muller and A. K. Cheetham, Chemistry of Nanomaterials, Vol. I & II, Wiley VCH Wiley-VCH Verlag GmbH & Co, 2014.

REFERENCE BOOKS:

1. A.S. Edelstein and R.C. Cammarata, Nanomaterials: Synthesis, Properties and Applications, Institute of Physics Publishing, 2nd edition, 2002.
2. G. Schmid, Nanoparticles from Theory to Applications, Wiley VCH, 2004.
3. K. Glosekotter and J. Dienstthi, Nanoelectronics and Nano systems, Springer, 2004.
4. M. Raj Shankar, Textbook of Nanoscience and Nanotechnology, Orient Black swan Publishers, New Delhi, 2012.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/113/106/113106093/>
2. <https://archive.nptel.ac.in/courses/108/106/108106186/>
3. <https://archive.nptel.ac.in/courses/117/108/102108078/>
4. <https://archive.nptel.ac.in/courses/113/107/113107081/>
5. <https://archive.nptel.ac.in/courses/102/104/102104069/>

WEB RESOURCES:

1. <https://drive.google.com/file/d/1JtCaZOzHr5fX0jB88m3ARzcSgr-XAzAq/view>
2. <https://drive.google.com/file/d/1AMY3IXnvhvcxqgGztgz84SeDiLqYCxQT/view>
3. https://drive.google.com/file/d/1Z1VNUWyjZEE3f9XkskKgumVoFUVQ_-gu/view
4. <https://www.sciencedirect.com/science/article/abs/pii/S2214785321049683>
5. <https://drive.google.com/file/d/1jsg10OQpcfLzK0REdhrgRLJTjW8PtPtO/view>
6. https://drive.google.com/file/d/1HnuUIbKIJuq_mcf8UPilj4UwKrH6eFcE/view

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS201021	HETEROCYCLIC CHEMISTRY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on nomenclature of monocyclic, fused and bridged heterocycles and properties of aromatic heterocycles. This course also provides a detailed discussion on the synthetic routes for the synthesis of three, four, five, six membered heterocycles and their chemical reactivities.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Name monocyclic, fused and bridged heterocycles.
- CO2.** Get familiarized with the concepts of molecular orbital picture, structure and reactivity of the aromatic heterocycles.
- CO3.** Understand preparation, properties and chemical reactions of three and four membered heterocycles.
- CO4.** Discuss about the synthesis, properties and chemical reactions of five and six membered heterocycles. Compare the basicity of the five and six membered heterocycles.
- CO5.** Understand and discuss the reactivity, stability, physical and chemical properties of five and six membered benzo fused hetero aromatic compounds.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	2	-	-
CO2	3	-	-	-	-	-	-	-	2	2	-	-
CO3	3	-	-	-	-	-	-	-	2	2	1	-
CO4	3	-	-	-	-	-	-	-	2	2	1	-
CO5	3	-	-	-	-	-	-	-	2	2	1	-
Course Correlation Mapping	3	-	-	-	-	-	-	-	2	2	1	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION AND NOMENCLATURE OF HETEROCYCLIC COMPOUNDS (09 Periods)
Introduction, definition, classification and nomenclature of heterocyclic compounds (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles.

Module 2: AROMATIC HETEROCYCLES (09 Periods)
Molecular orbital picture, structure and aromaticity of pyrrole, furan, thiophene and pyridine. Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

Module 3: THREE MEMBERED AND FOUR MEMBERED HETEROCYCLES (09 Periods)

Three membered heterocycles: Synthesis, properties and chemical reactions of aziridines, oxiranes, thiiranes.

Four membered heterocycles: Synthesis, properties and chemical reactions of azetidines, oxetanes and thietanes.

Module 4: FIVE AND SIX MEMBERED HETEROCYCLIC COMPOUNDS (09 Periods)

Preparation, properties and chemical reactions of Pyrrole, Furan, Thiophene and Pyridine. Comparison of basicity of Pyridine, Piperidine and Pyrrole.

Module 5: CONDENSED FIVE AND SIX MEMBERED HETEROCYCLIC COMPOUNDS (09 Periods)

Preparation, properties and chemical reactions of indole, quinoline and isoquinoline.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a document on the role of Heterocyclic compounds in pharmaceutical industry
2. Design the synthesis of Heterocyclic compounds in a conventional way
3. Discuss the biological applications of Heterocyclic compounds
4. List the various Heterocyclic compounds used in clinical treatment
5. Design the synthesis of Heterocyclic compounds using Microwave-assisted techniques

RESOURCES

TEXT BOOKS:

1. J.A. Joule, K. Mills and G.F. Smith, Heterocyclic Chemistry, 3rd edition, Chennai Microprint Pvt. Ltd. 2004.
2. A.R. Katritzky, Christopher A. Ramsden, J. Joule, and V. Hdankin, Handbook of Heterocyclic Chemistry, Elsevier, 2010.

REFERENCE BOOKS:

- 1 J.J. Li, Name reactions in heterocyclic chemistry, Wiley India Pvt Ltd, 2012.
- 2 A.R. Parikh, H. Parikh, R. Khunt, The Essence of Heterocyclic Chemistry, New Age

International, 1st Edition, 2013.

- 3 V.K. Ahluwalia, Heterocyclic Chemistry, Alpha Science International, 2012.
- 4 F.A. Carey and Richard J Sundberg, Advanced Organic Chemistry: Structure and Mechanisms (Part A &B), Springer, 2015
- 5 R.K. Bansal, Heterocyclic chemistry, New Age International Private Limited; 5th edition, 2017

VIDEO LECTURES:

- 1. <https://www.youtube.com/watch?v=uvjVY2SYejw>
- 2. <https://www.youtube.com/watch?v=GBxsKQR2HjE>

WEB RESOURCES:

- 1. https://coursecontent.indusuni.ac.in/wp-content/uploads/sites/8/2020/03/Unit-III_Heterocyclic-Chemistry.pdf
- 2. <https://old.amu.ac.in/emp/studym/99998885.pdf>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE201001	RESEARCH METHODOLOGY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION:

The course is developed for the students to understand the underlying concepts of research methodology and a systematic approach for carrying out research in the domain of interest. The course is emphasized on developing skills to recognize and reflect the strength and limitation of different types of research; formulation of the research hypothesis and its systematic testing methods. The course also emphasizes on interpreting the findings and research articulating skills along with the ethics of research.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the underlying concepts of research methodology, types of research and the systematic research process.
- CO2.** Demonstrate the philosophy of research design, types of research design and develop skills for a good research design.
- CO3.** Demonstrate the philosophy of formulation of research problem, methods of data collection, review of literature and formulation of working hypothesis.
- CO4.** Analyze the data and parametric tests for testing the hypothesis.
- CO5.** Interpret the findings and research articulating skills along with the ethics of research.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	2
CO3	3	3	-	-	-	-	-	-	2
CO4	3	3	-	-	-	-	-	-	3
CO5	3	3	-	3	-	-	3	3	2
Course Correlation Mapping	3	3	-	3	-	-	3	3	2

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO RESEARCH METHODOLOGY (08 Periods)

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research.

Module 2: RESEARCH DESIGN (08 Periods)

Research design—Basic Principles, Need of research design, Features of good design, Important concepts relating to research design, Different research designs, Basic principles of experimental designs, Developing a research plan.

Module 3: RESEARCH FORMULATION (08 Periods)

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Data collection – Primary and secondary sources; Critical literature review – Identifying gap areas from literature review; Hypothesis—Types of hypothesis, Development of working hypothesis.

Module 4: ANALYSIS OF DATA AND HYPOTHESIS TESTING (14 Periods)

Quantitative Tools: Testing and Significance of Measures of Central Tendency, Dispersion; correlation, Principles of least squares—Regression; Errors-Mean Square error, Mean absolute error, Mena absolute percentage errors.

Testing of Hypothesis: Hypothesis Testing Procedure, Types of errors, Parametric testing (t, z and F), Chi-Square Test as a Test of Goodness of Fit; Normal Distribution- Properties of Normal Distribution; Analysis of Variance.

Module 5: INTERPRETATION AND REPORT WRITING (07 Periods)

Interpretation: Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation.

Report Writing—Significance, Different Steps, Layout, Types of reports, Mechanics of Writing a Research Report, Precautions in Writing Reports; Research ethics—Plagiarism, Citation and acknowledgement.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Should conduct a survey based on a hypothesis, analyze the data collected and draw the inferences from the data.
2. Should review the literature on the given topic and should identify the scope/gaps in the literature and develop a research hypothesis.
3. Should study a case, formulate the hypothesis and identify an appropriate testing technique for the hypothesis.
4. Study an article and submit a report on the inferences and should interpret the findings of the article.

RESOURCES

TEXT BOOKS:

1. C.R. Kothari, Research Methodology: Methods and Techniques, New Age International Publishers, 2nd revised edition, New Delhi, 2004.

2. B.L. Garg, R. Karadia, F. Agarwal, and U.K. Agarwal, An introduction to Research Methodology, RBSA Publishers, 2002.

REFERENCE BOOKS:

1. R. Panneerselvam, Research Methodology, PHI learning Pvt. Ltd., 2009.
2. S. Yogesh Kumar, Fundamental of research methodology and statistics. New Age International, 2006.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/121106007>
2. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
3. <https://www.youtube.com/watch?v=VK-rnA3-41c>

WEB RESOURCES:

1. <https://www.scribbr.com/category/methodology/>
2. <https://leverageedu.com/blog/research-design/>
3. <https://prothesiswriter.com/blog/how-to-formulate-research-problem>
4. <https://www.formpl.us/blog/hypothesis-testing>
5. <https://www.datapine.com/blog/data-interpretation-methods-benefits-problems/>
6. <https://leverageedu.com/blog/report-writing/>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS207602	CHEMISTRY OF BIOMOLECULES	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on structure, classification, properties and biological significance of carbohydrates, proteins and peptides, lipids, nucleic acids and vitamins.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Get familiarize chemical behavior of carbohydrates.
- CO2.** Acquire knowledge on properties, synthesis, structure and biological functions of peptides/proteins/lipids.
- CO3.** Understand the structure, functions and conformations of nucleic acids.
- CO4.** Awareness on the importance of vitamins and results of its deficiency.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	2
CO3	3	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	2
Course Correlation Mapping	3	-	-	-	-	-	-	-	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: CARBOHYDRATES **(06 Periods)**

Classification of carbohydrates, configuration, redox reactions of monosaccharides, Kiliani-Fischer synthesis, Ruff degradation, hemiacetals and cyclic structure of monosaccharides, Glycosides, anomeric effect, reducing and non-reducing sugars, disaccharides and polysaccharides.

Module 2: PEPTIDES AND PROTEINS **(06 Periods)**

Peptides and Proteins-Methods of peptide synthesis, sequence determination, structure of oxytocin, proteins-classification, structure, conformation and properties.

Module 3: LIPIDS **(06 Periods)**

Definition, classification and biological significance. Lipid Biosynthesis. Structure,

properties and functions of fatty acids.

Module 4: NUCLEIC ACIDS

(06 Periods)

Nucleic acids-Nucleosides, Nucleotides, DNA and RNA, structure and conformations, Functions of nucleic acids, structure and functions of adenine (A), cytosine (C), guanine (G), thymine (T), and uracil (U).

Module 5: VITAMINS

(06 Periods)

Source, biological function, daily requirement and deficiency symptoms of fat-soluble vitamins (A, D, E and K) and water-soluble vitamins (Ascorbic acid, thiamine, riboflavin, pyridoxine, niacin, pantothenic acid, lipoic acid, biotin, folic acid and vitamin B12).

Total Periods: 30

EXPERIENTIAL LEARNING

1. Carbohydrates are important to living things. Discuss
2. Is carbohydrate bad for blood sugar? Justify
3. Why the amino acid is called building blocks of proteins? Give a presentation.
4. Discuss the role of lipids in human body.
5. Give a presentation on the latest research on nucleic acids.
6. Prepare a flow chart on the synthesis of vitamin D in the human body.
7. Discuss the total synthesis of vitamin B12.

RESOURCES

TEXT BOOKS:

1. T. K. Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley 3rd edition, 2007.
2. P.Y. Bruice, Organic Chemistry, 5th edition, Pearson, 2014.
3. D.V. Vranken and G.A. Weiss, Introduction to Bioorganic Chemistry and Chemical Biology, Garland Science, 1st edition, 2012.

REFERENCE BOOKS:

1. L.N. David, and Michael M.C. Lehninger, Principles of Biochemistry, worth publishers, 8th edition, 2021
2. N. Sewald and H.D. Jakubke, Peptides: Chemistry and Biology, Wiley publications, 2nd edition, 2009.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=jQi84TnstI4>
2. <https://archive.nptel.ac.in/courses/102/101/102101049/>
3. <https://study.com/learn/lesson/what-are-lipids.html>
4. <https://archive.nptel.ac.in/courses/104/103/104103121/>
5. <https://www.youtube.com/watch?v=ISZLTJH5IYg>

WEB RESOURCES:

1. <https://www.medicalnewstoday.com/articles/161547#nutrition>

2. <https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/peptides-and-proteins>
3. <https://www.lipidmaps.org/resources/lipidweb/index.php?page=index.html>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6822018/>
5. <https://www.hsph.harvard.edu/nutritionsource/vitamins/>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS207601	ECOLOGY	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

Objectives: This course provides broad umbrella that covers levels of biological organization from individuals to entire ecosystems. Students will explore ecological concepts across these different levels of organization, and gain an understanding of general ecological concepts. The course will focus particularly on population and community ecology, which aims to understand the processes which govern the abundance and diversity of species.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand and explain foundational ecological concepts
- CO2.** Distinguish the structure, organization and processes in various ecosystems
- CO3.** Understand and analyze the concept of biological community, changes and interactions within community.
- CO4.** Develop a knowledge on the structural and functional aspects of a population as an ecological unit
- CO5.** Apply the above skills to address novel ecological questions.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Specific Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	2	2
CO2	3	3	-	-	-	-	-	-	-	-	2	2
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	-	3	-	-	3	-
Course Correlation Mapping	3	3	-	3	-	-	-	3	-	-	3	2

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ENVIRONMENT (07 Periods)

Basic concepts of Environment – Multidisciplinary approach, Basic concepts - Science, Matter and Energy, Evolution of earth, origin of species, diversity and distribution of species, Global environmental issues – an introduction

Module 2: BASICS CONCEPTS OF ECOLOGY (06 Periods)

Definition, History of ecology, Subdivisions, Ecology and other subjects, Fundamental ecological variables, Ecosystems: Definition, Components, Structure and function and size, Classification of ecosystems, Comparative Ecosystem Ecology.

Module 3: POPULATION ECOLOGY (06 Periods)

Definition, Structure and Measures, Definition, Structure and Measures, Regulation strategies of species, Survivability Population genetics, Human population.

Module 4: COMMUNITY ECOLOGY (05 Periods)

Concepts, Community gradients, Characters of community, Ecological Succession and climax Community, Organization -interactions between species, Stress ecology and adaptation.

Module 5: APPLIED ECOLOGY (06 Periods)

Estimating abundance, species diversity measures, Diversity indices, Mathematical ecology: Eco-informatics, Museology, Taxonomy and Biosystematics, Biomass productivity and estimation techniques.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Assignment submission on the topic "Learning Ecology. A New Approach to Learning and Transforming Ecological Consciousness".
2. A case study submission on the topic "Ecosystem-based Theoretical Models for Learning in Environments of the 21st Century".

RESOURCES

TEXT BOOKS:

1. R. Brewer, The Science of Ecology, Saunders College Publishing, New York, 1994.
2. J.L. Chapman, And M. J. Reiss, Ecology: Principles and Application, Cambridge University Press, Cambridge, 1990.
3. B. Groom bridge, Global Biodiversity: Status of the Earth's Living Resources, Chapman and Hall, London, 1992.
4. J.D. Hughes, An Environmental History of the World, Routledge, London, 2001.

REFERENCE BOOKS:

1. P. Michael, Ecological methods for Laboratory and Field Investigations, Tata McGraw Hill Publishing Company Ltd, New Delhi, 1990.
2. W.J. Sutherland, Ecological Census Techniques - A Handbook, Cambridge University Press, 1997.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=3vDQi1_z2Ac&pp=ygUIZWNvbG9neSA%3D

2. <https://www.youtube.com/watch?v=wcwPdLcPAhc&pp=ygUIZWNvbG9neSA%3D>
3. <https://www.youtube.com/watch?v=v4HHR8eCGOA&pp=ygUIZWNvbG9neSA%3D>

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/127/106/127106004/>
2. https://onlinecourses.nptel.ac.in/noc21_ge16/preview

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CB207601	ESSENTIALS OF CYBER SECURITY	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Security Fundamentals, Cyber Security Fundamentals, Attacker techniques and motivations, Fraud techniques, Threat infrastructure, Exploitation, Malicious code, Defense and analysis techniques, Intrusion detection techniques

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understanding the fundamental concepts of cyber security concepts
- CO2.** Identify the pattern of launching attacker and fraud techniques to reduce risk and impact of cyber-attacks.
- CO3.** Identify the vulnerabilities using the SQL injection and web exploitation techniques in a system for securing data.
- CO4.** Apply code obfuscation techniques to prevent any unauthorized party from accessing logic of an application
- CO5.** Apply honey pots and malicious code-naming techniques to defend against attacks in memory.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-
CO5	3	2	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	-	-	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: CYBER SECURITY FUNDAMENTALS

(05 Periods)

Network Security Concepts: Information assurance fundamentals, Basic cryptography, Symmetric encryption, public key encryption, The Domain Name System (DNS), Firewalls, Virtualization, Radio-Frequency Identification.

Module 2: ATTACKER TECHNIQUES

(07 Periods)

Attacker techniques and motivations: Anti forensics, proxy usage, Tunneling techniques: HTTP, DNS, ICMP, Intermediaries, Steganography and other concepts, Detection and prevention.

Fraud techniques: Phishing, smishing, vishing and mobile malicious code, rogue antivirus, click fraud.

Threat infrastructure: Botnets, Fast Flux, Advanced Fast Flux.

Module 3: EXPLOITATION

(06 Periods)

Shellcode, Integer overflow vulnerabilities, Stack based buffer overflows, Format string vulnerabilities, SQL injection, Malicious PDF files, Race conditions, Web exploit tools, DoS conditions, Brute force and dictionary attacks.

Module 4: MALICIOUS CODE

(06 Periods)

Worms, viruses, Evading detection and elevating privileges: obfuscation, Virtual Machine obfuscation Persistent software techniques, Token kidnapping, Virtual machine Detection, Rootkits, Spyware, Attacks against privileged user accounts and escalation of privileges, Stealing information and Exploitation.

Module 5: DEFENSE AND ANALYSIS TECHNIQUES

(06 Periods)

Importance of memory forensics, Capabilities of memory forensics, Memory analysis frameworks, Dumping physical memory, Installing and using volatility, Finding hidden processes, Volatility analyst pack.

Honeypots, Malicious code naming, Automated malicious code analysis systems, Intrusion detection techniques

Total Periods:30

EXPERIENTIAL LEARNING

1. Observe the firewall settings on your personal computer or smartphone.
 - What configurations are enabled?
 - How does this firewall protect your device from threats?
2. Compare phishing, smishing, and vishing using real-life examples. Which of these do you think people are most vulnerable to, and why?
3. Research a recent Do's attack in the news.
 - What services were affected?
 - What preventive measures could have reduced the impact?
4. Explore your antivirus software logs.

- What types of threats were blocked recently?
- Were any of them worms, viruses, or spyware?

5. Reflect on the importance of intrusion detection systems (IDS).

- How does an IDS differ from a firewall?
- Why are both needed in an organisation's security framework?

RESOURCES

TEXT BOOKS:

1. James Graham, Richard Howard, Ryan Olson, "Cyber Security Essentials", CRC Press, 2011.
2. Chwan-Hwa (john) Wu, J. David Irwin, "Introduction to Cyber Security", CRC Press T&F Group.

REFERENCE BOOKS:

1. Nina Godbole and Sunit Belpure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley publications.
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, "Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives", CRC Press, ISBN 9780815371335, 2018.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106106129>
2. <https://www.coursera.org/professional-certificates/ibm-cybersecurity-analyst>

WEB RESOURCES:

1. <https://www.interpol.int/en/Crimes/Cybercrime>
2. <https://www.geeksforgeeks.org/ethical-hacking/cyber-security-tutorial/>
3. <https://owasp.org/www-project-top-ten/>
4. <https://www.netacad.com/courses/cybersecurity-essentials?courseLang=en-US>

SCHOOL CORE

Course Code	Course Title	L	T	P	S
25AI207601	STATISTICS WITH R	2	-	-	-
Pre-Requisite	-				
Anti-Requisite	-				
Co-Requisite	-				

COURSE DESCRIPTION: This course introduces the basic concepts of statistics using R language. The course also deals with various types of sampling methods and its impact in the scope of inference through the computation of confidence intervals. The topics covered in the course also includes descriptive statistics, marginal and conditional distribution, statistical transformations, chi-squared test and ANOVA.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Import, manage, manipulate, structure data files and visualize data using R programming.
- CO2.** Identify trends and patterns in data using Marginal, Conditional distributions and Statistical transformations.
- CO3.** Analyse data using sampling and probability distribution methods and compute confidence intervals for statistical inference.
- CO4.** Apply chi-squared goodness-of-fit test, Pearson's χ^2 2-statistic and ANOVA to investigate the distribution of data.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-
Course Correlation Mapping	3	2	-	-	-	-	-	-	-

Correlation Levels: **3: High; 2: Medium; 1: Low**

COURSE CONTENT

Module 1: INTRODUCTION (05 Periods)

Data, R's command line, Variables, Functions, The workspace, External packages, Data sets, Data vectors, Functions, Numeric summaries, Categorical data.

Module 2: BIVARIATE AND MULTIVARIATE DATA (07 Periods)

Lists, Data frames, Paired data, Correlation, Trends, Transformations, Bivariate categorical data, Measures of association, Two-way tables, Marginal distributions, Conditional distributions, Graphical summaries, Multivariate data - Data frames, Applying a function over a collection, Using external data, Lattice graphics, Grouping, Statistical transformations.

Module 3: POPULATIONS (06 Periods)

Populations, Discrete random variables, Random values generation, Sampling, Families of distributions, Central limit theorem, Statistical Inference - Significance tests, Estimation, Confidence intervals, Bayesian analysis.

Module 4: CONFIDENCE INTERVALS (06 Periods)

Confidence intervals for a population proportion, p - population mean, other confidence intervals, Confidence intervals for differences, Confidence intervals for the median, Significance test - Significance test for a population proportion, Significance test for the mean (t-tests), Significance tests and confidence intervals, Significance tests for the median.

Module 5: GOODNESS OF FIT (06 Periods)

The chi-squared goodness-of-fit test, The multinomial distribution, Pearson's χ^2 2-statistic, chi-squared test of independence and homogeneity, Goodness-of-fit tests for continuous distributions, ANOVA - One-way ANOVA, Using lm for ANOVA.

Total Periods: 30

EXPERIENTIAL LEARNING

1. The data set baby boom (Using R) contains data on the births of 44 children in a one- day period at a Brisbane, Australia, hospital. Compute the skew of the wt. variable, which records birth weight. Is this variable reasonably symmetric or skewed? The variable running. Time records the time after midnight of each birth. The command diff (running time) records the differences or inter-arrival times. Is this variable skewed?
2. An elevator can safely hold 3, 500 pounds. A sign in the elevator limits the passenger count to 15. If the adult population has a mean weight of 180 pounds with a 25-pound standard deviation, how unusual would it be, if the central limit theorem applied, that an elevator holding 15 people would be carrying more than 3, 500 pounds?
3. The data set MLB Attend (Using R) contains attendance data for Major League Baseball between the years 1969 and 2000. Use lm to perform a t-test on attendance for the two levels of league. Is the difference in mean attendance significant? Compare your results to those provided by t-test.

RESOURCES

TEXT BOOKS:

1. John Verzani, Using R for Introductory Statistics, CRC Press, 2nd Edition, 2014.
2. Sudha G Purohit, Sharad D Gore, Shailaja R Deshmukh, Statistics Using R, Narosa Publishing house, 2nd Edition, 2021.

REFERENCE BOOKS:

1. Francisco Juretg, R Statistics Cookbook, Packt Publishing, 1st Edition, 2019.
2. Prabhanjan N. Tattar, Suresh Ramaiah, B. G. Manjunath, A Course in Statistics with R, Wiley, 2018.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_ma76/preview
2. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
3. <https://youtu.be/WbKiJe5OkUU?list=PLFW6IRTa1g83jjpIOte7RuEYCwOJa-6Gz>
4. <https://youtu.be/svDAkh6utM?list=PLFW6IRTa1g83jjpIOte7RuEYCwOJa-6Gz>
5. <https://nptel.ac.in/courses/111104120>

WEB RESOURCES:

1. <https://www.geeksforgeeks.org/r-statistics/>
2. <https://www.geeksforgeeks.org/r-programming-exercises-practice-questions-and-solutions/>
3. https://www.w3schools.com/r/r_stat_intro.asp
4. https://www.w3schools.com/r/r_stat_intro.asp
5. <https://statsandr.com/blog/descriptive-statistics-in-r/>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25MG207601	PROJECT MANAGEMENT	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite						

COURSE DESCRIPTION: To understand the importance of decision-making while implementing any project and interpret and discuss the results of qualitative and quantitative analysis

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the basic introduction to project management
- CO2.** Apply the methods of project identification and selection.
- CO3.** Understand project allocation methods and evaluation.
- CO4.** Analyse the techniques for project time, review, and cost
- CO5.** Understand the factors of risk and quality of a project.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	2	-	-	-	-	-	-
CO2	1	1	2	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-
CO4	3	1	2	1	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-
Course Correlation Mapping	2	2	2	1	-	-	-	-	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: INTRODUCTION (05 Periods)

Concept of project management, project definition and key features of projects, project life cycle phases, typical project management issues, basic project activities

Module 2: PROJECT IDENTIFICATION AND SELECTION (06 Periods)

Identification and screening (brainstorming, strength and weakness in the system, environmental opportunities and threats), Project evaluation methods- Payback period, Net present value, Internal rate of return and project evaluation under uncertainty.

Module 3: PROJECT RESOURCE MANAGEMENT (07 Periods)

Scheduling resources, resource allocation methods, project crashing and resource leveling, working of systems, design of systems, project work system design, project execution plan, project procedure manual project control system, planning scheduling and monitoring

Module 4: TIME AND COST MANAGEMENT (05 Periods)

Time Management-Network diagram, forward and backward pass, critical path, PERT and CPM, AOA and AON methods, tools for project network, Cost management-earned value method

Module 5: RISK AND QUALITY MANAGEMENT

(07 Periods)

Risk identification, types of risk, risk checklist, risk management tactics, risk mitigation and contingency planning, risk register, communication management, Quality assurance and quality control, quality audit, methods of enhancing quality

Total Periods: 30

EXPERIENTIAL LEARNING

1. Refer to any video lecture on project evaluation methods and give a brief seminar using PPT
2. Select any company wherein you will get the details of activities and time and draw the project network diagram and submit a report.

3.

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (Rs.)	Crash Cost (Rs.)
A	-	4	3	8,000	9,000
B	A	5	3	16,000	20,000
C	A	4	3	12,000	13,000
D	B	6	5	34,000	35,000
E	C	6	4	42,000	44,000
F	D	5	4	16,000	16,500
G	E	7	4	66,000	72,000
H	G	4	3	2,000	5,000

Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks.

4. Collect any case study that discusses the process of probability calculation of success of the project and submit a report.

RESOURCES

TEXT BOOKS:

1. R. Panneerselvam and P. Senthil Kumar (2013), Project Management, PHI Learning Private Limited.
2. Prasanna Chandra (2014), Projects: Planning, Analysis, Selection, Financing, implementation, and Review.

REFERENCE BOOKS:

1. A Guide to the Project Management Body of Knowledge: (PMBOK Guide) by Project Management Institute, 2013.
2. Gopala Krishnan & Rama Murthy, A Text book of Project Management, McMillan India.

3. S. Choudhary (2004), Project Management, Tata McGraw Hill Publication.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2. <https://archive.nptel.ac.in/courses/110/104/110104073/>

WEB RESOURCES:

1. <https://www.pmi.org/about/learn-about-pmi/what-is-project-management>
2. <https://www.manage.gov.in/studymaterial/PM.pdf>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25MG207602	ESSENTIALS OF BUSINESS ETIQUETTE	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course develops the concept of business etiquette and the proper etiquette practices for different business scenarios. It builds student awareness of professional conduct and cultural sensitivity, preparing them to navigate diverse global environments with confidence, respect, and appropriate etiquette for every scenario.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** To understand the concept of Etiquette.
- CO2.** Develop life skills or etiquette in order to succeed in corporate culture.
- CO3.** Present oneself with finesse and making others comfortable in a business
- CO4.** Adopt behaviors consistent with standard workplace expectations
- CO5.** Demonstrate an understanding of professionalism in terms of workplace behaviors and workplace relationships.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	2	-	3	-	-	-	2	-
CO4	1	1	-	-	-	-	3	3	-
CO5	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	2	2	3	3	-	-	3	3	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ETIQUETTE (06 Periods)

Introduction to etiquette, benefits- Business etiquette – ABCs of etiquette- Manners, poor manners and good manners- - Role of good manners in business –Professional conduct and personal spacing.

Module 2: CLASSIFICATION OF ETIQUETTE (06 Periods)

Telephone Etiquette - Email etiquette - Dining Etiquette - Dress Etiquette, - Online chat etiquette - Virtual Etiquette - Work place Etiquette

Module 3: MULTI-CULTURAL ETIQUETTE (06 Periods)

Inclusivity and Diversity - cultural awareness –cultural sensitivity - Adaptability and Flexibility - Inter-cultural communication - Ethical Considerations -Taboos and practices

Module 4: WORKPLACE COURTESY AND BUSINESS ETHICS (06 Periods)

Workplace Courtesy - Business Ethics - Hierarchy and Protocol - Developing good relations with peers, superiors, subordinates - Offering compliments and criticism- Preventing Sexual Harassment - Conflict Resolution Strategies

Module 5: NEW ISSUES IN ETIQUETTE & WORKPLACE SUCCESS (06 Periods)

Ethical Issues in Business Etiquette - Cultural Differences and their Effects on Business Etiquette - Sexual Etiquette in the Workplace - Preventing Sexual Harassment- Professionalism - Interpersonal relations- Following Company Policy for Business Etiquette

Total Periods: 30

EXPERIENTIAL LEARNING

1. Role play activity in Telephone etiquette practices.
2. As a new employee, how do you follow workplace courtesies?
3. Group presentation of Etiquette in different countries.
4. Imagine you are a supervisor and explain your subordinates the importance of business etiquette.
5. You came to know that one of male employees in your company sexually harassed a female employee. As a boss of a company, how do you handle the situation and suggest steps to prevent sexual harassment at work place.

RESOURCES

TEXTBOOK:

1. Dhanavel, S.P. English and Soft Skills. Hyderabad: Orient Black Swan, 2021.
2. Pachter Barbara & Cowie Denis (2013) Essentials of Business Etiquette, New York: McGraw Hill Education.

REFERENCE BOOKS:

1. Fox Sue (2010) Business Etiquette for Dummies, New Jersey: Wiley Publications.
3. Kumar Suresh E, Shreehari P, Savithri J (2010) Communication Skills and Soft Skills: An Integrated Approach, Chennai: Pearson Education.
2. Stephen P. Robbins and Timothy A. Judge, Organizational Behaviour, Prentice Hall, Delhi, 16th edition, 2014.
3. Kumar Suresh E, Shreehari P, Savithri J (2010) Communication Skills and Soft Skills: An Integrated Approach, Chennai: Pearson Education.

VIDEO LECTURES:

1. <https://in.video.search.yahoo.com/yhs/search?fr=yhs-sz-002&ei=UTF-8&hsimp=yhs-002&hspart=sz¶m1=2723087361&p=cultural+awareness+%E2%80%93cultural+sensitivity+video&type=type80160-2362144563#id=8&vid=11d76fd8f4c9b5419344ccfd30f291c1&action=click>
2. <https://in.video.search.yahoo.com/yhs/search?fr=yhs-sz-002&ei=UTF-8&hsimp=yhs-002&hspart=sz¶m1=2723087361&p=cultural+awareness+%E2%80%93cultural+sensitivity+video&type=type80160-2362144563#id=9&vid=ea7c85dbd21b03e8dec303c23c6bcb7b&action=view>

WEB RESOURCES:

1. <https://theengine.biz/wp-content/uploads/2020/12/Business-Etiquette-ebook.pdf>
2. <https://insights.si/wp-content/uploads/hunt-chaney-l.-i-st.-clair-martin-j.-2007.-the-essential-guide-to-business-etiquette.pdf>
3. <https://www.scribd.com/document/732526337/Types-of-Business-Etiquette-and-its-Importance>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG207601	TECHNICAL REPORT WRITING	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with preparing effective technical documents for both written and digital media, with particular emphasis on technical memos, problem-solving and decision-making reports, and organizational, product-support, and technical-information webs.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge of Technical Report Writing and structures with a scientific attitude.
- CO2.** Analyze the process of writing in preparing effective reports.
- CO3.** Demonstrate styles of writing for Publication in a Scientific Journal.
- CO4.** Apply the process of referencing and editing techniques for effective communication in written documents.
- CO5.** Analyze the strategies in the technical report presentation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	2	-	3	-	-
CO2	2	3	2	-	2	-	3	-	-
CO3	3	-	-	-	2	-	3	-	-
CO4	2	-	-	3	2	-	3	-	-
CO5	2	3	2	2	2	-	3	-	-
Course Correlation Mapping	2	3	-	3	2	-	3	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO TECHNICAL REPORT WRITING (06 Periods)

Concepts of Technical Report, Types of Reports, Planning Technical Report Writing, Components of a Technical Report, Report Writing in Science and Technology, Selecting and Preparing a Title, Language Use

Module 2: PROCESS OF WRITING (06 Periods)

Writing the 'Introduction', Writing the 'Materials and Methods', Writing the Findings/Results, Writing the 'Discussion', Preparing and using "Tables".

Module 3: STYLE OF WRITING (06 Periods)

Preparing and using Effective 'Graphs', Citing and Arranging References, Writing for Publication in a Scientific Journal.

Module 4: REFERENCING (06 Periods)

Literature citations, , Bibliographical data according to ISO standards, Citations in the text, Copyright, and copyright laws, the text of the Technical Report, Using a word processing and desktop publishing (DTP) systems, Document or page layout, hints on editing Typographic details, Cross-references.

Module 5: PRESENTATION (06 Periods)

Presentation with appropriate pointing, Dealing with intermediate questions, Review and analysis of the presentation, Rhetoric tips from A to Z.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on technologies of modern times that enriched the originality of research works and their impacts on society concerning plagiarism.
2. Make PowerPoint presentations on the various style of writing academic reports.
3. Error-free Reports are so important for successful communication and sharing of information. Prepare a detailed chart on proofreading techniques to make a report effective and error-free.
4. Design a logo for a company and write down the copy-right laws for that.
5. Read research articles from any international journal of science and technology and differentiate research writing from other academic and non-academic writings.
6. Write an organizational memo Include a heading, introduction, and summary at the beginning of your memo, and present the details of your discussion in a logical order. Use headings and topic or main-idea sentences to clarify the organization.
7. Prepare an appraisal report on the staff performance of your company.
8. Prepare a PowerPoint presentation on the annual performance report of a company.
9. Critically review and write a report on any one of the recently released products.
10. Read the newspaper and write a detailed report about the content coverage and analyze the factors for the popularity of the newspaper.

RESOURCES

TEXTBOOK

1. RC Sharma Krishna Mohan, "Business Correspondence and Report" McGraw-Hill Publishing. Writing," Tata Company Limited, New Delhi", 3rd Edition, 2005 (reprint).
2. Patrick Forsyth, "How to Write Reports and Proposals", THE SUNDAY TIMES (Kogan Page), New Delhi, Revised 2nd Edition, 2010.

REFERENCE BOOKS:

1. John Seely, "The Oxford Writing & Speaking", Oxford University Press, Indian Edition
2. Anne Eisenberg, "A Beginner's Guide to Technical Communication", McGraw-Hill Education (India) Private Limited, New Delhi, 2013.

VIDEO LECTURES:

1. <https://vimeo.com/143714818>
2. https://digitalmedia.sheffield.ac.uk/media/002.+The+Anatomy+of+a+Technical+Report/1_u8wntcge

WEB RESOURCES:

1. <http://www.resumania.com/arcindex.html>
2. <http://www.aresearchguide.com/writing-a-technical-report.htm>
3. <http://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/technical-report-writing>

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS202013	BASICS OF ORGANIC CHEMISTRY	3	-	3	-	4.5
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on reactive intermediates, basic concepts about how the organic reactions are carried out, stereochemistry of the compounds, mechanism and reactivity of substitution, elimination reactions, conversion of alkenes to diols.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Recall the fundamental principles of organic reactions.
- CO2.** Illustrate the mechanism of substitution reactions and effects of reactivity.
- CO3.** Explain the mechanism of elimination reactions and effects of reactivity.
- CO4.** Apply their understanding about the organic reactions of industrial significance.
- CO5.** Understand the concepts related to nomenclature, isomerism and stereochemistry.
- CO6.** Develops independent working ability, through the preparation of compounds and effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	3	-	-
CO2	3	2	2	-	-	-	-	-	2	3	2	-
CO3	3	2	2	-	-	-	-	-	2	3	2	-
CO4	3	2	2	-	-	-	-	-	2	3	2	-
CO5	3	2	2	-	-	-	-	-	2	3	2	-
CO6	3	-	2	-	-	-	3	2	2	1	2	3
Course Correlation Mapping	3	2	2	-	-	-	3	2	2	3	2	3

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: REACTIVE INTERMEDIATES (10 Periods)

Types of reactions, types of bond cleavage mechanisms, generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and arynes. Thermodynamic and kinetic requirements, kinetic and thermodynamic control, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

Module 2: SUBSTITUTION REACTIONS (09 Periods)

Aliphatic Nucleophilic substitutions: The SN1, SN2, mixed SN1 and SN2, SET mechanisms. Reactivity-effects of substrates, nucleophiles, leaving groups, solvents and reaction medium. Classical and nonclassical carbocations,

Aromatic Nucleophilic Substitution: The SNAr, SN1, benzyne and SRN1mechanisms. Reactivity - effect of substrate, structure, leaving group and attacking nucleophile. The von Richter, Sommelet - Hauser and Smiles rearrangements.

Module 3: ELIMINATION REACTIONS (07 Periods)

Elimination reactions -1,2; 1,3, 1,4 and pyrolytic-eliminations- E1, E1cB, E2 mechanism, stereo-selectivity in E2 reaction, Saytzeff vs. Hoffmann elimination.

Module 4: ELECTROPHILIC AND NUCLEOPHILIC ADDITION (08 Periods) REACTION TO C-C DOUBLE BOND

Syn and anti-additions. Reaction mechanisms in hydroboration, addition of alcohols, dienes, thiols, hydrogen cyanide, bisulphite anions and hydride ions. Conversion of alkenes to diols (Manganese, Osmium based), Prevost reaction and Woodward modification.

Module 5: INTRODUCTION TO STEREOCHEMISTRY (11 Periods)

Stereoisomerism - Stereoisomers Classification – Configuration and conformation. Molecular Three-dimensional representations: Wedge, Fischer, Newman and Saw-horse formulae, their description and interconversions.

Optical isomerism: Molecular Symmetry and Chirality-Cahn-Ingold-Prelog rules R, S-nomenclature, stereoisomerism resulting from more than one chiral center, meso and pseudo asymmetric compounds - Axial Chirality

Geometrical isomerism: E, Z - nomenclature - Physical and Chemical methods of determining the configuration of geometrical isomers.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted)

1. Identification of single organic component by systematic qualitative analysis.
2. Single step preparations.
 - a) Preparation of aspirin
 - b) Preparation of p-nitroacetanilide
 - c) Preparation of p-bromoacetanilide

RESOURCES

TEXT BOOKS:

1. J. March and M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6th edition, Wiley, 2013.
2. F.A. Carey and R.J Sundberg, Plenum, Advanced Organic Chemistry, 5th edition, Springer publishers, USA, 2007.

REFERENCE BOOKS:

1. L. Finar, Organic Chemistry, Vol. I & Vol. II, Longman (Cambridge), 2011.
2. W. Carruthers, I. coldham, Modern Methods of Organic Synthesis, Cambridge University Press, 4th edition, 2015.
3. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part B: Reaction and Synthesis, Springer, 5th edition, 2010.

VIDEO LECTURES:

1. <https://youtu.be/t55YpuLHFHg>
2. <https://youtu.be/CMeia7DoneM>
3. <https://www.youtube.com/watch?v=yrvV85H737o>
4. <https://www.youtube.com/watch?v=B494VE1IVfo>
5. <https://www.youtube.com/watch?v=Q8W70IDU31E>

WEB RESOURCES:

1. <https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/5-6-reactive-intermediates/>
2. <https://courses.lumenlearning.com/suny-potsdam-organicchemistry/?s=STEREOCHEMISTRY>
3. <https://courses.lumenlearning.com/suny-potsdam-organicchemistry/?s=SUBSTITUTION+REACTIONS>
4. <https://courses.lumenlearning.com/suny-potsdam-organicchemistry/?s=ELIMINATION+REACTIONS+NS>
5. <https://archive.nptel.ac.in/courses/104/105/104105086/>

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS202015	PHYSICAL CHEMISTRY-I	3	-	3	-	4.5
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on quantum chemistry and its applications, chemical dynamics, thermodynamics, and electrochemistry.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- Understand the quantum mechanical aspects of particle in box, harmonic oscillator, rigid rotator and work out solutions for hydrogen like atoms and applying practical aspects of quantum chemistry.
- CO1.** Understand the quantum mechanical aspects of particle in box, harmonic oscillator, rigid rotator and work out solutions for hydrogen like atoms and applying practical aspects of quantum chemistry.
- CO2.** Illustrate the mechanism of substitution reactions and effects of reactivity.
- CO3.** Evaluate the thermodynamics of equilibrium and relation between equilibrium and temperature and pressure.
- CO4.** Discuss the theories in electrochemistry and their applications.
- CO5.** Develops independent working ability, through problem solving and effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	-	-	-	-	1	2	-	-
CO3	3	2	-	-	-	-	-	-	1	2	-	-
CO4	3	2	-	-	-	-	-	-	1	2	-	-
CO5	3	2	-	-	-	-	3	2	1	2	2	2
Course Correlation Mapping	3	2	-	-	-	-	3	2	1	2	2	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: QUANTUM CHEMISTRY

(09 Periods)

Wave Mechanics and Schrödinger Equation: Derivation of the time-dependent Schrödinger equation, followed by separation of variables to obtain the time-independent form. Physical significance and interpretation of the wavefunction.

Quantum Operators and Operator Algebra: Definition and properties of quantum mechanical operators. Fundamentals of linear operators, operator algebra, and the concept of commutators.

Eigen value Problems: Understanding eigenfunctions and eigenvalues associated with quantum operators. Discussion on degeneracy, orthogonality, and linear combinations of eigenfunctions.

Wavefunction Properties and Interpretation: Conditions imposed on wavefunctions for physical validity — normalization, continuity, and single-valuedness. Interpretation of the probability density and physical meaning of standing and progressive waves. Introduction to the expectation value and its role in quantum measurement.

Module 2: APPLICATIONS OF QUANTUM CHEMISTRY

(09 Periods)

Application of Quantum Chemistry in Translation motion: Particle in one dimension box: Differential equation and its solution, Graphical representation of wave functions and probability densities, Normalization and orthogonality of wave functions. Even and Odd Functions. Particle in a two- and three-dimensional box: Differential equation and its solution, Degeneracy, Energy level Diagram. Concept of Hydrogen atom.

Module 3: CHEMICAL DYNAMICS

(09 Periods)

Unimolecular reactions: Lindemann, Lindemann-Hinshel wood, and RRKM theories. Termolecular reactions. Complex reactions-Rate expressions for opposing, parallel and consecutive reaction (all first order type)

Chain reactions: Dynamic chain, hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane, photochemical reactions- H_2-Br_2 , H_2-Cl_2 reactions, Autocatalysis, H_2-O_2 reaction explosion limits.

Fast Reactions: Flow system – Temperature and pressure Jump Methods – Relaxation Techniques.

Module 4: THERMODYNAMICS

(09 Periods)

Introduction to thermodynamics, Internal energy, Enthalpy, Gibbs free energy, Heat capacity, Relation between C_p and C_v , State and path functions, reversible and irreversible processes. Brief resume of first, second and zeroth law of thermodynamics. concept of entropy, third law of thermodynamics, Entropy changes in reversible and irreversible processes; variation of entropy with temperature, pressure and volume, entropy concept as a measure of unavailable energy and criteria for the spontaneity of reaction; free energy functions and their significance, criteria for spontaneity of a process.

Module 5: ELECTROCHEMISTRY

(09 Periods)

Electrical double layer and its significance (Helmholtz, Gouy-Chapmann and Stern model), evaluation of mean activity coefficients of ions from e.m.f. data, determination of dissociation constant of monobasic acid by e.m.f. method. Debye Huckel theory (without derivation) and limiting law. Storage batteries: acid, alkali and lithium-ion storage cells.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted and minimum 1 from each unit should cover)

1. **Data analysis I:** Calibration of volumetric apparatus, Significant figures, Precision and accuracy
2. **Distribution:**
 - a) Distribution of acetic acid between n-butanol and water

- b) Distribution of iodine between hexanes and water
- 3. **Chemical kinetics:**
 - a) Acid-catalyzed hydrolysis of methyl acetate Peroxy disulphate- I- reaction (over all order)
 - b) Oxidation of iodide ion by hydrogen peroxide- iodine clock reaction
- 4. **Conductometry:**
 - a) Titration of strong acid vs strong base
 - b) Titration of weak acid vs strong base
 - c) Determination of cell constant
 - d) Determination of dissociation constant of a weak acid
- 5. **Potentiometry:**
 - a) Titration of strong acid vs strong base
 - b) Titration of weak acid vs strong base
 - c) Determination of dissociation constant of a weak acid
- 6. **Polarimetry:**
 - a) Determination of specific rotation of sucrose
 - b) Acid-catalyzed hydrolysis of sucrose (inversion of sucrose)
- 7. **Adsorption and others:**
 - a) Adsorption of acetic acid on animal charcoal or silica gel
 - b) Determination of critical solution temperature of phenol-water system
 - c) Effect of added electrolyte on the CST of phenol-water system
 - d) Determination of molecular weight of a polymer by viscometry.

RESOURCES

TEXT BOOKS:

1. P.W. Atkins and J. Atkins, Physical Chemistry, International 11th edition, Oxford University Press, United Kingdom, 2018.
2. I.N. Levine, Quantum Chemistry, Pearson Prentice Hall, London, 7th edition, 2014.

REFERENCE BOOKS:

1. K.J. Laidler, Chemical Kinetics, Harper & Row, New York, 3rd edition, 1987.
2. R.J. Silbey, R.A. Alberty, and M.G. Bawendi, Physical Chemistry, Wiley, India, 4th edition, 2015.
3. R.S. Berry, S.A. Rice and J. Ross, Physical Chemistry, 3rd edition, Wiley, New York, 2001.
4. A.K. Chandra, Quantum Chemistry, McGraw Hill Education, India, 4th edition, 2017.

VIDEO LECTURES:

1. https://youtu.be/VZWg6_5KupY
2. https://youtu.be/Yf_4Qv-A55Q
3. <https://youtu.be/djBVBZ72xOQ>
4. <https://youtu.be/z2eUCNHkxEA>
5. <https://www.youtube.com/watch?v=4uYwubIg1fU>

WEB RESOURCES:

1. https://chem.libretexts.org/Courses/Mount_Royal_University/Chem_1201/Unit_1%3A_Quantum_Chemistry
2. <https://archive.nptel.ac.in/courses/112/106/112106133/>
3. <https://archive.nptel.ac.in/courses/104/106/104106129/>

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS202014	INORGANIC CHEMISTRY-I	3	-	3	-	4.5
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on CFT, splitting of d-orbitals in various geometries and MOT diagrams of various complexes, reaction mechanism in complexes, synthesis, structure and properties of metal carbonyls and metal nitrosyls. Also describes about the chemistry of boranes, Carboranes, borazines, Silicates, Carbides, Sulphur-nitrogen compounds and organometallic compounds.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand and differentiate different theories of coordination chemistry
- CO2.** Explain the reaction mechanism of different metal complex reactions
- CO3.** Illustrate about metal π -complexes, nature of π -bonding, classification of π -ligands. Synthesis, structure and properties of metal carbonyls and metal nitrosyls.
- CO4.** Discuss the chemistry of Si, B, C- based compounds.
- CO5.** Apply the fundamental principles of organometallic chemistry, including the types of ligands, the 18-electron rule, structure and bonding in metal-alkyls, metal carbonyls.
- CO6.** Develops independent working ability, through analysis of salt mixture and effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	2	2	-	-
CO3	3	2	-	-	-	-	-	-	2	2	-	-
CO4	3	-	-	-	-	-	-	-	-	2	1	-
CO5	3	-	-	-	-	-	-	-	2	2	-	-
CO6	3	-	-	-	-	-	3	2	2	2	-	2
Course Correlation Mapping	3	2	-	-	-	-	3	2	2	2	1	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: CO-ORDINATION CHEMISTRY**(10 Periods)**

Introduction-CFT, CFSE and its calculation, pairing energy, splitting of d orbitals under various geometries (Trigonal bi pyramidal, square planar, square pyramid and pentagonal bipyramidal), factors affecting splitting- spectrochemical series - Jahn-Teller distortion - application to spinels - limitations of and applications of CFT. Evidence for covalency - Nephelauxetic effects. MOT of co-ordinate bonds -M.O. Diagrams for octahedral, tetrahedral and square planar complexes-sigma & pi bonding in MOT.

Module 2: REACTION MECHANISMS IN COMPLEXES**(09 Periods)**

Reactivity of metal complexes. Inert and Labile complexes. Concept of Labile and Inert Complexes in terms of Valence bond and Crystal Field theories. Anation Reactions - Substitution Reactions in Square Planar complexes- Trans effect - Mechanisms of Trans effect: polarization and π -bonding theories. Electron Transfer Reaction-Inner Sphere and outer Sphere Mechanisms- Marcus theory.

Module 3: METAL π COMPLEXES**(10 Periods)**

Nature of π bonding, Classification of π ligands, π donor ligands and π -acceptor ligands.

Metal Carbonyls: Synthesis of metal carbonyls, Structures of metal carbonyls of the types M (CO) n (M= Cr, Fe, Ni; n=4-6), M2 (CO)n (M=Co, Fe, Mn; n=8-10), M3(CO)12 (M=Fe, Ru and Os), M4(CO)12 (M=Co, Rh, Ir). IR Spectra of metal carbonyls (i) Detection of bridging and terminal CO ligand, (ii) Synergistic effect, EAN and 18-electron rule. Electron counting methods (i) Oxidation state method and (ii) Neutral Atom method.

Module 4: CHEMISTRY OF NON-TRANSITION ELEMENTS**(08 Periods)**

General characteristics of the non- transition elements special features of individual elements; "Synthesis" properties and structure of their Halides and Oxides, Polymorphism of Carbon, Phosphorus and Sulphur, Synthesis, properties and structure of boranes, Carboranes, borazines, Silicates, Carbides, Sulphur-nitrogen compounds. Electron counting in boranes, Wade's rules (Poly hedral skeletal electron pair theory), Isopoly and hetero poly acids.

Module 5: ORGANOMETALLIC CHEMISTRY**(08 Periods)**

Types of ligands in organometallic compounds - eighteen Electron rule, alkyl compounds, metal carbonyls, isolobal concepts. Metallocenes: Ferrocene. Catalysis by Organometallic Compounds-Homogeneous catalysis (e.g., Wilkinson's catalyst, hydroformylation) - Applications in industrial processes (e.g., Ziegler-Natta polymerization).

Total Periods: 45**EXPERIENTIAL LEARNING****LIST OF EXPERIMENTS:**

- 1 Qualitative analysis of inorganic cations: Semi-micro qualitative analysis of a mixture of salts containing two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Mg) and less common cations (W, Se, Mo, Ce, Th, Zr, V, Li).

RESOURCES**TEXT BOOKS:**

1. D.F. Shriver and P.W. Atkins, Inorganic Chemistry, Oxford University Press, 5th edition, 2010.

2. J.D. Lee, Concise Inorganic Chemistry, Oxford University Press, 5th edition, 2014.
3. F.A. Cotton and G. Wilkinson, Advanced inorganic Chemistry, John Wiley & Sons, 6th edition, 1999.

REFERENCE BOOKS:

1. J.E. Huheey, E.A. Kelter and R.L. Kelter, Principles of structure and reactivity, Inorganic Chemistry, Harper Collins College Publishers, 4th edition, 2011.
2. Lesley E. Smart, Elaine A. Moore, Solid State Chemistry: An Introduction, CRC Press, 4th edition, 2012.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=Hs5JBjX51dc>
2. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Inorganic_Chemistry_\(Saito\)/06%3A_Chemistry_of_Transition_Metals/6.06%3A_Reactions_of_Complexes](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Inorganic_Chemistry_(Saito)/06%3A_Chemistry_of_Transition_Metals/6.06%3A_Reactions_of_Complexes)
3. https://www.youtube.com/watch?v=n4cIKKI3_eU
4. <https://youtu.be/ztQVyuNuiBc>
5. https://youtu.be/v63Cug8_NFs

WEB RESOURCES:

1. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_\(Inorganic_Chemistry\)/Coordination_Chemistry/Structure_and_Nomenclature_of_Coordination_Compounds/Introduction_to_Coordination_Chemistry](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Coordination_Chemistry/Structure_and_Nomenclature_of_Coordination_Compounds/Introduction_to_Coordination_Chemistry)
2. https://www.newworldencyclopedia.org/entry/Organometallic_chemistry
3. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Inorganic_Chemistry_\(Wikibook\)/05%3A_Coordination_Chemistry_and_Crystal_Field_Theory/5.05%3A_-Bonding_between_Metals_and_Ligands](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Inorganic_Chemistry_(Wikibook)/05%3A_Coordination_Chemistry_and_Crystal_Field_Theory/5.05%3A_-Bonding_between_Metals_and_Ligands)
4. https://www.google.co.in/books/edition/Essentials_of_Coordination_Chemistry/492ECgAAQBAJ?hl=en&gbpv=1&dq=COORDINATION+CHEMISTRY&printsec=frontcover

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS201019	BIOORGANIC CHEMISTRY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on biocatalysts in organic synthesis, use of biocatalyst in various organic transformation, basic concepts of bio-organic chemistry and development of crown ethers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the concepts of classification, nomenclature properties of enzyme and biocatalyst.
- CO2.** Get familiarize with the organic transformations using biocatalyst.
- CO3.** Understand the basics concepts of biocatalysts.
- CO4.** Understand the development of crown ethers.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	2
CO3	3	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	2
Course Correlation Mapping	3	-	-	-	-	-	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BIOCATALYSTS IN ORGANIC SYNTHESIS (09 Periods)

Enzyme, Properties and Nomenclature, Classification of enzymes, pros and cons of biocatalyst, Mechanistic Aspects, Coenzymes, Enzyme Sources, Immobilized enzymes, comparisons between the homo and heterogeneous biocatalysts.

Module 2: ORGANIC TRANSFORMATIONS USING BIOCATALYSTS-I (09 Periods)

Organic transformations using biocatalysts: Hydrolysis of esters, amides, phosphates epoxides, nitriles- Oxidations of alcohols, aldehydes, Sulfoxidation, Baeyer-Villiger oxidation, Dihydroxylation of Aromatic Compounds

Module 3: ORGANIC TRANSFORMATIONS USING BIOCATALYSTS-II (09 Periods)

Reduction of C=C, aldehydes, ketones- Formation of C-C bond (e.g. Aldol, Acyloin, Benzoin, Machael)-Addition and Elimination Reactions by biocatalysts: Cyanohydrin

Formation, Addition of Water and Ammonia - Group Transfer Reactions (e.g. glycosyl and amino transfer) – Halogenation and De-halogenation reactions,

Module 4: BASICS OF CONCEPTS IN BIOORGANIC CHEMISTRY (09 Periods)

Basic considerations, proximity effects in organic chemistry, molecular adaptation- Bio-isosterism, molecular recognition at the supra molecular level.

Module 5: DEVELOPMENTS IN CROWN ETHER CHEMISTRY (09 Periods)

Developments in crown ether chemistry- Aza crown ethers-Lariat, Lariat pivot, Bi cyclic, tri cyclic (mono aza, bi-aza, tri-aza), pH regulation and ion-selectivity. Host-Guest complexation chemistry, membrane chemistry-micelles. Bis and Photo responsive crown ethers. Regulation of membrane transport phenomenon.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a document on the role of enzymes in organic synthesis.
2. Discuss the mechanism of action of enzymes.
3. Discuss the role of enzymes in various organic transformations.
4. Give a power point presentation on development of various crown ethers.
5. Discuss the biochemical models and its industrial applications in organic synthesis.

RESOURCES

TEXT BOOKS:

1. K. Faber, Bio-transformations in Organic Chemistry, Springer, 7th edition, 1995.
2. P.S. Kasi and J.P. Kalsi, Bioorganic, Bioinorganic and Supramolecular Chemistry, New Age Publications, 3rd edition, 2017.
3. G.L Patrick, An Introduction to Medicinal Chemistry, Qxford, 5th edition, 2013.
4. D. Abraham, Burger's Medicinal Chemistry & Drug discovery, John Wiley and sons, 15th edition, 2014.

REFERENCE BOOKS:

1. John E. McMurry and Tadhg P. Begley, The Organic Chemistry of Biological Pathways, Roberts and Company Publishers, 2nd edition, 2005.
2. A. Harish Kumar and Parmjit S. Panesar, Bio-organic Chemistry, published by Narosa Publishing House Pvt. Ltd., New Delhi, 2012.
3. G. Gonzalo, P. Domíngue, Biocatalysts: An Industrial Perspective, RSC Publishers, 2017.
4. David A. Williams, Foye's Principles of Medicinal Chemistry, 7th Edition, 2012.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/104/103/104103018/>
2. <https://archive.nptel.ac.in/courses/104/103/104103111/>
3. https://onlinecourses.nptel.ac.in/noc21_cy48/preview

WEB RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10459234/>

2. <https://archive.org/details/bioorganicchemis0000chop>
3. <https://books.rsc.org/books/monograph/599/Biocatalysis-in-Organic-Synthesis-The>
4. [https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_\(Morsch_et_al.\)/18%3A_Ethers_and_Epoxides_Thiols_and_Sulfides/18.07%3A_Crown_Ethers](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_(Morsch_et_al.)/18%3A_Ethers_and_Epoxides_Thiols_and_Sulfides/18.07%3A_Crown_Ethers)

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS201028	DRUG DESIGN	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on introduction of drug discovery, development, drug design and lead modification strategies. This course also provides a detailed discussion on quantitative structural activity relationship, molecular modelling and virtual screening techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand and demonstrate the steps involve in the drug discovery, development and design process.
- CO2.** Understand the lead modification strategies.
- CO3.** The concept of QSAR
- CO4.** Identify the screening methods in the design of drugs and molecular docking.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	-	-	-	-	-	-	2	2	-	-
CO3	3	-	-	-	-	-	-	-	2	2	-	-
CO4	3	-	-	-	-	-	-	-	2	2	-	-
Course Correlation Mapping	3	-	-	-	-	-	-	-	2	2	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO DRUG AND DISCOVERY (09 Periods)

Definition: Drug, bioassay, agonist, antagonist, pharmacokinetics and pharmacodynamics.

Sources, classification and nomenclature of drugs. Inhibitors-different types.

Stages of drug discovery and development.

Module 2: DRUG DESIGN (09 Periods)

Lead discovery, Existing drugs as leads (me too drugs), Pharmacophore, Principles of design of agonists, antagonists and enzyme inhibitors, Design of salbutamol, cimetidine and captopril. Drug discovery without lead – serendipity- Penicillin and Librium as examples.

Module 3: LEAD MODIFICATION STRATEGIES (09 Periods)

Bioisosterism, variation of alkyl substituents, chain homologation and branching, variation of aromatic substituents, extension of structure, ring expansion and ring contraction, ring variation, variation and position of hetero atoms, ring fusion, simplification of the lead, rigidification of lead.

Module 4: QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIP (09 Periods) (QSAR)

Introduction to QSAR, physicochemical properties-lipophilicity: partition coefficient (P) and the lipophilicity substituent constant (n), electronic effects: Hammett constants (σ), steric effects: Taft's constant (Es), Hansch analysis, Craig's plot, Topliss scheme, Free Wilson approach, Lipenski rule of five.

Module 5: MOLECULAR MODELLING AND VIRTUAL SCREENING TECHNIQUES (09 Periods)

Concept of Virtual screening, pharmacophore mapping and pharmacophore-based screening. Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a document on the role of drugs in pharmaceutical industry.
2. Design the synthesis of Heterocyclic compounds in a conventional way.
3. Discuss about drugs affecting the central nervous system (CNS).
4. Discuss and prepare about drugs affecting the autonomous nervous system (ANS).
5. Brief account on the chemistry, structure - activity relationship and mode of action of Estrogens, progestogens, androgens and anabolic agents and adrenal cortex hormones.

RESOURCES

TEXT BOOKS:

1. K. Kristian Stromgaard, Povl Krogsgaard-Larsen, Textbook of Drug Design and Discovery, CRC Press, 4th edition, 2010.
2. Richard B Silverman, The organic chemistry of drug design and drug action, Elsevier Publishers, 3rd edition, 2014.
3. H. Kubinyi, QSAR: Hansch Analysis and Related Approaches, VCH Publishers, 2006.

REFERENCE BOOKS:

1. K.M. Merz, J.D. Ringe, C.H. Reynolds, Drug Design: Structure and Ligand- Based Approaches, Cambridge University Press, 2010.
2. D.J. Abraham, D.P. Rotella, A. Burger, Burger's Medicinal Chemistry, Drug Discovery and Development, Academic press, 2010.
3. P. Tomas, L. Jerzy, M.T. Cronin, Recent Advances in QSAR Studies: Methods and Applications, Springer, 2010.
4. L. Tommy, P.K. Larsen, U. Madsen, Textbook of Drug Design and Discovery, 3rd edition, CRC Press, 2006.

VIDEO LECTURES:

1. <https://pll.harvard.edu/course/drug-discovery-and-development>
2. https://onlinecourses.nptel.ac.in/noc21_bt29/preview
3. <https://archive.nptel.ac.in/courses/102/107/102107086/>

WEB RESOURCES:

1. <https://pharmacentral.com/learning-hub/technical-guides/drug-discovery-and-development-a-step-by-step-guide/>
2. <https://ftlscience.com/medicinal-chemistry-lead-modification-optimization/>
3. <https://link.springer.com/article/10.1007/s41061-021-00349-3>
4. <https://www.nature.com/articles/s41589-022-01234-w>

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS202016	ORGANIC REACTION MECHANISM	3	-	3	-	4.5
Pre-Requisite	Basics Of Organic Chemistry					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on molecular rearrangements to electron deficient carbon, nitrogen, electron rich carbon, aromatic and sigmatropic rearrangements, oxidative addition reactions, reduction by metal and metal hydrides, synthesis, mechanism and functions of various reagents used in organic synthesis and organometallic compounds.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Get familiarize with the molecular rearrangements used for designing of new compounds.
- CO2.** Understand the concepts of conversion of reactions using various oxidizing agents.
- CO3.** Explain the reduction of various functional groups using metal and metal hydrides.
- CO4.** Understand the concepts related to synthesis, mechanisms and the functions of various reagents.
- CO5.** Apply their understanding about synthesis, application of various organometallic reagents in designing of new compounds.
- CO6.** Develops independent working ability, through the preparation of compounds and effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	3	-	-
CO2	3	2	2	-	-	-	-	-	2	3	2	-
CO3	3	2	2	-	-	-	-	-	2	3	2	-
CO4	3	2	2	-	-	-	-	-	2	3	2	-
CO5	3	2	2	-	-	-	-	-	2	3	2	-
CO6	3	-	2	-	-	-	3	2	2	1	2	3
Course Correlation Mapping	3	2	2	-	-	-	3	2	2	3	2	3

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: MOLECULAR REARRANGEMENTS (10 Periods)

Rearrangements to electron deficient carbon atom: Pinacol-Pinacolone, Wagner Meerwein, Die none-Phenol and Demjonov Rearrangements

Rearrangements to electron deficient Nitrogen atom: Hofmann, Curtius, Schmidt and Beckmann Rearrangements.

Rearrangements to electron rich carbon atom: Favorski and Neber Rearrangements.

Aromatic and Sigmatropic Rearrangements: Fries and Claisen Rearrangements.

Module 2: OXIDATION REACTIONS (09 Periods)

Oxidations: Alcohols to carbonyls-Dimethyl sulfoxide oxidation, periodate oxidation, Oppenauer oxidation.

Alkenes to epoxides-peroxide induced epoxidations.

Ketones to esters-Bayer-Villiger oxidation.

Oxidation of alkyl or alkenyl fragments-selenium dioxide and chromium trioxide oxidations.

Module 3: REDUCTION REACTIONS (07 Periods)

Reduction by metals: Li/Na in liquid ammonia (Birch reduction), Clemmenson reduction

Reduction by metal hydrides: Lithium aluminum hydride, sodium borohydride, Boran aluminium hydride.

Module 4: REAGENTS IN ORGANIC SYNTHESIS (10 Periods)

Anhydrous AlCl_3 , Boran trifluoride, N-Bromosuccinimide, Diazomethane, Dicyclohexylcarbodiimide, Lead tetraacetate, DDQ.

Module 5: ORGANOMETALLIC REAGENTS (09 Periods)

Synthesis and applications of Grignard reagents, Organolithium, Zinc, Copper compounds in Organic Synthesis, Homogeneous catalytic hydrogenation and hydroformylation reactions.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 4 exercises shall be conducted)

1. Separation and Identification of two component organic mixture by systematic qualitative analysis.

RESOURCES

TEXT BOOKS:

1. J. March and M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Wiley, 6th edition, 2013.
2. F.A. Carey and R.J. Sundberg, Plenum. Advanced Organic Chemistry, Springer, 5th edition. Publishers, USA, 2007.

REFERENCE BOOKS:

1. L. Finar, Organic Chemistry Vol. I & Vol. II, Cambridge publications, Longman, 2011.
2. W. Carruthers, Iain coldham, Modern Methods of Organic Synthesis, Cambridge University Press, 4th edition, 2015.
3. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part B: Reaction and Synthesis, Springer, 5th edition, 2010.
4. P. Powell, Principles of organometallic chemistry, Springer Netherlands, 2013

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=fYJ05Xe_DVQ
2. https://www.youtube.com/watch?v=oQNj-sO_v00
3. https://www.youtube.com/watch?v=p4M2q1t_Up8
4. https://www.youtube.com/watch?v=T_iUUsOI5fE
5. <https://www.youtube.com/watch?v=-JZFT0gMNbA>

WEB RESOURCES:

1. <https://onlinelibrary.wiley.com/doi/10.1002/>
2. 9781118939901<https://organicchemistrydata.org/hansreich/resources/redox/?page=redox>
10%2F
3. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Organometallic_Chemistry_\(Evans\)/Organometallic_Ligands/Metal_Hydrides](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Organometallic_Chemistry_(Evans)/Organometallic_Ligands/Metal_Hydrides)
4. <https://www.wiley.com/en-us/Essential+Reagents+for+Organic+Synthesis-p-9781119278306>
5. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Organometallic_Chemistry_\(Evans\)/Introduction_to_Organometallic_Chemistry/Resources_for_Organometallic_Chemistry](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Organometallic_Chemistry_(Evans)/Introduction_to_Organometallic_Chemistry/Resources_for_Organometallic_Chemistry)

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS202020	ORGANIC SYNTHESIS	3	-	3	-	4.5
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on chemistry of organoboran, phosphorus, sulfur and silicon reagents. Describes photochemistry, pericyclic reactions and asymmetric synthesis of organic compound.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Get familiarize with the unique reactivity of Boron, Phosphorus reagents.
- CO2.** Understand the unique reactivity of sulfur and silicon reagents.
- CO3.** Use Photochemical energy in organic synthesis.
- CO4.** Understand the concept and application of pericyclic reactions.
- CO5.** Understand the various strategies in asymmetric synthesis.
- CO6.** Develops independent working ability, through problem solving and effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	-	-	2	1	2	-
CO2	3	-	1	-	-	-	-	-	2	1	2	-
CO3	3	-	1	-	-	-	-	-	2	1	2	-
CO4	3	-	1	-	-	-	-	-	2	1	2	-
CO5	3	-	1	-	-	-	-	-	2	1	2	-
CO6	3	2	1	1	-	-	3	2	2	1	2	3
Course Correlation Mapping	3	2	1	1	-	-	3	2	2	1	2	3

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: CHEMISTRY OF ORGANO BORAN, PHOPHORUS (08 Periods) REAGENTS

Electronic structure and bonding in Boron, and Phosphorus compounds - Their reactivity and applications in Organic Synthesis.

Boron Reagents-Hydroboration-Organoboranes in the formation of C-C bonds, alcohols, amines, halogen and carbonyl compounds-Free radical reactions of organoboranes.

Phosphorus Reagents-Formation of carbon-carbon double bonds-Functional group transformations - deoxygenation reactions-reactivity as electrophiles- conversion of alcohols to alkyl halides, Wittig reaction and nucleophiles - Corey-Winters reaction, Michaelis-Arbuzov reaction-Perkow reaction and Mitsunobu reaction.

Module 2: CHEMISTRY OF ORGANO SULFUR AND SILICON (07 Periods) REAGENTS

Sulphur Reagents-Sulphur ylides, stabilized and non-stabilized-Preparation and reactivity Pommerer reaction - sulphonyl carbanions-Julia reaction.

Silicon reagents-Peterson's olefination, influence of trialkyl silyl reagents in electrophilic reactions, aryl silanes, alkenyl silanes, alkynyl silanes, allyl silanes.

Module 3: PHOTOCHEMISTRY (10 Periods)

Photochemical energy, Frank-Condon principles, Jablonski diagram, singlet and triplet states, photosensitization, quantum efficiency and quantum yield.

Photochemistry of carbonyl compounds: $n \rightarrow n^*$ and $n \rightarrow n^*$ transitions, Norrish type-I and Norrish type-II cleavages, Paternò-Büchi reactions, photoreduction, Rearrangement of Cyclohexanones, cyclohexadienones.

Photochemistry of unsaturated systems (olefins): Cis-trans isomerization, benzene and its derivatives.

Photochemistry of benzene and its derivatives, photo-Fries rearrangement of phenyl esters and anilides; photolysis of nitrite esters: Barton reaction.

Module 4: PERICYCLIC REACTIONS (10 Periods)

Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene. Classification of pericyclic reaction.

FMO approach. Electrocyclic reactions-Conrotatory and disrotatory. $4n$ and $4n+2$ system.

Sigmatropic rearrangements-Suprafacial and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties, 3, 3 and 5, 5 Sigma tropic rearrangements. Claisen, Cope and Oxy-Cope rearrangements. Ene reaction.

Module 5: ASYMMETRIC SYNTHESIS (10 Periods)

Introduction and terminology: Topicity in molecules: homotopic, heterotopic (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.

Strategies in Asymmetric Synthesis:

Chiral substrate controlled asymmetric synthesis-Nucleophilic additions to chiral carbonyl compounds. 1, 2-asymmetric induction, Cram's rule.

Chiral auxiliary controlled asymmetric synthesis- α -Alkylation of chiral enolates, Use of chiral auxiliaries in Diels-Alder reaction and Aldol reactions.

Chiral reagent controlled asymmetric synthesis-Asymmetric reductions using BINAL-H.

Chiral catalyst controlled asymmetric synthesis-Sharpless and Jacobsen asymmetric epoxidations.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Organic estimations and multistep preparations of an organic compound.

Organic Estimations:

Estimation of Glucose
Estimation of phenol
Estimation of Aniline
Estimation of Aspirin

2. **Multistep preparations:**

Preparation of benzilic acid
Preparation of benzanilide
Preparation of p-bromoaniline

RESOURCES

TEXT BOOKS:

1. J. March and M.B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Wiley, 6th edition, 2013.
2. F.A. Carey and R.J. Sundberg, Plenum, Advanced Organic Chemistry, Springer publishers, USA, 5th Edition, 2007.

REFERENCE BOOKS:

1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part B: Reaction and Synthesis, Springer, 5th edition, 2010.
2. Von A. Gilbert und J. Baggott, Essentials of Molecular Photochemistry, Blackwell Scientific Publications, Oxford, 1991.
3. A. I. Vogel, Practical Organic Chemistry, Longman Group Ltd, Britain, 5th edition, 1989
4. Thomas A Albright, Jeremy Burdett, Myung-Hwan Whangbo, Orbital interactions in chemistry, Wiley, 2nd Edition.
5. R.E. Gawley and J. Aube, Principles of Asymmetric synthesis, Elsevier, 2nd Edition, 2012.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/104/103/104103110/>
2. <https://archive.nptel.ac.in/courses/104/105/104105034/>
3. <https://archive.nptel.ac.in/courses/104/105/104105038/>
4. <https://archive.nptel.ac.in/courses/104/106/104106077/>
5. <https://archive.nptel.ac.in/courses/104/103/104103067/>

WEB RESOURCES:

1. https://www2.chem.wisc.edu/areas/reich/chem842/_chem842-07-boron.htm
2. <https://www.britannica.com/science/organosulfur-compound/Thiols>
3. [https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Basic_Principles_of_Organic_Chemistry_\(Roberts_and_Caserio\)/28%3A_Photochemistry](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Basic_Principles_of_Organic_Chemistry_(Roberts_and_Caserio)/28%3A_Photochemistry)
4. [https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_\(Organic_Chemistry\)/Reactions/Pericyclic_Reactions](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Reactions/Pericyclic_Reactions)
5. <https://unacademy.com/content/csir-ugc/study-material/chemical-sciences/asymmetric-synthesis/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS202017	INORGANIC CHEMISTRY-II	3	-	3	-	4.5
Pre-Requisite	INORGANIC CHEMISTRY-I					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides an introductory knowledge on bioinorganic Chemistry, Interpretation of electronic spectra of aqua Complexes, metal-ligand equilibria in solutions, metal ion catalysis and synthesis of nanomaterials and their biomedical applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** To obtain an introductory knowledge on bioinorganic Chemistry and understand the biomedical applications of inorganic compounds.
- CO2.** To understand the concept of term symbols, electronic spectra and magnetic properties of complexes.
- CO3.** To obtain a detailed knowledge in understanding the influence of metal and ligand on stabilization of complexes.
- CO4.** Discuss the mechanism of metal catalyzed reactions.
- CO5.** Explain the classification, synthesis techniques, properties, and biomedical/technological applications of nanomaterials.
- CO6.** Develops independent working ability, thorough analysis on determination of the metal ions and preparation of metal complexes.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	2	2	-	-
CO3	3	2	-	-	-	-	-	-	2	2	-	-
CO4	3	-	-	-	-	-	-	-	-	2	1	-
CO5	3	-	-	-	-	-	-	-	2	2	-	-
CO6	3	-	-	-	-	-	3	2	2	2	-	2
Course Correlation Mapping	3	2	-	-	-	-	3	2	2	2	1	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: BASICS OF BIOINORGANIC CHEMISTRY (10 Periods)

Metal ions in the biological systems, Photosynthesis, Nitrogen fixation, Oxygen uptake proteins-hemoglobin and myoglobin. Metals/ Metal compounds in medicine - Introduction, Metal deficiency and diseases, Iron deficiency, Zinc deficiency and Copper deficiency. Metals used for diagnosis and radiodiagnosis-Vanadium based diabetic drugs, Lithium, Gold and Platinum compounds used in therapy.

Module 2: ELECTRONIC SPECTRA OF TRANSITION METAL COMPLEXES (10 Periods)

Term symbols, Free Ion terms and Energy Levels, Configurations, Terms, States and Microstates, calculation of Microstates for P^2 and d^2 Configuration, spin-orbit coupling, Russell – Saunders coupling, derivation of term symbols for various configurations, Spectroscopic ground states, selection rules, Orgel diagrams of d^1 to d^9 metal complexes. Interpretation of electronic spectra of aquo Complexes of Ti (III), V(III), Cr (III), Mn (II), Fe (II), Fe (III), Co (II), Ni (II) and Cu (II), charge transfer spectra.

Module 3: METAL-LIGAND EQUILIBRIA IN SOLUTIONS (09 Periods)

Metal-Ligand Equilibria in solutions: Stepwise and overall formation constants and their interaction, trends in successive formation constants, factors effecting the stability of metal complexes with reference to the nature of metal ion and ligand, the chelate effect, Pearson's theory of hard and soft acids and bases (HSAB), determination of formation constants by pH metry and spectrophotometry. The Irving-Williams series.

Module 4: CATALYSIS (08 Periods)

Homogeneous catalysis, Metal ion catalyzed reactions, Redox potentials and processes – Mechanism of redox processes involving ligands, Factors affecting redox potentials - other types of metal catalyzed reactions, Reactions involving Ag (I) , Cu (II) and Os (VIII), Reactions of Oxyanions, Factors affecting rate (General discussion only), Induced reactions, Free radical reactions, Thermal decomposition of peroxydisulphate – Fe(III) – S_2O_8 reactions, chain reactions, H-Br reactions, H_2O_2 – S_2O_8 reactions.

Module 5: CHEMISTRY OF NANOMATERIALS (08 Periods)

Introduction to Nanomaterials-Definition and importance of nanomaterials Classification of nanomaterials based on dimensions: Zero-dimensional (0D)- One-dimensional (1D) -Two-dimensional (2D)-Synthesis and Biomedical Applications of Metal Nanoparticles: Gold nanoparticles (AuNPs)-Silver nanoparticles (AgNPs)-Iron oxide nanoparticles (Fe_3O_4 or $\gamma-Fe_2O_3$)-Carbon-based Nanomaterials: Introduction to Fullerenes-Carbon Nanotubes (CNTs)- Types: Single-Walled Carbon Nanotubes (SWCNTs)- Multi-Walled Carbon Nanotubes (MWCNTs)-Synthesis, properties and applications.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 8 exercises shall be conducted)

Quantitative Analysis: Separation and determination of two component mixtures

- (i) Separation of Al (III) and Determination of Fe (III).
- (ii) Separation of Cu (II) and Determination of Zn (II).
- (iii) Separation of Ca (II) and Determination of Mg (II).
- (iv) Separation of Cu (II) and Determination of Ni (II).
- (v) Determination of Ferrocyanide and Ferricyanide.
- (vi) Spectrophotometric determination of Fe in water sample.
- (vii) Estimation of Fe (II) by Dichrometry

Preparation of Metal Complexes:

- (viii) Tetra(ammime) copper (II) sulphate.
- (ix) Mercury tetra (thiocyanato)cobaltate (II).
- (x) Hexa(ammime) Nickel (II) chloride.
- (xi) Tris(acetylacetonato) Manganese (III) chloride.
- (xii) Tris(ethylenediammine) Nickel (II) thiosulphate.

RESOURCES

TEXT BOOKS:

1. D.F. Shriver and P.W. Atkins, Inorganic Chemistry, Oxford University Press, 5th edition, 2010.
2. J.D. Lee, Concise Inorganic Chemistry, Oxford University Press, 5th Edition, 2014.
3. F.A. Cotton and G. Wilkinson, Advanced inorganic Chemistry, John Wiley and Sons, 6th edition, 1999.

REFERENCE BOOKS:

1. F. Basalo and R.G. Pearson, Mechanisms of Inorganic reactions: A study of metal complexes in solutions, Wiley-Eastern Pvt Ltd., 2nd edition, 1967.
2. R.M. Roat-Malone, Bioinorganic Chemistry: A short course, John-Wiley Sons. Inc., 2002.
3. J.E. Huheey, E.A. Kelter and R.L. Kelter, Principles of structure and reactivity, Inorganic Chemistry, Harper Collins College Publishers, 4th edition, 2011.
4. G. Svehla, Vogel's Qualitative Inorganic Analysis, Pearson Education Ltd., 7th edition, 1996

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/104/104/104104109/>
2. <https://www.youtube.com/watch?v=8MP5Mfue4Q4>
3. https://www.youtube.com/watch?v=z_VZKBUPrf0
4. <https://www.youtube.com/watch?v=meIzBa4hxJQ&list=PLDjIJRH6sIC75nF-oDbyievkNyz1YAot8>
5. <https://www.youtube.com/watch?v=GpC-GxGa42g>

WEB RESOURCES:

1. https://www.uni-siegen.de/fb8/ac/hjd/lehre/master/bioinorganic_handout.pdf
2. <https://authors.library.caltech.edu/25052/1/BioinCh.pdf>
3. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Inorganic_Chemistry_\(Wikibook\)](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Inorganic_Chemistry_(Wikibook))
4. https://link.springer.com/chapter/10.1007/978-3-662-25191-1_8
5. <https://archive.nptel.ac.in/courses/104/105/104105032/>
6. <https://download.e-bookshelf.de/download/0000/6027/27/L-G-0000602727-0013842673.pdf>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS202018	PHYSICAL CHEMISTRY-II			3	-	3 - 4.5
Pre-Requisite	Physical Chemistry-I					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on quantum chemistry and its applications, phase rule and its applications and concepts of surface chemistry.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the various electro analytical methods and their applications
- CO2.** Apply the X-ray Diffraction technique to understand the crystal structures
- CO3.** Discuss the Phase rule and its applications
- CO4.** Understand the concepts involved in surface chemistry and surface analysis
- CO5.** Develops independent working ability, through problem solving and effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	-	-	-	-	1	2	-	-
CO3	3	2	-	-	-	-	-	-	1	2	-	-
CO4	3	2	-	-	-	-	-	-	1	2	-	-
CO5	3	2	-	-	-	-	3	2	1	2	2	2
Course Correlation Mapping	3	2	-	-	-	-	3	2	1	2	2	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: ADVANCED ELECTROCHEMISTRY (09 Periods)

Nernst Equation, Reference electrode, Standard Hydrogen electrode, Calomel electrode. Determination of EMF of cell, Applications of EMF measurements. Electroanalytical methods- Chronoamperometry, Cyclic Voltammetry and Chronopotentiometry. Electrochemical reduction of carbon dioxide to valuable organic products.

Module 2: SOLID STATE CHEMISTRY (09 Periods)

Symmetry in crystals. Definition of lattice point, space lattice, unit cell. Bravais lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law. Defects in crystals. Stoichiometric and non-stoichiometric defects. Applications of X-ray Diffraction (XRD) and Interpretation of X-ray diffraction pattern of crystal structure using JCPDS software.

Module 3: PHASE RULE AND ITS APPLICATIONS-I (09 Periods)

Phase rule, Phase diagrams and their classification, Lambda transitions.

Two component system: Vapor pressure – composition diagrams, Phase diagrams for partially miscible liquids for two components, Critical solution temperature, influence of foreign substances on CST, fractional distillation of Zeotropic and Azeotropic mixtures.

Module 4: PHASE RULE AND ITS APPLICATIONS-II (09 Periods)

Three component systems: Type I-Formation of one pair of partially miscible liquids: Graphical representations, bimodal curves, plait point, influence of temperature-System showing real critical solution temperature, System showing no real critical solution temperature.

Type II - Formation of two pairs of partially miscible liquids. Type III - Formation of three pairs of partially miscible liquids, Influence of impurities, Ternary Azeotropic mixtures, Preparation of absolute alcohol by azeotropic elimination of water.

Module 5: SURFACE CHEMISTRY (09 Periods)

Adsorption, Langmuir and Freundlich adsorption isotherms, Gibbs adsorption isotherm, BET adsorption isotherm, derivation of BET equation, limitations of BET equation, estimation of surface area from BET equation

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted and minimum 1 from each unit should cover)

1. **Distribution:** Distribution of I_2 between hexanes/cyclohexanes/CCl₄ and aq.KI solution- calculation of equilibrium constant.
2. **UV-Visible spectrophotometer:**
 - a) Ni-DMG complex formation
 - b) Fe(II)-Phenanthroline complex
 - c) Study of complex formation between ammonia and metal ion
3. **Chemical kinetics:**
 - a) Stoichiometry of peroxy disulphide- iodide reaction.
 - b) Peroxy disulphide- iodide reaction: order w.r.t $[I^-]$ by isolation method.
 - c) Peroxy disulphide- iodide reaction: order w.r.t $[S_2O_8^{2-}]$ by initial rate method.
4. **Conductometry:**

- a) Titration of a mixture of strong and weak acids vs strong base
- b) Determination of the hydrolysis constant of aniline hydrochloride
- c) Determination of solubility product

5. **Potentiometry:**

- a) Determination of specific rotation of glucose and fructose
- b) Enzyme catalyzed inversion of sucrose Colorimetry
- c) Verification of Beer's law and calculation of molar absorption coefficient using CuSO₄ and KMnO₄ solutions

6. **Polarimetry:**

- a) Calibration of a pH meter and measurement of pH of different solutions
- b) Preparation of phosphate buffers
- c) Titration of strong acid vs strong base

RESOURCES

TEXT BOOKS:

1. P.W. Atkins and Atkins' Physical Chemistry, Oxford University Press, United Kingdom, International 11th edition, 2018.
2. A.J. Bard, L.R. Faulkner and H. S. White, Electrochemical Methods: Fundamentals and Applications, John Wiley and Sons, Oxford University Press, United Kingdom, 3rd edition, 2022.

REFERENCE BOOKS:

1. R.J. Silbey, R.A. Alberty, and M. G. Bawendi, Physical Chemistry, Wiley, India, 4th edition, 2015.
2. R.S. Berry, S.A. Rice and J. Ross, Physical Chemistry, Wiley, 3rd edition, New York, 2001.
3. A.K. Chandra, Quantum Chemistry, McGraw Hill Education, 4th edition, India, 2017.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/104/106/104106137/>
2. <https://archive.nptel.ac.in/courses/104/104/104104101/>
3. <https://www.youtube.com/watch?v=E4xRiUAqdVo>
4. <https://archive.nptel.ac.in/courses/104/104/104104130/>

WEB RESOURCES:

1. https://www.unige.ch/sciences/chifi/sugiharalab/files/1214/2349/9399/Lecture_1_upload.pdf
2. <https://ncert.nic.in/ncerts/l/lech101.pdf>
3. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=941>
4. <https://testbook.com/learn/surface-chemistry/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201022	GREEN CHEMISTRY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on fundamentals and significance of green chemistry, principles of green chemistry and its applications and also the role of chemistry in sustainable development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Getting an idea of fundamentals, significance of green chemistry and principles of green chemistry
- CO2.** Design and execute organic synthesis using various green synthetic methods, which enable to think different possible ways to synthesis an organic compound in an eco-friendly way.
- CO3.** Understand greener methodologies using ultrasound and microwave methodologies.
- CO4.** Analyse the role of chemistry in sustainable development and its goals.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	2	-	-	2	3	2	-
CO2	3	2	-	-	2	2	-	-	2	3	2	-
CO3	3	2	-	-	2	2	-	-	2	3	2	-
CO4	3	2	-	-	2	2	-	-	2	3	2	-
Course Correlation Mapping	3	2	-	-	2	2	-	-	2	3	2	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: FUNDAMENTALS AND SIGNIFICANCE OF GREEN CHEMISTRY (09 Periods)

Discussion of the current state of Chemistry and the environment and the definition of Green Chemistry. Assessment of the impact of Chemistry in the environment and definition of risk hazards; An introduction to the tools of green Chemistry and its fundamental principles

Module 2: PRINCIPLES OF GREEN CHEMISTRY (09 Periods)

Prevention of waste / by-products, Hazardous products- Designing of safer chemicals- Selection of appropriate solvents and starting materials- Use of protecting groups and catalysis- Designing of biodegradable products.

Module 3: CATALYSIS FOR GREEN CHEMISTRY (09 Periods)

Utilization of biocatalysts in ecofriendly synthesis, Biochemical oxidation and Reduction processes, Enzyme-catalyzed hydrolysis, modified biocatalytic techniques. Emphasis on green catalysts, Oxidation and Reduction reactions, Friedel-Crafts acylations, Epoxide rearrangements, Esterification of amino acids, and carbon-carbon bond formation.

Module 4: SOLVENT FREE REACTIONS (09 Periods)

Solvent free techniques- Reactions on solid mineral supports

Phase Transfer Catalysis- C-alkylation, N-alkylation, S-alkylation, Darzen's reaction, Wittig reaction.

Microwave assisted green synthesis- Biginelli reaction, Aza-Michael reaction, Suzuki reaction, Stille reaction, Sonogashira reaction.

Module 5: SUSTAINABLE DEVELOPMENT (09 Periods)

Sonochemistry: Sonochemical reactions - substitution, addition, elimination, hydrolysis, esterification, oxidation, reduction.

Biodegradable polymers: Chemical syntheses of biodegradable polymers, mechanism of degradation and applications.

Sustainable Development Goals: Introduction and key concepts on SDG 3, 6, 12 and 13.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a document on the role of green chemistry in pharmaceutical industry.
2. Design the synthesis of organic compounds under green protocol.
3. Discuss the role of nanoparticles in green catalysis.
4. Prepare a document on the green approach in solid phase.
5. The role of Ionic liquids in green chemistry.
6. Submit a document on the synthetic approach of Biodegradable polymers.

RESOURCES

TEXT BOOKS:

1. V.K. Ahluwalia and M. Kidwai, New Trends in Green Chemistry, Anamaya Publishers, New Delhi, 2012.
2. M. Lancaster, Green Chemistry: An Introductory Text: RSC publications, USA, 3rd edition 2010.
3. A.S. Matlack, "Introduction to Green Chemistry" CRC press, USA, 2010.

REFERENCE BOOKS:

1. V. Nelson, Introduction to Renewable Energy, Solar Energy International, 2012.
2. E. Michaelides Alternative Energy Sources, Springer, Germany, 2012.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=MHROd9ly7OQ>
2. https://19january2017snapshot.epa.gov/greenchemistry_.html
3. <https://www.youtube.com/watch?v=rIE4T2HLW7c>

WEB RESOURCES:

1. [https://chem.libretexts.org/Courses/University_of_Arkansas_Little_Rock/Chem_1402%3A_General_Chemistry_1_\(Belford\)/Text/1.A%3A_Basic_Concepts_of_Chemistry/1.02%3A_Physical_and_Chemical_Properties](https://chem.libretexts.org/Courses/University_of_Arkansas_Little_Rock/Chem_1402%3A_General_Chemistry_1_(Belford)/Text/1.A%3A_Basic_Concepts_of_Chemistry/1.02%3A_Physical_and_Chemical_Properties)
2. <https://www.epa.gov/greenchemistry>
3. <https://www.acs.org/content/acs/en/greenchemistry/principles/12-principles-of-green-chemistry.html>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201023	POLYMER CHEMISTRY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on polymerization, characterization of polymers, polymerization techniques, synthetic and advanced polymers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the basics of polymers
- CO2.** Characterize polymers in terms of their physical concept.
- CO3.** Get familiarize with various polymerization techniques.
- CO4.** Develop conceptual knowledge on synthetic polymers.
- CO5.** Understand the trends and applications of advanced polymeric materials

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	3	-	-
CO3	3	-	1	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	1	1	-	-	1	3	1	-
Course Correlation Mapping	3	2	1	-	1	1	-	-	1	3	1	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: POLYMERS (09 Periods)

Introduction, nomenclature, some basic definitions, classification of polymers. Polymerization methods: Addition, condensation, copolymerization, radical chain, ionic and coordination, controlled free radical polymerization.

Module 2: CHARACTERIZATION-AVERAGE MOLECULAR WEIGHT CONCEPTS (09 Periods)

Number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution, measurement of molecular weight: end group, viscosity, light scattering, osmotic and ultracentrifugation methods.

Module 3: TECHNIQUES OF POLYMERISATIONS (09 Periods)

Bulk polymerisation, solution polymerisation, suspension polymerisation, emulsion polymerisation, melt polycondensation, solution polycondensation, and interfacial polycondensation, solid and gas phase polymerization.

Module 4: SYNTHETIC POLYMERS

(09 Periods)

Stereospecific Polymers-Preparation and significance- classification of polymers based on physical properties-Thermoplastics-Thermosetting plastics- General applications.

Preparation of Polymers based on different types of monomers, Industrial applications-olefin polymers-Diene polymers-nylons-Glyptal Resins-Urea-formaldehyde, phenol formaldehyde and melamine resins- Epoxy resins - Ion exchange resins

Module 5: ADVANCED POLYMERS

(09 Periods)

Trends and Applications in Advanced Polymeric Materials

Conducting polymers: Definition, types of conducting polymers and applications.

Biodegradable polymers: Definition, properties, classification, synthesis of PHBV, PGA, PCL, Nylon-2-nylon-6, General mechanism of degradation and applications.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Discuss various polymerization types in the polymer chemistry
2. Give a presentation on the characterization of polymers by NMR
3. Summarize any two latest articles on advances in Polymer Technology
4. Prepare a document on advanced polymer and biopolymers
5. Detailed discussion on the advanced Polymers

RESOURCES

TEXT BOOKS:

1. George Odian, Principles of Polymerization, 4th Edition, Wiley publications, 2004
2. Joel R. Fried, Polymer Science and Technology, 3rd Edition, Prentice Hall, 2014

REFERENCE BOOKS:

1. J. Karl Fink, High Performance Polymers, Elsevier, 2nd edition, 2014.
2. E.S. Guerra and Eduardo Vivaldo-Lima, Handbook of Polymer Synthesis, Characterization, and Processing, Wiley-Blackwell, 2013
3. M. Fontanille and Y. Gnanou, Chemical and physical chemistry of polymers, Wiley-2008

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/104/105/104105124/>
2. <https://archive.nptel.ac.in/courses/104/105/104105039/>
3. <https://archive.nptel.ac.in/courses/113/105/113105028/>
4. <https://archive.nptel.ac.in/courses/113/105/113105077/>
5. <https://archive.nptel.ac.in/courses/103/106/105106205/>

WEB RESOURCES:

1. <https://www.sciencedirect.com/topics/materials-science/chain-growth-polymerization>
2. <https://ncert.nic.in/textbook/pdf/lech206.pdf>
3. <https://earthwormexpress.com/wp-content/uploads/2020/07/seymour-carraher-polymer-chemistry.pdf>
4. <https://www.sciencedirect.com/topics/materials-science/polymer-application>
5. <https://edu.rsc.org/download?ac=15050>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201024	CHEMISTRY OF NATURAL PRODUCTS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on occurrence, nomenclature, isolation, structural determination, synthesis of Terpenoids, alkaloids, steroids, hormones, flavonoids and isoflavonoids.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Get familiarize structural determination and synthesis of terpenoids.
- CO2.** Understand the classification of alkaloids based on nitrogen heterocyclic ring structural determination and synthesis of alkaloids.
- CO3.** Explain the basic skeleton, structure determination of cholesterol, biosynthesis and stereochemistry of steroids.
- CO4.** Understand the isolation and synthesis of hormones.
- CO5.** Know about isolation, structural determination and synthesis of flavonoids and isoflavonoids.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	3	-	-
CO2	3	-	-	-	-	-	-	-	2	3	-	-
CO3	3	-	-	-	-	-	-	-	2	3	-	-
CO4	3	-	-	-	-	-	-	-	2	3	-	-
CO5	3	-	-	-	-	-	-	-	2	3	-	-
Course Correlation Mapping	3	-	-	-	-	-	-	-	2	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: TERPENOIDS (09 Periods)

Occurrence, isolation, general methods of structure determination, isoprene rule; structure determination, synthesis of farnesol, zingiberene, cadinene, abietic acid.

Module 2: ALKALOIDS (09 Periods)

Introduction, isolation, classification based on nitrogen heterocyclic ring, general methods of structural elucidation, structural elucidation, synthesis of morphine, papaverine and reserpine.

Module 3: STEROIDS (10 Periods)

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry of steroids; isolation, structure determination and synthesis of cholesterol, biosynthesis of steroids.

Module 4: HORMONES (08 Periods)

Occurrence, isolation and synthesis of androsterone, testosterone, estrone and progesterone.

Module 5: FLAVONOIDS AND ISOFLAVONOIDS (09 Periods)

Occurrence, nomenclature and general methods of structure determination; isolation, structure elucidation and synthesis of apigenin, luteolin, kaempferol, quercetin, and daidzein; biosynthesis of flavonoids and Isoflavonoids: acetate pathway and shikimic acid pathway.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Submit a document on the application of Terpenoid Compounds in Food and Pharmaceutical Products
2. Give a PPT presentation on pharmacological applications of alkaloids
3. Submit a report as alkaloids can act as narcotics agent
4. Prepare a document on the side effects of steroids
5. Explain the conversion of cholesterol to vitamin-D in presence of sunlight
6. Name five Important Hormones and discuss how they help you function
7. Modern lifestyle habits cause hormonal imbalance. Justify
8. Educate your near and dear to balance hormones naturally.
9. Prepare a document on the biological importance of flavonoids and isoflavonoids
10. Give presentation using latest research publications on the extractions of flavonoids and isoflavonoids from plant materials.

RESOURCES

TEXT BOOKS:

1. O.P. Agrawal, Chemistry of Organic Natural Products, Vols. 1 &2, Goel Pubs, 3rd edition, 1974.
2. P.S. Kalsi, Chemistry of Natural products, Kalyani Publishers, 1st edition, 1983.

REFERENCE BOOKS:

1. Atta-ur-Rahman and M.I. Choudhary, New Trends in Natural Products Chemistry, Harwood Academic Publisher, 1998.
2. I.L. Finar, Organic Chemistry, Vol. 2, 1956.
3. R.D. Herbert, Chapman and Hall, The Biosynthesis of Secondary Metabolite, 2nd edition, 1984.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=QkK-sULWDv0>
2. <https://www.youtube.com/watch?v=xQDhXoJwSEI>
3. <https://www.youtube.com/watch?v=BI5qc9-W8DM>
4. <https://www.youtube.com/watch?v=gHLvO-BH4og>
5. <https://www.youtube.com/watch?v=AhMrhjVWAdE>

WEB RESOURCES:

1. <https://novapublishers.com/shop/terpenes-and-terpenoids-sources-applications-and-biological-significance/>
2. <https://www.britannica.com/science/alkaloid>.
3. <https://www.biologyonline.com/dictionary/steroid>
4. <https://byjus.com/question-answer/give-the-brief-explanation-of-all-the-hormones-in-males-and-females-respectively-with-their/>
5. <https://encyclopedia.pub/entry/1237>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS202021	ORGANIC SPECTROSCOPY AND ITS APPLICATIONS		3	-	3	- 4.5
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on ultraviolet and visible spectrometry, IR spectroscopy, NMR technique and mass spectrometry.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Interpret UV-Visible spectra of organic compounds using electronic transitions, solvent effects, and empirical rules (e.g., Fieser-Woodward).
- CO2.** Analyze IR spectra to identify functional groups and structural features based on characteristic vibrational frequencies.
- CO3.** Explain chemical shifts, spin-spin coupling, and dynamic effects in ^1H NMR and apply them to determine molecular structure.
- CO4.** Analyze ^{13}C NMR spectra, understand chemical shift calculations, and apply spectral editing techniques for compound identification.
- CO5.** Interpret mass spectra for structural elucidation using ionization methods, fragmentation patterns, and isotopic analysis.
- CO6.** Develops independent working ability, through problem solving and effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	2	1	1	3
CO2	3	2	-	-	-	-	-	-	2	1	1	3
CO3	3	2	-	-	-	-	-	-	2	1	1	3
CO4	3	2	-	-	-	-	-	-	2	1	1	3
CO5	3	2	-	1	-	-	2	1	3	1	1	3
CO6	3	2	-	2	-	-	-	1	2	1	1	3
Course Correlation Mapping	3	2	-	1	-	-	2	1	2	1	1	3

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: ULTRAVIOLET AND VISIBLE SPECTROSCOPY (08 Periods)

Various electronic transitions (185-800 nm), effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes and conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds, Steric effect in biphenyl compounds.

Module 2: INFRARED SPECTROSCOPY (09 Periods)

Instrumentation and sample handling. Overtones, combination bands and Fermi resonance, bending and stretching vibrations, factors influencing vibrational frequencies, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Data analysis or interpretation of infrared spectra of compounds. (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds).

Module 3: ^1H NMR SPECTROSCOPY (10 Periods)

Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, deshielding, chemical shifts and its measurements, factors influencing chemical shift, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines and amides), spin-spin interactions, coupling constant (J): Types and classification (ABX, AMX, ABC etc.) of coupling constants, Karplus curve variation of coupling constant with dihedral angle, virtual coupling, chemical exchange, effect of deuteration, hindered rotation, Simplification of complex spectra: nuclear magnetic double resonance (spin decoupling), contact shift reagents, Nuclear Overhauser effect (NOE).

Module 4: ^{13}C NMR SPECTROSCOPY (09 Periods)

Types of ^{13}C NMR spectra: un decoupled, proton- decoupled and off-resonance decoupled (ORD) spectra. ^{13}C chemical shifts, factors affecting the chemical shifts, chemical shifts of organic compounds. Calculation of chemical shifts of alkanes, alkenes and alkynes. Homonuclear (^{13}C - ^{13}C J) and heteronuclear (^{13}C - ^1H J) coupling. ^{13}C -NMR spectral editing techniques: principle and applications of DEPT.

Module 5: MASS SPECTROMETRY (09 Periods)

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mc. Lafferty rearrangement. Nitrogen rule, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: Composite spectral problems in three modes, **10** examples

1. Spectral identification of organic compounds by using UV, IR, multi-NMR and Mass spectroscopy

RESOURCES

TEXT BOOKS:

1. J. Singh and J. Singh, Organic Spectroscopy Principles, Problems and Their Solutions, A Pragadhi edition, 2016.
2. S. Chand and Company, Elementary Organic Spectroscopy, Principles and Chemical Applications, 5th edition, 2013.
3. P.S. Kalsi, Spectroscopy of Organic Compounds, New Age international Publishers, 17th Edition, 2016.

REFERENCE BOOKS:

1. D.N. Sathyanarayana, Introduction to Magnetic Resonance Spectroscopy, I K International Publishing House Pvt. Ltd; 2nd edition, 2013.
2. R.M. Silverstein, F.X. Webster, D.J. Kiemle, D.L. Bryce, Spectrometric Identification of Organic Compounds, Wiley, 8th edition, 2015.
3. K. Shankar, M.B. Mukhopadhyay, Organic Spectroscopy through Solved Problems, 1st edition, 2013.
4. D.L. Pavia, G.M. Lampman and G.S. Kriz, Introduction to Spectroscopy, A guide for students of organic chemistry, Thomson, 3rd edition, 2001.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/104/101/104101135/>
2. <https://archive.nptel.ac.in/courses/104/106/104106122/>
3. <https://archive.nptel.ac.in/courses/104/101/104101117/>
4. <https://archive.nptel.ac.in/courses/104/108/104108124/>
5. <https://archive.nptel.ac.in/courses/103/108/103108139/>

WEB RESOURCES:

1. <https://www.vedantu.com/chemistry/uv-visible-spectroscopy>
2. <https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/infrared/infrared.htm>
3. <https://organicchemistrydata.org/hansreich/resources/nmr/?page=nmr-content%2F>
4. <https://organicchemistrydata.org/hansreich/resources/nmr/?page=06-cmr-01-spectra/>
5. <https://edu.rsc.org/resources/mass-spectrometry-resources/943.article>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201027	RETROSYNTHESIS	3	1	-	-	4
Pre-Requisite	Basics Of Organic Chemistry					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on disconnection approach, how to plan and execute retrosynthesis, multistep synthesis and retrosynthesis of some natural products. Also, describes the various methods used in organic synthesis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Get familiarize with the basics concepts of disconnection approach.
- CO2.** Familiar with rules of disconnection in retrosynthesis
- CO3.** Plan, execute and understand the various strategies of alcohols and carbonyl disconnection.
- CO4.** Understand the application of retrosynthesis in multi step synthesis.
- CO5.** Explain role of retrosynthesis in organic synthesis.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	2	3	-	-
CO2	3	2	2	-	-	-	-	-	2	3	-	-
CO3	3	2	2	-	-	-	-	-	2	3	-	-
CO4	3	-	2	-	-	-	-	-	2	3	-	-
CO5	3	2	2	-	-	-	-	-	2	3	-	-
Course Correlation Mapping	3	2	2	-	-	-	-	-	2	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DISCONNECTION APPROACH - I (09 Periods)

Functionalization and interconversion of functional groups, formation of carbon-carbon single and double bonds.

General strategy in disconnection: Synthon approach, retrosynthetic analysis, key intermediates and starting materials in designing a synthesis, linear and convergent synthesis.

Module 2: DISCONNECTION APPROACH - II (09 Periods)

Importance of order of events, one group C-X disconnections, chemoselectivity, two group C-X disconnections, reversal of polarity (umpolung), cyclization reactions.

One group C-C disconnections—synthesis of alcohols and carbonyl compounds; regioselectivity, olefin synthesis, use of alkynes in synthesis.

Two group C-C disconnections: Diels-Alder reaction; 1,3-difunctionalized compounds – 1,3-dicarbonyl, β -hydroxy carbonyl and α , β -unsaturated compounds, 1,5-dicarbonyl compounds – Michael addition and Robinson annulation, synthesis 1,2- and 1,4-dicarbonyl compounds.

Module 3: PLANNING AND EXECUTION OF RETROSYNTHESIS (08 Periods)

Retro synthesis of alkenes, acetylenes, nitro and amine compounds with specific example to synthesis of simple molecule for each functional group.

Strategies of alcohols and carbonyl disconnections:

Alcohols and carbonyl compounds with specific example to synthesis of simple molecule for each functional group.

Module 4: MULTI STEP SYNTHESIS AND RETROSYNTHETIC ANALYSIS (09 Periods)

Multi step synthesis of some complex naturally occurring compounds involving through retrosynthetic analysis and control of stereochemistry, Longifolene, Taxol, Juvabione, Fediricamycine A (any three).

Module 5: METHODS IN ORGANIC SYNTHESIS (10 Periods)

Introduction, Strecker synthesis, Ugi reaction, Mannich reaction, Biginelli reaction, and Hantzsch synthesis; Tandem Synthesis—Definition, advantages, polyene cationic cyclizations, conjugate addition-aldol reaction, Mannich-cation olefin cyclization, Knoevenagel-hetero-Diels-Alder reaction.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a document on the retrosynthesis software.
2. Give a presentation on Computer-guided retrosynthesis.
3. Outline the retrosynthetic analysis and synthetic Planning.
4. Retrosynthesis is milestone in organic chemistry—Justify
5. Submit a PPT on rules of disconnection in retrosynthesis.
6. Discuss the importance and impact of retrosynthesis on Organic Synthesis.
7. Retrosynthesis in the Manufacture of Generic Drugs: Case Studies

RESOURCES

TEXT BOOKS:

1. S. Warren and P. Wyatt, *Organic synthesis, the disconnection approach*, Wiley, 2nd edition, 2012.
2. J. Li, E.J. Corey, *Total Synthesis of Natural Products: At the Frontiers of Organic Chemistry*, 1st Edition, 2012.
3. K.C. Nicolaou, E.J. Sorensen, *Classics in total synthesis*, Wiley-VCH, 4th edition, 1996

REFERENCE BOOKS:

1. I.L. Finar, *Organic Chemistry*, Vol. I & Vol. II, Longman (Cambridge), 2011.
2. W. Carruthers, I. coldham, *Modern Methods of Organic Synthesis*, Cambridge University Press, 4th edition, 2015.
3. F.A. Carey and R.J. Sundberg, *Advanced Organic Chemistry Part B: Reaction and Synthesis*, Springer, 5th edition, 2010.
4. L.S. Starkey, *Introduction to Strategies for Organic Synthesis*, John Wiley and Sons, 2012.
5. M.B. Smith, *Organic synthesis*, Academic Press, 4th edition, 2016

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/104/105/104105087/>
2. <https://www.youtube.com/watch?v=CMmz1Db0KfI>
3. <https://www.youtube.com/watch?v=DSjfknh3iNo>
4. <https://www.youtube.com/watch?v=I85LgmfkJ0o>
5. <https://www.youtube.com/watch?v=t5SDp9IDrww&list=PLiJEr0rDlw5IzqsOXduyoxWMWYuK4TTRA&index=2>

WEB RESOURCES:

1. https://profiles.uonbi.ac.ke/andakala/files/sch_302_retrosynthetic__analysis_and_synthetic_planning.pdf
2. <https://www.massey.ac.nz/~gjrowlan/chem312/tutorial.pdf>
3. <https://pubs.acs.org/doi/10.1021/acscentsci.7b00355>
4. <https://chembam.com/resources-for-students/the-chemistry-of/retrosynthesis-aspirin-paracetamol/>
5. <http://www.oxfordsynthesiscdt.ox.ac.uk/resources/SBM-CDT-Pharma-Disconnections.pdf>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201026	SEPARATION TECHNIQUES	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on classification, principle, working and applications of various separation techniques which includes paper, thin layer, column, high pressure liquid and gas chromatography.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Get familiarize with the basics concepts of chromatography and its classification.
- CO2.** Understand the principle and application of paper and thin layer chromatography.
- CO3.** Apply column chromatography in laboratory for separation.
- CO4.** Get familiarize with principle, instrumentation and applications of HPLC and GC.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	-	-	-	-	-	-	2	-	-	2
CO3	3	-	-	3	-	-	-	-	2	-	-	2
CO4	3	-	-	3	-	-	-	-	2	-	-	2
Course Correlation Mapping	3	-	-	3	-	-	-	-	2	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CHROMATOGRAPHY **(08 Periods)**
 Introduction, Definition, classification, partition or distribution coefficient, partition ratio, efficiency, resolution, plate height, plate number, theories of chromatography: plate theory, rate theory, band broadening.

Module 2: PAPER and THIN LAYER CHROMATOGRAPHY **(10 Periods)**
Paper chromatography (PC): Theory and principle, mechanism of separation, types of paper, methodology, sample preparation, choice of solvents, location of spots and measurement of RF value, factors affecting RF values, advantages and applications
Thin-layer chromatography (TLC): Classification, Principle, selection of stationary and mobile phases, sample application, development of plate, retardation factor.

Module 3: COLUMN CHROMATOGRAPHY AND ION EXCHANGE CHROMATOGRAPHY **(10 Periods)**
Column chromatography: Introduction, principle, column preparation, stationary phase, mobile phase, working and applications.

Ion exchange chromatography: Introduction, principle, working and applications.

Module 4: HIGH PRESSURE LIQUID CHROMATOGRAPHY (10 Periods)

Principles of HPLC, instrumentation of HPLC, Types of column, Types of detectors use in HPLC, Application of HPLC.

Module 5: GAS CHROMATOGRAPHY (07 Periods)

Introduction, Basic principle of GC, difference between GLC and GSC, Types of detectors use in GC. Application of GC.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Discuss the importance of Chromatography in organic synthesis.
2. Outline the preparation of TLC plates.
3. Discuss the use of GC and HPLC in pharmaceutical industry.
4. Prepare a PPT on Reverse phase chromatography.
5. Discuss Chromatography techniques used in pharmaceutical industry.

RESOURCES

TEXT BOOKS:

1. H.A. Willard, L.L. Merrit, J.A. Dean, Von Nostrand, Instrumental Methods of Analysis, CBS Publishers, 7th edition, 1986.
2. D.A. Skoog, D.M. West, F. James Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, Wadsworth Publishing Co Inc., 9th edition, 2014.
3. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denny, Vogel's Text Book of Quantitative Chemical Analysis, Longman Scientific & Technical Longman Group, UK, 5th edition, 1994.

REFERENCE BOOKS:

1. S.M. Khopkar, Analytical Chemistry: Problems and Solutions, New Age International Pvt. Ltd., 2nd edition, 2010.
2. J. Bassett, R.C. Denny, C.H. Jaffery and J. Mendham, Vogel's Text Book of Quantitative Chemical Analysis, ELBS, Longman Group Publishers, 6th edition, 2009.
3. J. Mendham, R. C. Denney, J. D. Barnes and M. J. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, Pearson Education Asia, 4th and 6th edition 2009.
4. J.D. Seader and E.J. Henley, Separation Process Principles, John Wiley and Sons Inc, 2006.

VIDEO LECTURES:

1. https://www.youtube.com/results?search_query=chromatography+in+english
2. <https://www.youtube.com/watch?v=SabFoRNOQv8>
3. https://www.youtube.com/watch?v=jOf_zHw2Hd4
4. <https://www.youtube.com/watch?v=ZN7euA1fS4Y>
5. <https://www.youtube.com/watch?v=UycPljfrnWo>

WEB RESOURCES:

1. <https://www.longdom.org/open-access/chromatography-and-its-techniques-by-chromatographic-bed-shape-87962.html>
2. <https://www.slideshare.net/pharmaguideline/principle-of-gc-and-hplc>

3. <https://lab-training.com/reverse-phase-chromatography/>
4. <https://www.britannica.com/science/reverse-phase-chromatography>
5. <https://www.rasayanika.com/2020/10/23/importance-of-chromatography-technique-in-research/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201004	ADVANCED CLINICAL AND PHARMACEUTICAL TECHNIQUES	4	-	-	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion Drug discovery, Drug development, Drug commercialization, Design and conducting trials and Molecular spectroscopy.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand methods of drug discovery and key concepts in Drug delivery.
- CO2.** Gain knowledge on the different phases in the drug development process.
- CO3.** Identify methods used for commercialization of drugs and marketing strategies.
- CO4.** Understand the design of conducting clinical trials and ethical aspects.
- CO5.** Familiarize with basic principle, instrumentation and applications of various spectroscopic techniques.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	1	-	-	1	-	1	3	3	3
CO2	3	3	-	1	-	-	1	-	1	3	2	3
CO3	3	3	-	1	-	-	1	-	1	3	3	3
CO4	3	3	-	1	-	-	1	-	1	3	3	3
CO5	3	3	-	1	-	-	1	-	1	3	3	3
Course Correlation Mapping	3	3	-	1	-	-	1	-	1	3	3	3

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: DRUG DISCOVERY (12 Periods)

Pharmaceutical and Biotechnology industry Landscape, Drug discovery- Proteomics and Genomics, Compound selection and Preclinical studies, Challenges in Fragment based drug discovery for Protein Kinases, Key concepts in Drug delivery.

Module 2: DRUG DEVELOPMENT (12 Periods)

Regulatory considerations during filing of Investigational New drug Application, Clinical study and startup activities, Clinical trial Phase I, Clinical trial Phase II, Clinical trials Phase III, New drug application filing, product labeling.

Module 3: DRUG COMMERCIALIZATION (12 Periods)

Pharmacoconomics in drug development, Intellectual property strategy, Marketing Pharmaceuticals and Biotechnology drugs, Managing Market and sales strategy, Strategic alliance between Industry and Academia, Business Models and Portfolio management from startup to success in Biotech.

Module 4: DESIGN AND CONDUCTING CLINICAL TRIALS (12 Periods)

Types of trial designs, Randomization and masking, Outcomes and analysis, Regulatory affairs and trial misconduct, standardization, transparency and research reproducibility, Clinical trial sample size, trial monitoring, Analyzing trials and advanced topics.

Module 5: INTRODUCTION TO MOLECULAR SPECTROSCOPY (12 Periods)

UV-Visible spectroscopy: Principle, instrumentation and applications.

Infrared-spectroscopy: Principle, Instrumentation, and Applications.

NMR: Basic principles, elementary ideas and instrumentation, chemical shifts, spin-spin coupling, and applications

Total Periods: 60

EXPERIENTIAL LEARNING

1. Prepare a document on the Clinical trials carrying by India pharmaceutical
2. Quiz regarding IPR and drug marketing strategies
3. Seminars on the current drug development strategies
4. Outline the methods used in the development of COVID vaccine
5. The role of Indian scientists in the drug development
6. Submit a document on role of instrumental techniques in drug designing

RESOURCES

TEXT BOOKS:

1. K. Stromgaard, P. Krogsgaard and U. Madsen, Drug design and discovery, CRC Press, 5th edition, 2022.
2. K. Wilson and J. Walker, Principles and techniques of Biochemistry and Molecular Biology, Cambridge University press, 7th edition, 2010.

REFERENCE BOOKS:

1. R.G. Hill and D. Richards, Drug discovery and development, Elsevier publications, 3rd edition, 2021.
2. G. Gauglitz, and D.S. Moore, Handbook of Spectroscopy, Wiley publications, 2nd edition, 2014.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/102106070>
2. <https://nptel.ac.in/courses/104105120>
3. <https://archive.nptel.ac.in/courses/104/101/104101135/>
4. <https://www.youtube.com/watch?v=CcQfJXIAlbw>
5. <https://archive.nptel.ac.in/courses/104/101/104101135/>

WEB RESOURCES:

1. <https://nptel.ac.in/courses/103108100>
2. <https://archive.nptel.ac.in/courses/103/108/103108100/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS203001	MODERN METHODS OF ORGANIC SYNTHESIS	2	-	-	4	3
Pre-Requisite	Organic Reaction Mechanism					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course will cover advanced topics in organic synthesis, focusing on specific reagents, methodologies, and reactions. Students will gain an in-depth understanding of the mechanisms, strategies, and applications of modern synthetic tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** To apply the advanced synthetic methods.
- CO2.** To design and analyze synthetic strategies to critically evaluate different synthetic approaches for a given target molecule.
- CO3.** To explain the theoretical basis of reactions for deep understanding of the theoretical concepts.
- CO4.** To interpret and evaluate scientific literature by reading and understanding the research articles related to organic synthesis.
- CO5.** To develop communication and research skills.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	-	-	-	-	-	-	2	-	-	2
CO3	3	-	-	-	-	-	-	-	2	-	-	2
CO4	3	-	-	3	-	-	-	-	2	-	-	2
CO5	3	-	-	3	-	-	-	-	2	-	-	2
Course Correlation Mapping	3	-	-	3	-	-	-	-	2	-	-	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: ENAMINES

(06 Periods)

Methods of preparation of enamines: condensation of secondary amine and aldehyde or ketone, reaction between alkynes and secondary amines. Comparison of reactivity of enamines and enolates. Synthetic reactions of enamines including asymmetric reactions of chiral enamines derived from chiral secondary amines.

Module 2: METALS IN ORGANIC SYNTHESIS

(06 Periods)

Mercury compounds: oxymercuration and demercuration of alkenes, mechanism and regiochemistry, solvo mercuration, mercuration of aromatics and transformation of aryl mercurials to aryl halides.

Organotin compounds: preparation of alkenyl and allyl tin compounds and their applications in C-C bond formation.

Module 3: NONMETALS AND METALLOIDS

(06 Periods)

Organ boron compounds-Suzuki coupling reaction and its applications.

Selenium in organic synthesis: Preparation of selenols/selenoxide, selenoxide elimination to create unsaturation, selenoxide and seleno acetals as α - C-H activating groups.

Module 4: SUPRAMOLECULAR CHEMISTRY

(06 Periods)

Principles of molecular associations and organizations as exemplified in biological macromolecules like nucleic acids, proteins and enzymes.

Synthetic molecular receptors: receptors with molecular cleft, molecular tweezers, receptors with multiple hydrogen sites.

Molecular recognition and catalysis, molecular self-assembly.

Module 5: NEWER METHODS IN ORGANIC SYNTHESIS

(06 Periods)

Basic principles and applications of the following in organic synthesis: Crown ethers, cryptands, micelles, cyclodextrins, clay and zeolites and phase transfer catalysts.

Introduction to polymer supported reagents and organocatalysts.

Barton-Kellogg olefination, Bestmann-Ohira Reagent, Bamford-Stevens Reaction.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Literature review and presentation on a recent enamine-based synthesis.
2. Group discussion on the environmental and safety considerations of using mercury and organotin compounds.
3. Literature review and presentation on a recent application of boron or selenium in organic synthesis.
4. Literature review and presentation on the potential applications of supramolecular chemistry in drug delivery or sensing.
5. Case study on the design and optimization of a multi-step synthesis using new methods.

RESOURCES

TEXT BOOKS:

1. M. Smith and J. Davies, *Organic Synthesis: Strategy and Control*, Oxford University Press, 2003
2. W. Carruthers and I. Coldham, *Modern Organic Synthesis: An Introduction*, Springer, 2017
3. J. March, *Advanced Organic Chemistry: Part A: Structure and Mechanisms*, John Wiley and Sons, 2007

REFERENCE BOOKS:

1. S.A. Godrej and D.C. Rees, *Enamines: Synthesis, Structure and Reactions*, Pergamon Press, 1988
2. A. Laguna, *The Organometallic Chemistry of Mercury*, Academic Press, 2000.
3. P. Renaud and F. Chevallier, *Boron Reagents in Organic Synthesis: Applications in Medicine and Chemical Biology*, Wiley-VCH, 2014
4. N. Bandini and A. Togni, *Selenium in Organic Synthesis*, Wiley-VCH, 2013
5. J.M. Lehn, *Supramolecular Chemistry: From Molecules to Nanomaterials*, Wiley-VCH, 1995
6. G.W. Gokel, *Crown Ethers and Cryptands*, Royal Society of Chemistry, 1991
7. P. Hodge, *Supported Reagents in Organic Synthesis*, Springer, 1999
8. L. Benjamin, *Modern Organocatalysis: From Theory to Applications*, Wiley-VCH, 2011.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=_0C7XXWjOpQ
2. <https://www.youtube.com/watch?v=IRGYkv44QFg>
3. https://www.soc.chim.it/sites/default/files/ths/24/chapter_14.pdf
4. <https://www.youtube.com/watch?v=mdwUnjipR28>

WEB RESOURCES:

1. <https://www.vanderbilt.edu/AnS/Chemistry/Rizzo/Chem220b/Enamines.pdf>
2. https://ccsuniversity.ac.in/ccsu/syllabus_camp/322syl.pdf
3. [sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/supramolecular-chemistry](https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/supramolecular-chemistry)
4. [http://www.rajsichemistrypoint.com/PDF/\[W.Carruthers,IainColdham\]Modern_Methods_of_Organic_Chemistry.pdf](http://www.rajsichemistrypoint.com/PDF/[W.Carruthers,IainColdham]Modern_Methods_of_Organic_Chemistry.pdf)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201029	INSTRUMENTAL METHODS OF ANALYSIS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a comprehensive overview of instrumental methods employed in organic chemistry to analyse organic compounds qualitatively and quantitatively. Topics include theoretical principles, instrumentation, experimental techniques, data analysis, and practical applications of each method.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the fundamental principles of different instrumental methods of analysis.
- CO2.** Gain practical experience with the operation and troubleshooting of various instruments.
- CO3.** Develop skills in data acquisition, analysis, and interpretation.
- CO4.** Apply analytical techniques to identify, characterize, and quantify organic compounds.
- CO5.** Evaluate the strengths and limitations of different instrumental methods for specific applications

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	-	2	-	-	-	-	2	-	-	2
CO3	3	-	-	3	-	-	-	-	2	-	-	2
CO4	3	-	-	3	-	-	-	-	2	-	-	2
CO5	3	-	-	3	-	-	-	-	2	-	-	2
Course Correlation Mapping	3	-	-	3	-	-	-	-	2	-	-	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO INSTRUMENTAL ANALYSIS (08 Periods)

Overview of different instrumental methods of analysis, Classification of instrumental methods based on physical and chemical principles, Sample preparation techniques for organic analysis, Quality control and error analysis in instrumental methods.

Module 2: SPECTROSCOPIC TECHNIQUES (10 Periods)

UV-Vis Spectroscopy: Principles, instrumentation, applications in functional group analysis, quantitative analysis.

Infrared (IR) Spectroscopy: Theory, instrumentation, functional group identification, structural analysis.

Nuclear Magnetic Resonance (NMR) Spectroscopy: Principles, instrumentation, $^1\text{H-NMR}$, $^{13}\text{C-NMR}$, advanced techniques, structural elucidation.

Mass Spectrometry (MS): Principles, ionization methods, instrumentation, mass spectra interpretation, structural analysis, quantitative analysis.

Module 3: CHROMATOGRAPHIC TECHNIQUES (10 Periods)

High-Performance Liquid Chromatography (HPLC): Theory, instrumentation, different modes of chromatography (normal phase, reverse phase), separation mechanisms, applications in organic analysis.

Gas Chromatography (GC): Principles, instrumentation, column selection, capillary GC, headspace analysis, qualitative and quantitative analysis.

Module 4: OTHER ANALYTICAL TECHNIQUES (10 Periods)

X-ray Crystallography: Basic principles, structure determination by diffraction methods.

Electrochemical Methods: Cyclic voltammetry, polarography, applications in oxidation-reduction studies.

Thermal Analysis: Thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), differential thermal analysis (DTA), applications in thermal stability studies.

Module 5: HYPHENATED TECHNIQUES AND ADVANCED TOPICS (07 Periods)

Hyphenated Techniques: LC-MS, GC-MS, NMR-MS, their combined power for structural analysis.

Multivariate Analysis: Chemometrics, principal component analysis (PCA), pattern recognition.

Emerging Analytical Techniques: Microfluidics, lab-on-a-chip devices, biosensors.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design an experiment to compare the sensitivity of UV-Vis and IR spectroscopy for detecting different functional groups in organic compounds.
2. Plan and carry out an experiment to identify an unknown organic compound using UV-Vis, IR, and NMR spectroscopy.
3. Compare and contrast the advantages and limitations of different mass spectrometry ionization techniques for analyzing specific types of organic compounds.
4. Troubleshoot a common problem encountered in GC analysis, such as peak tailing or ghost peaks, and propose solutions.
5. Research and present on a recent advancement in analytical techniques and its potential applications in organic chemistry research.
6. Plan and interpret a hyphenated technique experiment, such as LC-MS or GC-MS, to analyze a complex biological sample.

7. Apply chemometrics techniques, such as principal component analysis, to analyze and classify a dataset of spectroscopic data from different organic compounds.
8. Research and present on the potential future directions and challenges in the field of instrumental analysis for organic chemistry.

RESOURCES

TEXT BOOKS:

1. R.M. Silverstein, F.X. Webster, D.J. Kiemle, Spectrometric Identification of Organic Compounds, John Wiley and Sons, 8th edition, 2014.
2. W. Kemp, Organic Spectroscopy, Macmillan, 4th edition, 2008.
3. J.M. Harris, NMR Spectroscopy and Related Techniques, Oxford University Press, 2007.
4. F.G. Foster, Chemical Applications of Mass Spectrometry: Organic Mass Spectrometry, Wiley, 2003.
5. D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, Cengage Learning, 9th edition, 2014.

REFERENCE BOOKS:

1. J.H. Noggle, R.E. Schirmer, Understanding NMR Spectroscopy, John Wiley and Sons, 4th edition, 2017.
2. J.B. Pendley, Mass Spectrometry: Principles and Applications, John Wiley and Sons, 2004.
3. C.S. Hawkes, High-Performance Liquid Chromatography: Applications in Analytical Chemistry, John Wiley and Sons, 1992.
4. G.K. Kronick, J. I. Shafer, Modern Size-Exclusion Chromatography: Theory and Practice of Gel Permeation Chromatography, American Chemical Society, 1980.
5. A. Mitra, Hyphenated Techniques in Modern Chemical Analysis, John Wiley and Sons, 2003.
6. S.D. Haaland, Chemometrics: Multivariate Data Analysis in Analytical Chemistry, Elsevier, 2nd edition, 2010.

VIDEO LECTURES:

1. <https://youtu.be/vSmH1oenW6I>
2. <https://youtu.be/uuAjA9UbA7Y>
3. https://youtu.be/g_u1tR0cZHE
4. <https://youtu.be/oKkW7NCRzx8>
5. <https://youtu.be/SzVxYTp3pZY>

WEB RESOURCES:

1. <https://www.khanacademy.org/science/organic-chemistry/spectroscopy-jay>
2. https://ocw.mit.edu/courses/5-310-laboratory-chemistry-fall-2019/video_galleries/video-lectures/
3. <https://www.khanacademy.org/science/organic-chemistry/spectroscopy-jay/proton-nmr/v/introduction-to-proton-nmr>
4. <https://www.chemguide.co.uk/analysismenu.html>
5. <https://www.acs.org/education/students/highschool/chemistryclubs/virtual-chemistry.html>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201030	GROUP THEORY AND MOLECULAR SPECTROSCOPY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on fundamentals and applications of group theory. Also, discusses on fundamentals of molecular, rotational spectroscopy and electronic spectra of molecules.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Remember the concepts of symmetry and symmetry operations in molecules.
- CO2.** Explore the applications of group theory in molecular spectroscopy.
- CO3.** Understand the fundamentals of molecular spectroscopy.
- CO4.** Understand the practical implementation of quantum chemistry in spectroscopy.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	-	-	-	-	-	-	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: FUNDAMENTALS OF GROUP THEORY (09 Periods)

Symmetry elements and symmetry operations, point groups, group multiplication table (C₂V and C₃V), reducible and irreducible representations - Direct product representation. Orthogonality theorem and its consequences – construction of Character Table (H₂O and NH₃).

Module 2: APPLICATIONS OF GROUP THEORY (10 Periods)

Orthogonality theorem and its consequences - construction of character table for linear (CO₂, HCl, N₂) and non- linear molecules (H₂O, CH₄, XeF₄, BF₃, SF₆ and NH₃). Determination of representations of vibrational modes in linear and non-linear molecules. Symmetry adapted linear combinations, symmetry aspects of MO theory, sigma- and pi-bonding in AB₄ (tetrahedral) molecule. Symmetry selection rules of infra-red and Raman spectra - application of group theory for the electronic spectra of ethylene and formaldehyde.

Module 3: FUNDAMENTALS OF MOLECULAR SPECTROSCOPY (09 Periods)

The basis of absorption and emission of radiation by molecular species, the wave properties of the light, the quantum theory of light, quantum theory of matter, molecular energies and the Born Oppenheimer approximation, the types of molecular motion and spectroscopy associated with each.

Module 4: ROTATIONAL SPECTROSCOPY (09 Periods)

Classical description of molecular rotation, quantum mechanics of molecular motion, rotational spectra, determination of the bond length from rotational constants, vibrational stretching and vibrational satellites, no-rigid rotor, centrifugal distortion, degeneracies and intensities, Stark effect, selection rules, rotational spectra of polyatomic molecules.

Module 5: ELECTRONIC SPECTRA OF MOLECULES (08 Periods)

The Born-Oppenheimer Approximation, Vibrational Coarse structure: Progressions, Intensity of vibrational-Electronic spectra: Franck-Condon Principle, Dissociation Energy, Dissociation Products and Predissociation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a document on the applications of orthogonality theorem.
2. Discuss how group theory and molecular spectroscopy to solve real world problems.
3. Discuss on practical implementation of quantum chemistry in spectroscopy.
4. Prepare a PPT on applications of IR spectroscopy.
5. Discuss how Woodward-Fischer rules is useful in the organic synthesis.

RESOURCES

TEXT BOOKS:

1. F.A. Cotton, Chemical Applications of Group Theory, Wiley India, 3rd edition, 2009.
2. P.W. Atkins, Physical Chemistry, Oxford University Press, United Kingdom, International 11th edition, 2018.
3. J. Keeler, Understanding NMR Spectroscopy, Wiley, 2nd edition, 2013.
4. C.N Banwell, E.M. McCash, Fundamentals of Molecular Spectroscopy, Tata McGraw-Hill Publishing Co. Ltd., 5th edition, 2013.

REFERENCE BOOKS:

1. P.K. Bhattacharya, Group theory and its applications, Himalaya Publishing House, 3rd edition, 2007.
2. F. Hammer, Inorganic Spectroscopy and Related Topics, Sarup and Sons, 1st edition, 2008.
3. P.S. Kalsi, Spectroscopy of Organic Compounds, New Age International Publishers, 6th edition, 2006.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_cy40/preview.
2. https://onlinecourses.nptel.ac.in/noc24_cy24/preview
3. https://onlinecourses.nptel.ac.in/noc21_cy13/preview

WEB RESOURCES:

1. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Group_Theory/Group_Theory_and_its_Application_to_Chemistry](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Group_Theory/Group_Theory_and_its_Application_to_Chemistry).
2. <https://libguides.lib.rochester.edu/CHEM415>.
3. [https://chem.libretexts.org/Courses/Douglas_College/DC%3A_Chem_2330_\(O%27Connor\)/2%3A_Symmetry_and_Spectroscopy/2.1%3A_Group_Theory%3A_Theory](https://chem.libretexts.org/Courses/Douglas_College/DC%3A_Chem_2330_(O%27Connor)/2%3A_Symmetry_and_Spectroscopy/2.1%3A_Group_Theory%3A_Theory)
4. <https://www.coursera.org/learn/spectroscopy>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201031	MEDICINAL CHEMISTRY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on fundamentals and significance of green chemistry, principles of green chemistry and its applications and also the role of chemistry in sustainable development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Getting an idea on drug action and mechanism
- CO2.** Know the action of analgesics, antipyretics and anti-inflammatory drugs
- CO3.** Familiar with various drugs and their chemistry used in malarial, diabetic, tuberculosis treatment

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	-	-	1	3	-	-
CO2	3	1	-	-	-	1	-	-	1	3	-	-
CO3	3	1	-	-	-	1	-	-	1	3	1	-
Course Correlation Mapping	3	1	-	-	-	1	-	-	1	3	1	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: DRUGS AND ANTIBIOTICS (10 Periods)

Drugs: Definition, Theories of Drug-receptor interaction, drug synergism and antagonism, Drug resistance, physicochemical factors influencing drug action.

Antibiotics: Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicillins and tetracyclines, Synthesis and clinical application of penicillins, cephalosporin, tetracyclines, Current trends in antibiotic therapy.

Module 2: ANALGESICS, ANTIPYRETICS AND ANTI-INFLAMMATORY DRUGS (08 Periods)

Introduction, Classification, mechanism of action of drugs, preparation, properties and side effects of Sodium salicylate, Aspirin, Diclofenac, Antipyrine, Ibuprofen, Naproxen, Paracetamol, Meperidine

Module 3: DRUGS FOR MALARIA**(09 Periods)**

Classification, mechanism of action of drugs employed for the treatment of malaria. Current treatment strategy for malaria, Antimalarial drugs in use, Synthesis properties and side effects of Chloroquine, Amodiaquine, Quinine.

Module 4: ANTIDIABETIC DRUGS**(09 Periods)**

Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, SAR, Mechanism of action, Study the treatment strategy of diabetic mellitus. Chemistry of insulin, sulfonyl ureas.

Module 5: DRUGS FOR TUBERCULOSIS**(09 Periods)**

Classification, tuberculosis drugs and mechanism of action of drugs employed for the treatment of Tuberculosis, Current treatment strategy for tuberculosis. Synthesis of tuberculosis drugs.

Total Periods: 45**EXPERIENTIAL LEARNING**

1. Prepare a document on the role of pharmaceutical industry on human health
2. Design the synthesis of malaria drug amodiaquine under green protocol
3. Discuss the drug discovery and drug designs
4. Outline how the COVID vaccine works chemically
5. The role of chemistry in the production of vaccines
6. Submit a document on Chemistry in Coronavirus Research
7. How was the COVID-19 vaccine developed so fast?
8. Prepare a document on Narcotics and the consequence on their use.

RESOURCES**TEXT BOOKS:**

1. J.M. Beale and J.H. Block, Textbook of organic medicinal and pharmaceutical chemistry, Lippincott Williams & Wilkins, New York, 12th edition, 2011.
2. G.L. Patrick, An Introduction to Medicinal Chemistry, Oxford University Press, New York, 5th edition, 2013.

REFERENCE BOOKS:

1. L. Williams, Foye's Principles of Medicinal Chemistry, New York, 7th edition, 2012.
2. D.J. Abraham, D.P. Rotella, A. Burger, Burger's Medicinal Chemistry, Drug Discovery and Development, Wiley publishers, New York, 6th edition, 2010.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/127/106/127106137/>
2. <https://archive.nptel.ac.in/courses/109/106/109106198/>

WEB RESOURCES:

1. <https://my.clevelandclinic.org/health/drugs/16386-antibiotics>
2. <https://www.sciencedirect.com/topics/medicine-and-dentistry/antipyretic-analgesic-agent>
3. <https://www.ncbi.nlm.nih.gov/books/NBK310759/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS201032	QUALITY CONTROL AND QUALITY ASSURANCE IN PHARMA INDUSTRY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on basics of quality audit, various documentation and handling process, organizational and personal responsibilities in pharma sector, basic knowledge about regulatory aspects, quality control and basic concepts of quality assurance.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Gain the knowledge about quality audit and understand the various documentation processes and handling of materials.
- CO2.** Understand the organizational responsibilities and personal responsibilities in the pharma sector.
- CO3.** Acquire basic knowledge about the regulatory aspects and quality control.
- CO4.** Gain knowledge about the basic concepts of Quality Assurance.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	-	-	2	-	1	1
CO2	3	-	1	-	-	-	-	-	2	-	1	1
CO3	3	-	1	-	-	2	-	-	2	-	1	1
CO4	3	-	1	-	-	-	-	-	2	-	1	1
Course Correlation Mapping	3	-	1	-	-	2	-	-	2	-	1	1

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: BASIC CONCEPTS OF PHARMACEUTICALS (09 Periods)

Pharmaceuticals Concept of drug, lead compound and lead modification, prodrugs and soft drugs. Importance of quality control, drugs and pharmaceuticals, sources of impurities in pharmaceutical chemicals, analytical quality control in finished/final products, common methods of assay.

Module 2: QUALITY AUDIT AND DOCUMENTATION (09 Periods)

Quality Audit, Documentation Quality audit. Standard operating procedure (SOP); international conference harmonization (ICH); ISO-9000; ISO-14000, WHO specifications, USFDA guidelines and ICMR. Documentation and Handling: Manufacturing documents, Master Formula, batch formula, Record, Distribution of records, Handling of returned goods, Recovered materials and Reprocessing.

Module 3: ORGANIZATIONAL AND PERSONAL RESPONSIBILITIES (09 Periods)

Organization and Personnel Responsibilities Training, Hygiene, Premises: Location, Design, Plant layout, Construction, Maintenance and Sanitations. Environmental control, sterile areas, control of contamination.

Module 4: REGULATORY PROCEDURES (09 Periods)

Regulatory Aspects and Quality Control Regulatory aspects. Validation of Personnel, Equipment and cleaning methods, regulatory aspects of pharmaceutics. Quality Control. In-process quality Control on various dosage forms, Sterile and non-sterile operations.

Module 5: BASIC CONCEPTS OF QUALITY ASSURANCE (09 Periods)

Basic concepts of Quality Assurance Basic concepts, principles or prescription, Needs, requirements and expectations, characteristics of quality, Achieving, sustaining and improving quality, Quality dimensions and costs of quality. Elements of quality Assurance, Quality Management System, Quality management concepts and principles: ISO 9001:2000, QMS Case studies on ISO 9001: 2000 in chemical industries.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Is quality control and assurance is important? Justify by preparing a document.
2. Prepare a document on the principles of quality management.
3. Give presentation on various quality assurance and quality control processes.
4. Prepare a document on the importance of quality control and assurance.
5. Give presentation on benefits of quality assurance and quality control.

RESOURCES

TEXT BOOKS:

1. D. Hoyle, ISO 9000 Quality Systems Handbook, 5th Ed., Butterworth Heinemann-Elsevier, New York, 2006.
2. M. Savaš, Quality Assurance and Management, InTech-Croatia, 2012, ISBN 978-953-51-0378- 3.

REFERENCE BOOKS:

1. R. Panner Selvam, Production and Operations Management, Prentice Hall India Learning Pvt. Ltd 3rd Ed., 2012.
2. D.C. Montgomery, Statistical Quality Control, John Wiley & Sons, 5th Ed., 2005.
3. E. Prichard, V. Barwick, Quality Assurance in Analytical Chemistry, John Wiley & Sons, 2007.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/110/101/110101150/>
2. <https://nptel.ac.in/courses/116102019>
3. <https://archive.nptel.ac.in/courses/110/104/110104080/>

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_mg18/preview
2. <https://link.springer.com/book/10.1007/978-981-99-9271-3>
3. https://link.springer.com/chapter/10.1007/978-981-99-9271-3_1

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25AI201701	BUSINESS ANALYTICS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course emphasizes on the basic concepts of Business Analytics. It covers the basic excel skills, Excel look up functions for database queries in business analytics. By the end of this course students will acquire basic knowledge to implement statistical methods for performing descriptive, predictive and prescriptive analytics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the basic concepts and models of Business Analytics
- CO2.** Select Suitable basic excel function to perform analytics on spread sheets.
- CO3.** Apply different statistical techniques and distributions for modeling the data
- CO4.** Develop user-friendly Excel applications by using statistical models for effectiveness decision making.
- CO5.** Analyze the performance of different optimization models used in prescriptive analytics on Binary and Categorical data.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	2	-	-	3	-	-	-	-
CO4	1	1	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	2	2	-	-	3	-	-	-	3

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: FOUNDATIONS OF BUSINESS ANALYTICS (09 Periods)

Introduction, what is Business Analytics, Evolution of Business Analytics, Scope of Business Analytics, Data for Business Analytics, Applications of Business Analytics, Models in Business Analytics, Problem Solving with Analytics.

Module 2: ANALYTICS ON SPREADSHEETS (09 Periods)

Basic Excel Skills, Excel Functions, Using Excel Lookup Functions for Database Queries, Spreadsheet Add-Ins for Business Analytics.

Visualizing and Exploring Data: Data Visualization, Creating Charts In Microsoft Excel, Other Excel Data Visualization, Statistical Methods for Summarizing Data, Exploring Data Using Pivot tables.

Module 3: DATA MODELING (09 Periods)

Basic concepts of Probability, Random Variables and Probability Distributions, Continuous Probability Distributions.

Statistical Sampling, Estimation population parameters, Sampling Error, Sampling Distributions, Hypothesis Testing, ANOVA, Chi Square Test.

Module 4: PREDICTIVE ANALYTICS (09 Periods)

Trend lines And Regression Analysis, Modeling Relationships and Trends in Data, Simple Linear Regression, Multiple Linear Regression, Building Good Regression Models,

Strategies for predictive decision modeling, implementing models on spreadsheets, spreadsheet applications in business analytics, developing user-friendly excel applications, analysing uncertainty and model assumptions, model analysis using analytic solver platform

Module 5: PRESCRIPTIVE ANALYTICS (09 Periods)

Linear Models: Building Linear Models, Implementing Linear Optimization Models On Spreadsheets, Graphical Interpretation of Linear Optimization, Linear Optimization Models for prediction and Insight.

Integer Models: Solving models with Integer Variables, Integer Optimization Models with Binary Numbers

Decision Analysis: Formulating Decision Problems, Decision Strategies Without Outcome Probabilities, Decision Trees with Outcome Probabilities, Decision Trees.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Diabetic Prediction:

The National Institute of Diabetes and Digestive and Kidney Diseases has a created a dataset. The objective of the dataset is to diagnostically predict whether or not a patient has diabetes, based on certain diagnostic measurements included in the dataset. Several constraints were placed on the selection of these instances from a larger database. In particular, all patients here are females at least 21 years old of Pima Indian heritage. The datasets consist of several medical predictor variables and one target variable, Outcome. Predictor variables include the number of pregnancies the patient has had, their BMI, insulin level, age, and so on. Build a machine learning model to accurately predict whether or not the patients in the dataset have diabetes or not?

2. Solve the house price prediction problem using Linear regression analysis method.

Optimize the parameters of the regression function using gradient descent method.

3. Visualize the decision tree built for solving heart disease prediction problem and measure the impurity of nodes created via Decision Tree Analysis.
Dataset: <https://www.kaggle.com/arviinndn/heart-disease-prediction-uci> dataset/data

4. The data set baby boom (Using R) contains data on the births of 44 children in a one-day period at a Brisbane, Australia, hospital. Compute the skew of the wt variable, which records birth weight. Is this variable reasonably symmetric or skewed?

5. Visualize the Distribution of data with different feature scaling methods on online news popularity dataset for article word count.
Dataset: <https://www.kaggle.com/datasets/deepakshende/onlinenewspopularity>

6. Human Activity Recognition System:
The human activity recognition system is a classifier model that can identify human fitness activities. To develop this system, you have to use a smart phone dataset, which contains the fitness activity of 30 people which is captured through smart phones. This system will help you to understand the solving procedure of the **multi-classification problem**.

RESOURCES

TEXT BOOKS:

1. James Evans, Business Analytics, Pearson Education, 2nd Edition, 2017.

REFERENCE BOOKS:

1. Marc J. Schniederjans, Business Analytics, Pearson Education, 2015
2. Camm, Cochran, Essentials of Business Analytics, Cengage learning, 2015

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/110105089>
2. <https://archive.nptel.ac.in/courses/110/107/110107092/>
3. <https://nptel.ac.in/courses/110106050>

WEB RESOURCES:

1. <https://www.proschoolonline.com/certification-business-analytics-course/what-is-ba>
2. https://michael.hahsler.net/SMU/EMIS3309/slides/Evans_Analytics2e_ppt_01.pdf
3. <https://www.guru99.com/business-analyst-tutorial-course.html>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25AI201702	ETHICS FOR AI	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION:

Recognize the fundamental ideas and standards of AI ethics. Recognizing fairness and prejudice in artificial intelligence. Obstacles to obtaining explainability and openness. Frameworks based on ethics and the law that designate accountability. Privacy and security concerns related to AI ethics. Ethics in AI in the future.

COURSE OUTCOMES: At the end of the course, student will be able to:

- CO1.** Understand the basic concepts of AI Ethics and ethical principles.
- CO2.** Understanding the concept of bias and fairness in AI.
- CO3.** Challenges in achieving the transparency and explainability.
- CO4.** Legal and ethical frameworks for assigning responsibility.
- CO5.** Security and privacy issues of AI Ethics. Future of AI ethics.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-
CO4	2	3	3	-	-	-	-	-	-
CO5	-	-	-	3	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	-	-	-	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO AI ETHICS (09 Periods)

Overview of ethical issues in AI. Historical context and key concepts. Importance of ethical considerations in AI development and deployment.

Ethical Principles and Frameworks:

Utilitarianism, deontology, virtue ethics, and other ethical theories. Ethical principles for AI, such as fairness, transparency, accountability, and privacy.

Module 2: BIAS AND FAIRNESS IN AI (09 Periods)

Understanding bias in AI systems. Types of bias (e.g., algorithmic bias, dataset bias). Approaches to detecting and mitigating bias. Fairness metrics and fairness-aware machine learning algorithms.

Module 3: TRANSPARENCY AND EXPLAINABILITY (09 Periods)

Importance of transparency and explainability in AI. Techniques for explaining AI decisions. Challenges and trade-offs in achieving transparency and explainability. Regulatory requirements and guidelines for transparent AI systems.

Module 4: ACCOUNTABILITY AND RESPONSIBILITY (09 Periods)

Holding AI developers, users, and organizations accountable for AI systems' actions. Legal and ethical frameworks for assigning responsibility. Challenges in attributing responsibility in complex AI systems.

Module 5: PRIVACY AND DATA PROTECTION (09 Periods)

Privacy issues in AI, including data collection, storage, and sharing. Privacy-preserving AI techniques. Regulatory frameworks (e.g., GDPR) and ethical guidelines for data protection in AI. Ethical considerations in emerging AI technologies.

Total Periods: 45

EXPERIENTIAL LEARNING

Case -1: Emergence of Bias and Fairness Interventions

For the problem of Loan Approval and Hiring by AI, specify the steps and practices to the entry of bias and fairness improvement interventions.

Case-2: AI governance with critical thinking, negotiation skills, and a multi-stakeholder perspective

Undertake the study from ethical perspective for the problem of Public response system, Policy making and Contract negotiation.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Müller, Vincent C., Ethics of Artificial Intelligence and Robotics. The Stanford Encyclopedia of Philosophy, 2021.
2. Meredith Broussard, Artificial Unintelligence: How Computers Misunderstand the World, Cambridge, MA: MIT Press, 2018.

REFERENCE BOOKS:

1. Brett Frischmann and Evan Selinger, Re-Engineering Humanity, Cambridge University Press, Cambridge, 2018.
2. Cathy O'Neil, Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy, Crown Publishers, 2016.
3. Shoshana Zuboff, The Age of Surveillance Capitalism, Financial Times, 2020.

VIDEO LECTURES:

1. <https://rainermuehlhoff.de/en/EoAI2025/>
2. https://www.youtube.com/watch?v=qpp1G0iEL_c
3. <https://rainermuehlhoff.de/en/EoAI2025/>

WEB RESOURCES:

1. <https://www.ibm.com/topics/ai-ethics>
2. <https://www.coursera.org/articles/ai-ethics>
3. <https://ai.google/responsibility/principles/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CM201701	COST MANAGEMENT OF ENGINEERING PROJECTS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course will provide an understanding of the cost tools and techniques that can be used throughout a project's design and development. The students will be exposed to the methods, processes, and tools needed to conduct economic analysis, estimation of Project.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the costing concepts and their role in decision-making.
- CO2.** Understand the project management concepts and their various aspects in selection.
- CO3.** Interpret costing concepts with project execution.
- CO4.** Knowledge of costing techniques in the service sector and various budgetary control techniques.
- CO5.** Become familiar with quantitative techniques in cost management.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	-	-	-	-	2	-	-	-
CO2	2	-	-	-	-	2	-	-	-
CO3	2	-	-	-	-	2	-	-	-
CO4	2	-	-	-	-	2	-	-	-
CO5	2	-	-	-	-	2	-	-	-
Course Correlation Mapping	2	-	-	-	-	2	-	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO COSTING CONCEPTS (05 Periods)

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost, and Opportunity cost; Creation of a Database for operational control.

Module 2: INTRODUCTION TO PROJECT MANAGEMENT (10 Periods)

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre-project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts

Module 3: PROJECT EXECUTION AND COSTING CONCEPTS (10 Periods)

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

Module 4: COSTING OF SERVICE SECTOR AND BUDGETARY CONTROL (10 Periods)

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets

Module 5: QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT (10 Periods)

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a mini-project report regarding cost control techniques in manufacturing units.
2. Prepare a report on real-life engineering project case studies, especially those that faced cost overruns or successfully managed costs
3. Conduct hands-on budgeting exercises where participants are given a project scope, and they have to create detailed budgets.

RESOURCES

TEXT BOOKS:

1. John M. Nicholas, Herman Steyn Project Management for Engineering, Business and Technology, Taylor & Francis, 2 August 2020, ISBN: 9781000092561
2. Albert Lester, Project Management, Planning and Control, Elsevier/Butterworth-Heinemann, 2007, ISBN: 9780750669566, 075066956X.

REFERENCE BOOKS:

1. Charles T. Horngren et al Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011.
2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991.
3. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=rck3MnC7OXA>
2. <https://www.youtube.com/watch?v=QWD1LMzStI4>

WEB RESOURCES:

1. <https://www.superfastcpa.com/what-are-cost-concepts-in-decision-making>
2. <https://www.indeed.com/career-advice/career-development/project-cost-controls>
3. <https://www.geeksforgeeks.org/difference-between-pert-and-cpm/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201701	DISASTER MANAGEMENT	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on disaster prone areas in India, repercussions of disasters and hazards, disaster preparedness and management, risk assessment and disaster management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.
- CO2.** Analyze the causes and impacts of disasters using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.
- CO3.** Suggest the preparedness measures using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.
- CO4.** Analyze the Risk Assessment using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.
- CO5.** Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	-	-	-	-	-	2	-	-	-
CO2	-	-	-	-	-	2	-	-	-
CO3	-	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	2	-	-	-
CO5	-	-	-	-	-	2	-	-	-
Course Correlation Mapping	-	-	-	-	-	2	-	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: DISASTER PRONE AREAS IN INDIA

(09 Periods)

Introduction: Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. **Disaster Prone Areas:** Study Of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Module 2: REPERCUSSIONS OF DISASTERS AND HAZARDS

(09 Periods)

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Module 3: DISASTER PREPAREDNESS AND MANAGEMENT

(11 Periods)

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

Module 4: RISK ASSESSMENT

(08 Periods)

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Module 5: DISASTER MANAGEMENT

(08 Periods)

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost-benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Perform hazard assessment and vulnerability analysis for any nearby town/city and prepare a detailed report of possible impacts of various disasters on environment, infrastructure and development.
2. Prepare a detailed report on the causes and effects of Tsunami that was occurred in the year 2004. Also discuss various advancements in Tsunami warning systems.
3. Identify the major causes of urban floods in cities like Chennai, Hyderabad & Mumbai. Also list various mitigation strategies to reduce the impact of floods.
4. Prepare a detailed report on how various man-made activities are directly/indirectly related to the occurrence of landslides that occurred in recent days in India.
5. Visit AP State Disaster Response and Fire Services Department and record about various methods used by them in mitigating disasters and their management.

RESOURCES

TEXT BOOKS:

1. Sharma V. K., Disaster Management, Medtech Publishing, 2nd Edition, 2013.
2. Anand S. Arya, Anup Karanth, and Ankush Agarwal, Hazards, Disasters and Your Community: A Primer for Parliamentarians, GOI-UNDP Disaster Risk Management Programme, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, Natural Hazards and Disasters, Cengage Learning, USA, 5th Edition, 2015.
2. Disaster Management in India, A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. Rajendra Kumar Bhandari, Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers, Springer India, 2014.
4. Singh R. B., Natural Hazards and Disaster Management, Rawat Publications, 2009.
5. R. Nishith, Singh AK, Disaster Management in India: Perspectives, issues and strategies, New Royal book Company.
6. Sahni, Pardeep Et. Al. (Eds.), Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.
7. Goel S. L, Disaster Administration and Management Text and Case Studies, Deep &Deep Publication Pvt. Ltd., New Delhi

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/105104183>
2. <https://www.digimat.in/nptel/courses/video/124107010/L01.html>

WEB RESOURCES:

1. <https://egyankosh.ac.in/handle/123456789/25093>
2. <https://www.egyankosh.ac.in/handle/123456789/25912>
3. <https://www.nios.ac.in/media/documents/333courseE/12.pdf>
4. <https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS201701	VALUE EDUCATION	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with understanding the value of education and self-development, imbibe good values in students, and making them know about the importance of character.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the knowledge of values and self-development
- CO2.** Analyze the importance of the cultivation of values.
- CO3.** Learn suitable aspects of personality and behavioral development
- CO4.** Function as a member and leader in multi-disciplinary teams by avoiding faulty thinking.
- CO5.** Develop character and competence for effective studies.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	3	2	-	-
CO2	2	3	-	-	2	3	2	-	-
CO3	2	-	-	-	2	3	2	-	-
CO4	2	-	-	-	-	3	2	-	-
CO5	2	2	-	-	-	3	2	-	-
Course Correlation Mapping	2	3	-	-	2	3	2	-	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: VALUES AND SELF-DEVELOPMENT (09 Periods)

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements- Case studies

Module 2: IMPORTANCE OF CULTIVATION OF VALUES. (09 Periods)

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline- Case studies

Module 3: PERSONALITY AND BEHAVIOR DEVELOPMENT (09 Periods)

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness - Case studies

Module 4: AVOID FAULTY THINKING. (09 Periods)

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature - Case studies

Module 5: CHARACTER AND COMPETENCE (09 Periods)

Character and Competence –Holy books vs Blind faith. Self-management and good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and the same message. Mind your Mind, Self-control. Honesty, Studying effectively- Case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. Demonstrate orally using your experiences of what values are naturally acceptable in a relationship to nurture or exploit others.
2. Prepare a report by identifying and analyzing the importance of cultivation of values.
3. Present a poster on different attitudes and behaviours.
4. Students give a PowerPoint presentation on doing best for nature.
5. Students are encouraged to bring a daily newspaper to class or to access any news related to the need for human values and note down the points.
6. Prepare a case study on how to maintain harmony with different religious people through character and competence.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in the Course Handout)

RESOURCES

TEXTBOOKS:

1. R. Subramanian, Professional Ethics, Oxford Higher Education, 2013.
2. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw-Hill, 3rd Edition, 2007.
3. Chakravarthy, S.K.: Values and ethics for Organizations: Theory and Practice, Oxford University Press, New Delhi, 1999.

REFERENCE BOOKS:

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003
2. Awakening Indians to India, Chinmayananda Mission, 2003
3. Satchidananda, M.K.: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=90VQPZURN5c>
2. <https://www.youtube.com/watch?v=6ofPcK0uDaA>
3. https://www.youtube.com/watch?v=5_f-7zCi79A
4. <https://www.youtube.com/watch?v=2ve49BWAJRE>
5. <https://www.youtube.com/watch?v=kCOIfnxxQ5U>

WEB RESOURCES:

1. <https://www.livingvalues.net/>
2. <https://livingvalues.net/materials-for-schools/>
3. <https://www.edb.gov.hk/en/curriculum-development/4-key-tasks/moral-civic/index.html>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS201702	PEDAGOGY STUDIES	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with understanding pedagogical practices that are being used by teachers in formal and informal classrooms, the effectiveness of pedagogical practices, teacher education (curriculum and practicum), and the school curriculum and guidance materials that can best support effective pedagogy.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge of pedagogical methodology
- CO2.** Analyze the functional knowledge in Pedagogical practices, Curriculum, and Teacher Education
- CO3.** Learn effective pedagogical practices and apply strategies.
- CO4.** Function effectively as an individual and as a member of the Professional development.
- CO5.** Understand research Gaps and provide future Directions.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	-	-	-	-	-	3	
CO2	2	3	-	3	-	-	-	3	
CO3	2	2	-	3	-	-	-	3	
CO4	1	1	-	-	-	-	3	3	
CO5	-	-	-	-	-	-	-	3	
Course Correlation Mapping	2	2	-	3	-	-	3	3	

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION AND METHODOLOGY (09 Periods)

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of Methodology and Searching- Case studies

Module 2: THEMATIC OVERVIEW (09 Periods)

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher Education- Case studies

Module 3: EFFECTIVENESS OF PEDAGOGICAL PRACTICES (09 Periods)

Evidence on the effectiveness of pedagogical practices, Methodology for the in-depth stage: quality

Assessment of included studies, teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' Attitudes and beliefs and Pedagogic strategies- Case studies

Module 4: PROFESSIONAL DEVELOPMENT (09 Periods)

Alignment with classroom practices and follow-up support, Peer support, and Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes- Case studies

Module 5: RESEARCH GAPS AND FUTURE DIRECTIONS (09 Periods)

Research design, Contexts, Pedagogy, Teacher Education, Curriculum and Assessment, Dissemination and research impact- Case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the self-improvement in you after going through pedagogical methodologies.
2. Discuss different practices that you would like to adopt in the curriculum.
3. Describe in your own words how can you bring effectiveness to the curriculum.
4. Imagine you are a head teacher and illustrate different barriers to learning.
5. Assume you are a teacher and interpret different directions that you would bring for the assessment of the students.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in the Course Handout)

RESOURCES

TEXTBOOK:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, *Compare*, 31 (2): 245-261.
2. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.

REFERENCES:

1. Akyeampong K (2003) Teacher training in Ghana - does it count? *Multi-site teacher education* Agrawal M (2004) Curricular reform in schools: The importance of evaluation, *Journal of Curriculum Studies*, 36 (3): 361-379.Oxford and Boston: Blackwell.
2. Educational Development, 33 (3): 272–282.
3. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of Basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
4. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=WL40UeySag4>
2. <https://www.youtube.com/watch?v=MMXaXDIHFJ8>
3. <https://www.youtube.com/watch?v=7uJL1R6M4Iw>

WEB RESOURCES:

1. <https://acrl.ala.org/IS/instruction-tools-resources-2/pedagogy/a-selected-list-of-journals-on-teaching-learning/>
2. <https://guides.douglascollege.ca/TLonline/resourcesforonlinepedagogy>
3. https://www.refseek.com/directory/teacher_resources.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25LG201701	PERSONALITY DEVELOPMENT THROUGH ESSENTIAL LIFE SKILLS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course gives awareness to students about the various dynamics of personality development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge in Self-Management and Planning Career
- CO2.** Analyze the functional knowledge in attitudes and thinking strategies
- CO3.** Learn and apply soft skills for professional success.
- CO4.** Function effectively as an individual and as a member in diverse teams
- CO5.** Communicate effectively in public speaking in formal and informal situations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	2	-	-	3	-	-	-	-
CO4	1	1	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	2	2	3	-	3	-	-	-	3

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: SELF-ESTEEM & SELF-IMPROVEMENT	(09 Periods)
Concept of personality, significance of personality-Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve - Actively Working to Improve Yourself- SWOT Analysis- Exercises- case studies	
Module 2: DEVELOPING POSITIVE ATTITUDES	(09 Periods)
How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies- Positive attitude and its advantages, negative attitude and its disadvantages-case studies	
Module 3: SELF-MOTIVATION & SELF-MANAGEMENT	(09 Periods)
Concept of motivation, significance, factors leading to de-motivation- Show Initiative – Be Responsible - Self-Management; Efficient Work Habits – Stress Management – Employers Want People Who Can Think – Thinking Strategies- Exercises- case studies	
Module 4: GETTING ALONG WITH THE SUPERVISOR	(09 Periods)
Know your supervisor – Communicating with your Supervisor – Special Communication with Supervisor – What Should you Expect of Your Supervisor? – What your supervisor expects of you - Moving Ahead Getting Along with your Supervisor- Exercises- case studies	
Module 5: WORKPLACE SUCCESS	(09 Periods)
First Day on the Job – Keeping Your Job – Planning Your Career – Moving Ahead- Essential employability skills, professional attributes, and career development strategies -Exercises- Case studies.	

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the self-improvements in you on the charts and explain in detail.
2. Discuss different famous personalities and their attitudes.
3. Describe different personalities concerning self-motivation and self-management.
4. Imagine you are a supervisor and illustrate different special communications.
5. Assume and interpret different experiences on the first day of your job.

RESOURCES

TEXTBOOK:

- 1 Harold R. Wallace and L. Ann Masters, Personal Development for Life and Work, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)
- 2 Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.

REFERENCE BOOKS:

- 1 K. Alex, Soft Skills, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition, 2011.
- 2 Stephen P. Robbins and Timothy A. Judge, Organizational Behaviour, Prentice Hall, Delhi, 16th edition, 2014

VIDEO LECTURES:

- 1 <https://www.youtube.com/watch?v=6Y5VWBLi1es>
- 2 <https://www.youtube.com/watch?v=H9qA3inVMrA>

WEB RESOURCES:

- 1 <https://www.universalclass.com/.../the-process-of-perso>
- 2 <https://www.ncbi.nlm.nih.gov/pubmed/25545842>
- 3 <https://www.youtube.com/watch?v=Tuw8hxrbH8>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25ME201701	ENTREPRENEURSHIP AND INNOVATION MANAGEMENT	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course aims to provide students with a deep understanding of entrepreneurship and innovation. It explores entrepreneurial processes, opportunity identification, business planning, innovation management, intellectual property rights, and venture growth strategies. Students will develop entrepreneurial thinking, creativity, and problem-solving abilities to create and manage innovative ventures that contribute to economic and societal development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Explain the fundamentals of entrepreneurship and its role in economic development.
- CO2.** Analyze opportunities and prepare business plans for entrepreneurial ventures.
- CO3.** Apply creativity and innovation techniques to business problems.
- CO4.** Demonstrate knowledge of technology management, IPR, and startup ecosystem.
- CO5.** Evaluate financing options, marketing strategies, and growth models for ventures.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-
CO3	2	3	3	2	2	1	-	-	-
CO4	2	2	2	2	2	1	-	-	-
CO5	3	3	2	2	3	1	-	-	-
Course Correlation Mapping	3	3	2	2	2	1	-	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO ENTREPRENEURSHIP (09 Periods)

Concept, meaning and importance of entrepreneurship – Characteristics and skills of entrepreneurs – Types of entrepreneurs: social, women, corporate, rural, technology-based – Intrapreneurship vs. entrepreneurship – Entrepreneurial ecosystem and its components.

Module 2: ENTREPRENEURIAL PROCESS AND BUSINESS PLANNING (09 Periods)

Stages of entrepreneurial process: Idea, Feasibility, Startup, Growth – Opportunity identification and evaluation – Market research and environmental scanning – Structure and components of a business plan – Case studies of successful entrepreneurs.

Module 3: INNOVATION MANAGEMENT (09 Periods)

Meaning, scope and significance of innovation – Types of innovation: product, process, business model, disruptive, frugal – Creativity techniques: brainstorming, lateral thinking, design thinking, TRIZ – Managing innovation in organizations – Innovation as a competitive advantage.

Module 4: TECHNOLOGY, IPR AND STARTUP ECOSYSTEM (09 Periods)

Technology management and commercialization – Intellectual Property Rights (IPR): patents, copyrights, trademarks, designs, trade secrets – Technology transfer and licensing – Startup India, Atal Innovation Mission, MSME policies – Role of incubators, accelerators and innovation hubs.

Module 5: FINANCING AND GROWTH OF VENTURES (09 Periods)

Sources of finance: bootstrapping, angel investors, venture capital, crowdfunding, government support – Entrepreneurial marketing strategies – Financial planning for startups – Scaling up ventures: challenges and strategies – Exit strategies: mergers, acquisitions, IPO.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a mini-business plan for a startup idea.
2. Visit a nearby incubation/innovation center and prepare a report.
3. Conduct a creativity workshop (brainstorming/design thinking session).
4. Prepare a case study presentation on a successful entrepreneur/startup.

RESOURCES

TEXT BOOKS:

1. Hisrich, R.D., Peters, M.P., & Shepherd, D.A. (2017), Entrepreneurship, McGraw-Hill Education.
2. Drucker, P. (2007), Innovation and Entrepreneurship, Harper Business.
3. Kuratko, D.F. (2020), Entrepreneurship: Theory, Process and Practice, Cengage Learning.

REFERENCE BOOKS:

1. Timmons, J.A., & Spinelli, S. (2019), New Venture Creation: Entrepreneurship for the 21st Century, McGraw-Hill Education.
2. Schilling, M.A. (2020), Strategic Management of Technological Innovation, McGraw-Hill Education.
3. Scarborough, N.M. (2018), Essentials of Entrepreneurship and Small Business Management, Pearson.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=rA4uKIy5gO0&list=PLsh2FvSr3n7fQlIDbfKutmSL26TsWitGQ>
2. <https://www.youtube.com/watch?v=itRVzjk9mkg>

WEB RESOURCES:

1. https://nacosadsu.org.ng/main/docs/300L/ENT%20301.pdf?utm_source=chatgpt.com
2. https://www.measiim.edu.in/myweb/uploads/2022/05/PMFEA-IE-1.pdf?utm_source=chatgpt.com
3. https://ocw.mit.edu/courses/15-351-managing-innovation-and-entrepreneurship-spring-2008/pages/lecture-notes/?utm_source=chatgpt.com