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CENTRAL UNIVERSITY OF PUNJAB

M.Sc. Chemical Sciences

(Medicinal Chemistry)

Batch- 2026-28

Department of Pharmaceutical Sciences and Natural Products

Graduate attributes for M. Sc. Chemical Sciences (Medicinal Chemistry) Research

Graduates will have quality-conscious service providing attribute by adopting the knowledge of spectral analysis and chromatographic techniques in manufacturing and R & D of drugs. They will be able to implement the role of Computer-Aided Drug Design (CADD) in the modern drug discovery & development process and its applicability in higher studies and at the industrial level. They will be able to apply the knowledge of medicinal chemistry for the development of synthetic methodologies, including green chemistry, peptide chemistry, retro-synthesis for making the drugs affordable to the public. They will have the ability to create, select and apply appropriate techniques, resources and modern analytical tools to identify, formulate, and solve problems of medicinal chemistry and will develop attribute to become self-reliant in Active Pharmaceutical Ingredients (APIs) by the development of scale-up of APIs and intermediates, unit operations and industrial safety guidelines. Moreover, the program will help them make their career in academic, research, and industry.

Course Structure

SEMESTER 1

S. No.	Paper Code	Course Title	Course Type	L	T	P	Cr
1.	MCMC.401	Advanced Organic Chemistry-I	DSC	4	0	0	4
2.	MCMC.402	Organic Synthesis-I (Practical)	SEC	0	0	6	3
3.	MCMC.403	Modern Spectral and Chromatography Techniques	DSC	4	0	0	4
4.	MCMC.404	Advanced Medicinal Chemistry-I	DSC	4	0	0	4
5.	XXX	Interdisciplinary Course	IDC	2	0	0	2
6.	MCMC.405	Entrepreneurship Course	EC	2	0	0	2
7.	MCMC.406	Communication Skills and Scientific Writing (Practical)	SEC	0	0	4	2
8.	XXX	Individualizes Education Plan/ Tutorial	-	0	0	0	N. Cr
Opt any one course from following electives							
9.	MCMC.407	Chemistry of Natural Products	DSE	3	0	0	3
10.	MCMC.408	Quantum Chemistry					
11.	MCHE.401	Inorganic Chemistry-1					
12.	MCHE.403	Physical Chemistry – I					
		Total		**19**	**0**	**10**	**24**

DSC: Discipline Specific Core Course, **DSE**: Discipline Specific elective course, **SEC**: Skill Enhancement Course
L: Lectures T: Tutorial P: Practical Cr: Credits

MOOC: MOOC may be taken up 40% of the total credit (excluding dissertation credits). MOOC may be taken in lieu of any course but content of that course should match minimum 70%.

SEMESTER II

S. No.	Paper Code	Course Title	Course Type	L	T	P	Cr
1.	MCMC.421	Advanced Organic Chemistry-II	DSC	4	0	0	4
2.	MCMC.516	Organic Synthesis-II-(Practical)	SEC	0	0	6	3
3.	MCMC.517	Computer Aided Drug Design	AEC	2	0	0	2
4.	MCMC.518	Advanced Spectral Analysis	DSC	4	0	0	4
5.	XXX	Value Added Course	VAC	2	0	0	2
6.	XXX	Indivisualized Education Plan/ Tutorials	-	2	0	0	N. Cr
Opt any Course from following electives							
7.	MCMC.519	Green Chemistry	DSE	3	0	0	3
8.	MCMC.520	Nuclear Chemistry					
9.	MCMC.521	Advanced Medicinal Chemistry-II					
		Total		**15**	**0**	**6**	**18**

DSC: Discipline Specific Core Course, **DSE**: Discipline Specific elective course, **SEC**: Skill Enhancement Course, **AEC**: Ability Enhancement Courses
L: Lectures T: Tutorial P: Practical Cr: Credits

MOOC: MOOC may be taken up 40% of the total credit (excluding dissertation credits). MOOC may be taken in lieu of any course but content of that course should match minimum 70%.

List of MOOC courses may be selected

- Solid and hazardous waste management
- Arctic Studies
- Biostatistics and Mathematical Biology

- The Science of Happiness and Wellbeing

Multiple Entry/Exit scheme (After Second Semester)

Post-Graduate Diploma will be awarded as per NEP 2020 in multiple entry/exit scheme for students leaving the course after the end of first year (Second Semester) of M.Sc. Chemical Sciences (Medicinal Chemistry) programmes, provided students have to opt any one of the following 4 credit skill-based course.

MOOC Course							
1.	MCMC.526	Analytical Techniques	SB	4	0	0	4
2.	MCMC.527	Introduction to Computer Network and Internet Protocols	SB	4	0	0	4
3.	MCMC.528	Solid and Hazardous Waste Management	SB	4	0	0	4
4.	MCMC.529	Fundamentals of Bioinformatics	SB	4	0	0	4
Training							
5.	MCMC.530	Training at National Labs/Research Institutes/Central Instrumental Laboratory Facility of University/Industry for two months, subject to the submission of report for evaluation	SB	4	0	0	4
Lab rotation							
6.	MCMC.531	Lab rotation of two months within and the other relevant departments of the University.	SB	4	0	0	4
Publication							
7.	MCMC.532	One publication in an International repute journal indexed in Scopus/Web of Science.	SB	4	0	0	4

SEMESTER III

S. No.	Paper Code	Course Title	L	T	P	Cr
1.	MCMC. 599-1	Dissertation/Internship/Apprenticeship	0	0	40	20

SEMESTER IV

S. No.	Paper Code	Course Title	L	T	P	Cr
1.	MCMC. 599-2	Dissertation/Internship/Apprenticeship	0	0	40	20

Examination Pattern

Core, Discipline Elective, Compulsory Foundation,			**Interdisciplinary Course, Value Added, Entrepreneurship, Innovation and skill development Courses**	
	Marks	Evaluation	Marks	Evaluation
Internal Assessment	25	Various methods	-	-
Mid-semester test (MST)	25	Descriptive	50	Descriptive (70%) Objective (30%)
End-semester test (EST)	50	Descriptive (70%) Objective (30%)	50	Descriptive (70%) Objective (30%)

Objective Questions- one-word/sentence answers, fill-in the blanks, MCQs', and matching

Descriptive Questions- Short answer and essay type questions

Internal assessment- any two or more of the given methods: Surprise Tests, open book examination, assignments, term paper, etc.).

Evaluation Criteria for Practical

Item	**Practical Note book and continuous evaluation**	**Synopsis**	**Performance**	**Viva voce**
Marks	40	10	20	30

Evaluation Criteria for Dissertation

Dissertation (Fourth Semester)		
	Marks	Evaluation
Supervisor	50	Continuous assessment (regularity in work, mid-term evaluation) dissertation report, presentation, final viva-voce
External expert, HoD and senior-most faculty of the department	50	Dissertation report (30), presentation (10), final viva-voce (10)

Evaluation pattern similar to fourth semester dissertation will apply for internship where supervisor will award 50% marks and external co-supervisor, HoD and senior-most faculty will award 50% marks.

Semester 1

Course Title: Advanced Organic Chemistry-I

L	T	P	Credits
4	0	0	4

Paper Code: MCMC.401
Course Hours: 60h

Learning Outcomes:

After completing this course, the learner will be able to:

CLO1: Analyze the mechanistic pathways of elimination and addition reactions and their governing factors.
CLO2: Evaluate different disconnection strategies and synthetic routes for efficiency and feasibility.
CLO3: Design synthetic methodologies for the preparation of heterocyclic compounds with desired properties.

Course Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **15 Hours**	**Basic Aspects of Organic Chemistry**: Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications. Types of reaction mechanisms and methods of determining them, Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations. **Learning activities:** Learner will be engaged in Molecular models to explain the stability of organic intermediates	**CLO1**
Unit 2 **15 Hours**	**Addition reactions** a) Nucleophilic uni- and bimolecular reactions (SN1 and SN2) b) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule) c) Rearrangement reaction **Learning activities:** Learner will be engaged in Molecular models to explain the stereochemistry in elimination reactions	**CLO1**

Unit 3 **15 Hours**	**Synthetic methodologies:** Synthon, Synthetic equivalent, Functional group interconversion (FGI), Functional group addition, Functional group elimination, Criteria for selection of target, Linear and convergent synthesis, Retrosynthetic analysis and synthesis involving chemoselectivity, Regioselectivity, Reversal of Polarity (Umpolung), Synthesis of cyclic molecules, Strategic bond: Criteria for disconnection of strategic bonds, Importance of the order of events in organic synthesis. One group and two group C-X disconnections in 1,2-, 1,3-, 1,4 & 1,5- difunctional compounds, One group C-C disconnections, alcohol and carbonyl compounds, regioselectiviity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis, Two group C-C disconnections, Diels-Alder reaction, 1,3-difunctionalised compounds, Control in carbonyl condensation, 1,5-difunctionalised compounds. **Learning activities:** Learner will be engaged in Group discussion to explain disconnection approaches in synthesis	**CLO2**
Unit 4 **15 Hours**	**Heterocyclic chemistry:** Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles, Aromatic heterocycle, Non-aromatic heterocycle: Bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles and their synthesis (a) Three-membered and four-membered heterocycles: synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and thietanes. (b) Five membered heterocycles containing two heteroatoms (S,N,O): Diazoles, imidazole, pyrazole,oxazoles and thiazoles. (c) Benzo-fused five-membered and six membered heterocycles: Synthesis and	**CLO3**

	reactions of indoles, benzofurans and benzimidazoles, benzothiazoles. (d)Six-membered heterocycles with heteroatom: Synthesis and reactions of pyrylium salts and pyrones, coumarins, chromones, pyridine, pyrimidine, *etc.* **Learning activities:** Learner will be engaged in using ball and stick models and web mediated activity to explain heterocyclic Chemistry	

Suggested Readings:

1. Clayden, J., Greeves, N., Warren, S., Wothers, P. (2012). *Organic chemistry Organic Chemistry* Oxford press.
2. Finar, I.L., (2012). *Organic Chemistry Vol. 1*, Pearson Education, UK.
3. Mc Murry J., (2015). *Organic Chemistry*, Asian Book Pvt. Ltd, New Delhi
4. Smith, M. B. (2013). *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*. John Wiley & Sons.
5. Ahluwalia, V. K., and Parasar R. K., (2011). *Organic Reaction Mechanism***,**Narosa Publishing House (P) Ltd., New Delhi-110002.
6. Bansal, R. K., (2010). *A text book of Organic Chemistry*, New Age Inrternational (P) Ltd., New Delhi.
7. Bansal R.K., (2010). *Organic Reaction Mechanism*, New Age International (P) Ltd., New Delhi.
8. Kalsi, P.S., (2010). *Organic Reactions and Their Mechanisms*. New Age International Pub., New Delhi.
9. Kalsi, P.S., (2010). *Stereochemistry: Conformation and Mechanism*, New Age International (p) Ltd. New Delhi.
10. Morrison, R.T., Boyd, R.N. (2011). *Organic Chemistry*, Prentice- Hall of India, New Delhi.
11. Mukherjee, S.M. Singh, S.P., (2009). *Reaction Mechanism in Organic Chemistry.* Macmillan India Ltd., New Delhi.
12. Eliel, E. L., & Wilen, S. H. (2008). *Stereochemistry of organic compounds*. John Wiley & Sons.
13. Carey, F. A., Guiliano, R. M. (2012). *Organic Chemistry*. McGraw Hill.
14. Kofie, W., Caddick, S. (2016). *Problems in Advanced Organic Chemistry*. Auris Publishing.
15. Solomons, T. W. G., Fryhle, C. B., Snyder, S. A. (2017). *Solomons' Organic Chemistry*. John Willey & Sons.
16. Acheson, R.M. (1976). *An Introduction to the Chemistry of Heterocyclic Compounds*, Wiley India Pvt. Ltd.
17. Gupta R.R., Kumar M., Gupta V. (2010). *Heterocyclic Chemistry-II Five Membered Heterocycles Vol. 1-3*, Springer Verlag, India.

18. Warren, S., (2010). *Organic Synthesis: The Synthon Approach*. John Wiley & Sons, New York,
19. Warren, S., (2010). *Designing Organic Synthesis: A Disconnection Approach*. John Wiley & Sons, New York.
20. John A. J., Keith M. (2010). Heterocyclic Chemistry. John Wiley & Sons, New York.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Team teaching
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Course Title: Organic Synthesis –I (Practical)

L	T	P	Credits
0	0	6	3

Paper Code: MCMC.402
Course Hours: 90h

Learning Outcomes:

After completing this course, the learner will be able to:

CLO1: Analyze the stereochemistry of organic compounds to interpret spatial arrangements and predict stereochemical outcomes.

CLO2: Develop comprehensive safety protocols for handling, storage, and disposal of hazardous chemicals based on MSDS.

CLO3: Analyze the progress of chemical reactions using thin layer chromatography (TLC) data.

CLO4: Evaluate the efficiency of different purification methods for achieving desired purity and yield.

Course Content

Practical	**Content/Title**	**Mapping with course learning outcome**
1.	Awareness to various glassware and plasticwares used in the organic synthesis.	**CLO1**
2.	Demonstration of Stereochemical aspects of the compounds through molecular models	**CLO1**
3.	Awareness to handling, storage and disposal of hazardous chemicals and their Material safety data sheets (MSDS)	**CLO2**
4.	Thin layer chromatography: Monitoring the progress of chemical reactions, identification of unknown organic compounds by comparing the R_f values of known standards, preparative TLC for separation of mixtures	**CLO3**
5.	Purification of a given organic compound through crystallization, fractional distillation or column chromatography	**CLO4**
6.	**Organic Synthesis:** Single or multi- steps synthesis of organic compounds. Aspects such as conversion, yield, selectivity, effluent treatment, atom economy, etc. should be paid attention. TLC should be used to monitor the reaction. (attempt any five) a) Synthesis of an anticancer stilbene via Wittig reaction b) Synthesis of chalcones via Claisen-Schmidt condensation. c) Preparation of vanillyl alcohol from vanillin	**CLO4**

	d) Reduction of 3-nitroacetophone using $NaBH_4/LiAlH_4$ e) Preparation of bromohydrin from methylstyrene f) Preparation of aniline from nitrobenzene g) Synthesis of ethyl *N*-butyl acetoacetate by A.E.E. condensation h) Cannizzaro reaction: 4-chlorobenzaldehyde as substrate. i) Preparation of Iodoxybenzoic acid (IBX) and its application in oxidation. j) Preparation of pyridine chlorochromate (PCC) and its application in oxidation. k) Multistep synthesis of phenytoin.	

Suggested Readings:

1. Adams, R., Johnson, J.R., Wilcox, C.F. (1970). *Laboratory Experiments in Organic Chemistry*, The Macmillan Limited, London.
2. Mann, F. G. (2009). *Practical Organic Chemistry*. Pearson Education India.
3. Pasto, D.P., Johnson, C., Miller, M. (2010). *Experiments and Techniques in Organic Chemistry*, Prentice Hall.
4. Roberts, R.M., Gilbert, J.C., Rodewald, L.B., Wingrove, A.S. (1969). *An Introduction to Modern Experimental Organic Chemistry*, Ranehart and Winston Inc., New York.
5. Vogel, A.I. (latest edition). *Text Book of Practical Organic Chemistry*, Pearson
6. Williamson, K.L., Health, D.C. (1999). *Macroscale and Microscale Organic Experiments*, *Heath,* D. C & Co., Lexington, MA.
7. Armarego, W. L., & Chai, C. (2012). *Purification of Laboratory Chemicals*. Butterworth-Heinemann.
8. Young, J. A. (Ed.). (1991). *Improving Safety in the Cemical Laboratory: a Practical Guide*. Wiley.
9. Zercher, C. A. (2010). *Organic Syntheses*. John Wiley & Sons.
10. Leonard, J., Lygo, B., Procter, G. (2013). *Advanced Practical Organic Chemistry*. CRC Press.
11. *https://www.vlab.co.in/broad-area-chemical-sciences*
12. *https://www.vlab.co.in/ba-nptel-labs-chemical-sciences*

The following are some of the modes of classroom transaction

- Experimentation
- Group discussion
- Demonstration
- Self-learning

Transaction Mode

- PPT
- Google classroom
- Google meet

Course Title: Modern Spectral and Chromatographic Techniques

Paper Code: MCMC.403
Course Hours: 60h

L	T	P	Credits
4	0	0	4

Learning Outcomes

After completing this course, the learner will be able to:

CLO1: Evaluate the suitability of UV–Vis, IR, and spectrofluorimetry for qualitative and quantitative analysis of different chemical systems.

CLO2: Analyze the concepts and instrumentation of NMR and mass spectrometry for structural identification.

CLO3: Design optimized chromatographic protocols for efficient separation and purification of complex mixtures..

CLO4: Analyze the principles, thermal transitions, and instrumentation of DSC, DTA, and TGA.

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit I **15 Hours**	**UV-Visible spectroscopy** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy. **IR spectroscopy** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier- Transform IR Spectrometer, Factors	**CLO1**

	affecting vibrational frequencies and applications of IR spectroscopy, Data Interpretation, Theory of NIR. **Spectroflourimetry** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Applications of fluorescence spectrophotometer, Instrumentation **Learning activities:** Learner will be provided hands on training to different instruments like UV, IR and spectroflourimetry.	
Unit 2 **15 Hours**	**NMR spectroscopy** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and ^{13}C NMR, Applications of NMR spectroscopy **Mass Spectroscopy** • Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy. **Learning activities:** Learner will be provided NMR and mass spectra for the characterization of compounds.	**CLO2**
Unit 3 **15 Hours**	**Chromatography** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: Thin Layer chromatography, High Performance Thin Layer Chromatography, Ion exchange chromatography, Column chromatography, Gas chromatography, High Performance Liquid chromatography, Ultra High-Performance Liquid chromatography, Affinity chromatography, Gel Chromatography	**CLO3**

	Learning activities: Learner will be provided experience of chromatography by using different techniques like TLC, Column, HPLC, HPTLC and GC.	
Unit 4 **15 Hours**	**Thermal Techniques** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications **Learning activities:** Learner will be provided Web based learning to explain thermal techniques	**CLO4**

Suggested readings

1. Silverstein, R. M., Webster, F. X., Kiemle, D. J., & Bryce, D. L. (2014). *Spectrometric Identification of Organic Compounds*. John Wiley & Sons.
2. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2018). Principles of Instrumental Analysis. Singapore: Cengage Learning Asia Pte Ltd.
3. Willard, H. H. (2012). Instrumental methods of analysis. New Delhi: CBS.
4. Beckett, A. H., & Stenlake, J. B. (Eds.). (1988). *Practical Pharmaceutical Chemistry: Part II*, A&C Black.
5. Kemp, W. (1991). *Organic Spectroscopy* (pp. 42-51). London: Macmillan.
6. Sethi, P. D. (1985). *Quantitative Analysis of Drugs in Pharmaceutical Formulations*. Unique Publishers.
7. Munson, J. W. (Ed.). (1984*). Pharmaceutical Analysis: Modern Methods* (Vol. 11). CRC Press.
8. Kalsi, P. S. (2007). *Spectroscopy of Organic Compounds*. New Age International.
9. Connors, K. A. (2007). *A Textbook of Pharmaceutical Analysis*. John Wiley & Sons.
10. McHale, J. L. (2017). *Molecular Spectroscopy*. CRC Press.
11. Kromidas, S. (2017). *The HPLC Expert Possibilities and Limitations of Modern High Performance Liquid Chromatography*. John Wiley and Sons.
12. Pavia, D.L.,Lampman, G.M., Kriz, G.S., Vyvyan, J.R. (2015). Introduction to Spectroscopy (5th edition). Cengage India Private Limited

13. Keeler J. (2011). Understanding NMR spectroscopy. John Wiley and Sons
14. Vitha M.F. (2016). Chromatography: Principles and instrumentation. John Wiley and Sons

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Course Title: Advanced Medicinal Chemistry-I
Paper Code: MCMC.404
Course Hours: 60h

L	T	P	Credits
4	0	0	4

Learning Outcomes

After completing this course, the learner will be able to:

CLO1: Analyze the basic concepts of drugs, their pharmacological effects, and screening methods

CLO2: Evaluate drug–enzyme and drug–receptor interactions for their therapeutic efficacy and selectivity

CLO3: Design an integrated drug discovery and development pipeline for novel therapeutic agents

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **15 Hours**	**History of drug discovery** Introduction, Drug discoveries, Recent trends in drug discovery, Enzymes as drug targets, Membrane transporters as drug targets, Voltage-gated ion channels as drug targets **Learning activities:** Learner will be engaged in group discussion to explain history of drug discovery	**CLO1**
Unit 2 **15 Hours**	**Drug discovery:** Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets **Biological drug targets** Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonist vs antagonists, artificial enzymes. **Measurement and expression of drug effects**	**CLO2**

	Introduction, *In-vitro* experiments, *Ex-vivo* experiments, *In-vivo* experiments. **Learning activities:** Learner will be explained about drug interaction and target through molecular modeling studies	
Unit 3 **15 Hours**	**Prodrug Design and Analog design** **Prodrug design** Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design. **Combating drug resistance** Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance. **Analog Design** Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance. **Learning activities:** Learner will be engaged in Web based training to familiarize with prodrug and analog design	**CLO3**
Unit 4 **15 Hours**	Medicinal chemistry aspects of the following class of drugs, Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs: a). Anti-hypertensive drugs, Psychoactive drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Antineoplastic and Antiviral agents. b). Stereochemistry and Drug action: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific	**CLO3**

	therapeutic agents. Case studies, enantioselectivity in drug adsorption, metabolism, distribution and elimination. **Learning activities:** Learner will be engaged in Group discussion to explain SAR, Mechanism of action and synthesis of drugs	

Suggested Readings:

1. Foye, W. C. (2019). *Principles of Medicinal Chemistry*, Publisher: Wolters Kluwer.
2. King, F. D. (2006). *Medicinal Chemistry Principles and Practice*, Royal Society of Chemistry.
3. Nogardy, T. and Weaver D F (2005). *Medicinal Chemistry: A Molecular and Biochemical Approach*, Oxford University Press.
4. Patrick, G.L. (2017). *An Introduction to Medicinal Chemistry*, Publisher: Oxford university Press, UK.
5. Singh, H., Kapoor, V.K. (1996). *Medicinal and Pharmaceutical Chemistry* Vallabh Prakashan, Delhi.
6. Smith, H.J. (2006). *Introduction to the Principles of Drug Design and Action*, Taylor and Francis.
7. Wermuth, C.G. (2009). *The Practice of Medicinal Chemistry*, Academic Press (Elsevier).
8. Wolff, M E, Ed., (Latest Edition). *Burger's Medicinal Chemistry and Drug Discovery* John Wiley and Sons, New York.
9. Ferrant, E., (2011). *New Synthetic Technologies In Medicinal Chemistry*. Royal Chemical Society.
10. Medicinal Chemistry by Burger, Vol I –VI.
11. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, 12th Edition, (2004). Lppincott Williams & Wilkins, Woltess Kluwer (India) Pvt. Ltd, New Delhi.
12. Comprehensive Medicinal Chemistry – Corwin and Hansch.
13. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore
14. Thomas, G. (2015). Medicinal Chemistry An Introduction, Wiley India

The following are some of the modes of classroom transaction

- Lecture
- Group discussion

- Demonstration
- Team teaching

Transaction Mode

- Molecular Models
- PPT
- YouTube
- Software for *In silico* study
- Google meet

Course Title: Entrepreneurship Course

L	T	P	Credits
2	0	0	2

Paper Code: MCMC. 405
Course Hours: 30h

Learning Outcomes: After completing this course, the learner will be able to:

CLO1: Analyze the fundamental concepts of skill entrepreneurship and assess its importance in the pharmaceutical sector.

CLO2: Evaluate challenges and opportunities in skill entrepreneurship to determine feasible business approaches.

CLO3: Analyze the essential components required for preparing proposals for small pharmaceutical businesses.

CLO4: Design a start-up model integrating institutional support systems for drug discovery ventures

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **6 Hours**	Introduction to entrepreneur and entrepreneurship; Characteristics of an entrepreneur; Characteristics of entrepreneurship; entrepreneurial traits and skills; innovation and entrepreneurship; Types of entrepreneurial ventures; enterprise and society in Indian context; Importance of women entrepreneurship **Learning activities:** Learner will be engaged in Group discussion to explain the concept of entrepreneurship	**CLO1**
Unit 2 **8 Hours**	Promotion of a venture – Why to start a small business; How to start a small business;	**CLO2**

	opportunity analysis, external environmental analysis, legal requirements for establishing a new unit, raising of funds, and establishing the venture - Project report preparation – format for a preliminary project report, format for a detailed/final project report. **Learning activities:** Learner will interact with Entrepreneurs to understand how to start small business	
Unit 3 **10 Hours**	Launching and Organising an Enterprise in Medicinal and Process Chemistry: Environment scanning – Information, sources, schemes of assistance, problems. Enterprise selection, market assessment, enterprise feasibility study, Resource mobilisation - finance, technology, raw material, site and manpower. Costing and marketing management and quality control. Feedback, monitoring and evaluation. **Learning activities:** Learner will be engaged in Group discussion to explain about resource mobilization, costing and marketing management	**CLO1, CLO2**
Unit 4 **6 Hours**	Introduction to Intellectual Property Rights: Importance of IPR, Patentable and non-patentable, Trade Secrets, Know-how agreements, Types of inventions protected by a patent, Need for a patent, Preparing Project Proposal to Start On New Enterprise Project work in Drug Design development – Feasibility report; Planning, resource mobilisation and implementation. **Learning activities:** Learner will be engaged to prepare project proposal to start new enterprise	**CLO3, CLO4**

Suggested Readings:

1. Arora, Renu (2008). *Entrepreneurship and Small Business*, Dhanpat Rai & Sons Publications.
2. Chandra, Prasaaan (2018). *Project Preparation, Appraisal, Implementation*, Tata Mc-Graw Hills.
3. Desai, Vasant (2019). *Management of a Small-Scale Industry*, Himalaya Publishing House.

4. Jain, P. C. (2015). *Handbook of New Entrepreneurs*, Oxford University Press.
5. Srivastava, S. B. (2009). *A Practical Guide to Industrial Entrepreneurs*, Sultan Chand & Sons.
6. Akhauri, M.M.P. (1990): Entrepreneurship for Women in India, NIESBUD, New Delhi.
7. Hisrich, R.D & Brush, C.G. (1996) The Women Entrepreneurs, D.C. Health & Co., Toranto.
8. Hisrich, R.D. and Peters, M.P. (1995): Entrepreneurship – Starting, Developing and Managing a New Enterprise, Richard D., Inwin, INC, USA.
9. Meredith, G.G. etal (1982): Practice of Entrepreneurship, ILO, Geneva.
10. Patel, V.C. (1987): Women Entrepreneurship – Developing New Entrepreneurs, Ahmedabad EDII.
11. Douglas, F.S. etal (2010). The case for entrepreneurship in R&D In the Pharmaceutical industry. Nature Reviews Drug Discovery, 6, 683-689
12. Shorr, R.R.G. (2008). Entrepreneurship in Pharmaceutical and Biological Drug Discovery and Development. In: Madhavan, G., Oakley, B., Kun, L. (eds) Career Development in Bioengineering and Biotechnology. Series in Biomedical Engineering. Springer, New York, NY.

The following are some of the modes of classroom transaction

- Group discussion
- Lecture
- Demonstration
- Team teaching

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Course Title: Communication Skills and Scientific Writing (P)

L	T	P	Credits
0	0	4	2

Paper Code: MCMC406

Course Hours: 30h

Learning Outcomes:

After completing this course, the learner will be able to:

CLO1: Communicate effectively (Verbal and Non-Verbal) and Improve proof-readings kills and language awareness so that one can spot mistakes and correct their own work

CLO2: Comprehend the behavioral needs for a pharmacist to function effectively in the areas of pharmaceutical operation. Develop interview skills
CLO3: Define an appropriate research problem
CLO4: Describe the objectives based on literature search

CLO5: Prepare poster and dissertation work

Course content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **9 hrs**	•**Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process– Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context •**Elements of Communication:** Introduction, Face to Face Communication- Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication •**Communication Styles:** Introduction, The Communication Styles Matrix with example for each-	**CLO1,CLO3, CLO4**

	Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	
Unit-2 **9 hrs**	•**Effective Written Communication:** Introduction, When and When Not to Use Written Communication-Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication •**Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message •**Interview Skills:** Purpose of an interview, Do's and Don'ts of an interview •**Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery •**Group Discussion:** Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion	**CLO3, CLO4, CLO5**
Unit-3 **6 hrs**	**Technical writing:** Scientific writing, Writing research paper, Poster preparation and Presentation and Dissertation. **Literature Search & Management:** Techniques for searching databases like Google Scholar, reading papers critically, and using reference management tools like Zotero or EndNote.	**CLO1, CLO5**
Unit-4 **6 hrs**	**The Anatomy of a Scientific Paper: IMRaD** (Introduction, Methods, Results, and Discussion) **Methods:** Detailed description of procedures to allow for reproducibility. **Results**: Objective presentation of data through text, core tables, and figures. **Discussion & Conclusion**: Interpretation of results, address limitations, and	**CLO4, CLO4**

	relate findings to existing literature. **Introduction & Abstract**: background, research gap, and summary	

Recommended Books

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011

2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011

3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013

4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5.The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala SwamyRamesh, 5thEdition, Pearson, 2013

6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010

7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals PHI, 2011

8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011

9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning indiapvt.ltd, 2011

10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011

11. Effective communication, John Adair, 4thEdition, Pan Mac Millan, 2009

12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

Discipline Specific Elective courses

Course Title: Chemistry of Natural Products

L	T	P	Credits
3	0	0	3

Paper Code: MCMC.407
Course Hours: 45h

Learning Outcomes
After completing this course, the learner will be able to:

CLO1: Analyze the classification, synthesis, and biosynthetic pathways of terpenoids.
CLO2: Evaluate nomenclature systems and synthetic strategies of alkaloids in relation to their structural diversity.
CLO3: Analyze the occurrence, nomenclature, and structural elucidation methods of steroids.
CLO4: Design optimized protocols for isolation, purification, and structural characterization of flavonoids

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **10 Hours**	**Terpenoids and carotenoids:** Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Geraniol, Menthol and β-Carotene **Learning activities:** Learner will be engaged in molecular models to explain the structure and stereochemistry of terpenoids.	**CLO1**
Unit 2 **10 Hours**	**Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, Nicotine and Morphine **Learning activities:** Learner will be able to explain chemical tests for the identification of	**CLO2**

	plant alkaloids	
Unit3 **10 Hours**	**Steroids:** Occurrence, nomenclature, basic skeleton and stereochemistry, Structure determination and synthesis of cholesterol, partial synthesis of Testosterone and Progesterone, Chemical tests for steroids **Learning activities:** Learner will be engaged in molecular models to explain the structure and stereochemistry of steroids.	**CLO3**
Unit 4 **15 Hours**	**Flavonoids:** Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin **Chemistry of Carbohydrates** Introduction, classification, configuration and conformation, reactions of monosaccharides; oxidation, reduction, osazone formation, chain shortening and chain lengthening, mutarotation, Structure elucidation and chemistry of Glucose **Learning activities:** Learner will be provided spectral data for the identification of above-mentioned natural compounds.	**CLO4**

Suggested Readings

1. Bhat, S.V., Nagasampagi, B.A., Meenakshi, S. (2013). *Natural Product Chemistry & Applications*, Narosa Publishing House, New Delhi.
2. Bhat, S.V., Nagasampagi, B.A., Sivakumar, M. (2005), *Chemistry of Natural Products.* Narosa Publishing House, New Delhi.
3. Brahamchari, G. (2009). *Natural Product: Chemistry, Biochemistry and Pharmacology*. . Narosa Publishing House, New Delhi.
4. Cseke, L.J. (2009). *Natural Products from plants*. CRC Press, Taylor and Francis, US.
5. Dewick, P.M. (2009). *Medicinal Natural Products: A Biosynthetic Approach*. Willey & Sons, UK.
6. Finar, I.L. (2006). *Organic Chemistry: Stereochemistry and the Chemistry of Natural Products.* Dorling Kindersley Pvt. Ltd., India.
7. Peterson, F., Amstutz, R. (2008). *Natural Compounds as drugs.* Birkhauser Verlay.
8. Thomson, R.H. (2008). *The Chemistry of Natural Products*, Springer.
9. Singh, J., Ali, S. M., Singh, J. (2010) *Natural Products Chemistry*. Pragati Books.
10. Xu, R., Ye, Y., Zhao, W., (2011). *Introduction to Natural Products Chemistry.* CRC Press.

11. Rehman, A., (2015). *Studies in Natural Products Chemistry,* Elsevier Books.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Tutorial

Transaction Mode

- PPT
- YouTube
- Google meet

Course Title: Quantum Chemistry

L	T	P	Credits
3	0	0	3

Paper Code: MCMC.408
Course Hours: 45 h

Learning Outcomes
After completing this course, the learner will be able to:

CLO1: Analyze quantum chemical descriptions of chemical bonding and reactivity, and their applications in molecular spectroscopy and inorganic chemistry.
CLO2: Evaluate the applicability and limitations of electronic and Hamiltonian operators in solving molecular systems.
CLO3: Design methods to determine angular momentum states and term symbols for complex electron systems.
CLO4: Analyze the principles of the Born–Oppenheimer approximation, Pauli principle, Hund's rules, Hückel theory, and the variation principle.

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **10 Hours**	**Fundamental Background:** Postulates of quantum mechanics, Eigen values and Eigen functions, operators, hermitian and unitary operators, some important theorems. Schrodinger equation-particle in a box (1D, 3D) and its application, potential energy barrier and tunneling effect, one-dimensional harmonic oscillator and rigid rotor, Particle in a Ring, Hydrogen Atom. **Learning activities:** Learner will apply Schrodinger equation for particle in 1D and 3D	**CLO1, CLO2**
Unit 2 **10 Hours**	**Approximate Methods:** Perturbation theory for non-degenerate and degenerate states and its applications, Variation theorem and its application. **Learning activities:** Web based approach will be used to explain perturbation and variation theory	**CLO1**
Unit 3 **10 Hours**	**Angular Momentum:** Ordinary angular momentum, Eigen functions and Eigen values for angular momentum, Addition of angular momenta, Spin, Anti-symmetry and Pauli exclusion principle.	**CLO3**

	Electronic Structure of Atoms: Electronic configuration, Russell-Saunders terms and Coupling Schemes, Magnetic Effects: Spin-orbit Coupling and Zeeman Splitting, the self-consistent field method, Hartree-Fock SCF method for molecules. **Learning activities:** Learner will apply Angular momentum and Pauli exclusion principle to solve numerical problems	
Unit 4 **15 Hours**	**Born-Oppenheimer Approximation:** LCAO-MO and VB treatments of the H_2^+ and H_2, Hybridization and valence MOs of H_2O and NH_3. Huckel Theory of acyclic and cyclic conjugated systems, Bond Order and Charge Density Calculations. **Learning activities:** Learner will be engaged in web-based learning to explain Born-Oppenhelmer approximation concept	**CLO4**

Suggested Readings:

1. Levine, I.N. *Quantum Chemistry*, 2016, Pearson Educ., Inc. New Delhi.
2. Chandra, A.K. 1994, *Introductory Quantum Chemistry*, Tata McGraw Hill.
3. Prasad, R.K., 2009, *Quantum Chemistry*, New Age Science.
4. Mc Quarrie, D. A. (2011). *Quantum Chemistry*. Viva Publishers.
5. Murrell, J.N. Kettle S.F.A. and Tedder, J. M. Valence Theory, 1965, John Wiley.
6. Lowe, J. P. and Peterson, K. 2006, *Quantum Chemistry*, Academic Press.

The following are some of the modes of classroom transaction

- Demonstration
- Group discussion
- Lecture
- Self-learning

Transaction Mode

- Google meet
- PPT
- YouTube

Semester –II

Course Title: Advanced Organic Chemistry-II
Paper Code: MCMC.421
Course Hours: 60h

L	T	P	Credits
4	0	0	4

Learning Outcomes
After completing this course, the learner will be able to:

CLO1: Analyze stereochemistry and spatial arrangements of atoms/groups to predict reaction pathways and mechanisms.

CLO2: Analyze chemical reactions in peptides with respect to their structure and reactivity.

CLO3: Design photochemical reaction pathways for novel or optimized chemical transformations.

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **15 Hours**	**Stereochemistry:** IUPAC nomenclature of organic molecules, Elements of symmetry, Chirality, Projection formulae [Fly wedge, Fischer, Newman and Saw horse], Configurational and conformational isomerism in acyclic and cyclic compounds; Stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity, racemic mixture and their resolution, Configurational notations of simple molecules, D/L, R/S, *E*/*Z* and *cis*/*trans* configurational notations, Threo and erythro isomers, Methods of resolution, Optical purity, Enantiotopic and diastereotopic atoms, groups and faces, Stereospecific and stereoselective synthesis, Asymmetric synthesis, Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), Chirality due to helical shape, Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus, Conformational	**CLO1**

	analysis of cyclic compounds such as cyclopentane, cyclohexane, cyclohexanone derivatives, decalins, 1,2-; 1,3-, 1,4-disubstituted cyclohexane derivatives and D-Glucose, Effect of conformation on the course of rate of reactions, Effect of conformation on reactivity, Conformation of sugars, strain due to unavoidable crowding. **Learning activities:** Learner will be engaged in Molecular models and online modeling tools to explain the stereochemistry of compounds	
Unit 2 **15 Hours**	**Chemistry of peptides:** a) Coupling reactions in peptide synthesis b) Principles of solid phase peptides synthesis, t-BOC and FMOC protocols, various solid supports and linkers: Activation procedures, peptide and bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides. c) Segment and sequential strategies for solution phase peptide synthesis with any two case studies d) Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, over- activation and side reactions of individual amino acids **Learning activities:** Learner will be engaged in practical's involving coupling, protection/deprotection and coupling reactions for peptide synthesis.	**CLO2**
Unit 3 **15 Hours**	**Photochemistry:** Franck-Condon principle, Jablonski diagram, Singlet and triplet states, Photosensitization, Quantum efficiency, Photochemistry of carbonyl compounds, Norrish type-I and type-II cleavages, Paterno-Buchi reaction, Photoreduction, Di π – methane rearrangement. Photochemistry of aromatic compounds, Photo-Fries reactions of anilides, Photo-Fries rearrangement, Barton reaction Singlet molecular oxygen reactions	**CLO3**

	Learning activities: Learner will be engaged in web-based learning to explain photochemical reactions	
Unit 4 **15 Hours**	**Pericyclic Chemistry:** Main features of pericyclic reactions, Classification of pericyclic reactions, Thermal and photochemical pericyclic reactions. Electrocyclic reactions: Conrotation and disrotation, Electrocyclic closure and opening in 4n and 4n+2 systems. Woodward-Hoffmann selection rules for electrocyclic reactions. Explanation for the mechanism of electrocyclic reactions by (i) symmetry properties of HOMO of open chain partner (ii) Conservation of orbital symmetry and orbital symmetry correlation diagrams and (iii) Huckel-Mobius aromatic and antiaromatic transition state method. Examples of electrocyclic reactions. Cycloaddition reactions: Suprafacial and antarafacial interactions. $\pi^2 + \pi^2$ and $\pi^4 + \pi^2$ cycloadditions. Cycloreversions. Stereochemical aspects in supra-supra, supra-antara, antara-supra and antara-antara $\pi^2 + \pi^2$ and $\pi^4 + \pi^2$ cycloadditions. Diels-Alder reaction. Woodward-Hoffmann Selection rules for cycloaddition reactions. Sigmatropic reactions: [1,j] and [i,j] shifts; Suprafacial and antarafacial shifts; Selection rules for [lj} shifts; Cope and Claisen rearrangements **Learning activities:** Learner will be engaged in web-based learning to explain cycloaddition, electrocyclic and sigmatropic reactions.	**CLO3**

Suggested Readings

1. Morrin Acheson, R. (2008) *An Introduction to the Chemistry of heterocyclic compounds.* Wiley India Pvt. Ltd.
2. Clayden, J., Greeves, N., Warren, S., Wothers, P. (2012). *Organic Chemistry.* Oxford press.
3. Ahluwalia, V. K., and Parasar R. K., (2011). *Organic Reaction Mechanism*, Narosa Publishing House (P) Ltd., India.

4. Bansal, R. K., (2012). *Organic Reaction Mechanism*, New Age International (P) Ltd., New Delhi.
5. Bansal, R. K., (2007). *A Text Book of Organic Chemistry*, New Age International (P) Ltd., New Delhi.
6. Bansal, R.K. (2010). *Heterocyclic Chemistry*, New Age International (P) Ltd., New Delhi.
7. Carey B. F. A., Sundberg R.J., (2007). *Advanced Organic Chemistry Part A and Part B, Springer*.
8. Finar, I. L., (2012). *Organic Chemistry Vol. 1*, Pearson Education, UK.
9. Gilchrist, T.L. (1997). *Heterocyclic Chemistry*, Longman, Prentice Hall, US.
10. Gupta R.R., Kumar M., Gupta V. (2010). *Heterocyclic Chemistry-II Five Membered Heterocycles*, Springer Verlag, India.
11. Joule, J.A., Mills, K. (2010). *Heterocyc1ic Chemistry*, Blackwell Publishers, New York.
12. Kalsi P. S., (2010). *Organic Reactions and Their Mechanisms*, New Age International Publication, New Delhi.
13. Lowry, T. H., Richardson K. S., (1998). *Mechanism and Theory in Organic Chemistry*, Addison-Wesley Longman Inc, US.
14. Morrison, R.T., Boyd R.N., (2011). *Organic Chemistry*, Prentice- Hall of India, New Delhi.
15. Mukherjee S. M., Singh S. P., (2009). *Reaction Mechanism in Organic Chemistry*, Macmillan India Ltd., New Delhi.
16. R. Katritzky, (2010). *Handbook of Heterocyclic Chemistry* Elsevier, UK.
17. Smith, M. B. (2013). *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*. John Wiley & Sons.
18. Sykes, P., (1997). *A Guide Book to Mechanism in Organic Chemistry*, Prentice Hall, US.
19. Norman, R.O.C.; Coxon, J.M. (1995). *Principles of Organic Synthesis*, Blackie Academic & Professional.
20. Warren, S., (2010). *Organic Synthesis: The Synthon Approach*. John Wiley & Sons, New York,
21. Warren, S., (2010). *Designing Organic Synthesis: A Disconnection Approach*. John Wiley & Sons, New York.
22. Corey E.J., Cheng Xue-Min, (1989) *The Logic of Chemical Synthesis*, Pubs: John Wiley & Sons,
23. Carey, F. A., Guiliano, R. M. (2012). *Organic Chemistry*. McGraw Hill.
24. Kofie, W., Caddick, S. (2016). *Problems in Advanced Organic Chemistry*. Auris Publishing.
25. Solomons, T. W. G., Fryhle, C. B., Snyder, S. A. (2017). *Solomons' Organic Chemistry*. John Willey & Sons.
26. Fleming (1999). *Pericyclic Reactions***,** Oxford University Press, Oxford.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Team teaching

Transaction Mode

- PPT
- Google meet
- YouTube

Course Title: Organic Synthesis-II (Practical)

L	T	P	Credits
0	0	6	3

Paper Code: MCMC.516
Course Hours: 90h

Learning Outcomes
After completing this course, the learner will be able to:

CLO1: Design optimized chromatographic methods for separation of ortho/para and cis/trans isomeric mixtures.
CLO2: Evaluate multi-step synthesis strategies based on yield, selectivity, and feasibility.
CLO3: Analyze compounds through integrated spectral interpretation of ^{1}H NMR, ^{13}C NMR, IR, UV, Mass, and 2-D NMR data.

Course content

Practical	**Content/Title**	**Mapping with course learning outcome**
1.	Separation and purification of organic compounds by column chromatography: Separation of mixture of *ortho* and *para* mixture and cis/trans mixture. The column chromatography should be monitored by TLC.	**CLO1**
2.	**Multi-Step Synthesis of Organic Compounds:** The Learning activities should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques. (Any five) a) Synthesis of isoxazole derivatives via 1,3-dipolar cycloaddition. b) Synthesis of pyrazole derivatives from chalcones. c) Synthesis of an antihypertensive drug-propranolol via epoxide ring opening reaction. d) Synthesis of Diltiazem (a calcium channel blocker) via Darzen condensation, a key step in its synthesis. e) Protection and deprotection of alcohols and amines. f) Preparation of Triphenyl Carbinol from Bromobenzene (Grignard's reaction) g) Preparation of allylic alcohols via Baylis-Hillman reaction using DABCO as a catalyst under neat condition and their characterization through various spectroscopic techniques. h) Preparation of homoallyl alcohols via Barbier type reaction under aqueous condition using Indium as a catalyst.	**CLO2**

	i) Suzuki reaction of 3,4-dimethoxy phenyl boronic acid with aryl halides using $Pd(PPh_3)_4$ as a catalyst.	
3.	Exercises on identification of compounds *via* combined spectral interpretation of ^{1}H, ^{13}C NMR, IR, UV and Mass along with 2-D NMR spectra.	**CLO3**

Suggested Readings

1. Adams, R.; Johnson, J.R.; Wilcox, C.F. (1970). *Laboratory Experiments in Organic Chemistry*, The Macmilan Limited, London.
2. Mann and Saunders. (2009). *Practical organic chemistry*, Pearson.
3. Pasto, D.P., Johnson, C., Miller, M. (2010). *Experiments and Techniques in Organic Chemistry*, Prentice Hall.
4. Roberts, R.M.; Gilbert, J.C.; Rodewald, L.B.; Wingrove, A.S. (1969). *An introduction to Modern Experimental Organic Chemistry*, Ranehart and Winston Inc., New York.
5. Vogel, A.I. (Latest edition). (1989). *Text book of practical organic chemistry*, Pearson
6. Williamson, K.L., Health, D.C. (1999). *Macroscale and Microscale Organic Experiments*, *Heath, D. C*and Co.,Lexington, MA.
7. Findeisen, M., (2013). *50 And More Essential NMR Experiments: A Detailed Guide.* John Willey & Sons.
8. *https://www.vlab.co.in/broad-area-chemical-sciences*
9. *https://www.vlab.co.in/ba-nptel-labs-chemical-sciences*
10. *https://virtualchemlabs.com/virtual-lab.html*

The following are some of the modes of classroom transaction

- Experimentation
- Group discussion
- Demonstration
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Course Title: Computer Aided Drug Design

L	T	P	Credits
2	0	0	2

Paper Code: MCMC.517
Course Hours: 30h

Learning outcome:
After completing this course, the learner will be able to:

CLO1: Evaluate the effectiveness of CADD approaches in improving efficiency and success rates in drug discovery.
CLO2: Design and develop novel drug candidates using molecular modeling tools and techniques.
CLO3: Analyze structural features and properties required for designing drug-like molecules.

Course Content

Units/Hours	**Content**	**Mapping with course learning outcome**
Unit 1 **8 Hours**	**Introduction to Computer Aided Drug Design (CADD)**: History, different techniques and applications. Quantitative Structure Activity Relationships: Basics. History and development of QSAR: Physiochemical parameters and methods to calculate physiochemical parameters: Hammett equation and electronic parameters (sigma), lipoiphilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physiochemical parameters. Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages: Deriving 2D-QSAR equations. 3D- QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters.	**CLO1**

	Learning activities: Learner will be engaged in group discussion to explain 2D-QSAR, 3D-QSAR and importance of statistical parameters	
Unit 2 **8 Hours**	**Molecular Modeling and Docking:** a) Molecular and Quantum Mechanics in drug design. b) Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation. c) Molecular docking and drug receptor interactions: rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE) **Learning activities:** Learner will be engaged in molecular modeling of compounds	**CLO2**
Unit 3 **7 Hours**	**Molecular Properties and Drug Design:** a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design. b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. c) Homology modelling and generation of 3D-structure of protein. **Learning activities:** Learner will study Molecular model to explain interactions between ligand and drug target	**CLO3**
Unit 4 **7 Hours**	**Pharmacophore Mapping and Virtual Screening:** Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore's modelling; Conformational search used in pharmacophore mapping. In-silico Drug Design and Virtual Screening Techniques. Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.	**CLO2, CLO3**

	Learning activities: Learner will be engaged in Pharmacophore band structure based *In-silico* virtual screening protocols	

Suggested Readings

1. Ellis, G.P., West, G. B. (1983). *Progress in Medicinal Chemistry Series*. Elsevier Science.
2. Foye, W.O., Lemke, T. L., Williams, D. A. (2019). *Principles of Medicinal Chemistry*, Indian Ed. Waverly, Pvt. Ltd. New Delhi.
3. Ganellin, C.R.; Roberts S. M., (1993). *Medicinal Chemistry: The Role of Organic Chemistry in Drug Research*. Publisher: Academics Press Inc.
4. Kadam, Mahadik, Bothara (2010). *Principle of Medicinal Chemistry (Volume I & II)*, Nirali publication
5. Kulkarni, V. M., Bothra, K.G., (2008). *Drug Design*, Nirali Publication.
6. Lawton, G., Witty, D.R. (2011). *Progress in Medicinal Chemistry Series. Volume 50*.
7. Lednicer D., Laster A. M. (1998). *The Organic Chemistry of Drug Synthesis(3 Volumes)* John Wiley & Sons.
8. Lednicer, D. (2008). *Strategies for Organic Drug Synthesis and Design. (7 volume)* Publisher: John Wiley & Sons.
9. Lemke, T.L., Williams, D.A. (2012). *Foye's Principles of Medicinal Chemistry*.
10. Silverman R.B., (2014). *Organic Chemistry of Drug Design and Drug Action*, Publisher: Elsevier.
11. Wilson, C.O.; Block, J.H.; Gisvold, O.; Beale,J. M. Wilson and Gisvold's (2003) *Textbook of Organic Medicinal and Pharmaceutical Chemistry*. Lippincott Willaiams & Wikins.
12. Gore, M., & Jagtap, U. (2018). *Computational Drug Discovery and Design*. Springer Publishers.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Team teaching
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube
- Molecular modeling software
- Google drive
- Google meet

Course Title: Advanced Spectral Analysis
Paper Code: MCMC.518
Course Hours: 60h

L	T	P	Credits
4	0	0	4

Learning outcome:
After completing this course, the learner will be able to:

CLO1: Analyze the applications of UV, IR, and Raman spectroscopy in chemical and pharmaceutical analysis.

CLO2: Analyze 1D and 2D NMR data for structural interpretation of different compounds.
CLO3: Evaluate mass spectral fragmentation patterns for reliable identification of compounds.
CLO4: Design optimized chromatographic methods for separation and quantitative estimation of drugs.

Course Content

Units/Hours	**Content**	**Mapping with course learning outcome**
Unit 1 **15 Hours**	**UV and IR spectroscopy:** Wood ward – Fisher rule for 1,3- butadienes, cyclic dienes and carbonyl compounds and interpretation compounds of enones. **Infrared spectroscopy**: IR Interpretation of organic compounds, NIR Applications. **Raman Spectroscopy:** Introduction, Principle, Instrumentation and Applications. • Learner will calculate λmax for conjugated diene and enone derivatives	**CLO1**

Unit 2 **15 Hours**	**NMR spectroscopy:** 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds. **Learning activities:** Learner will be provided spectra for the identification of compounds	**CLO2**
Unit 3 **15 Hours**	**a. Mass Spectroscopy:** Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds. **b. Spectral Characterization of the following compounds by spectroscopic techniques**: UV, IR, MS, NMR (1H, 13C) a) Carvone, Citral, Menthol b) Luteolin, Kaempferol c) Nicotine, Caffeine d) Glycyrrhizin **Learning activities:** Students will develop advanced skills in data interpretation and problem-solving through the rigorous analysis of spectral data acquired from UV, IR, MS, and NMR experiments conducted on natural products.	**CLO1, CLO2, CLO3**
Unit 4 **15 Hours**	**Chromatography:** Principle, Instrumentation and Applications of the following: a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CE-MS g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-EC (Ion-Exclusion Chromatography) k) Flash chromatography **Learning activities:** Learner will be engaged in Learning experience of chromatography by using different techniques like TLC, Column, HPLC, HPTLC and GC	**CLO4**

Suggested Readings:

1. Silverstein, R. M., Webster, F. X., Kiemle, D. J., & Bryce, D. L. (2014). *Spectrometric Identification of Organic Compounds*. John wiley & sons.
2. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). *Principles of Instrumental Analysis*. Cengage learning.
3. Willard, H. H., Merritt Jr, L. L., Dean, J. A., & Settle Jr, F. A. (1988). *Instrumental Methods and Analysis.*

4. Kemp, W. (1991). *Organic Spectroscopy* (pp. 42-51). London: Macmillan.
5. Sethi, P. D. (1996). *HPTLC: High Performance Thin-layer Chromatography; Quantitative Analysis of Pharmaceutical Formulations.* CBS Publishers & Distributors.
6. Sethi, P. D. (1985). *Quantitative Analysis of Drugs in Pharmaceutical Formulations*. CBS Publishers, New Delhi, 1997.
7. Munson, J. W. (Ed.). (1984). *Pharmaceutical Analysis: Modern Methods* (Vol. 11). CRC Press.
8. Findeisen, M., (2013). *50 And More Essential Nmr Experiments: A Detailed Guide.* John Willey & Sons.
9. Kromidas, S. (2017). *The HPLC Expert Possibilities and Limitations of Modern High Performance Liquid Chromatography*. John Wiley and Sons
10. Pavia, D.L.,Lampman, G.M., Kriz, G.S., Vyvyan, J.R. (2015). Introduction to Spectroscopy (5th edition). Cengage India Private Limited
11. Keeler J. (2011). Understanding NMR spectroscopy. John Wiley and Sons
12. Vitha M.F. (2016). Chromatography: Principles and instrumentation. John Wiley and Sons

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Problem solving

Transaction Mode

- PPT
- YouTube
- Google meet

Discipline Specific Elective Course

Course Title: Green Chemistry
Paper Code: MCMC.519
Course Hours: 45h

L	T	P	Credits
3	0	0	3

Learning outcome

After completing this course, the learner will be able to:

CLO1: Evaluate green chemistry approaches for their effectiveness in promoting sustainability and reducing environmental impact.

CLO2: Evaluate the efficiency of ionic liquids and solid-supported systems as alternatives to conventional solvents.
CLO3: Analyze the application of microwave (MW) and sonication techniques in enhancing organic synthesis.
CLO4: Develop innovative solid-state and aqueous reaction strategies for environmentally benign synthesis.

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **12 Hours**	**Introduction to green chemistry**: History, need and goals. Green chemistry and sustainability, dimensions of sustainability, limitations/obstacles in pursuit of the goals of green chemistry. Opportunities for the next generation of materials designers to create a safer future. Basic principles of green chemistry: Atom economy and scope, Prevention/Minimization of hazardous/toxic products, designing safer chemicals, Selection of appropriate auxiliary substances (solvents, separation agents etc.), use of renewable starting	**CLO1**

	materials, Avoidance of unnecessary derivatization-careful use of blocking/protection groups. Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents, designing biodegradable products, Prevention of chemical accidents, Strengthening/development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. **Learning activities:** Learner will be engaged in Group discussion to explain Green Chemistry Principles	
Unit 2 **12 Hours**	**Approaches to green synthesis:** Basic principles of green synthesis. Different approaches to green synthesis, Use of green reagents in green synthesis: polymer supported reagents, polymer supported peptide coupling reagents. Green catalysts, Phase-transfer catalysts in green synthesis. Advantages of PTC, Reactions to green synthesis, Application of PTCs in C-alkylation, N-alkylation, S-alkylation. Darzens reaction, Williamson's synthesis, Wittig reaction, Click Chemistry. Use of Crown ethers in esterification, saponification, anhydride formation, aromatic substitution and elimination reactions. Water and ionic liquids as green solvents. **Learning activities:** Learner will be engaged in Group discussion to explain the use of PTC and crown ethers	**CLO2**
Unit 3 **12 Hours**	**Microwave induced and ultrasound assisted green synthesis:** Introduction to synthetic organic transformation under microwave (i) Microwave assisted reactions in water (ii) Microwave assisted reactions in organic solvents. (iii) Microwave solvent free reactions Ultrasound assisted reactions: Introduction, substitution reactions, addition, oxidation, reduction reactions. Biocatalysts in organic synthesis: Introduction, Biochemical oxidation and reductions. **Learning activities:** Learner will be engaged in Web based learning to Perform Microwave induced and ultrasound assisted reactions	**CLO3**
Unit 4 **9 Hours**	**Organic synthesis in aqueous phase and in solid state:** Aqueous reactions. Solid state reactions (i) Solid	**CLO4**

	phase synthesis without using any solvent (ii) Solid supported synthesis	

Suggested Readings:

1. Ahulwalia, V.K.; Kidwai M. (2004). *New Trends in Green Chemistry*, Springer
2. Anastas, P.T.; Warner J. C. (2000). *Green Chemistry, Theory and Practical*. Oxford University Press.
3. Grieco, P.A. (1997). *Organic Synthesis in Water*. Publisher: Kluwer Academic.
4. Matlack, A. (2010). *Introduction to green chemistry*. CRC Press.
5. Ahluwalia, V. K. (2011). *Green Chemistry: Greener Alternatives to Synthetic Organic Transformations*. Alpha Science International.
6. Torok, B.; Dransfield, T. (2018). *Green Chemistry: An Inclusice Approach*, Elsevier

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Course Title: Nuclear Chemistry

L	T	P	Credits
3	0	0	3

Paper Code: MCMC.520
Course Hours: 45h

Learning outcome:
After completing this course, the learner will be able to

CLO1: Analyze nuclear structure and factors influencing nuclear stability.

CLO2: Evaluate different nuclear reaction pathways and fission models for efficiency and applicability.

CLO3: Analyze reactor theory and the utilization of nuclear resources in energy production.

CLO4: Develop applications utilizing gamma radiation based on its interaction with matter.

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **11 Hours**	**Nuclear Structure and Stability** Binding energy, empirical mass equation, nuclear models, the liquid drop model, the shell model, the Fermi gas model & collective nuclear model, nuclear spin, parity & magnetic moments of odd mass numbers nuclei. **Learning activities:** Learner will be provided models to explain structure and stability of nucleus	**CLO1**
Unit 2	**Nuclear reaction**	**CLO2**

11 Hours	Introduction, Production of projectiles, nuclear cross section, nuclear dynamics, threshold energy of nuclear reaction, Coulomb scattering, potential barrier, potential well, formation of a compound nucleus, Nuclear reactions, direct Nuclear reactions, heavy ion induced nuclear reactions, photonuclear reactions. **Nuclear fission** Liquid drop model of fission, fission barrier and threshold, fission cross section, mass energy and charge distribution of fission products, symmetric and Asymmetric fission, decay chains and delayed neutrons. **Learning activities:** Learner will be provided Web based learning to understand nuclear fission reactions	
Unit 3 **11 Hours**	**Reactor Theory** Nuclear fission as a source of energy, Nuclear chain reacting systems, critical size of a reaction, research reactors, graphite moderated, heterogeneous, enriched uranium reactors, light water moderated, heterogeneous, enriched uranium reactors, water boilers enriched aq. Homogeneous reactors, Thermonuclear reactors, gamma interactions, shielding and health protection. Reactors in India. **Nuclear Resources in India** Uranium and Thorium resources in India and their extractions, Heavy water manufacturing in India. **Learning activities:** Learner will be engaged in group discussion to understand reactor theory and natural resources in India	**CLO3**
Unit 4 **12 Hours**	**Elements of Radiation Chemistry** Radiation Chemistry, Interaction of radiation with matter, Passage of neutrons through matter, Interaction of gamma radiation with matter, Units for measuring radiation absorption, Radiolysis of water, Free radicals in water radiolysis, Radiolysis of some aqueous solutions **Learning activities:** Learner will be provided Web based learning to understand radiation	**CLO4**

	chemistry and interaction of gamma radiation	

Suggested readings:

1. Friedlander, G., Kennedy, J. W., & Macias, E. S. (1981). *Nuclear and radiochemistry*. John Wiley & Sons.
2. Harvey, B. G. (1962). *Introduction to Nuclear Physics and Chemistry*. Soil Science, 94(4), 274.
3. Haissinsky, M. (1964). *Nuclear chemistry and its applications*. Addison-Wesley Pub. Co.
5. Choppin, G. R., Liljenzin, J. O., & Rydberg, J. (2002). *Radiochemistry and Nuclear Chemistry*. Butterworth-Heinemann.
6. Friedlander, G., Kennedy, J. W., & Macias, E. S. (1981). *Nuclear and Radiochemistry*. John Wiley & Sons.
7. Kanne, W. R. (1961). *Basic Principles of Nuclear Science and Reactors*. Journal of the American Chemical Society, 83(2), 508-508.
8. Darmstadter, J., Landsberg, H. H., & Morton, H. C. (1983). *Energy, today and tomorrow: living with uncertainty*. Prentice Hall.
9. Kenneth: Nuclear Power Today, Tomorrow: ELBS
10. Arnikar, H. J. (1995). *Essentials of nuclear chemistry* (No. 1653). New Age International.
11. Cottingham, W. N., Greenwood, D. A., & Greenwood, D. A. (2001). *An Introduction to Nuclear Physics*. Cambridge University Press.

The following are some of the modes of classroom transaction

- Lecture
- Demonstration
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube

Course Title: Advanced Medicinal Chemistry-II
Paper Code: MCMC.521
Course Hours: 45h

L	T	P	Credits
3	0	0	3

Learning outcome:
After completing this course, the learner will be able to:

CLO1: Analyze the basic concepts of drugs, their pharmacological effects, and screening methods.

CLO2: Analyze drug interactions with various types of enzymes and receptors to understand their mechanisms.

CLO3: Develop novel drug candidates by applying SAR principles and mechanistic insights.

Course Content

Units/Hours	**Content**	**Mapping with course learning outcome**
Unit 1 **10 Hours**	Physicochemical and stereochemical aspects: In relation to biological activity, Drug receptor interaction, Adrenergic hormones and Drugs including biosynthesis, storage, release and metabolism of catecholamines (Adrenaline, Isoprenaline, Salbutamol, Amphetamine, Naphazoline), Cholinergics and Anticholinesterases including biosynthesis, storage and metabolism of acetylcholine (Methacholine Chloride, Neostigmine Bromide), Antiparkinsonism Drugs (Apomorphine). **Learning activities:** Learner will be engaged in Web based learning to study Physicochemical and Stereochemical aspect of drugs	**CLO1**
Unit 2 **10 Hours**	Neuromuscular blocking agents: Gallamine Triethiodide, Succinylcholine chloride,	**CLO2**

	Hypoglycaemic drugs (Tolbutamide), Thyroid hormones and Antithyroid drugs (L- Thyroxine, Propylthiouracil) Pancuronium, vecuronium, rocuronium, rapacuronium, dacuronium, malouètine, duador, dipyrandium, pipecuronium, chandonium. Anticoagulants and haemostatic agents: Warfarin, Phenindione, Oxytocics (includes discussion on Ergot alkaloids) (Ergometrine). Antihistamines including discussion on Sodium cromoglycate (Mepyramine, Diphenhydramine, Chlorpheniramine, Promethazine). Non-steroidal anti-inflammatory drugs and anti–gout drugs: Indomethacin, Phenylbutazone, Allopurinol, Probenecid. **Learning activities:** Learner will be engaged in Molecular modeling study to understand neuromuscular blocking reagent	
Unit 3 **10 Hours**	General Anaesthetic Agents: Introduction, medicinal aspects of anaesthetics, mode of action, gases and volatile liquid anaesthetics, intravenous anaesthetics or fixed anaesthetics, toxicity of general anaesthetics (Divinyl ether, Ethyl chloride, Cyclopropane, Thiopentone Sodium). Local Anaesthetic Agents: Introduction, Structure-activity relationships, benzoic acid derivatives, aminobenzoic acid derivatives, lidocaine derivatives, miscellaneous, toxicity, mode of action (Benzocaine, Procaine Hydrochloride, Lidocaine Hydrochloride). **Learning activities:** Learner will be engaged in web-based study to understand aesthetic reagent	**CLO2**
Unit 4 **15 Hours**	Sedatives-Hypnotics: Introduction, classification of sedative-hypnotics, structure-activity relationships, barbiturates, amides and imides, alcohols and their carbamate derivatives, aldehydes and their derivatives, mode of action, pharmacological properties and side effects (Barbitone, Phenobarbitone, Cyclobarbitone, Pentobarbitone Sodium, Thiopentone Sodium), non-barbiturates (Official drugs). Anticonvulsants: Introduction, epilepsy and its types, SAR, barbiturates (official products), hydantoins, Oxazolidinediones, Succinamides;	**CLO3**

	miscellaneous drugs, (Phenytoin Sodium, Troxidone), Antipsychotic agents: introduction, SAR and drugs like chlorpromazine, prochlorperazine, *etc.* **Learning activities:** Learner will be engaged in group discussion to understand the structures of different sedatives and hypnotics and anticonvulsants.	

Suggested Readings

1. Delgado, J. N. and Remers W A, Ed. (2010). *Wilson & Gisvold's Textbook of Organic and Pharmaceutical Chemistry*, J. Lippincott Co., Philadelphia.
2. Foye, W. C. (2019). *Principles of Medicinal Chemistry*, Publisher: Wolter Kluwer.
3. King, F. D. (2006). *Medicinal Chemistry Principles and Practice*, Royale Society of Chemistry, London.
4. Nogardy, T. and Weaver D F (2005). *Medicinal Chemistry: A Molecular and Biochemical Approach*, Oxford University Press, UK.
5. Patrick, G.L. (2017). *An Introduction to Medicinal Chemistry*, Oxford University PressUS.
6. Singh, H., Kapoor, V.K. (1996). *Medicinal and Pharmaceutical Chemistry* Vallabh Prakashan, Delhi.
7. Smith, H.J. (2006). *Introduction to the Principles of Drug Design and Action*, Taylor and Francis.
8. Wermuth, C.G. (2009). *The Practice of Medicinal Chemistry*, Academic Press (Elsevier).
9. Wolff, M E, Ed., (2010). *Burger's Medicinal Chemistry and Drug Discovery* John Wiley & Sons, New York.
10. Ferrant, E., (2011). *New Synthetic Technologies In Medicinal Chemistry*. Royal Chemical Society.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Semester III

Course Title:
Dissertation/Internship/Apprenticeship
Paper Code: MCMC. 599-1

L	T	P	Credits
0	0		20

Learning outcome:
After completing this course, the learner will be able to:

CLO1: Designing of research problem and prepare synopsis
CLO2: Preparation of synopsis for Project
CLO3: Planning of experiments

Evaluation criteria:
- Literature survey/background information
- Organization of content
- Physical presentation
- Questions and answers
- Report evaluation

Mapping with course learning outcome: CLO1, CLO2, CLO3

The following are some of the **modes of classroom transaction**

- Lecture cum demonstration
- Project Method
- Seminar
- Group discussion

The following **tools** can be used in **different transactional modes**:

PPT Video

Multimedia packages	google drive
TED Talks	

Software tools

- Tracker
- ChemBioDraw
- Schrodingermaestro/AutoDck
- ppt
- BLAST
- Endnote

Semester IV

Course Title:
Dissertation/Internship/Apprenticeship
Paper Code: MCMC. 599-2

L	T	P	Credits
0	0		20

Learning outcome:
After completing this course, the learner will be able to:

CLO1: Perform Experiments
CLO2: Research Presentation
CLO3: Preparation of Dissertation

Evaluation criteria:

- Literature survey/background information
- Organization of content
- Physical presentation
- Questions and answers
- Report evaluation

Mapping with course learning outcome: CLO1, CLO2, CLO3

The following are some of the **modes of classroom transaction**

- Lecture cum demonstration
- Project Method
- Seminar
- Group discussion

The following **tools** can be used in **different transactional modes**:

PPT
Video
Multimedia packages
TED Talks
google drive

Software tools

- Tracker
- ChemBioDraw
- Schrodingermaestro/AutoDck
- ppt
- BLAST
- Endnote