MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102

MBU
MOHAN BABU
UNIVERSITY
DREAM. BELIEVE. ACHIEVE

SCHOOL OF LIBERAL ARTS AND SCIENCES

M.Sc. – Organic Chemistry

CURRICULUM AND SYLLABUS

(From 2022-23 Admitted Batches)

FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM (FFCBCS)

MOHAN BABU UNIVERSITY

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	
22BS201001	Environment and the Society	2	-	-	-	2	-
22BS206001	Basics of Computer for Chemist and Biologist	-	-	2	4	2	-
22BS201025	Nano Chemistry	3	-	-	-	3	-
22BS201021	Heterocyclic Chemistry	3	-	-	-	3	-
22EE201001	Research Methodology	3	-	-	-	3	-
22BS201101	Internship	-	-	-	-	2	-
22BS200801	Capstone Project	-	-	-	-	10	-
Mandatory Non-Credit Courses (Min. 4 Credits to be earned) Earned Credits will not be considered for CGPA							
22BS207602	Chemistry of Biomolecules	2	-	-	-	2	-
22BS207601	Ecology	2	-	-	-	2	-
22MG207607	Project Management	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	
22BS202013	Basics of Organic chemistry	3	-	3	-	4.5	-
22BS202014	Inorganic Chemistry-I	3	-	3	-	4.5	-
22BS202015	Physical Chemistry-I	3	-	3	-	4.5	-
22BS201019	Bioorganic Chemistry	3	-	-	-	3	-
22BS201028	Drug Design	3	-	-	-	3	
22BS202016	Organic Reaction Mechanism	3	-	3	-	4.5	Basics of Organic chemistry
22BS202020	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	
22BS202017	Inorganic Chemistry-II	3	-	3	-	4.5	Inorganic Chemistry-I
22BS202018	Physical Chemistry-II	3	-	3	-	4.5	Physical Chemistry-I
22BS201030	Group Theory and Molecular Spectroscopy	3	-	-	-	3	-
22BS201022	Green Chemistry	3	-	-	-	3	-
22BS201023	Polymer Chemistry	3	-	-	-	3	-
22BS201024	Chemistry of Natural Products	3	-	-	-	3	-
22BS202021	Organic Spectroscopy and its applications	3	-	3	-	4.5	-
22BS201027	Retrosynthesis	3	1	-	-	4	Basics of Organic chemistry
22BS201026	Separation Techniques	3	-	-	-	3	-
22BS203001	Modern methods of Organic Synthesis	2	-	-	4	3	Organic Reaction Mechanism
22BS201004	Advanced Clinical and Pharmaceutical techniques	4	-	-	-	4	-
22BS201029	Instrumental Methods of Analysis	3	-	-	-	3	-
22BS201031	Medicinal Chemistry	2	1	-	-	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	
22CE201701	Disaster Management	3	-	-	-	3	
22SS201701	Value Education	3	-	-	-	3	
22SS201702	Pedagogy Studies	3	-	-	-	3	
22EC101701	AI in Healthcare	3	-	-	-	3	
22CB101703	Forensic Science	3	-	-	-	3	
22LG201701	Personality Development	3	-	-	-	3	
22SS101706	Women Empowerment	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
22BS201001	**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, O_3, PAN, Pesticides, MIC and carcinogens in air.

Module 3 ENVIRONMENTAL POLLUTION ***(07 Periods)***

Air*:* Types and major sources of air pollutants, effects of air pollutants on physico-chemical and biological properties surrounding atmosphere.

Water: Types and major sources of water pollutants, effects of water pollutants on physico-chemical and biological properties of water bodies, Potable water and water quality standards.

Soil: Types and major sources of soil pollutants, effects of soil pollutants on physico-chemical and biological properties of soil. Solid waste disposal and its effects on surrounding environment.

Module 4 ENVIRONMENTAL REFORMS IN INDIA ***(05 Periods)***

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 (Trans 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 Triupathi 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. Brarucha, *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
22BS206001	**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 strictures 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-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	-	-	-
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 strictures)

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 molecules 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
22BS201025	**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**	**-**	**-**	**-**	-	-	**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, Piezoelectric nanomaterials: principle and working mechanism. Fabrication of a piezoelectric sensor using electrospun nano fiber web, nanomaterials for water purification

Total Periods: 45

EXPERIENTIAL LEARNING

1. Discuss nanomaterials 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. Narate 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 Interscience, 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, *Nanopracticles from Theory to Applications,* Wiley VCH, 2004.
3. K. Glosekotter and J. Dienstuthi, *Nanoelectronics and Nanosystems,* 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
22BS201021	**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 heterocyles 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
22EE201001	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
22BS207602	**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-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	-	-	-
CO3	3	-	-	-	-	-	-	-	2	-	-	-
CO4	3	-	-	-	-	-	-	-	2	-	-	-
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**-**	-	-	**2**	**-**	**-**	**-**

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

COURSE CONTENT

Module 1: CARBOHYDRATES ***(6 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 ***(6 Periods)***

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

Module 3: LIPIDS ***(6 Periods)***

Definition, classification and biological significance. Lipid Biosynthesis. Structure, properties and functions of fatty acids.

Module 4: NUCLEIC ACIDS ***(6 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 ***(6 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=ISZLTJH5lYg

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
22BS207601	**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. Groombridge, *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 McGrew 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
22MG207607	**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	1	-	-	-	-	-
CO2	1	1	2	2	-		2		1
CO3	2	2	1	2	1	-	-	1	-
CO4	3	1	2	2	1	-	-	-	-
CO5	2	2	1	2	1	1	-	-	-
Course Correlation Mapping	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**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, *Project Management*, PHI Learning Private Limited, 2013.
2. P. Chandra, *Projects: Planning, Analysis, Selection, Financing, implementation, and Review*, 2014.

REFERENCE BOOKS:

1. *A Guide to the Project Management Body of Knowledge: (PMBOK Guide)* by Project Management Institute, 2013.
2. P. Gopala Krishnan and V. E. Rama Murthy, *A Text book of Project Management,* McMillan India, 2010.
3. S. Choudhary, *Project Management*, Tata McGraw Hill Publication, 2004.

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

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS202013	**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 REACTION TO C-C DOUBLE BOND ***(08 Periods)***

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)***

Sereoisomerism - 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 pseudoasymmetric 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. Carruthares, 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
22BS202015	**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:

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)***

Introduction: Failures of classical mechanics, emergence of quantum mechanics,
Wave mechanics and derivation of Schrodinger wave equation.
Operators-Operator algebra: Commutation of operators, linear operators. Complex functions. Hermitian operators. Operators ∇ and ∇^2. Eigen functions and eigenvalues. Degeneracy. Linear combination of Eigen functions of an operator. Well behaved functions. Normalized and orthogonal functions.
Operators for the dynamic variables of a system such as position, linear momentum, angular momentum and total energy, Expectation Value, Progressive and standing waves, Conditions

on the wave function and its interpretation, Normalization and orthogonality, Separation of variables, Obtaining Schrödinger's time independent wave equation from Schrödinger's time dependent wave equation.

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 Cp and Cv, 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 Peroxydisulphate- 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 o f 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
22BS202014	**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 Discuss the concepts of organometallic compounds.

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.

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 п-bonding theories. Electron Transfer Reaction-Inner Sphere and outer Sphere Mechanisms- Marcus theory.

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

Nature of п bonding, Classification of п ligands, п donor ligands and п -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.
Metal Nitrosyls: Synthesis of metal Nitrosyls, bonding, Electron donation by nitric oxide, Models for NO bonding (i) Covalent model and (ii) Ionic models, Structures of metal nitrosyls (1) [Fe4S3(NO)] (2)[Fe2(NO)2I2] (3) [(ϕ3P)2Ir(CO)Cl(NO)]+ (4) [(ϕ3P)2Ru(NO)2Cl], Detection of bridging NO ligand, Applications of metal nitrosyls.

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, Wades rules (Poly hedral skeletal electron pair theory), Isopopoly 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.

Total Periods: 45

EXPERIENTIAL LEARNING

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

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
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
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
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
22BS201019	**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-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	-	-	-
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 (eg. Aldol, Acyloin, Benzoin, Machael)-Addition and Elimination Reactions by biocatalysts: Cyanohydrin Formation, Addition of Water and Ammonia - Group Transfer Reactions (eg. 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 (monoaza, 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

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS201028	**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 stratergies. 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 DEVELOPMENT ***(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 (QSAR) ***(09 Periods)***

Introduction to QSAR, physicochemical properties–lipophilicity: partition coefficient (P) and the lipophilicity substituent constant (π), 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://ftloscience.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
22BS202016	**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**	**2**

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, Dienone-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), Clemmension reduction
Reduction by metal hydrides: Lithium aluminium 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. Carruthares, 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_iUUsOl5fE
5. https://www.youtube.com/watch?v=-JZFT0gMNbA

WEB RESOURCES:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/
2. 9781118939901https://organicchemistrydata.org/hansreich/resources/redox/?page=redox10%2F
3. 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

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS202020	**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 REAGENTS ***(08 Periods)***

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, Witting reaction and nucleophiles - Corey-Winters reaction, Michaelis-Arbusov reaction-Perkow reaction and Mitsunobu reaction.

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

Sulphur Reagents-Sulphur ylides, stabilized and non-stabilized–Preparationand 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→π* and π→π* transitions, Norrish type-I and Norrish type-II cleavages, Paternò-Büchi reactions, photoreduction, Rearrangement of cyclohexenones, 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 Sigmatropic rearrangements. Claisen, Cope and Oxy-Cope rearrangements. Ene reaction.

Module 5: Asymmetric Synthesis ***(10 Periods)***

Introduction and terminology: Topocity 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
4. 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
22BS202017	**INORGANIC CHEMISTRY-II**	3	-	3	-	4.5

Pre-Requisite INORGANIC CHEMISTRY-I

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a introductory knowledge on bioinorganic Chemistry, Interpretation of electronic spectra of aqua Complexes, metal-ligand equilibria in solutions, metal ion catalysis and synthesis of nanomaterial's 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 Understand the advanced aspects of Nanoscience and 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_8reactions.

Module 5: CHEMISTRY OF NANOMATERIALS ***(08 Periods)***

Chemistry of Nanomaterials: Classification – zero, one and two dimensional nanomaterials. Synthesis and biomedical applications of gold, silver and iron oxide nanoparticles, Introduction to fullerenes and carbon nanotubes (SWCNTs, MWCNTs). Synthesis, Properties and applications of CNTs.

Total Periods: 45

EXPERIENTIAL LEARNING

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

1 **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(ammine) copper (II) sulphate.

(ix)Mercury tetra (thiocyanato) cobaltate(II).

(x) Hexa(ammine) 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)
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
22BS202018	**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. Bravis 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 peroxydisulphide- iodide reaction
   b) Peroxydisulphide- iodide reaction: order w.r.t $[I^-]$ by isolation method
   c) Peroxydisulphide- 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 catalysed inversion of sucrose Colorimetry
   c) Verification of Beer's law and calculation of molar absorption coefficient using $CuSO_4$ and $KMnO_4$ 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
22BS201022	**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.

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)***

Use of biocatalysts- Biochemical Oxidation, Biochemical Reduction, Enzyme Catalyzed Hydrolytic Process, Modified biocatalysis, Green Catalysts in oxidation reactions, Reduction reactions, Friedel-Crafts acylations, epoxide rearrangements, esterification of amino acids, C-C 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 - Introduction, types of sonochemical reactions, a few synthetic applications - substitution, addition, elimination, hydrolysis, esterification, oxidation, reduction.
Biodegradable polymers: Definition, classification, Chemical syntheses of biodegradable polymers, mechanism of degradation and applications.

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
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
22BS201023	**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 poylmerisation.

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, phenolformaldehyde 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, 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, Wiely 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,* Wiely-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-carrahers-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
22BS201024	**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 andsynthesis 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
22BS202021	**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 Identification of the organic compounds using Ultraviolet and Visible spectrometry

CO2 Understand the role of IR spectroscopy in identification of specific functional groups

CO3 Apply the multi NMR spectroscopy to ascertain the structure of the molecule.

CO4 Use the mass spectrometry to know the molecule's mass and to determine the composition of the molecule.

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	-	-	-	-	-	-	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
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 *(8 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 ***(9 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: ^{1}H 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 ***(9 Periods)***

Types of ^{13}C NMR spectra: undecoupled, 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-, ^{1}H J) coupling. ^{13}C-NMR spectral editing techniques: principle and applications of DEPT.

Module 5: MASS SPECTROMETRY ***(9 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 CORE

Course Code	Course Title	L	T	P	S	C
22BS201027	**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)***

Classification of organic reactions. Functionalization and interconversion of functional groups, formation of carbon-carbon single and double bonds, general strategy, disconnection and synthon approach, retrosynthetic analysis, key intermediates and starting materials in designing a synthesis, linear and convergent synthesis, reconnections. Protecting Groups-Principles of protection of alcohol, amine, carbonyl and carboxyl groups.

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 – reconnection.

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.

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, Knoevenagal-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 restrosynthesis 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. Carruthares, 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=t5SDp9lDrww&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
22BS201026	**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. Basset, R.C. Denny, C.H. Jaffery and J. Mendhan, *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 Weily 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
22BS201004	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)***

Pharmacoeconomics in drug development, Intellectual property strategy, Marketing Pharmaceuticals and Biotechnology drugs, Managing Market and sales strategy, Stragetic 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=CcQfJXlAlbw
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
22BS203001	**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 ***(08 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 ***(10 Periods)***

Mercury compounds: oxymercuration and demercuration of alkenes, mechanism and regiochemistry, solvo mercuration, mercuration of aromatics and transformation of arylmercurials 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 ***(07 Periods)***

Organoboron 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 ***(10 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 ***(10 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: 45

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
4. http://www.rajsichemistrypoint.com/PDF/[W._Carruthers,_Iain_Coldham]_Modern_Methods_of_Or(BookZZ.org).pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201029	**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 ***(8 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, 1H-NMR, 13C-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 *(7 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/vSmHIoenW6I
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
22BS201030	**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-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
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-group multiplication table-subgroups, similarity transformations and classes-identifications of symmetry operations and determination of point groups- reducible and irreducible representations-Mullikan symbols.

Module 2: APPLICATIONS OF GROUP THEORY ***(10 Periods)***

Orthogonality theorem and its consequences - construction of character table for linear (CO_2, HCl, N_2) and non- linear molecules (H_2O, CH_4, XeF_4, BF_3, SF_6 and NH_3). 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 AB_4 (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. Disuss 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.
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
4. https://www.coursera.org/learn/spectroscopy

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201031	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 penicllins and tetracyclins, 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 work 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 Princles 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/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE201701	**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-PSO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	2	2	2	2	2	-	-	-	-
CO2	3	3	-	2	2	2	2	-	-	2	-	-
CO3	3	3	-	2	2	2	2	-	-	-	-	-
CO4	3	3	-	3	2	2	2	-	-	-	-	-
CO5	3	2	3	2	2	2	1	2	-	1	3	2
Course Correlation Mapping	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**-**	**2**	**3**	**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. V.K. Sharma, *Disaster Management, Medtech Publishing, 2nd Edition, 2013*.
2. A.S. Arya, A. 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. D. Hyndman and D. Hyndman, *Natural Hazards and Disasters*, Cengage Learning, USA, 5th Edition, 2015.
2. K.J.A. Kumar, *Disaster Management in India,* A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. B. Rajendra Kumar, *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. P. Sahni, *Disaster Mitigation Experiences And Reflections*, Prentice Hall of India, New Delhi.
7. S. L. Goel, *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

UNIVERISTY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS201701	**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 behavioural 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**	**PO10**	**PO11**	**PO12**
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. Subramanaian, *Professional Ethics*, Oxford Higher Education, 2013.
2. M.W. Martin and R. Schinzinger, *Ethics in Engineering*, Tata McGraw-Hill, 3rd Edition, 2007.
3. S.K. Chakravarthy, *Values and ethics for Organizations: Theory and Practice,* Oxford University Press, NewDelhi, 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. M.K. Satchidananda, *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

UNIVERISTY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS201702	**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	PO10	PO11	PO12
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. J. Ackers, F. Hardman, Classroom interaction in Kenyan primary schools, Compare, 2001.
2. R.J. Alexander, *Culture and pedagogy: International comparisons in primary education,* 2001.

REFERENCES:

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

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
22EC101701	**AI IN HEALTHCARE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

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

CO1 Understand the fundamental concepts of AI in Healthcare sector.

CO2 Analyse the present state and future of AI in Healthcare specialties for different scenarios.

CO3 Apply design concepts and metrics for AI in Healthcare.

CO4 Demonstrate basic concepts and terminologies of future applications of Healthcare in AI.

CO5 Develop AI applications through AI techniques for healthcare

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	2	2	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	2	-	-	-	-	-	-
CO5												
Course Correlation Mapping	2	-	-	-	-	2	2	-	-	-	-	-

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

COURSE CONTENT

Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE ***(08 Periods)***

Introduction to AI in Healthcare, Benefits & Risks, AI in the health sector, AI versus human intelligence, The future of AI in health sector, AI & Neural networks.

Module 2: THE PRESENT STATE & FUTURE OF AI IN HEALTHCARE SPECIALTIES ***(10 Periods)***

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

Module 3: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE ***(08 Periods)***

IBM Watson, The role of Google & Deep mind in AI in Healthcare, Baidu, Facebook & AI in Healthcare, Microsoft & AI in Healthcare.

Module 4: FUTURE OF HEALTHCARE IN AI ***(10 Periods)***

Evidence-based medicine, personalized medicine, Connected medicine, Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Incentivized Wellness, Block chain, Robots, Robot-Assisted Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals.

Module 5: APPLICATIONS OF AI IN HEALTHCARE ***(09 Periods)***

Case Study 1: AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

Case Study 2: Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

Case Study 3: Delivering A Scalable and Engaging Digital Therapy.

Case Study 4: Improving Learning Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy.

Case Study 5: Big Data, Big Impact, Big Ethics: Diagnosing Disease Risk from Patient Data.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Analyze how the artificial intelligence is used to predict the disease result and Prognosis Assessment of a patient.
2. How does drug discovery happen and how does AI is helping in drug discovery and Labs.
3. Justify that artificial intelligence provide engineering solutions for early detection and Diagnosis of diseases.
4. Demonstrate the prediction of bladder volume of a patient.

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

RESOURCES

TEXT BOOKS:

1. P. Mahajan, *Artificial Intelligence in Healthcare*, Med Manthra Publications, 1st edition 2019.
2. A. Panesar, *Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

REFERENCE BOOKS:

1. M. Matheny, S. Thadaney Israni, M. Ahmed, and Danielle Whicher, *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, 1st edition 2019.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=-aHBwTQQyNU
2. https://intellipaat.com/blog/artificial-intelligence-in-healthcare/

WEB RESOURCES:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/
2. https://www.ibm.com/topics/artificial-intelligence-healthcare
3. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101703	**FORENSIC SCIENCE**	3	-		-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Forensic Science, Tools and Techniques in Forensic Science, Forensic Photography, Crime Scene Management, Crime Scene Management Laws and Forensic Science.

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

CO1 Understand the basic concepts of Forensic science.

CO2 Apply various tools and techniques in forensic science for crime investigation.

CO3 Understand Forensic Photography fundamentals.

CO4 Perform Crime scene investigation, scene reconstruction and prepare reports.

CO5 Understand Legal aspects of Forensic Science.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-
CO5	3	3	2	2	2	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

Introduction, Need, Scope, Concepts and Significance of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Branches of forensic science, Organizational set-up of a Forensic Science Laboratory. Investigative strategies. Expert testimony and eye-witness report.

Module 2: TOOLS AND TECHNIQUES IN FORENSIC SCIENCE ***(09 Periods)***

Basic principles of microscopy, spectroscopy, chromatography, Electrophoresis, Enzyme Linked Immunosorbent Assay (ELISA), Radio Immuno Assay (RIA). Measuring and optical instruments. Research methodologies; Formation of research design on a specific problem. Central tendency and Dispersion. Test of significance. Analysis of variance, Correlation and Regression.

Module 3: FORENSIC PHOTOGRAPHY ***(08 Periods)***

Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters, depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene & laboratory photography.

Module 4: CRIME SCENE MANAGEMENT ***(11 Periods)***

Crime scene investigations, protecting and isolating the crime scene; Documentation, sketching, field notes and photography. Searching, handling and collection, preservation and transportation of physical evidences, Chain of custody and Reconstruction of scene of crime. Report writing.

Module 5: LAW AND FORENSIC SCIENCE ***(08 Periods)***

Legal aspects of Forensic Science: Forensic Science in the Criminal Justice System, The Criminal Investigation Process, Production of Evidence: The Subpoena, The Rules of Evidence, Authentication of Evidence: The Chain of Custody, The Admissibility of Evidence, Laboratory Reports, Examples of Analysis and Reports, Expert Testimony, Getting into Court, Testifying, Being a Witness and an Expert, Considerations for Testimony.

Total Periods: 45

EXPERIENCIAL LEARNING

1. Study of Computer Forensics and different tools used for forensic investigation
2. Identify and list the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.

RESOURCES

TEXT BOOKS:

1. M.M. Houck and J.A. Siegel, *Fundamentals of Forensic Science*, Elsevier, 2nd edition, 2010.
2. B.R. Sharma, *Forensic Science in Criminal Investigation and Trials*, Universal Publishing Co., New Delhi, 2003.

REFERENCE BOOKS:

1. B.B. Nanda and R.K. Tewari, , *Forensic Science in India- A vision for the Twenty First Century*, Select Publisher, New Delhi, 2001.
2. S.H. James, and J.J. Nordby, *Forensic Science- An Introduction to Scientific and Investigative Techniques*, CRC Press, USA, 2003.
3. S. Saferstein, Criminalistics, *An Introduction of Forensic Science*, Prentice Hall Inc, USA, 2007.
4. B.A.J. Fisher, *Techniques of Crime Scene Investigation*, CRC Press, NewYork, 7th edition, 2003.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106178
2. https://www.youtube.com/watch?v=X5fo1H7bc0g

WEB RESOURCES:

1. https://www.nist.gov/forensic-science
2. https://www.coursera.org/learn/forensic-science

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG201701	**PERSONALITY DEVELOPMENT**	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)***

Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve - Actively Working to Improve Yourself- Exercises- case studies

Module 2: DEVELOPING POSITIVE ATTITUDES ***(09 Periods)***

How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies

Module 3 SELF-MOTIVATION & SELF-MANAGEMENT ***(09 Periods)***

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 y 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- Exercises- 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 with respect to 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 H.R. Wallace and L. Ann Masters, *Personal Development for Life and Work*, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011.

2 B.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. S.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=Tuw8hxrFBH8

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101706	**WOMEN EMPOWERMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Concept & Framework, Status of Women, Women's Right to Work, International Women's Decade, and Women Entrepreneurship.

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

CO1 Demonstrate the knowledge of the characteristics and achievements of empowered women and women's empowerment techniques by analyzing women's legal and political status.

CO2 Apply the knowledge of women's rights by analyzing various societal issues and obstacles in different fields, including science and technology.

CO3 Demonstrate the knowledge of the significance of women's participation in policy debates, National conferences, and common forums for equality and development by identifying and analyzing issues.

CO4 Analyze the concept of women's entrepreneurship, government schemes, and entrepreneurial challenges and opportunities.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	1	3	-	1	–	–	-	-
CO2	3	1	-	-	-	2	-	-	-	–	-	-
CO3	3	1	-	-	-	2	-	-	-	3	-	-
CO4	3	1	-	-	-	-	-	-	-	-	2	-
Course Correlation Mapping	**3**	**1**	**-**	**-**	**1**	**3**	**-**	**1**	**–**	**3**	**2**	**-**

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

COURSE CONTENT

Module 1: CONCEPT & FRAMEWORK ***(09 Periods)***

Introduction– Empowered Women's Characteristics – Achievements of Women's Empowerment **Concept of Empowerment:** Meaning & Concept – Generalizations about Empowerment – Empowerment Propositions – Choices women can make for empowerment – Women's participation in decision making, development process & in Governance. **Framework for Empowerment** – Five levels of equality – Tenets of Empowerment– Elements – Phases and aspects – Techniques – Categories and Models – Approaches.

Module 2: STATUS OF WOMEN ***(09 Periods)***

Legal Status: Present Scenario – Call for Social Change – Significant Trends – Legal & Schemes – Personal Law – Joint Family – Criminal Law – Shift towards Dowry – Deterrent Punishment – Criminal Law (II Amendment) – Discrimination in Employment.

Political Status: Present Scenario – Political Participation & its NatureSocio–economic Characteristics – Political Mobilization: Mass Media – Campaign Exposure – Group Orientation – Awareness of issues and participation – Progress & Future Thrust.

Module 3: WOMEN'S RIGHT TO WORK ***(09 Periods)***

Introduction – Present Scenario – Changes in Policy and Programme – National Plan of Action– Women's Cells and Bureau – Increase in the work participation rate – Discrimination in the labour market – Women in unorganized sector – Issues and Obstacles– Women in Education – Women in Science & Technology – Case Study: Linking Education to Women's Access to resources.

Module 4: WOMEN'S PARTICIPATORY DEVELOPMENT ***(09 Periods)***

Dynamics of social change – conscious participation – Information Explosion – Organized Articulation–National Conference – Common Forums – Participatory Development – New Issues Identified Role of other Institutions.

Module 5: WOMEN ENTREPRENEURSHIP ***(09 Periods)***

Introduction – Definition – Concept – Traits of women Entrepreneurs – Role of Women Entrepreneurs in India – Reasons for Women Entrepreneurship – Government schemes & Financial Institutions to develop Women Entrepreneurs – Key policy recommendations – Project Planning – Suggestions and measures to strengthen women entrepreneurship – Growth & Future challenges – Training and Opportunities – Case Study: Training Women as Hand–pump Mechanics– Case Study: Literacy for Empowering Craftswomen

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare poster presentation on "impact of women's self-help groups on their empowerment and socio-economic development."
2. Prepare a comparative analysis chart on the status of women in various countries.
3. Prepare a presentation on women and cultural responsibilities in different societies.
4. Prepare a presentation on the women of the past, present and future in terms of responsibilities and duties.
5. Prepare a presentation on the great women entrepreneurs of India.

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

RESOURCES

TEXT BOOKS:

1. S. Sushama, *Women and Empowerment,* Discovery Publishing House, New Delhi, 2013.
2. N. Sarojini, S. Jeevan Nair, *Women's Empowerment in India*, Pointer Publishers, Jaipur, 2017.

REFERENCE BOOKS:

1. S. Baluchamy., *Women's Empowerment of Women*, Pointer Publishers, Jaipur, 2010.
2. K. Grishma, *Women's Empowerment: Challenges and Strategies Empowering Indian Women*, Booksclinic Publishing, Chhattisgarh, 2020.

WEB RESOURCES:

1. https://www.economicsdiscussion.net/entrepreneurship/women–entrepreneurs–in–india
2. https://www.businessmanagementideas.com/entrepreneurship–2/women entrepreneurs