Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B^{++}'Grade (CGPA 2.96)

Name of the Faculty: Science &Technology

(As per New Education Policy 2020)

Syllabus: Medicinal Chemistry

Name of the Course: M.Sc. II (Sem. III &IV)

(Syllabus to be implemented from June 2024)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
NEP 2020 Compliant Curriculum
M.Sc. II (Sem–III & IV)
MEDICINAL CHEMISTRY
Program Preamble

The Master of Science (M.Sc. II (Sem–III & IV) degree program in Medicinal Chemistry is a modern and broad curriculum that aims to equip students with the practical skills needed to apply their knowledge in a variety of scientific and technological contexts, as well as a thorough understanding of the fundamental concepts of Medicinal Chemistry. The program, which aligns with the goal of the National Education Policy (NEP) 2020, provides a versatile, interdisciplinary, and learner-centered curriculum that promotes creative thinking, innovation, and holistic development. The one-year MSc-II Medicinal Chemistry program offers a gradually more complex curriculum that aims to provide a solid foundation in medicinal chemistry while facilitating specialization and interdisciplinary learning. The curriculum is organized around a few major components:

1. **Discipline Specific Core Courses:** These core courses form the backbone of the program, providing in-depth knowledge and understanding of essential medicinal chemistry concepts, theories, and methodologies. Students will engage with topics ranging from Advanced Spectroscopic methods, Drug Development, Advanced organic chemistry, Biochemistry ensuring a robust and comprehensive education in the discipline.
2. **Discipline Specific Elective Courses:** The program encourages intellectual exploration beyond the core discipline by offering a wide range of elective courses. Advanced organic chemistry, Biochemistry, Pharmaceutical Dosage Forms and Pharmaceutical Technology. With the help of these electives, students can explore their interests in a variety of disciplines, which promotes creativity, critical thinking, and a well-rounded education.
3. **Field Projects/Internships/Apprenticeships/Community Engagement Projects:** To bridge the gap between theoretical knowledge and real-world applications, the program includes opportunities for field projects, internships, apprenticeships, and community engagement. These experiences provide students with practical insights, problem-solving abilities, and exposure to professional environments, enhancing their readiness for careers in Chemistry and related fields.
4. **Research Methodology and Research Projects:** The MSc Medicinal Chemistry curriculum places a strong emphasis on research, where students learn about data analysis, scientific inquiry, synthesis of pharmaceutically significant compounds, and research technique. Students are prepared for further education and employment focused on research by being encouraged to solve challenging scientific challenges creatively through individual research projects.

Multiple Entry and Multiple Exit Options

In accordance with the NEP 2020, the MSc Medicinal Chemistry program incorporates a Multiple Entry and Multiple Exit framework, offering students the flexibility to enter or exit the program at various stages. This approach ensures that students can tailor their educational journey according to their personal and professional goals, with options to earn certificates, diplomas, or degrees based on the duration of study completed.

Year1:
Upon completion of the first year, students may exit with a **Certificate in Medicinal Chemistry**.
Year2:
After two years, students may choose to exit with a **MSc Degree in Medicinal Chemistry**

M.Sc. II Medicinal Chemistry (w.e.f. 2024-25)
Syllabus Structure and Credit Distribution

Level/ Difficulty	Semester	Paper Code	Title of the Paper	Semester exam			L	T	P	Credits
			Mandatory	**Theory**	**IA**	**Total**				
		DSC-5 2327301	Advanced Spectroscopic Methods	60	40	100	4	--	-	4
		DSC-6 2327302	Drug Development	60	40	100	4		-	4
			Elective (Anyone)							
		DSE-3 A 2327306	Advanced Organic Chemistry	60	40	100	4		-	4
	III	**DSE-3 B 2327307**	Biochemistry	60	40	100	4		-	
			Field Project/RP/Internship/Apprenticeship							
		RP 2327303	Research Project	60	40	100	4	-	0	4
			Practical							
		DSC-5 P 2327304	Spectral Analysis	30	20	50	-	-	2	6
		DSC-6 P 2327305	Organic Synthesis	30	20	50	-	-	2	
			Elective (Any one)							
		DSE-3A P 2327308	Organic Ternary Mixture	30	20	50			2	
		DSE-3B P 2327309	Biochemistry	30	20	50			2	
			Total for III semester	**330**	**220**	**550**	**16**	**550**	**6**	**22**
			Mandatory							
		DSC-7 2327401	Modern Organic Chemistry	60	40	100	4	--	-	4
		DSC-8 2327402	Drugs & Heterocycles	60	40	100	4		-	4
			Elective (Any one)							
		DSE-4A 2327405	Pharmaceutical Dosage Forms	60	40	100	4		-	4
	IV	**DSE-4B 2327406**	Pharmaceutical Technology	60	40	100	4		-	
			Field Project/RP/Internship/Apprenticeship/							
		RP 2327403	Research Project	90	60	150	6	-	0	6
			Practical							
		DSC-7 P 2327404	Organic Chemistry	30	20	50	-	-	2	4
			Elective (Any one)							
		DSE-4A P 2327401	Drug assay and drug formulations	30	20	50			2	
		DSE-4B P 2327408	Pharmaceutical Technology	30	20	50			2	
			Total for IV semester	**330**	**220**	**550**	**18**	**550**	**4**	**22**
6.5/400										

DSC- Discipline Specific Course
DSE- Discipline Elective course
RM- Research Methodology
OJT- On Job Training
RP – Research Project
L – Lecture, **T** – Tutorial, **P** – Practical
Credits of Theory = 4 Hours of teaching per week
2 Credits of Theory = 4 Hours per week

Important Note:

1. Student should choose any one subject from Elective for Sem-III.
2. The Research Project can be initiated at the end of Semester II and the midterm examination will be conducted at the end of Semester- III, for 4 credits.
3. Student should choose any one subject from Elective for Sem-IV
4. Each theory course prescribed for M. Sc. should be covered in 4 lectures per course per week each of 60 minutes duration including lectures, tutorials, seminars, classroom discussions, etc. (Total 60 h / theory course)
5. Each practical course will require 12 h of laboratory work per week per semester.
6. The research project may be extended over two semesters viz. Semester III and IV of 06 h/ week /group and can be initiated at the end of Semester II. The examination will be conducted at the end of Semester IV for 6 credits.
7. For theory course, the question paper (Internal/External) may include numerical, short answer, long answer, MCQ questions to test understanding of the subject.
8. The marks for each paper are distributed as - external examination 60 marks and internal examination 40 marks. For internal assessment of each theory and practical course, 2 written tests will be taken.
9. Organizing educational tour aiming at giving practical exposure to students is expected (at their own cost). At the end of tour, students should submit the observations/report to the School.
10. To train the students for the SET/NET/GATE and other competitive examinations, University/College assessment questions should test the understanding of candidate rather than the memory. The question paper should cover all the Units included in the syllabus of the respective paper and the weightage of the questions should correspond to the number of lectures allotted to the respective Units / Topics.

M. Sc. II, Semester-III (Medicinal Chemistry)

DSC-5: Advanced Spectroscopic Methods

Course Code: 2327301

(Credit: 04, Theory: 60 Periods, Marks: 100)

Course Preamble: In advanced spectroscopic method, study of ^{1}H NMR, ^{13}C NMR, 2D NMR spectroscopy and mass spectrometry are described and discussed. Their application for determining structure of molecule such as electronic environment, coupling constant, Mass of the molecule and related spectroscopic problems are introduced and illustrated. This part of the course includes different NMR and mass techniques where advanced technique is used for structure determination.

Course Objectives

- To know the applications of IR spectroscopy
- To understand the different types of NMR techniques and their applications for structural determination
- To get skill for the confirmation of drug structure based on mass spectrometry
- To analyze drug molecules based on all spectral techniques.

Unit 1: Nuclear Magnetic Resonance Spectroscopy [Hrs: (15), Weightage: 20 Marks]
General introduction and definition, criteria required for NMR signal, origin of NMR, integration of a peak, different solvents used in NMR, chemical shift and factors affecting on chemical shifts in NMR, origin of spin-spin splitting, coupling constant, Nomenclature for coupling constant (*J*), Spin-spin couplings and n+1 rule, different types of couplings and factors affecting on coupling constants, Karplus equation, Chemical and magnetic equivalence, Nonequivalence within groups, first ordered and second ordered spectra, different spin systems (AB, AX, A_2, AB_2, AX_2, A_2B_2, A_2X_2, AA'XX', AA'BB', ABX, AMX), solvents used in NMR like shift reagents.

Unit 2: A] ^{13}C-Nuclear Magnetic Resonance Spectroscopy

[Hrs: (8), Weightage: 12 Marks]

Salient facts about ^{13}C NMR and elementary ideas, instrumental difficulties, FT technique advantages and disadvantages, factors affecting on chemical shifts, analogy with ^{1}H NMR, calculations of chemical shift of hydrocarbons, different types of carbons (alkene, alkyne, allene, carbonyl, nitrile, oxime, aromatic carbons etc. and effect of substituent on chemical shifts of carbons, chemical shifts of solvents, proton noise decoupling technique advantages

and disadvantages, off-resonance technique. spectral problems on ^{13}C NMR application.

B] Two-Dimensional (2D) NMR Spectroscopy [Hrs: (7), Weightage: 8 Marks]

Introduction, Types of 2D NMR, COSY, TOCSY or HOHAHA, 2D-INADEQUATE, NOESY, ROESY, DEPT and APT, HETCOR (including interpretation of COSY and HETCOR spectra).

Unit-3: Mass Spectrometry [Hrs: (15), Weightage: 20 Marks]

Introduction, principle of MS, Formation of ions, ion production (EI, CI, FD, MALDI, FAB), ion analysis, ion abundance, factors affecting on fragmentation, Different types of ion peaks like molecular ion peak, base peak, isotopic peaks, metastable peak, Nitrogen rule, fragmentation of different functional groups, Retro-Diels-Alder reaction, McLafferty rearrangement, Ortho-effect.

Unit 4: Joint problems-based application of IR, NMR & Mass spectroscopy

[**Hrs: (15)**, **Weightage: 20 Marks**]

Course Outcomes

After completion of course students will be able to

- Determine the structure from the provided structural data
- Apply the theoretical knowledge of spectroscopy to determine the structure of unknowncompounds.
- The student can determine the structure of drug molecules on the basis of different NMRtechniques.
- The student can adopt the skill to interpret spectra of drug molecules.
- The student is able to analyse and confirm drug molecules by using spectral techniques.
- The student is able to apply IR techniques to drug molecules.

Reference books

1. D. L. Pavia, G.M. Lamp man, G. S. Kriz, 3rdEd. Introduction to Spectroscopy, Harcourt College publishers
2. Sharma B K: Instrumental methods of Chemical Analysis, Goel Publishing House
3. Silverstein R M, Bassler G C: Spectrometric Identification of Organic Compounds, John Wiley
4. Sharma Y R: Elementary Organic Spectroscopy, Jalandhar
5. Kalsi P S: Spectroscopy of Organic Compounds, New Age International Ltd.
6. V. M. Parikh: Absorption spectroscopy of organic molecules

7. D. H. Williams and I. Flemming: Spectroscopic methods in organic chemistry, McGraw Hill
8. Nuclear Magnetic Resonance – Basic Principles- Atta-Ur-Rehman, Springer- Verlag (1986)
9. Atta -Ur-Rehman: One- and Two-dimensional NMR Spectroscopy- Elsevier (1989)
10. Joseph B. Lambert, Shurvell, Lightner: Organic structural spectroscopy- Cooks, Prentice-Hall (1998)
11. Field L. D., Kalman J.R. and Sternhell S: Organic structures from spectra- 4th Ed. John Wiley and sons Ltd.
12. Jackmann and Sternhell S: NMR spectroscopy of Organic compounds

DSC-6: Drug Development

Course Code: 2327302

(Credit: 04, Theory: 60 Periods, Marks: 100)

Course Preamble: In this part, basic and advanced points of drug developments are included. First unit contains Concept of drug. Various computer aided drug designing concepts are discussed in unit II. Unit III includes study of pharmacokinetics. Concept of Pharmacodynamics is discussed in Unit IV.

Course Objectives

- To understand the concept and sources of drug
- To get ability to design structure of drug molecule based on SAR and CADD
- To understand the concept of ADME
- To know the mechanism of action of drug
- To understand the concept of Pharmacodynamics

Unit-1: Concept of drug [**Hrs: (15)**, **Weightage: 20 Marks**]

Concept of drug, Sources of drugs, Drug development, Lipinski rule of 5, Physico chemical properties of molecules: lipophilicity, electrokinetic parameters, steric parameters, pKa (eg. Cimetidine development), and solubility. Types of receptors, Protein and Protein Data Bases.

Unit-2: Computer aided drug designing **[Hrs: (15), Weightage: 20 Marks]**

Structure and ligand-based drug designing, Lead and druglike properties, concept of lead identification and modification, Structure-activity relationship (SAR), Factors affecting bioactivity, History and development of QSAR, Types of molecular descriptors, Methods of molecular descriptor selection, 2D QSAR modeling, Introduction to molecular docking and

illustrations (NNRTIs and COX-inhibitors).

Unit-3: Pharmacokinetic **[Hrs: (15), Weightage: 20 Marks]**

Introduction to drug absorption, distribution, metabolism, elimination and toxicity (ADMET). Pharmacokinetic models, bioavailability, Pharmacokinetic parameters (volume of distribution, elimination half-life, clearance). Concept of pro-drug and soft drug.

Unit-4: Pharmacodynamics [**Hrs: (15)**, **Weightage: 20 Marks**]

Introduction to LD_{50}, ED_{50}, IC_{50}, MIC, MEC and Ki. Dose-response relationships, drug potency and efficacy. Principles of drug action, mechanisms of drug action, drug receptor interactions, combined effect of drugs.

Course Outcomes

- The student is able to understand the concept and sources of drug
- The student can get ability to design structure of drug molecule based on SAR and CADD
- The student is able to understand the concept of ADME
- The student knows the details about the mechanism of action of drug.

Reference Books

1. D. M. Brahmankar, Sunil S. Jaiswal, Biopharmaceutics and Pharmacokinetics
2. Ashutosh Kar, Medicinal Chemistry, New Age International Publishers, Fourth Edition
3. Gareth Thomas, Fundamentals of Medicinal Chemistry, University of Portsmouth, UK
4. Graham L. Patrick, An Introduction to Medicinal Chemistry, Fifth Edition, Oxford University Press
5. Edward H. Kerns and Li Di, Drug-like Properties: Concepts, Structure Design and Methods, Elsevier, 2008
6. Gupta, S. P. (2011) QSAR & Molecular Modeling. Anamaya Pub.: New Delhi.
7. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry, 3/eS, Chand Publications
8. Grigauge A, Introduction to Medicinal Chemistry; Wiley-VCH
9. Pandey S S, Dimmock J R, An Introduction to Drug Design; New Age International
10. Wolff Ed M EV, Burger's Medicinal Chemistry and Drug Discovery (6th Edition); John Wiley
11. Silverman R B, The Organic Chemistry of Drug Design and Drug Action; Academic Press
12. William Foye, Lippicott, Principles of Medicinal Chemistry (6th Edition); William and Wilkins

13. Kadam S S, Mahadik, Bothera, Principles of Medicinal Chemistry (11th Edition); Nirali Publication
14. Satoskar R S, Bhandarkar, Pharmacology and Pharmacotherapeutics; Popular Prakashan
15. Organic Chemistry: Clayden, Greeves, Warren and Wo

DSE-3A: Advanced Organic Chemistry

Course Code: 2327306

(Credit: 04, Theory: 60 Periods, Marks: 100)

Course Preamble: Advanced organic chemistry includes name reactions, rearrangements, enolates study and organoborane reagents which are important parts of organic synthesis. Unit I includes discussion of enolates of various functional groups, its formation and applications. Unit II and III includes advanced name reactions and rearrangements used in organic synthesis. Unit IV has study of various organoboranes and its applications in organic synthesis.

Course Objectives

- To understand the enolate chemistry in different reactions
- To study different name reactions, reagents and rearrangements.
- To know in detail chemistry of organoboranes.
- To apply knowledge all types of reactions while designing the drug molecules.

Unit-1: Alkylation of Enolates and Other Carbon Nucleophiles

[Hrs: (15), Weightage: 20 Marks]

Generation and Properties of Enolates and Other Stabilized Carbanions: Generation of Enolates by Deprotonation, Regioselectivity and Stereoselectivity in Enolate Formation from Ketones and Esters, Other Means of Generating Enolates, Solvent Effects on Enolate Structure and Reactivity. Alkylation of Enolates: Alkylation of Highly Stabilized Enolates, Alkylation of Ketone Enolates; Alkylation of Aldehydes, Esters, Carboxylic Acids, Amides, and Nitriles; Generation and Alkylation of Dianions; Intramolecular Alkylation of Enolates; Control of Enantioselectivity in Alkylation Reactions. The Nitrogen Analogs of Enols and Enolates: Enamines and Imine Anions

Unit -2: Name reactions **[Hrs: (15), Weightage: 20 Marks]**

Darzen, Prins, Henry, Bamford-Steven, Baylis-Hillmann, Corey-Fuchs Reaction, Julia Olefination, Mukaiyama aldol, Corey-Winter olefination, Shapiro, Ritter, Stille, Heck, Sonogashira, Suzuki, Negishi, Kumada, Hiyama, Tsuji-Trost, Duff, Chugaev, Ring closing metathesis (Grubb's metathesis), Aldol-Tishchenko reaction (Evans-Tishchenko reaction),

Strecker amino acid synthesis, Biginelli reaction, Gewald reaction, Hantzsch pyridine synthesis, Mannich reaction, Ugi reaction, Passerini reaction, Petasis reaction.

Unit-3: Rearrangements and Reagents [**Hrs: (15)**, **Weightage: 20 Marks**]

Rearrangements: Payne, Eschenmoser fragmentation, Brook, Wagner-Meerwein, Wolf, Semipinacol, Epoxide rearrangement with lewis acid, Tiffeneau-Demjanov, von Richter, Wittig, Neber, Smiles, Steven, Hofmann, Iodolactonisation, Hoffmann-Loffler Fretag reaction, **Reagents**: Lithium dialkylcuprate (LDC), DCC, DDQ, Organotin reagents, Peterson's synthesis, Trimethylsilyl iodide, PPA, Selenium dioxide

Unit-4: Organoboranes [**Hrs: (15)**, **Weightage: 20 Marks**]

Preparation and properties of organoborane reagents e.g. RBH_2, R2BH, R_3B, 9-BBN, catechol borane. Thexylborane, cyclohexylborane, $ICPBH_2$,-21-IPC_2BH, Hydrboration mechanism, stereo and regeoselectivity, uses in synthesis of primary, secondary tertiary alcohols, aldehydes, ketones, alkenes. Synthesis of EE, EZ, ZZ dienes and alkyenes. Mechanism of addition of IPC_2BH. Allyl boranes- synthesis, mechanism and uses.

Course Outcomes

- The student is able to understand enolate chemistry in different reactions
- The student study different name reactions, reagents and rearrangements.
- The student knows in detail chemistry of organoboranes.
- The student able to apply knowledge all types of reactions while designing the drug molecules.

Reference Books

1) A guidebook to Mechanism in Organic Chemistry (Orient- Longmens)- Peter Sykes
2) Francis A. Carey, Richard J. Sundberg - Advanced Organic Chemistry Part B. Reactions and Synthesis-Springer (2007)
3) Organic Reaction Mechanism (Benjamin)-R. Bresslow
4) Mechanism and Structure in Organic Chemistry (Holt Reinhartwinston)- B. S. Gould
5) Organic Chemistry (McGraw Hill)-Hendrikson, Cram and Hammond
6) Basic principles of Organic Chemistry (Benjamin) J. D. Roberts and M. C. Caserio.
7) Reactive intermediates in Organic Chemistry 9 Jojn Wiley) N. S. Issacs.
8) Organic reaction mechanism (Mc Graw Hill) R. K. Bansal
9) Advanced organic chemistry, part B: Reaction and synthesis by Francis A. Carey, Richard Y. Sandburg.
10) Organic Chemistry by Clayden, Greeves, Warren and Wothers.

DSE-3B: Biochemistry

Course Code: 2327307

(Credit: 04, Theory: 60 Periods, Marks: 100)

Course Preamble: Biochemistry includes different units which important for getting knowledge of chemical processes in living organisms. Unit 1 give detailed introduction of biochemistry. Carbohydrate biochemistry is discussed in unit 1. Unit 2 is related to discussion of lipids and proteins biochemistry. Study of biochemistry of nucleic acids, vitamins and coenzymes are included in unit 3. Unit 4 includes study of bioinorganic chemistry.

Course Objectives

- To know the basic concepts of biochemistry and carbohydrates
- To understand the classification and structures of proteins and lipids
- To get knowledge about DNA, RNA, Vitamins etc.
- To know the role of bioinorganic chemistry in human body

Unit-1 **[Hrs: (15), Weightage: 20 Marks]**

Introduction of Biochemistry: The molecular logic of life; Structural hierarchy in the molecular organization of Cells. The chemical unity of diverse living organisms, prokaryotic and Eukaryotic. Scope of the subject in pharmaceutical Sciences

Carbohydrates: Classification, basic chemical structure, monosaccharides, aldoses, and ketoses, cyclic structure of monosaccharides, stereoisomerisms, anomers and epimers. Reducing properties of monosaccharides, disaccharides, oiligosaccharides, polysaccharides, structural studies methylation and periodate oxidation. Polysaccharide's structure and function of complex carbohydrates, proteoglycans, glycoproteins, Glycolipids, mucopolysaccharides.

Unit-2: Protein and Lipids **[Hrs: (15), Weightage: 20 Marks]**

Protein: Classification and properties of amino acids, primary, secondary, tertiary and quaternary structure of protein. Synthesis, purification, characterization, and sequencing of protein molecules.

Lipids: Classification, structure, and function of lipids. Acylglycerols, circulating lipids: lipoproteins, chylomicrons, LDL, HDL, and VLDL. Pathalogical changes in lipid levels. Formation of micelles, monolayers, bilayer, liposomes. Lipid metabolism: Beta oxidation of fatty acids

Unit 3: Nucleic acids, Vitamins and Co-enzymes

[Hrs: (15), Weightage: 20 Marks]

Nucleic acids: Molecules of Heredity: Structure of deoxyribonucleic acid (DNA) and ribonucleicacid (RNA), DNA double helix, A, B and Z forms of DNA, DNA as genetic material, genetic code, flow of genetic information, DNA replication, transcription and translation.

Vitamins and Co-enzymes: Classification, water-soluble and fat-soluble vitamins. Structure, dietary requirements, deficiency conditions, coenzyme forms.

Unit 4: Bioinorganic Chemistry [Hrs: (15), Weightage: 20 Marks]

Principles of coordination chemistry related to bioinorganic–proteins, nucleic acids and other metal binding biomolecules. Choice, uptake, and assembly of metal containing units in biology. Control and utilization of metal ion concentration in cells. Metal ion folding and cross linking of biomolecules. Binding of metal ions and complexes to biomolecular active centers.

Course Outcomes

- The student knows the basic concepts of biochemistry and carbohydrates
- The student is able to understand the classification and structures of proteins and lipids
- The student is able to understand the role of bioinorganic chemistry, DNA, RNA and Vitamins etc.

Reference Books

1) Principle of Biochemistry, Lehinger D.L. Nelson and M.M. Cox. Macmillanworth Publishers
2) Biochemistry by Satyanarayana
3) Principle of Biochemistry, Lehinger D.L. Nelson and M.M. Cox. Macmillan worth Publishers
4) Biochemistry, L. Stryker, W.H. Freeman, San Francisco
5) Schaum's Outline Steries of Theory and Problems of Biochemistry, Philip W. Kuchel and G.B.Ralston. Int. Ed., McGraw-Hill Book Co.
6) Problem Approaches in Biochemistry. Wood and Hood
7) Biochemistry, L. Stryer, W.H. Freeman, San Francisco
8) Problem Approaches in Biochemistry Wood and Hood

Textbooks

1) Principles of Bioinorganic Chemistry: S.J. Lippard & J.M Berg (1994), University science books, Mill Valley, California Chapters-1,2,3,5,6,7,8
2) Ligand field theory & its application: B.N.Figgis & M.A. Hitchman (2000) Wiely VCH

publ. Chapters 5, 6, 8, 9, 11

3) Inorganic Chemistry: Shriver & Atkins (1999) Oxford
4) Inorganic Electronic spectroscopy: A.B.P. Lever, 2nd edn (1984), Elsevier Science Publishers, New York
5) Biological Chemistry of the Elements: R.J.P. Williams & F.R. de Salvia, Oxford University, Press-(1991)
6) Bioinorganic Chemistry: Inorganic elements in the Chemistry of life: An introduction & guide: W.Kaim, B.Schwederski, VCH,(1991)

RP: Research Project

Course Code: 2327303

(Credit: 04, Marks: 100)

Course Preamble: The research project for M. Sc. Medicinal Chemistry is mainly intended to evoke the innovation skill in student. The course will provide an opportunity to apply knowledge and analytical skills learned, to be developed as a prototype or simulation.

Course Objectives:

- The research project for M. Sc. Medicinal Chemistry is constructed to get familiarize with literature survey important for designing of organic product/new organic molecules/synthetic routes and related applications.
- It is expected that project should provide hands on training to the students on various instruments.
- They should learn independent working on a short research project. Students are required to work for a specific project under supervision of concerned faculty member. There will be computer laboratory session for hands on Chem draw software and literature survey by using Google Scholar/ Science Direct/Scopus/Web of Science etc. A student shall be expected to carry out literature survey in the field of interest and to select a topic for his/her project work in consultation with the supervisor. It shall be expected that a student justifies the gravity and also the relevance of the problem through his/her seminar.

Candidates are expected to do the following work at computer laboratory.

1. Literature survey
2. Work plan
3. Handling of Chem draw software for structure drawing
4. Chem draw assignment

5. Synopsis preparation

The allotment of the topic will be done in the initial period of third semester. Hence students can start their work in the third semester itself. Each student is supposed to work for at least 60 hours for his/her project. At the last he/she must submit project report and present thework done at the time of viva voce.

Course outcomes:

- After completion of course students will be able to
- Apply theoretical knowledge to carry out research.
- Review research going on in respective field.
- Use different practical techniques.
- Get information about different spectroscopic instruments and use of spectroscopic data for interpretation of the results.

DSC-5 P: Spectral Analysis

Course Code: 2327304

(Credit: 02, Practical: 60 Periods, Marks: 50)

Course Preamble: To get the practical knowledge of various spectroscopic methods such as IR, NMR, Mass spectroscopy. To impart knowledge in determining structures of pharmaceutically important molecules with the help of various spectra.

Course objective:

- To apply the basics of spectroscopy in determining the structure of pharmaceutically important molecule.
- To interpret various spectra.
- To identify the structure of pharmaceutically important molecule with the help of IR and NMR spectra.
- To analyze fragmentation pattern in the mass spectra of pharmaceutically important molecule.

Identification of Pharmaceutically important Intermediates by the analysis of their spectra. Photocopies of UV, IR, NMR and Mass spectra of standard compounds are to be interpreted to determine the structure of the compound. At the time of practical examination, candidates are expected to submit the Journal.

Course outcomes: After completion of the course students will be able to

- Apply the basics of spectroscopy in determining the structure of pharmaceutically important molecule.
- Interpret structures of molecules with the help of various spectra.
- Analyze fragmentation pattern in the mass spectra of pharmaceutically important molecule

DSC-6 P: Organic Synthesis

Course Code: 2327305

(Credit: 02, Practical: 60 Periods, Marks: 50)

Course preamble: The practical course is designed in such a way that students will learn about various methods for synthesis of pharmaceutically important molecules. Students will get knowledge about reaction set up, different work up methods in the synthesis; follow up of reactions with the help of TLC technique.

Course Objectives: This course is designed in such a way that students will get an experiential idea based on theoretical curriculum. This course contains one and two stage preparation based on name reactions, rearrangements and other basic concept from theory.

One/Two organic preparations starting with 5g or less (Any five)
(TLC, MP /BP analysis and recrystalization of product is recommended)

1. Preparation of aromatic aldehydes by Vilsmer Haack reaction or R. T.
2. Preparation of p-chloronitrobenzene by Sandmeyer reaction
3. Preparation of p-Iodonitrobenzene by Sandmeyer reaction
4. Stork enamine synthesis
5. Mukaiyama Esterification
6. Pechmann Condensation (Coumarin synthesis)
7. Aldol condensation (Chalcone)
8. Benzilic acid rearrangement
9. Fischer indole synthesis
10. Friellander Synthesis
11. Preparation of Benzanilide by Beckmann rearrangement
12. Preparation of Antharanilic acid
13. Preparation of Phthalimide
14. Preparation of N-Bromosuccinamide
15. Preparatin of p-Aminobenzoic acid

16. Pinacol- Pinacolone rearrangement
17. Preparation of Acetophenones by Fries rearrangement
18. Wittig reaction
19. Preparation of Benzopyrazole
20. Hantzsch pyridine synthesis
21. Ugi Reaction
22. Biginelli reaction
23. Gewald reaction
24. Dess-Martin Oxidation: Oxidation of benzyl alcohol to benzaldehyde
25. Synthesis of benzil from deoxybenzoin using SeO_2 reagent

(**Note**: Other suitable experiments may be added)

Course Outcomes: After completion of course, students will be able to

- Co-relate between theoretical concept and practical work.
- Learn One/Two organic preparations starting with 5g or less amount.
- To monitor reaction progress by using TLC chromatography.
- Students will understand the various methods of recrystallization of the product.

DSE-3A P: Organic Ternary Mixture

Course Code: 2327308

(Credit: 02, Practical: 60 Periods, Marks: 50)

Course preamble: To get knowledge of physical and chemical methods of separation of given ternary mixture. To use the basic knowledge of theory in identification of compounds separated from ternary mixture. Students will be able to determine physical constant, detect various element in the given compound, identify the functional group of given compound and prepare derivatives of separated compounds.

Course Objectives: This course is designed in such a way that students can learn to separate different organic compounds and determine the structure from various basic methods.

Separation, purification and identification of organic compounds (Three components' mixtures) by chemical tests, derivatives etc. using microscale technique. IR spectra to be used for functional group identification. TLC and Column Chromatography.

Course outcomes: After the completion of reaction students will be able to

- Separate acidic, phenolic, basic and neutral compounds from given ternary mixture using

physical and chemical methods.

- Identification of organic compounds from different chemical tests.
- Prepare derivatives of synthesized compounds.

DSE-3B P: Biochemistry

Course Code: 2327309

(Credit: 02, Practical: 60 Periods, Marks: 50)

Course preamble: Course is designed such that students will use different methods of quantitative analysis of biochemical compounds such as carbohydrates, proteins, lipids etc. Students will learn different methods of extraction and isolation methods of biochemical compounds.

Course objectives:

- To carry out experiments for quantitative analysis of biochemical compounds such as carbohydrates, proteins.
- To determine molar extinction coefficient, total viable counts of molecules.
- To know various methods of isolation of bacterial, animal, plant and plasmid DNA

List of Practicals

1. Estimation of carbohydrates
2. Estimation of proteins
3. Molar extinction coefficient of molecules
4. Extraction and estimation of lipids
5. Direct microscopic counts
6. Total viable counts
7. Control of microbial growth
8. Determination of MIC (plate method)
9. Isolation of Bacterial, animal, plant and plasmid DNA
10. Agarose gel electrophoresis of DNA

(**Note**: Other suitable experiments may be added)

Course outcomes: After completing the course students will be able to

- Perform quantitative analysis of molecules.
- Determine molar extinction coefficient, total viable counts of molecules
- Isolate biochemical molecules.
- Extract biochemical molecules.

M. Sc. II, Semester-IV (Medicinal Chemistry)

DSC-7: Modern Organic Chemistry

Course Code: 2327401

(Credit: 04, Theory: 60 Periods, Marks: 100)

Course Preamble: Modern organic chemistry includes basic concepts of stereochemistry and stereochemistry of reactions using chiral substrate, chiral auxiliary and chiral reagents. Unit I include basic concepts and terms involved in stereochemistry. Stereochemistry of fused and bridged rings is discussed in detail in unit II. Unit III and IV includes detailed study of asymmetric synthesis using chiral pool, chiral auxiliary, chiral substrate and chiral reagents

Course Objectives:

- To explain the basic concepts and terms involved in stereochemistry.
- To learn about stereo chemical notations.
- To describe the stereochemistry of substitution reaction
- To describe about chiral reagents and catalysts
- To learn about asymmetric synthesis

Unit-1: Conformational Analysis and Reactivity [Hrs: (15), Weightage: 20 Marks]

Differences in the stability of Diastereomers, Relative reactivity of Diastereomers in ionic elimination, Intramolecular rearrangement, Neighboring Group Participation (NGP), Molecular elimination. Curtin- Hammett principle, Conformational stability and Reactivity of cyclohexane six membered ring system.

Unit-2: Fused and Bridged rings [Hrs: (15), Weightage: 20 Marks]

Introduction, Nomenclature of bicyclic systems, cis- and trans-decalins and nine methyl decalins, perhydroanthracene, perhydraphenanthrene, Bridged rings systems and its reactivity, Bredts rule and stereo chemical restrictions

UNIT-3: Asymmetric synthesis-I [Hrs: (15), Weightage: 20 Marks]

Introduction to Stereoselective and stereospecific reactions

Chiral Pool: [α-hydroxy acids and α-amino acids]

Chiral auxiliary: SAMP/RAMP, Mayers Oxazolines, Evans Oxazolidinones, L-valine (Schollkopf Bislactimethers), Seebach Imidazolens from (S)-mandelic acid, Seebach α-

hydroxy acids i.e. (*S)*-lactic acids, Cyclic hydrazones.

Chiral reagent: BINAL, BINAP; Hydroboration- Ipc_2BH, $IpcBH_2$, R/S-Alpine borane, DIP-Cl (diisopinocamphylborone chloride), Misamane's Ligand (2,5-dimethylborolane);

Chiral catalyst: CBS, NADH, baker's yeast. Asymmetric epoxidation: Sharpless epoxidation, Jacobson-katsuki epoxidation and Shi epoxidation. Sharpless asymmetric dihydroxylation

UNIT-4: Asymmetric synthesis-II [Hrs: (15), Weightage: 20 Marks]

Acyclic Stereocontrol – attack on aldehydes and ketones with α-stereocentres (Crams Model, Felkin-Anh model, Cram-Chelate model); Diastereoselective enolate alkylation, Diastereoselectivity of aldol reactions (Zimmerman-Traxler transition state model), Diastereoselective enolate alkylation by Evans oxazolidinone auxiliaries; Diastereoselective allylation reactions of crotyl boronates and chiral allyl boron reagents; Proline catalyzed asymmetric aldol reactions, mannich reactions; Diastereoselective Reduction; Diastereoselective reduction (Evans-Saksena and Evans-Tishenko); Stereocontrol– attack on alkenes with α-stereocentres in hydroboration and epoxidation reaction.

Course Outcome

After completion of course students will be able to

- Relate the structure and medicinal properties of drugs.
- Differentiate between different types of stereoisomers, including enantiomers and diastereomers
- Predict the accurate stereochemistry of products of asymmetric synthesis.

References

1) (Topics in Heterocyclic Chemistry 25) Géraldine Masson, Luc Neuville (auth.), Romano V. A. Orru, Eelco Ruijter (eds.) - Synthesis of Heterocycles via Multicomponent Reactions II-Springer-Verlag Berlin
2) Jieping Zhu, Qian Wang, Meixiang Wang - Multicomponent Reactions in Organic Synthesis-Wiley-VCH (2015)
3) K.L. Ameta Ph.D., Anshu Dandia - Multicomponent Reactions_ Synthesis of Bioactive Heterocycles-CRC Press (2017)
4) Zhu J., Bienhame H. (eds.) - Multicomponent Reactions-Wiley-VCH (2005)
5) Raquel P. Herrera, Eugenia Marqués-L_pez - Multicomponent Reactions_ Concepts and Applications for Design and Synthesis-Wiley (2015)
6) Majid M. Heravi, Vahideh Zadsirjan - Recent Advances in Applications of Name Reactions in Multicomponent Reactions-Elsevier (2020)

7) Stereochemistry of Organic Compounds (Principle and application): D. Nasipuri
8) Stereochemistry: Conformation and Mechanism: P. S. Kalsi
9) Stereochemistry of Organic compounds: Ernest L. Eliel / Samuel H. Wilen
10) Advanced Organic Chemistry; Part A and B: F. A. Carey & R. J. Sundberg
11) Organic Chemistry: Clayden, Greeves, Warren and Wothers
12) Organic Synthesis: M. B. Smith
13) Lukehart, Charles M. MacGillivray, Leonard R - Metal-Organic Framework Materials-Wiley (2014)
14) Xian-He Bu, Michael J. Zaworotko, Zhenjie Zhang - Metal-Organic Framework-From Design to Applications-Springer International Publishing_Springer (2020)
15) Wei Xia- Fabrication of Metal–Organic Framework Derived Nanomaterials and Their Electrochemical Applications-Springer Singapore (2018)
16) Wang Zhenqiang.- Design of metal-organic framework materials based upon inorganic clusters and polycarboxylates

DSC-8: Drugs and Heterocycles

Course Code: 2327402

(Credit: 04, Theory: 60 Periods, Marks: 100)

Course Preamble: This course includes synthesis and applications of drugs and bioactive heterocycles which are very important part of pharmaceuticals industry. Unit I and II includes definition, classification, SAR, mechanism of action and Synthesis of different drugs. Unit III and IV includes study of 5 and 6 membered and benzofused heterocycles rings having mainly N, O, and S, as a heteroatom's with respect to synthesis, chemical properties and bioactive importance.

Course Objectives: Upon completion of the course student shall be able to

- Understand about drugs and heterocycles used in the treatment of various diseases.
- Understand the chemistry of drugs and heterocycles with respect to their biological activity.
- Know the metabolism, adverse effects and therapeutic value of drugs
- Know the importance of SAR of drugs.

Unit-1: Definition, Classification, SAR, Mechanism of action and Synthesis* of drugs for following classes: [Hrs: (15), Weightage: 20 Marks]

Antibiotics: Penicillin: Ampicillin*, Amoxycillin. **Cephalosporin**: Cefadroxil, Cefixime*,

Tetracycline, Chloramphenicol*, **Amino glycosides**: Streptomycin. **Sulfonamides**: Sulfapyridine, Sulfacetamide* and Sulfamethoxazole*

Antimalerials: Quinine, Chloroquine*

Anticonvulsant: Phenytoin*

Anesthetics: Thiopental*

Sedative and hypnotics: Diazepam*

Unit-2: Definition, Classification, SAR, Mechanism of action and Synthesis* of drugs for following classes: [Hrs: (15), Weightage: 20 Marks]

NSAIDs: Aspirin*, Ibuprofen*, Paracetamol*, Diclofenac*, Aceclofenac, Indomethacin, Nimesulide

Antidiabetics: Insulin, Tolbutamide, Glipizide, Metformin*

Anti-hypertensive Drugs: Captopril*, Atenolol, Methyldopa.

Antineoplastic: Alkylating agent, Antimetabolites

UNIT 3: Five-membered and Six-membered heterocycles

[Hrs: (15), Weightage: 20 Marks]

A] 5-Membered heterocycles

Five-membered rings with one heteroatom: Furan, Pyrrole and Thiophene; Five-membered rings with two heteroatoms: Imidazole, Pyrazole, Oxazole, Isoxazole, Thiazole, Isothiazole; Five-membered rings with three heteroatoms: Triazoles, Oxadiazole, Thiadiazole, and Tetrazole.

B] 6-Membered heterocycles

Six-membered rings with one heteroatom: Pyran, Pyridine

Six-membered rings with two heteroatoms: Pyridazines, pyrimidines, pyrazines,

UNIT- 4: Benzofused heterocycles [Hrs: (15), Weightage: 20 Marks]

Benzopyrroles (Indole), Benzofuran, Benzothiophene, Benzoxazole, benzthiazole, Benzimidazole, Quinolines, Isoquinoline, Quinazolines, Coumarins and Chromones

Course Outcomes

- The students can able to understand the use of the drugs and heterocycles.
- The students know about the structural activity relationship of the drug.
- The students can able to explain the synthesis of the drugs and heterocycles.

Reference Books and Text Books

1) R. M. Acheson: An introduction to chemistry of heterocyclic compounds (Interscience)
2) Joule and Smith: Heterocyclic chemistry (Van Nossstrand)

3) R.K. BANSAL: Heterocyclic chemistry (Wiley E)
4) L.A. Paquitte: Principals of modern heterocyclic chemistry
5) M.H. Palamer: The structure and reactions of heterocyclic compounds.
6) A.R. Katrtzhy and A.V. Bootton: Advances in Heterocyclic chemistry (A.P.)
7) Finar: Organic chemistry (Vol. 1 and 2)
8) Conn and Stumf: Outline of Biochemistry
9) Williams, Introduction to the chemistry of enzyme action.
10) The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman Academic Press.
11) Strategies for Organic Drug Synthesis and Design. D. Lednicer, John Wiley.
12) Heterocyclic Chemistry Vol. 1-3, R. R. Gupta, M. Kumar, and V. Gupta, Springer Verlag.
13) The Chemistry of Heterocycles, T Eicher and S. Hauptmann, Thieme.
14) Heterocyclic Chemistry, J. A. Joule, K. Mills and G. F. Smith, Chapman ans Hall.
15) Heterocyclic Chemistry, T. L. Gilchrist, Longman Scietific Techinal
16) Contemporary Heterocyclic Chemistry, G. R. Newkome and W. W. Poudler, Wiley.
17) An Introduction to the Heterocyclic Compounds, R. M. Acheson, John Wiley.
18) Comprehensive Heterocyclic Chemistry, A. R. Katrizky and C. W. Rees, eds, Pergamon Press.

DSE-4A: Pharmaceutical Dosage Forms

Course Code: 2327405

(Credit: 04, Theory: 60 Periods, Marks: 100)

Course preamble: This course is designed to study various types of dosage forms and their routes of administration. Unit I include study of solid dosage forms. Unit II includes study of other dosage forms. Unit III includes study of concept of drug formulation. Unit IV includes study of drug delivery system.

Course Objectives

- To get the information about the routes of drug administration
- To know the different types of dosage forms and their routes of administration
- To understand the concept of formulation of drugs
- To study the different types of drug delivery systems

Unit-1: Solid Dosage Forms **[Hrs: (15), Weightage: 20 Marks]**

Routes of administration, Types of dosage forms, Oral solids: tablets, types of tablets, methods

of tablet production-wet granulation, coating of tablets. Quality control methods and measurement of tablet properties, packaging.

Unit-2: Other Dosage Forms [Hrs: (15), Weightage: 20 Marks]

Oral liquids: Suspensions and Emulsions: Definition, types, stability, suspending/ emulsifying agents, evaluation, and packaging. Parenterals, Ophthalmic products, Aerosols, Inhalation products. Topical lipids, semisolids, and powders.

Unit-3: Drug Formulation [Hrs: (15), Weightage: 20 Marks]

Concept of excipients, classifications with examples, colours, flavours and preservatives in formulations. Concept of Pre-formulation, factors influencing designing of dosage forms, drug excipients interaction, stability studies.

Unit-4: Drug delivery systems [Hrs: (15), Weightage: 20 Marks]

Fundamental of novel drug delivery: Rationale of sustained release, controlled release dosage forms. Oral controlled drug delivery systems, mucosal drug delivery system, ocular drug delivery systems, parenteral drug delivery systems, transdermal drug delivery systems.

Course Outcomes

- The student is able to get the information about the routes of drug administration.
- The student knows the different types of dosage forms
- The student is able to understand the concept of formulations and Pre-formulation of drug.
- The student study the different types of drug delivery systems

Reference Books

1) Pharmaceutical dosage forms and drug delivery systems by Ansel
2) The science of dosage forms design by Aulton
3) The theory and practice of Industrial pharmacy (CBS) Leon Lachman,
4) Dispensing of pharmaceuticals (CBS) Cooper and Gunn
5) The Science and Practice of Pharmacy by Remington
6) Biopharmaceutics and Pharmacokinetics by Brahmankar

DSE-4B: Pharmaceutical Technology

Course Code: 2327406

(Credit: 04, Theory: 60 Periods, Marks: 100)

Course preamble: This course is designed to understand the API, unit processes and

manufacturing processes. Unit I includes study of API manufacturing units. Unit II includes study of various unit processes. Unit-III includes study of unit operation in tableting & good manufacturing practices (GMP). Unit IV includes study of different types validations and regulatory guidelines.

Course Objectives

- To understand the API, unit processes and manufacturing processes
- To know plant layout of different unit processes
- To study the various kinds of unit operations in formulation and GMP
- To understand the different types validations and regulatory guidelines

Unit-1: API manufacturing units [Hrs: (15), Weightage: 20 Marks]

Chemical process, Chemical plants/Industry, Process flow diagram, Factors affecting chemical processes, Reaction systems, Reactors used in API manufacturing, Plant layout and Effluent Treatment Plant (ETP).

Unit-2: Unit Process [Hrs: (15), Weightage: 20 Marks]

Scale up techniques, plant layout of Oxidation: oxidation of Methanol, Liquid phase oxidation with oxygen-Acetaldehyde to Acetic acid, Halogenation: Technical Halogenations-Manufacturing processes for monochloroacetic acid, Chloral, Monochlorobenzene, and Vinyl chloride (Ethylene and Acetylene), Nitration: Typical industrial Nitration process (Nitrobenzene, and α-Nitronaphthalene); Esterification: Esterification by organic acid, Manufacture of Vinyl acetate and Cellulose related to active pharmaceutical ingredients (API) manufacturing-plant layout, Technology transfer

Unit-3: Unit operation in tableting & Good Manufacturing Practices (GMP)

[Hrs: (15), Weightage: 20 Marks]

Milling/Mixing, Granulation, Screening, Drying, Blending, Compression, Coating, Plant layout. GMP, WHO, ICH guidelines, USFDA, Orange book, role of Quality Assurance Vs Quality Control.

Unit-4: Validation

[Hrs: (15), Weightage: 20 Marks]

Validation, Qualifications (DQ, IQ, OQ, PQ), Master plan of validation, Process validation, Cleaning validation, Computer system validation, Utilities validation, Validation of manufacturing equipment's and analytical instruments, Analytical method validation, Regulatory guidelines.

Course Outcomes

- The student is able to understand the API unit processes
- The student knows plant layout of different unit processes
- The student study the various kinds of unit operations
- The student is able to understand the different types validations and Regulatory guidelines

Reference Books

1) The Theory and Practice of Industrial Pharmacy (CBS) by Leon Lachman
2) The Science and Practice of Pharmacy by Remington
3) Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up,Peter J. Harrington, John Wiley and Sons Inc. Publication 2011
4) Strategies for Organic Drug Synthesis and Design by Daniel Lednicer, 2nd Edition,John Wiley and Sons Inc. Publication, 2008
5) Process Chemistry in Pharmaceutical Industry, Kumar Gadamasetti, Vol I & II, CRC Press; First edition, 2007.
6) Practical Process Research and Development, Neal G. Anderson, Academic Press.,2000
7) Principles of Process Research and Chemical Development in the PharmaceuticalIndustry by O. Repic, John Wiley & Sons. Inc Publication New York, NY, 1998.
8) Organic Synthesis, Groggins P. H, (Third Edition). P. H. Groggins. McGraw-Hill,New York, 1947.
9) Fire Safety Management by Satish Tandon, Arise Publishers & Distributors; 1stedition, 2008.
10) Pollution Prevention of Chemical Processes, Allen David, Wiley-Blackwell, 1996.
11) The Treatment and Handling of Wastes, Bradshaw, A.D. Chapman and Hall for the Royal Society; First Edition edition, 1992.
12) Good Pharmaceutical Manufacturing Practice: Rationale and Compliance by Sharp John, CRC Press; 1st edition, 2004
13) Management Information Systems by Laudon Kenneth C. Prentice Hall; 12th edition,2011.
14) Plant Design and Economics for Chemical Engineers by Peters, Max S., McGrawHill Science/Engineering/Math; 5 editions, 2002.
15) Textbook of Pharmaceutical Validation (First Edition), by A. A. Kulkarni, V.S.Kashikar, A.H. Hosmani, I.D. Gonjari, Pharma Career Publications
16) ICH Guidelines, www.ich.org
17) WHO Guidelines and GMP Guidelines
18) P.H.Groggins: Unit processes in organic synthesis (MGH)

19) F.A.Henglein: Chemical Technology (Perga mon)
20) M.G.Rao & M. Sitting: Outlines of Chemical Technology (EWP)
21) Clausen, Mattson: Principle of Industrial Chemistry
22) Text book of pharmaceuticals by R. S. Gaud, P. G. Yeole, A. V. Yadav and S. B. Gokhale.
23) Forensic Pharmacy (Nirali Publications) by B. S. Kuchekar, A. M. Khadatare, S. C. Itakar
24) GMP in Pharmaceutical industries by Trupti Patil- Dongare

RP: Research Project

Course Code: 2327403

(Credit: 06, Marks: 150)

Course preamble: The research project for M. Sc. Medicinal Chemistry is mainly intended to evoke the innovation skill in student. The course will provide an opportunity to apply knowledge and analytical skills learned, to be developed as a prototype or simulation. The course will help students get familiarize with research work to students and apply knowledge of theory to study various aspects of the its practical usage.

Students are expected to work on assigned research project and submit the results at the end of the semester in the form a dissertation. Open defense of the student on his/her dissertation shall be arranged. This defense shall be in front of the panel of examiners. This will be valued for 60 marks.

Students are required to work for a specific project under supervision of concerned faculty member. Project work involving organic synthesis/evaluation of biological studies or in-plant training in any of the pharmaceutical or chemical industry for at least 21 days will be considered. Project should be completed under the guidance of a faculty member in the same Department or Industry or research organization. In case of Industry/ research organization one member of that body can also be included as project guide.

Guidelines for Assessment

- Quality of literature survey and novelty in the problem
- Clarity of problem definition and feasibility of problem solution
- Clarity of objective and scope
- Quality of work attempted

- Presentation skills

Course Outcomes: After completion of course, students will be able to

- Learn independent working on a short research project
- Write literature review in their subject of interest and choose a project topic in consultation with their supervisor.
- The work schedule, Using Chem Draw program to draw structures, Writing the synopsis.
- Perform project work involving organic synthesis/evaluation of biological studies or in-plant training in any of the pharmaceutical or chemical industry.

DSC-7 P: Organic Chemistry

Course Code: 2327404

(Credit: 02, Practical: 60 Periods, Marks: 50)

Course preamble: The course is designed in such a way that students will get knowledge of isolation of different constituents such as lycopene, limenonene, eugenol, piperine etc. from natural sources using different techniques.

Course objectives:

- To use different techniques of isolation of constituents from natural sources.
- To know about methods of recovery of isolated constituent.

List of Practicals:

Isolation of following constituents from the natural sources: (Any five)

1) Isolation of lycopene from tomato fruits

2) Isolation of limonene from citrus rinds-carotene from carrots

4) Isolation of Eugenol from cloves

5) Isolation of Piperine from black pepper

6) Isolation of Nicotine from tobacco

7) Isolation of Curcumin from turmeric

8) Isolation of capsaicinoids from peppers by Soxhlet extraction

(Note: Other suitable experiments may be added)

Course outcomes: After completion of the course students will be able to

- Use different methods to isolate constituents from natural sources.

DSE-4A P: Drug assay and drug formulations

Course Code: 2327407

Credit: 02, Practical: 60 Periods, Marks: 50)

Course preamble: This course is designed to study assay of different pharmaceutical drugs such as Paracetamol, Chloramphenicol, Aspirin, and Vitamin-C. To draw plant layout of tablet unit. To understand procedures for preparation of different types of suspensions, emulsion, and syrup.

Course objectives:

- To study Assay of different pharmaceutical drugs.
- To study different methods of Preparation and evaluation of tablet.
- To draw Plant layout of tablet unit.
- To draw process flow chart of parenteral formulation.
- Preparation of weak Iodine solution, Paracetamol suspension, Castor Oil emulsion, simple syrup IP, lemon syrup etc.

List of Practical's

1. Assay of Paracetamol tablet
2. Assay of Chloramphenicol capsule
3. Assay of Aspirin tablet
4. Assay of Vitamin-C
5. Preparation and evaluation of tablet
6. Draw Plant layout of tablet unit
7. Draw process flow chart of parenteral formulation
8. Validation of UV-Visible spectroscopic analytical method
9. Performance qualification of IR
10. Evaluation of packaging material (Glass/Plastic)
11. Preparation of weak Iodine solution
12. Preparation of Paracetamol suspension
13. Preparation of Castor Oil emulsion
14. Preparation of simple syrup IP
15. Preparation of lemon syrup
16. Preparation of Sodium chloride eye lotion

17. Preparation of Methyl salicylate ointment

(Note: Other suitable experiments may be added)

Course Outcomes: After completion of the course students will be able to

- Assay of different pharmaceutical drugs.
- Use different methods of Preparation and evaluation of tablet.
- To draw Plant layout of tablet unit
- To draw process flow chart of parenteral formulation.
- Prepare different solution, suspension, emulsion, and simple syrup IP

DSE-4B P: Pharmaceutical Technology

Course Code: 2327408

(Credit: 02, Practical: 60 Periods, Marks: 50)

Course preamble: This course is designed to get information about pre-formulation studies such as Drug-drug interaction and drug excipient interaction inphysical mixture. To determine solubility of drug in water. To study stability of drugs at room temperature.

Course objectives:

- To study drug-drug interaction and drug excipient interaction.
- To carry out pre formulation studies of drugs.
- To determine various physical parameters such as solubility, stability of drugs.

List of Practicals

1. Pre-formulation studies: Drug-drug interaction and drug excipient interaction in physical mixture.
2. Determination of solubility of Paracetamol in water, 0.1N HCl, 0.1N NaOH, Phosphate buffer pH 6.8 and 7.4
3. Study of drug stability at room temperature and degradation at UV light and Sun light

(Note: Other suitable experiments may be added)

Course outcomes: After completion of course, student will be able to

- Carry out pre formulation studies of drugs.
- Determine solubility of drug in water.
- Determine stability of drug at room temperature.

Reference books for Practicals (Sem-III & IV):

1. A Textbook of Practical Organic Chemistry - A. I. Vogel.
2. Practical Organic Chemistry - Mann & Saunders.
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blat.
5. Reagents in Organic Synthesis by Fieser and Fieser.
6. Organic Practicals by Ahluwalia.
7. Systematic Lab Experiments in Organic Chemistry by Arun Sethi. (New Age).
8. Advanced Practical Medicinal Chemistry by Ashutosh Kar
9. Practical Pharmaceutical Chemistry-part two by A.H.Beckett and J.B. Stenlake.
10. Practical Pharmaceutical Analysis by Dr.G. Devala Rao.
11. Laboratory Handbook of Instrumental Drug Analysis by B.G. Nagavi.
12. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
13. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy Nieman, 5th edition, Eastern press, Bangalore, 1998.
14. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
15. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
16. Quantitative analysis of pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi.
17. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3 rd Edition, CBS Publishers, New Delhi, 1997.
18. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series.
19. Indian pharmacacopoeia.
20. ICH guidelines-(Q2) Analytical method validation.

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Nature of question paper

(M. Sc. II, Medicinal Chemistry)

Time: 2 ½ hours Maximum Marks: 60

Instructions

1. All questions are compulsory
2. All questions carry equal marks.
3. Figures to the right indicate full marks.
4. Use of log tables and calculators is allowed.

Q 1. A) Choose correct alternative **Marks 8 (1 x 8)**

Sub-questions (i) to (viii)

B) Fill in the blanks **Marks 4 (1 x 4)**

Sub questions (i) to (iv)

Q 2. Answer the following (any six) **Marks 12 (2 x 6)**

Sub-questions (a) to (h)

Q 3. Answer the following (any three) **Marks 12 (3 x 4)**

Sub-questions (a) to (d)

Q 4. Answer the following (any two) **Marks 12 (6 x 2)**

Sub-questions (a) to (c)

Q 5. Answer the following (any two) **Marks 12 (6 x 2)**

Sub-questions (a) to (c)

At least 25 % questions should be problem oriented, where-ever possible, in view to train students for the SET/NET/GATE and other competitive examinations. These questions should test the understanding of candidate rather than the memory. The question paper should cover all the Units included in the syllabus of the respective paper and the weightage of the questions should correspond to the number of lectures allotted to the respective Units / Topics.