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VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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–: પરિપત્ર :–

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન રસાયણશાસ્ત્ર વિષયની અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રીને જણાવવાનું કે, M.Sc. Chemistry અને M.Sc. Pharmaceutical Chemistry ના Programme Outcome, Programme Specific Outcome અને Course Outcome બાબતે કેમેસ્ટ્રી વિષયની અભ્યાસ સમિતિની તા.૨૪/૦૧/૨૦૨૨ની સભાનાં ઠરાવ ક્રમાંકઃ૫ અન્વયે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખાનાં ડીનશ્રીએ વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૦૫/૦૨/૨૦૨૨ની સભાનાં ઠરાવ ક્રમાંકઃ૭ થી સ્વીકારી મંજુર કરેલ છે, જેની આથી જાણ કરવામાં આવે છે.

કેમેસ્ટ્રી વિષયની અભ્યાસ સમિતિની તા.૨૪/૦૧/૨૦૨૨ની સભાનાં ઠરાવ ક્રમાંકઃ૫

:: આથી ઠરાવવામાં આવે છે કે, Post Graduate Programme M.Sc. Chemistry અને M.Sc. Pharmaceutical Chemistry ના Programme Outcome, Programme Specific Outcome અને Course Outcome મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૦૫/૦૨/૨૦૨૨ની સભાનાં ઠરાવ ક્રમાંકઃ ૭

:: આથી ઠરાવવામાં આવે છે કે, કેમેસ્ટ્રી વિષયની અભ્યાસ સમિતિની તા.૨૪/૦૧/૨૦૨૨ની સભાનાં ઠરાવ ક્રમાંકઃ૫ અન્વયે કરેલ ભલામણ સ્વીકારી M.Sc. Chemistryઅને M.Sc. Pharmaceutical Chemistry ના Programme Outcome, Programme Specific Outcome અને Course Outcome મંજૂર કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

ક્રમાંક : એસ./કેમેસ્ટ્રી/પરિપત્ર/૨૫૫૨/૨૦૨૨
તા.૦૯–૦૨–૨૦૨૨

ઈ.ચા. કુલસચિવ

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન રસાયણશાસ્ત્ર વિષયની અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રી.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
૪) અનુસ્નાતક વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

Name of Program	**Master of Science (Chemistry)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**M.Sc. Chemistry** **(Organic/Inorganic/ Analytical/Physical)** ELIGIBILITY:(SC/ST- 35%, OPEN/SEBC-40%), A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M .Sc .Chemistry **M.Sc. (Organic Chemistry** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%), A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M.Sc.- Chemistry/Organic Chemistry. **M. Sc .Environmental Chemistry** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%) A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M.Sc.- Chemistry/Organic Chemistry (SF.)/ Environmental Chemistry (S.F.) Course. **M.Sc. Organic Chemistry (Evening)** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%) A candidate selecting M.Sc. Evening course (2 years) with Organic Chemistry as specialization must have passed the Bachelor's Degree examination with Chemistry and English as compulsory subject. Those who are in service will have to produce minimum one year's experience certificate from the Employer. **M. Sc .Pharmaceutical Chemistry** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%) A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M.Sc.- Pharmaceutical Chemistry (S.F.) Course.
Objective of Program	The core objective of the M.Sc. programme is to prepare the students for dynamic career in industry and academia by providing an excellent environment of teaching and research in the core and emerging areas of the discipline.
Program Outcome	1. Students will have a solid theoretical foundation as well as the requisite abilities in pharmaceutical sciences, as well as the capacity to use them in research and development. 2. Students will have a strong theoretical basis in pharmaceutical sciences, as well as the necessary skills to use them in research and development. 3. Students who have been trained in analytical methods in drug and formulation development, new drug application, and quality assurance in all parts of drug research will be able to use what they have learned to produce new products that will help people.

	4. Through creative teaching approaches that encourage students to self-learn and expand their knowledge, students will be equipped to thrive in pharmaceutical research as well as prosper in the pharmaceutical sector or academia. 5. Professional values, excellent research communication abilities, problem-solving prioritization, and the capacity to understand pharmaceutical concerns in a larger perspective will be instilled in students. 6. The ability to evaluate important aspects of the matter they have studied, weigh the pros and cons of the ideology they adhere to in the field of pharmaceutical science.
Program Specific Outcomes	Students need to build up foundation in the fundamentals & application of current chemical and scientific theories in the concerned branches of Inorganic, Organic, Analytical, Physical, Environmental and Pharmaceutical Chemistry. 1. Graduates will be able to exhibit pharmaceutical quality assurance expertise. As well as recognize, formulate, and solve quality problems in the pharmaceutical business. 2. Graduates will be able to assess and comprehend data from analytical studies in pharmaceutical manufacturing, quality control, and assurance,as well as address regulatory difficulties in formulation design while satisfying pharmaceutical industry expectations and standards. 3. Graduates will be able to create validation protocols for all pharmaceutical processes, from drug discovery through formulation as well as analyse and solve issues using current pharmaceutical techniques, software, and equipment. 4. Graduates will be able to analyse and understand the results of analytical studies in pharmaceutical manufacturing, quality control, and assurance as well as solve regulatory concerns in formulation design in accordance with the pharmaceutical industry's demands and standards. 5. Graduates will be able to create validation protocols for all pharmaceutical processes, from drug discovery through formulation. 6. Graduates will be able to show that they are aware of their professional and ethical responsibilities under pharmaceutical legislation. 7. Graduates will have the confidence to study on their own and the capacity to learn for the rest of their lives. 8. Graduates will be able to explore chances for research and development in all areas of Pharmaceutical Quality Assurance, as well as work as partof a team and lead when necessary.

Mapping between POs and PSOs		PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO8
	PO 1								
	PO2								
	PO3								
	PO4								
	PO5								
	PO6								
Medium of Instruction	English								

Structure of M. Sc, Syllabus
Semester-I

Sr. No.	Course Code	Course Title	L	T/C/S	Credit
1	CHI 101	Inorganic Chemistry	4		4
2	CHO 102	Organic Chemistry	4		4
3	CHP 103	Physical Chemistry	4		4
4	CHA 104	Instrumental and chemical analysis	4		4
5	CHPR 105	Practicals + T/C/S	12	3	6 + 3
			28	3	25

Faculty Code: Science Subject code: Level code:
Name of program: M. Sc. Subject: Chemistry
External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	I	CHI 101	Core	04	30	70	100
		CHO 102	Core	04	30	70	100
		CHP 103	Core	04	30	70	100
		CHA 104	Core	04	30	70	100
		CHPR 105	Practical + T/C/S	06 +3	60	140	200
			Total	25	180	420	600

Structure of M. Sc, Syllabus
Semester-II

Sr. No.	Course Code	Course Title	L	T/C/S	Credit
1	CHI 201	Inorganic Chem	4		4
2	CHO 202	Organic	4		4
3	CHP 203	Physical	4		4
4	CHA 204	Instrumental and chemical analysis	4		4
5	CHPR 205	Practicals + T/C/S	12	3	6 + 3
			28	3	25

Faculty Code: Science Subject code: Level code:
Name of program: M. Sc. Subject: Chemistry
External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	II	CHI 201	Core	04	30	70	100
		CHO 202	Core	04	30	70	100
		CHP 203	Core	04	30	70	100
		CHA 204	Core	04	30	70	100
		CHPR 205	Practical + T/C/S	06 + 3	60	140	200
			Total	25	180	420	600

M.Sc. Semester-III (PHARMACEUTICAL CHEMISTRY)

Sr. No	Course Title	L	T/C/S	Credit
1	Fundamentals of Pharmaceutical chemistry	4	1	4
2	Pharmaceutical Organic chemistry-I	4	1	4
3	Drug acting on central nervous system and antibiotics	4	1	4
4	Selected topics in pharmaceutical chemistry	4	1	4
5	Practicals	12		8
		28	4	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	III	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical	08	60	140	200
			Total	24	180	420	600

M.Sc. Semester-IV (PHARMACEUTICAL CHEMISTRY)

Sr. No	Course Title	L	T/C/S	Credit
1	Instrument & separation techniques	4	1	4
2	Pharmaceutical organic chemistry-II	4	1	4
3	Hormonal and pharmacokinetic agents	4	1	4
4	Chemotherapeutic agents	4	1	4
5	Practicals	12		8
		28	4	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	IV	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical	08	60	140	200
			Total	24	180	420	600

Master of Science, Pharmaceutical Chemistry
M.Sc. Organic Chemistry, Semester I

Course Code	CHO 102	Title of the Course	Organic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand concept of reactive intermediate and their application in organic synthesis. • To understand basics of pericyclic reaction, familiarize with various theories of pericyclic reaction to access the feasibility of various pericyclic reactions and implant the knowledge to predict stereo chemical outcome of various pericyclic reactions. • To learn anchimeric assistance, stereo chemistry and internal substitution reaction of aliphatic and allylic compounds. Aromatic nucleophilic substitution, cine substitution, elimination reactions, their stereo chemistry and mechanisms. • Understanding of concepts of chirality, topicity, prochirality, dynamic resolutions, types of stereo selective and stereo specific reactions, conformation of substituted and fused aromatic rings along with respective strains theories.

Course Content		
Unit	Description	Weightage* (%)
1.	**REACTION MECHANISM & REACTIVE INTERMEDIATES** Detailed study of organic reaction intermediates. Generation, structure, stability and reactions of – **Carbocations (Classical and non-classical):**Phenonium ion, norbornyl system, common carbocation rearrangements- Demjanov, Pinacole-Pinacolone, Rupe. **Carbanions:** Mechanism of condensation involving enolates - Aldol, Claisen, Mannich, Dieckmann, Michael and Shapiro reactions. **Carbenes:** Mechanism of Arndt-Eistert reaction, Reimer-Tiemann reaction and Bamford Steven's rearrangement reaction. **Free Radicals:**Allylic halogenation (NBS), coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmeyer reactions. Free radical rearrangements, Hunsdiecker reaction.	25
2.	**PERICYCLIC REACTIONS** **Introduction** - Definition, Characteristics and Classification Molecular orbitals and symmetry propertiesofethylene, 1,3- butadiene, 1,3,5- hexatriene and allylsystems. **Electrocyclic Reactions:** Woodward-Hoffman Correlation diagram and derivation of selectionrules,Conrotatory and disrotatory motions,	25

	FMO and PMO approach for 4n and (4n+2)Πelectron system and allyl systems. **Cycloaddition Reactions**: Antarafacial and suprafacial additions. FMOand PMO approach for 4n and (4n+2)Πelectron Systems(No correlation diagram),Diels-Alder reaction, stereoselectivity,Effect of substituents. **Sigmatropicrearrangements:** Suprafacial and antarafacialshifts involving H & C moieties, retention and inversion of configurations. The Cope and Claisen rearrangements, Ene reaction, 1, 3- dipolar cydoadditions. Examples of electrocyclic, cycloaddition and sigmatropic rearrangements.	
3.	**SUBSTITUTION AND ELIMINATION REACTIONS** **A: Aliphatic Nucleophilic Substitution:** The SN1 , SN2 , SNi mechanisms. Reactions of Allylic halides, neighbouring group participation by -OH, -NH2, -COO- , -RS, - halogen, aromatic ring. **B: Aromatic Nucleophilic Substitution:** The SN2 , SN1 and benzyne mechanisms, Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter rearrangement. **C: Elimination reaction:** Hoffmann and Zaitsev's rule of elimination, E1, E2 and E1CB Reaction mechanism and orientation.	25
4.	**A.** Stereo chemical principles; Enantiomeric relationships; Distereomeric relationship; R-S and E-Z nomenclature; Dynamic stereochemistry; Chiral-Prochiral relationships; Stereo selective and Stereo specific reactions; Racemates and racemic modification, Resolution of racemic modification, Optical activity in the absence of chiral carbons biphenyl, allenes, spiranes. **B.** Confirmational Analysis: Interconversion of Fischer, Newman and Sawhorse projections. Newer method of asymmetric synthesis (including enzymatic and catalytic nexus), enantio and diastereo selective synthesis.Simple acyclic and cyclic (chair and boat cyclohexanes, Decalins, Perhydrophenanthrene)systems.Effects of conformation on reactivity in acyclic compounds and substituted cyclohexanes.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books , IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand generation of reactive intermediates, their mechanism, rearrangement based on each intermediate, application of reactive intermediate in organic synthesis and industries application.
2.	Recognise pericyclic reactions, understanding of thermal and photochemical reaction, determination of mechanistic pathway, symmetry properties, aromaticity based on mobius method, application of pericyclic reactions in organic synthesis.
3.	Learn difference between eliminations and addition reaction, concept of anchimeric assistance in various groups like sulphide, halogen, phenyl, hydroxyl, tosylates & mesilates, amino group etc, aromatic nucleophilic substitution through addition elimination, elimination addition, cine substitution and their synthetic application.
4.	Detect chirallity in moleculer structure, recognize the relationship between enantiomeric and diastereomeric structures, understand & distinguish stereoselective and stereospecific reactions, dynamic resolution, confirmative study of various substituted aromatic and fused aromatic rings and their application inn pharmaceutical industry.

Reference Books Recommended:

Unit I:

1. Carbenes, Benzynes and Nitrenes by Gilchrist, T. L. and Rees.
2. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John
3. Wiley.
4. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
5. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
6. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
7. Advanced Organic Chemistry by Carey &Sundberg (3^{rd} edition).
8. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
9. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
10. Organic chemistry 2nd ed. Jonathan clayden, Nick greeves, Stuart Warren.
11. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).

UNIT II:

1. March's Advanced Organic Chemistry Reactions, Mechanisms, And Structure 7th ed. 2013 Michael B. Smith. Wiley
2. Mechanism AndTheory In Organic Chemistry-2007 by Thomas H. Lowry, Kathleen S. Richardson, Forbes.Harper& Row, Publishers. New York, Hagerstown, San Francisco, London
3. Advanced Organic Chemistry Part A: Structure and Mechanisms by Carey &Sundberg(5^{th} edition),2000, Springer.
4. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.

5. Photochemistry AndPericyclic Reactions 3rd ed. by Jagdamba Singh 2010. New Age International Publishers Ltd. New Delhi.
6. Pericyclic Reactions A mechanistic and problem solving approach Sunil Kumar, Vinod Kumar, S.P.Singh Academic Press 2015

UNIT III:

1. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John Wiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond
4. (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
5. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
6. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
8. Physical organic chemistry by Jack Hyne
9. Reaction mechanism by Jagdambasingh.
10. Organic chemistry - Reaction mechanism, by P.S. Kalsi, New age international publishers.

UNIT IV:

1. Advanced Organic Chemistry: Part A: Structure and Mechanisms; By Francis A. Carey, Richard J. Sundberg, fifth edition, Published by Springer.
2. Advanced Organic Chemistry: Part B: Reaction and Synthesis; By Francis A. Carey, Richard J. Sundberg, fifth edition, Published by Springer.
3. Stereochemistry of Carbon Compounds; By Ernest L. Eliel, Published by Tata McGraw- Hill Publishing Company Ltd.
4. Basic organic stereochemistry; By Ernest Ludwig Eliel, Samuel H. Wilen, Michael P. Doyle, Published by Wiley-Interscience.
5. Introduction to Stereochemistry; By Kurt Martin Mislow, Dover Publication INC.
6. Stereochemistry of Organic Compounds: Principles and Applications; By D. Nasipuri, New Age International (P) Ltd. Publisher.
7. Stereochemistry Conformation and Mechanism; By P.S. Kalsi, New Age International (P) Ltd. Publisher.
8. Basic Stereochemistry of Organic; By SubrataSen Gupta, First edition, Published by Oxford University Press.

On-line resources to be used if available as reference material

Master of Science, Pharmaceutical Chemistry
M.Sc.Organic Chemistry, Practicals

Course Code	CHPR 105	Title of the Course	Organic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for the separation of organic ternary mixture • To identify nature of mixture i.e., solid-solid, solid-liquid, liquid-liquid etc. • To impart knowledge of different purification techniques including distillation. • Separation and identification of component with their functional group test and M.P. /B.P. • To confirm the structure and prepare the relevant derivative.

Course Content

1. Mixture analysis: (Minimum eight mixtures) Ternary mixture to be given. (S+S+S), Semisolids or (L+L+L). Type, determination,Separation by physical and chemical methods. (both permitted in case of liquids)
2. Paper Chromatography

Teaching-Learning Methodology	Introduction, demonstration of handling equipments, reference books and frequent instruction according to the respective practical.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to

1.	Understand basics of separation of organic tertary mixtures.
2.	Identify and chemical nature of mixture.

3.	Separate of each component from mixture.
4.	Identify each component through their functional group test, elemental analysis and M.P/BP.
5.	Purify the compounds using different techniques including distillation, crystallization etc.
6.	Record physical constants for individual compounds.
7.	Appreciate good laboratory practices.

Reference Books Recommended

1. A text book of practical organic chemistry – A. I. Vogel
2. Practical organic Chemistry – Mann and Saunders
3. A handbook of quantitative and qualitative analysis – H. T. Clarke
4. Comprehensive Practical Organic Chemistry : Qualitative Analysis V K Ahluwalia& S.
5. Dhingra.
6. Comprehensive Practical Organic Chemistry : Preparations and Quantitative Analysis V K
7. Ahluwalia& R. Aggarwal Universities Press.
8. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

On-line resources to be used if available as reference material
On-line Resources

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Master of Science, Pharmaceutical Chemistry
M.Sc.Organic Chemistry, Semester II

Course Code	CHO 202	Title of the Course	Organic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn transition metal catalyst based on C-C, C-N coupling reaction, formylation reaction, various acid base catalyzed condensation reactions, reactions which changes configuration etc. and their mechanism. • To learn aromaticity based on different concept, measurement of aromaticity through various parameters, annulenes, azzulene and types of aromaticity. • To understand the role of chemical reactants in oxidation, reduction, dehydration, cyclisation and transformation of various organic functional groups. • To understand photochemistry, various types of its reaction, photochemical cleavage of carbonyl compounds, their mechanism and application in synthesis.

Course Content		
Unit	Description	Weightage* (%)
1.	**Organic Name Reactions** General nature, method, mechanism and synthetic applications of the following reactions: (i) Heck reaction (ii) Dakin reaction (iii) Darzen'sglycidic ester synthesis (iv) Leuckart reaction (v) Suzuki reaction (vi) Willgerodt reaction (vii) Buchwald-Hartwig reaction (viii) H. V. Z reaction (ix) Vilsmeyer-Hack reaction (x) Mitsunobu reaction (xi) Sonagashira reaction (xii) Dickmann reaction.	25
2.	**AROMATICITY** A. Aromaticity and Aromatic character; structure and stability of benzene, Frost circle diagram, concept of aromaticity; Resonance	25

	and chemical stabilization; criteria to checkaromatic character-IR, NMR, heat of hydrogenation; Huckel's rule; HMO method B. Antiaromaticity, homoaromaticity, nonaromaticity; aromaticity in benzanoid compounds: naphthalene, pyrene, acepleialdelene. C. Aromaticity non-benzenoid compounds: azulene, tropolones, charged rings,annulenes fullerenes, and hmesoionic compounds.	
3.	**ORGANIC TRANSFORMATION AND REAGENTS** I. Sharplessepoxidation II. Umpolung reagent (1,3-dithiane) III. Dess martin periodinane IV. DDQ V. Tri-n-butyltinhydride (C4H9)3SnH VI. Diisobutyl aluminum hybride (DIBAL-H) VII. Lithium disoprpyl amide (LDA) VIII. OZONE / IX. $K_3[Fe(CN)]_6$and DMSO X. Merrifield Peptide Synthesis XI. Crown ethers XII. Wilkinson's Catalyst	25
4.	**PHOTOCHEMISTRY** A. Energy of molecules, photochemical energy, electronic excitation, Jablonski diagram, laws of photochemistry, quantum efficiency. B. Photochemistry of carbonyl compounds- α- cleavage of acyclic, cyclicand α-β unsaturated cleavage of carbonyl compounds, β-cleavage of, inter and intramolecularhydrogen abstraction, addition to carbon- carbon doublr bond, photo reduction of carbonylcompounds. C. Photo induce rearrangement of enones, dienones and alkenes. Photochemistry of alkenesand aromatic compounds- isomerization, dimerization and addition reactions D. Photochemistry of visiob, singletoxygenoxygenations,solar energy conversion and storage	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand the role of transition metal in organic synthesis by studying Heck, Suzuki, Sonogashira and Buchwald Hartwing reaction, formylation by Villsmayer Heck reaction, substituted amines, amides formation reaction, cyclisation through condensation reaction and inverted configuration through Mitsunobu reaction.
2.	Understand aromaticity, various parameters for the measurement of aromaticity, frost circle method and calculation of energy for the determination of aromaticity. Aromaticity measurement through NMR, types of aromaticity and aromaticity measurement in fused rings, annulenes and azulenes etc
3.	To learn the chemistry involved in oxidation-reduction reactions by employing numerous reagents & appropriate chemo-selectivity of the reagents, suggest use of miscellaneous reagents in organic synthesis including Wilkinson catalyst, DIBAL-H, PTC-crown ether, 1,3-Dithiane etc.
4.	Get one self familiarize with usual photochemical reactions, terms of photochemistry, understanding fluorescence, phosphorence by photoexcitation decay/discipation of energy. Types photochemical reactions like Norrish type-I & II, Paterno-Buchi etc., Photodimensation and their application in organic synthesis.

Reference Books Recommended:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Name Reactions by A. R. Parikh &H.A.Parikh
8. Name reaction: A collection of detailed reaction machanisms by Jie Jack Li
9. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).
10. Organic Chemistry-Reactions and Mechanism by P S Kalsi
11. Advanced Organic Chemistry : Reactions and Mechanisms byM.S. Singh
12. Organic chemistrybyCram, Hammond, Pine and Handrickson
13. Photochemistry and Pericyclic Reactions by Jagdamba Singh
14. Pericyclic reactions: A text book by S. Sankararaman
15. Excited states in Organic Chemistry by J. D. Coyle and J. A. Barltrop
16. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by Michael B. Smith
17. Advanced Organic Chemistry: Part B: Reaction and Synthesis byCarey & Francis
18. Organic Chemistry byJonathanClayden

On-line resources to be used if available as reference material
On-line Resources

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Master of Science, Pharmaceutical Chemistry
Practicals

Course Code	CHPR 205	Title of the Course	Organic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for carrying out preparation. • Understand nature of reaction and establishment of reaction condition with mechanism. • To understand calculation of mole and mole ratio for each reaction. • Isolation of product from individual step and purification by crystallization. • Determination of physical constant and confirmation of product. • Concept of estimation and determination of each component quantitatively.

Course Content

Preparation of organic compounds:

i. Nitration
ii. Bromination
iii. Acylation
iv. Reduction
v. Oxidation
vi. Condensation reaction
vii. Diazotization reaction
viii. Friedl-Craft's reaction
ix. Cannizzaro reaction
x. Aldol condensation

Quantitative Estimations

a. Estimation of ester + acid
b. Estimation of formaldehyde
c. Estimation of glycine
d. Estimation of amide + acid

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, Carrying out experiments at each step according to the respective practical.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand the basics to carry out reactions, nature of reaction and calculation of mole and mole ratio.
2.	Establish mechanism and monitora reaction at specified condition.
3.	Work-up after the completion of reaction and purification.
4.	Confirmation of product through the references.
5.	Appreciate good laboratory practices.

Reference Books Recommended:

1. A text book of practical organic chemistry – A. I. Vogel
2. Practical organic Chemistry – Mann and Saunders
3. A handbook of quantitative and qualitative analysis – H. T. Clarke
4. Comprehensive Practical Organic Chemistry : Qualitative Analysis V K Ahluwalia & S. Dhingra.
5. Comprehensive Practical Organic Chemistry : Preparations and Quantitative Analysis V K Ahluwalia& R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

On-line resources to be used if available as reference material
On-line Resources

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Master of Science, Pharmaceutical Chemistry
Semester III
PAPER-I

Course Code		Title of the Course	Fundamentals of Pharmaceutical Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand drug design, drug targets, different parameters for drug design, SAR, drug receptor interactions and theory of drug action. Various physicochemical properties of drug action. • To learn about pharmacodynamics and pharmacokinetics, route of administration, pathway of drug metabolism biotransformation and drug excretion. Also study about classification concepts of drug receptors and chemical nature of binding of ligands to receptor. • To understand about pharmacognosy. Classification of drugs of nature origin distribution, chemical constitution and therapeutic efficiency of different classes of drugs. • To learn about IPR, rules of pharmacopeia like IP, BP, USP, GLP. Good manufacturing practice-GMP, TQM, ISO & other knowledge regarding pharmaceutical quality controls. Knowledge of quantification and qualification of molecules.

Course Content		
Unit	Description	Weightage* (%)
1.	**DRUG DESIGN** Introduction of Drugs and Drug Design, drug targets, Procedure of drug design, Pro-drug, concepts of lead compounds, lead modification, structure activity relationship (SAR), LD_{50}, ED_{50}, MIC- anti infective, Therapeutic index, Concepts of drug receptors, Elementary treatment of drug receptor interactions. Theories of drug action: Occupancy theory, Rate theory and induced fit theory, Biological and chemical defence, factors affecting on absorption Physico chemical properties: Solubility, Partition coefficients, Ionization constant, Steric effect, Stereochemical consideration, Isosterism and Bio-Isosterism.	25
2.	**PHARMACODYNAMICS and PHARMACOKINETICS** Introduction to Phramacokinetics and Pharmacodynamic, Routes of administration, Drug absorption, drug distribution, drug Metabolism (general pathway of drug metabolism: Phase-I and	25

	Phase-II), elementary treatment of enzyme stimulation, biotransformation, Drug excretion, Xenobiotics, Membrane active drugs. Receptor: Classification, Chemical nature of binding of ligands to receptor, Concepts of drug receptors, Elementary treatment of drug receptor interactions, Receptor complex and Allosteric modulation, Second and Third messenger system.	
3.	**PHARMACOGNOSY** Definition and scope of pharmacognosy, various system of classification of drugs of nature origin, Occurrence, distribution, organoleptic evaluation, chemical constitution including tests, therapeutic efficiency of following category of drugs: Laxatives: Castor oil, Senna, Isapaghula Cardiotonics: Digitalis, Arjuna Carminatives and GI regulator: Asafoetida, Clove, Cinnamon Drug acting on nervous system: Opium, Cannabis, Aconite, Ashwagandha Antihypertensive: Rauwolfia Antitussives: Tulsi Antitumor: Vinca Anti diabetics: Stevia Diuretics: Gokhru, Punarnava Antirheumatics: Guggul, Colchicum	25
4.	**PHARMACEUTICAL TERMINOLOGY** IPR: Patents: Conditions for patentable inventions, Patentable inventions under the patent Act 1970, Types of inventions not patentable in India, Term of patent in Indian System, Essential patent documents to be submitted, Provisional specification and complete specification, Criteria for naming inventors patent, Copyright Entitlement to copyright, works protected by copyright, Rights granted by copyright, Geographical indication, BP, IP, USP, Limits Tests, LCMS and its applications in pharmaceutical chemistry. TQM, GLP, GMP, Quality audit, SOP, ICH, ISO-9000, Regulatory aspects of pharmaceuticals Validation of Personnel, In-process quality control on various dosage forms (Sterile and non-sterile), Quality control of finished products, Factor affecting stability of formulations. Recent changes in IPR laws impacting pharmaceutical industry, intellectual cooperation in the pharmaceutical industry, some case studies.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools,, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand drug design, procedure of drug design, preparation of library of compounds-leads to identification and optimization. Various concept like pro drug, soft drug, SAR, MOA, ADMET and receptor, drug administration, etc.
2.	Understanding of pharmacokinetics and pharmacodynamics, drug metabolism, phase-I phase-II clinical trials, enzyme stimulation, biotransformation and membrane active drugs.
3.	To understand pharmacognosy of different category of drugs. Occurrence, distribution, organoleptic evaluation, chemical constitution of individual and their therapeutic efficiency.
4.	Understanding of IPR, filing of patents, clinical trials, quality control measurement by different pharmacopeia like BP, IP, USP, GLP, Manufacturing practice like GMP, TQM, ISO-9000 & related terms.

Reference Books Recommended:

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5, Edited by ManFred E. Wolff (John Wiley & Sons, inc., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. Fundamentals of Medicinal Chemistry by G Thomas.
8. Textbook of pharmacognosy by Trease and Evans
9. Textbook of pharmacognosy by T.E. Wallis
10. Introduction of medicinal chemistry, A Gringuage, wiley-VCH.
11. The organic chemistry of drug design and drug action, R.B. Silverman, academic

press
12. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor) (Interscience, 1968)
13. The Pharmaceutical Basis of Therapeutics by Goodman and Gilman (The Macmillan Co.).
14. Intellectual Property Law (Covering Copyright, Trademark, Design, Patent by Aditya Son.
15. Law Relating To Intellectual Property, 2011 by B.L. Wadehra
16. Writing Chemistry Patents and Intellectual Property: A Practical guide by Francis J. Waller

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Semester III
PAPER-II

Course Code		Title of the Course	PHARMACEUTICAL ORGANIC CHEMISTRY-1
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the concept of biomolecules, enzymes, nucleic acids and natural products, structural elucidation of natural alkaloids of different class, their interrelation to each other, synthesis of intermediates and their confirmation through synthetic pathways. • To learn multicomponent reaction, alkene formation, asymmetric synthesis, amide formation, role of intermediate in synthesis, transformation and study their mechanism. • To provide basic theoretical understanding of heterocyclic chemistry, improving general methodology for different kind of ring synthesis which implies the new heterocyclic systems by changing the functionality with respective positions in skeleton. • To understand green chemistry, selection of reagents, solvents, synthetic route, types of green reagents and selection of techniques to synthesize various molecules.

Course Content		
Unit	Description	Weightage* (%)
1.	**ALKALOIDS, ENZYMES AND NUCLIEC ACIDS** (a) Alkaloids: Nature, occurrence, extraction, general properties, test and physiological importance of following alkaloids: Adrenaline, Nicotine, Quinine, Morphine, Reserpine. (b) Enzymes: Classification, nomenclature and inhibition, factors affecting catalytic activity and specificity in action, regulation of enzyme activity (c) Nucleic Acids: Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding, Chemical and enzymatic hydrolysis of nucleic acids, Nucleosides and nucleotides, DNA replication, Transcription, Translation, Protein Biosynthesis.	25
2.	**NAME REACTIONS** General nature, method, mechanism and synthetic applications of the following reactions; 1. Ene reaction 2. Noyori reaction 3. Mcmurry reaction 4. Barton Reaction 5. Stork Enamine reaction 6. Stille coupling reaction 7. Peterson olefination reaction 8. Nef reaction 9. Robinson annulations reaction 10. Von-Richter Reaction 11. Negishi Coupling Reaction	25
3.	**HETEROCYCLIC CHEMISTRY-1** (a) Nomenclature of Monocyclic, Fused heterocycles and Bridged heterocyclic compounds (b) Synthesis, reactivity, aromatic character and importance of the following: I) Five Member heterocycles: Oxazole, Pyrazole, Imidazole, Isoxazole, 1,2,3- triazole, Benzthiazole II) Six Member heterocycles: Pyridazine, Pyrimidine, Pyrazine, Quinoxaline, Cinnoline, Quinazoline	25
4.	**GREEN SYNTHESIS** Green Reagents: Polymer supported reagents, Dimethylcarbonate Green Catalysts: Acid Catalyst, Oxidation Catalyst, Polymer Supported catalyst, Basic Catalyst, Phase transfer Catalyst Green Solvent: Ionic liquids Green Synthesis: Williamson's synthesis, Wittig reaction	25

	Microwave assisted Synthesis: Microwave reactions in various solvents, applications. Photo assisted Synthesis: Photo reactions in various solvents, applications Ultrasound assisted Synthesis: Ultrasound reactions in various solvents, applications	

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the nature of alkaloids, classification, structural elucidation of given alkaloid.To learn the role and classification of enzymes. Structure of nucleic acid, types of purine and pyrimidine bases. Their classification and determination of catalytic activities with different theories. Structures of nucleosides and nucleotides, DNA replication, Transcription, Translation, Protein synthesis.
2.	To learn multicomponent reaction, alkene formation, asymmetric synthesis, amide formation, role of intermediate in synthesis, transformation and study their mechanism.
3.	To provide basic theoretical understanding of heterocyclic chemistry, improving general methodology for different kind of ring synthesis which implies the new heterocyclic systems by changing the functionality with respective positions in skeleton.
4.	To learn about green chemistry, selection of solvents, catalyst, devices of synthesis like microwave, ultrasound, photochemistry etc. Development of synthetic pathways to synthesize target molecule including intermediates.

Reference Books Recommended:

1. Organic synthesis using transition metals-Roderick Bates (Wiley)
2. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
3. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
4. Organic synthesis – Michael B. Smith
5. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)
6. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken
7. Organic synthesis- Robert E Ireland
8. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako
9. Organic Synthesis, Jagdamba Singh & L.D.S. Yadav, 6th edition, Pragati Prakashan (2010).
10. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976)
11. Advance Organic Chemistry, Reaction Mechanism and Structure by Jerry March, 4th ed. John Wiley & Sons, 19927. An introduction to the chemistry of heterocyclic compounds-R M Acheso
12. Heterocyclic Chemistry- J A Joule and Smith
13. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt
14. Heterocyclic Chemistry, 4th Edition by J. A. Joule & K. Mills, Published by Chapman & Hall (1995)
15. Principles of modern heterocyclic chemistry, Edited by Leo A. Paquette, Published by Pearson Benjamin Cummings (1968)
16. Heterocyclic Chemistry, 3rd Edition by Thomas L. Gilchrist, Published by Prentice Hall (1997)
17. The Structure & Reactions of Heterocyclic Compounds, Edited by Michael Henry Palmer, Published by Edward Arnold (1967)
18. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.
19. New trends in Green Chemistry, 2nd edition, V.K. Ahluwalia and M. Kidwai, Anamaya publishers, New Delhi
20. Green Chemistry, theory and practice, Paul T. Anastas and John C. Warner, Oxford University Press, 2003, New York USA
21. Green Chemistry: an introductory text, Mike Lancaster, Green Chemistry network, University of New York, RSC, 2002
22. Handbook of Green chemistry and Technology, edited by James Clark and Duncan Macquarrie, blackwell publishing
23. Green Chemical synthesis and processes, Paul T. Anastas, Luren G. Heine, Tracy C. Williamsons, ACS Publication, 2000
24. Foye's principle of medicinal chemistry, 5th edition by David A. Williams and Thomas L. Lenke.
25. Organic Chemistry, Vol. I & II (Sixth edition), I. L. Finar.
26. S.W. Pelletier, Chemistry of the Alkaloids, Van Nostrand Reinhold Co., New York (1970).
27. K.W. Bentley, The Alkaloids, Vol. I., Interscience Publishers, New York (1957).
28. Chemistry of Organic Natural Products, Vol. I & II, O. P. Agrawal.
29. Organic Chemistry of Natural Products, Vol. I & II, Chatwal.
30. Organic Chemistry (5/e) by Morrison & Boyd.

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Semester III
PAPER-III

Course Code		Title of the Course	DRUGS ACTING ON CENTRAL NERVOUS SYSTEM AND ANTIBIOTICS
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand antipyretic analgesics and NSAIDs agents drugs. Opoid analgesics and its limitations. Their classification, Structure variations in Morphine, Morphan and 4-Phenylpiperidine. Synthesis and uses of selected class of drug compounds with SAR. • To understand psychoactive drugs, study general anesthetics, local anesthetics and sedatives & hypnotics also their classification, structural variations and mode of action. • To understand types of anti-parkinsonian and anti alzheimer's agents, study their division, classification, general structure, effect of substituent, mechanism of MPTP, synthesis and acetylcholinesterase inhibitors • Introduction and classification of antibiotics including β-lactam antibiotics and non classifiable antibiotics and learn about their medicinal importance, SAR and interfere with biosynthesis of bacterial cell walls.

Course Content		
Unit	Description	Weightage* (%)
1.	**ANTIPYRETIC ANALGESICS AND NSAIDs AGENTS** General classification of Non-narcotic analgesics and Antipyretic, Non-Steroidal Anti-Inflammatory, SAR of Pyazolone derivatives ,Narcotic and Opioid Analgesics, general mode of action, Receptors (Name only), Limitations of Opoids, Structure variations	25

	in Morphine, Morphan and 4-Phenylpiperidine Analogues, SAR of Morphine. Synthesis and therapeutic uses of only the following: Meperidine (Pethidine), Ketobemidone, Ibuprofen, Oxyphenbutazone, Diclofenac Sodium, Mefanamic acid, Celecoxib.	
2.	**PSYCHOACTIVE DRUGS** (i) General Anesthetics: General classification and Structural variations , Mode of Action (ii) Local Anesthetics: General classification and SAR , Mode of Action (iii) Sedatives and Hypnotics: General classification, Structural variations and Mode of action Synthesis and therapeutic uses of only the following: Thiopental (Pentothal), Amobarbital (Amytal), Chlorazepam, alprazolam, Benzocaine, Procaine, Lidocaine (xylocaine), Tetracaine (Anethaine), Etomidate	25
3.	**ANTI-PARKINSONIAN AND ANTIALZHEIMER AGENTS** Overview of neuromuscular disorder, introduction of Parkinson's disease, mechanism of MPTP, Classification, Pharmacotherapy of Parkinson's disease, dopamine receptor antagonist. Anti-alzheimer's agents: Acetylcholinesterase inhibitors, Pathogenesis, name of drugs. Synthesis and therapeutic uses of only the following: Levodopa, Trihexyphenidyl HCl, Ethopropazine HCl, Biperiden HCl, Methocarbamol.	25
4.	**β-LACTAM ANTIBIOTICS** • General introduction and classification of antibiotics Broad spectrum antibiotics Antibiotics that interfere with biosynthesis of bacterial cell walls. (a) β-lactam antibiotics: Penicillins (Structural variations and SAR), Cephalosporins (Structural variations) (b) Synthesis and therapeutic uses of only the following: Methicillin, Ampicillin, Cephalexin (c) Nonclassifiable antibiotics Medicinal importance/ clinical uses/ pharmacological applications of the following: Nalidixic acid, Norfloxacin, Ciprofloxacin.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand general classification of analgesic, antipyretic, NSAIDs Agents, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug.
2.	Understanding of CNS system, their classification and uses of selected class of drug compounds. Learn general classification of psychoactive agents, difference between sedative and hypnotics, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug.
3.	Understand about neuromuscular disorder, receptor antagonist. Learn about pathogenesis & name of related drugs and overview of different agents and inhibitors.
4.	Understand antibiotics, their classification, general structure, lactum, next generation antibiotics, structure variation, SAR, synthesis and uses of selected drug molecules.

Reference Books Recommended:

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5, Edited by ManFred E. Wolff (John Wiley & Sons, inc., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The Pharmaceutical Basis of Therapeutics by Goodman and Gilman (The Macmillan Co.).
8. The Organic Chemistry of Drug Synthesis, Vol. I, II & III (1980), Ed. By D. Lednicer and L. A. Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor) (Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvighyan, Dr. Anamik Shah, University

Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi., Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoy and Dr. V. R. Shenoy Multitech Publishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.
14. Textbook of Medicinal Chemistry, Volume I & II, Alagarsamy, 2010, Elsevier Publication.

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Semester III
PAPER-IV

Course Code		Title of the Course	Selected topics in Pharmaceutical chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand cardiovascular and antilipidaemic agents, learn about Anti-coagulant, Antihypertensive and Antilipidaemic agents. Synthesis, introduction, general classification, mode of action, mechanism and uses of selected class of drug compounds with SAR. • To understand Diuretics, classification and drug belong to that class, structural variation, synthesis and uses. Learn about Immune system, cellular humoral immunity, antigen & haptens, antigen & antibody reactions and their application. • To learn about overview, classification and mode of action of autocoids and anti-allergic drugs. To grab knowledge about usage of autocoids and allergic drugs. • To understand Radio Pharmaceuticals their applications in diagnosis and treatment, diagnostics techniques- ELISA, RIA, PET, SPET, isotopes, and metal complex with their general roles of metal complexes in biological processes.

Course Content		
Unit	Description	Weightage* (%)
1.	**CARDIOVASCULAR AND ANTILIPIDAEMIC AGENTS** General introduction of Anti-coagulants and Antihypertensive drugs, Classification, Structure variation in ß-adrenergic blockers and Dihydropyridines, Structure – activity Relationship of ACE Inhibitors, Mode of action, Mechanism of blood coating. Antilipidaemic agents: Introduction, General classification, Mode of action, disease and disorder caused by it. Synthesis and therapeutic uses of the following: Verapamil, Lisinopril, Losartan, Hydralazine, Warfarin, Fluvastatin, Benzafibrate, Dextrothroxine	25
2.	**DIURETICS AND IMMUNOLOGY** Diuretics: General classification. Structural variation and SAR of Thiazide Diuretics Synthesis and therapeutic uses of only the following: Chlorothiazide, Furosemide, Ethacrynic acid, Triamterene. Immune system, cellular humoral immunity, antigen and haptens, antigen and antibody reactions and their applications, Hypersensitivity, Active and passive immunization; Vaccines- their preparation, sterilization and storage.	25
3.	**AUTOCOIDS AND ANTI-ALLERGIC DRUGS** General Introduction & Classification, Classification of Histamine antagonists, Mode of Action of Antihistamines, Structure variation in Aminoalkylethers, Ethylenediamines and Piperazine derivatives. Eicosanoids and their synthesis inhibitors. Synthesis and therapeutic uses of only the following: Diphenhydramine (Benadryl), Antazoline, Chlorpheniramine, Primethazine, Clemastine, Cetirizine	25
4.	**PHARMACEUTICAL INORGANIC CHEMISTRY** Radio Pharmaceuticals and their applications in diagnosis and treatment, Diagnostics techniques- ELISA, RIA, PET, SPET. Isotopes: Isotopes- stable & radioactive, mode & rate of decay. Types & measurement of radioactivity. Radiopharmaceuticals & their diagnostic & therapeutic applications in pharmacy & medicine such as ^{125}I, ^{32}P, ^{51}Cr, ^{60}Co, ^{59}Fe, ^{99}Tc-M. Radiocontrast media, use of $BaSO_4$ in medicine. Dentifrices, desensitizing agents, & anticaries agents Metal complex: General Roles of metal complexes in biological processes, Therapeutic uses as Anti-cancer, Anti arthritics, Antimicrobial Complexes, Photo activated metal complex, Metal	25

	Poisoning, Drug action and metal chelation, medicinal significance of complex stability.	

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	To learn about anti-coagulants and anti hypertensive drugs. Learner should able to understand synthesis and uses of selected class of drug compounds.SAR and MOA of the studied class of compounds.To understand concept of Antilipidaemic agents.
2.	General classification of diuretics, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug of class..
3.	To comprehend classification and usage of autocoids and anti allergic drugs. To learn about synthesis and therapeutic uses of drug molecules.
4.	To understand the concept of radio pharmaceuticals, their applications in diagnosis and treatment, Diagnostics techniques- ELISA, RIA, PET, SPET. Learn about Isotopes: Isotope, types & measurement of radioactivity. To understand radiopharmaceuticals & their diagnostic & therapeutic applications in pharmacy & medicine. Dentifrices, desensitizing agents, & anticaries agents. To learn Metal complex:, General role in biological processes,

Reference Books Recommended:

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5, Edited by ManFred E. Wolff (John Wiley & Sons, inc., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry

(5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The Pharmaceutical Basis of Therapeutics by Goodman and Gilman (The Macmillan Co.).
8. The Organic Chemistry of Drug Synthesis, Vol. I, II & III (1980), Ed. By D. Lednicer and L. A. Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor) (Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvighyan, Dr. Anamik Shah, University Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi., Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoy and Dr. V. R. Shenoy Multitech Publishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.
14. Textbook of Medicinal Chemistry, Volume I & II, Alagarsamy, 2010, Elsevier Publication.

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Practicals
Semester- III

Course Code		Title of the Course	
Total Credits of the Course	8	Hours per Week	8 hrs

Course Objectives:	• To understand the concept of green chemistry. • To impart basic knowledge for carrying out multistep synthesis based on some name reactions. • Understand nature of reaction and establishment of reaction condition with mechanism • To learn about the calculation of mole ratio for each reaction. • Preparation of reagent to carry out estimation. • To understand the purpose of estimation and establishment of

	respective condition.

Course Content		
1	Green Synthesis	4- Credit
2	Preparation (From Given Name reactions)	
3	Estimation	4- Credit
4	Viva-Voce	

Green Synthesis (any four)

1. Preparation of acetanilide from aniline and acetic acid using Zn dust.
2. Base catalyzed aldol condensation using LiOH.H2O as a Catalyst.
3. Benzil-Benzilic acid rearrangement under solvent free condition
4. Synthesis of Paracetamol
5. Bromination of trans-stilbene using sodium bromide and sodium bromated.
6. Three component coupling reaction by green approach. (Synthesis of dihydropyrimidinone)

Preparation of industrially important compounds by following: (any six)

1. Skraup synthesis (Quinoline from aniline)
2. Preparation of 1,2,3,4-tetrahydrocarbazole from cyclohexanone and phenylhydrazine
3. Preparation of β-Resorcyclic acid from resorcinol.
4. Preparation of Benzoxazine from anthranilic acid.
5. Preparation of 2-amino-4-methyl thiazole from thiourea.
6. Preparation of Benztriazole from o-phenylene diamine.
7. Preparation of aspirin from phenol via salicylic acid
8. Preparation of p-amino benzoic acid from p-nitro toluene in via p-nitrobenzoic acid.

Estimation: (Any four)

1. Determination of Sulphonamides with silver nitrate solution by volumetrically.
2. Determination of aromatic primary amines by either diazotization or indirect diazotization.
3. Estimation of Benzyl Penicillin.
4. Non-aqueous titration of Sodium benzoate.
5. Estimation of Isonazid.
6. Determination of amount of Analgin in given solution

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, carrying out experiments at each step according to the respective practical.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics to carry out reactions, nature of reaction and calculation of mole ratio.
2.	Establish mechanism of reaction and monitoring specified reaction condition.
3.	Learn to work-up after the completion of reaction, purification.
4.	Confirm the product through the references.
6.	Learn to set up reaction condition for individual estimation of compound.
7.	Understand the calculation with reference to respective factors.
8.	Appreciate good laboratory practices.

Reference Books Recommended:

1. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. , P. W. G. Smith, A. R. Tatchell (Pearson Education).
2. Comprehensive practical organic chemistry: Preparation and Quantitative analysis, V. K. Ahluwalia, Renu Agarwal (Universities Press).
3. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
4. L. D. Field, S. Sternhell, J. R. Kalman - Organic Structures from Spectra-Wiley(2013)
5. Quantitative analysis by Arther I.Vogel
6. Quantitative analysis by V.K.Ahluwalia
7. Quantitative analysis by Mann and sanders

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Semester IV
Paper 1

Course Code		Title of the Course	Instrument and Separation Techniques
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the familiarize with the basic properties, theory & interpretation of ^{1}H NMR, ^{13}C NMR spectrometry, to impart knowledge in the theory & principless of spectroscopic techniques for characterization & differentiation of various molecules. • To understand and familiarize the basic principles, theory and instrumentation of mass spectroscopy, low and high resolution mass spectra, to impart knowledge in theory and principles of spectroscopy, spectroscopic technique for characterization and differentiation of various nucleus. • To learn various separation techniques and solvent extraction. Understanding of their principal, classification, different methods, mechanism and selection of reagents. To understand theory of dissolution, dissolution model, sample preparation, selecting and handling reagents. Dissolution-Testing Solid phase extraction, factors affecting on dissolution rates, different dosage form. • To understand various chromatographic separation methods, classification and theory with principle. Study of GC-MS, GC-TLC, LC-MS etc. and their applications General idea of XRD, SEM.

Course Content		
Unit	Description	Weightage* (%)
1.	**NMR SPECTROSCOPY** Theory and principles of NMR spectroscopy, Theory of Fourier Transform (i) ^{1}H NMR Spectroscopy: Proton resonance condition, nuclear spin, relaxation effect, Aspects of PMR spectra – number of signals, chemical shift, factors influencing chemical shift, deshielding, magnetic anisotropy, interpretation of protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei (alcohols, phenols, enols, acids, amides and mercaptans), effect of deuteration, spin-spin coupling, (n+1) rule, long range coupling, factors effecting coupling constant "J"	25

	(ii) ^{13}C NMR spectroscopy Types of 13C NMR Spectra: proton coupled and decoupled 13C spectra, chemical shift, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbons, factors affecting chemical shifts	
2.	**MASS SPECTROSCOPY** Theory and principles of mass spectroscopy; Instrumentation; low and high resolution mass spectra; Ionization techniques – Electron Impact (EI) ionization, Chemical Ionization (CI), Field Desorption (FD), Fast Atom Bombardment (FAB), Electron spray Ionization (ESI); Determination of molecular weight and molecular formula, nitrogen rule, detection of molecular ion peak, metastable ion peak; Fragmentations – rules governing the fragmentations, McLafferty rearrangement; Interpretation of mass spectra of different class of compounds, To write possible fragmentation for given compound; To identify structure from combined spectral data.	25
3.	**ANALYTICAL SEPARATION** Introduction of various separation techniques: Membrane separation, Precipitation, Electro deposition, distillation and miscellaneous methods. Theory of dissolution, dissolution model, sample preparation - dissolution and decompositions, selecting and handling reagents, Dissolution-Testing Solid phase extraction, factors affecting on dissolution rates, dissolution of different dosage form: solids, suspension; controlled drug release system. Solvent Extraction: Principles, Classification, Factors approaching solvent extraction, Quantitative treatment of solvent Extraction, Advantages, Applications, Synergistic Extraction, Mechanism of Extraction, Extraction Reagents.	25
4.	**CHROMATOGRAPHIC SEPARATION** Hyphenated Techniques: GC-MS, GC-TLC, LC-MS Etc. Principle and Application Adsorption Chromatography: Classification, definition of terms, principle and basic theory. column absorption chromatography: technique and application Partition chromatography: column, paper, TLC. Selection of stationary and mobile phase, detection technique, elementary idea of HPTLC. Characterization: General idea of XRD, SEM, TEM	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand fundamental & basic terms involved in ^{1}H NMR, ^{13}C NMR spectroscopy, know effects of various factors on the spectra, interpretation from spectral data, identify the structure of organic compounds by using combined spectral data, distinguish isomers and other closely related compounds by using spectral techniques.
2.	Understand the theory, instrumentation and important terms of mass spectrometry, fragmentation pattern, to set valuable insight into the types of molecular interaction and interpreting from obtained data.
3.	Learning of types of separation techniques, selection of solvents and development of methodology. To understand their principle, classification, different methods, mechanism and selection of reagents. To understand theory of dissolution, dissolution model, sample preparation, selecting and handling reagents. Dissolution-Testing Solid phase extraction, factors affecting on dissolution rates, different dosage form.
4.	Understanding of various chromatographic separation methods, classification and theory with principle. Study of GC-MS, GC-TLC, LC-MS etc. and their applications. General idea of XRD, SEM, TEM.

Reference Books Recommended:

1. R.M. Silverstein and F.X. Webster, Spectroscopic Identification of Organic Compounds, 6th Edition (2003) John Wiley, New York.
2. D.H. Williams and I.F. Fleming, Spectroscopic Methods in Organic Chemistry, 4th Edition(1988), Tata-McGraw Hill, New Delhi.
3. P.Y Bruice, Organic Chemistry, 2nd Edition (1998) Prentice – Hall, New Delhi.
4. Nuclear Magnetic Resonance – Basic Principles- Atta-Ur-Rehman, Springer-Verlag (1986).
5. One and Two dimensional NMR Spectroscopy – Atta-Ur-Rehman, Elsevier (1989).
6. Organic structure Analysis- Phillip Crews, Rodriguez, Jaspars, Oxford University Press (1998).
7. Holler, Skoog, principle of instrumental analysis, 6th edition, Crounch, India edition reprint, 2007
8. Douglas A. Skoog, F. James Holler, Timothy A. Nieman, principle of instrumental analysis, Brooks Cole Publisher.

9. Willard, marritt, Dean, Settle, Instrumental methods of analysis, CBS publisher and distributor.

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Semester IV
Paper I1

Course Code		Title of the Course	Pharmaceutical Organic Chemistry-2
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• Study of Vitamins and Steroids, including biochemical functions of Vitamin A, Vitamins B_1 and B_2, Vitamin H and structure determination of Cholesterol and Ergosterol and biosynthesis of sterols. • To understand different kind of molecular rearrangement involving migration to electron deficient carbon, electron rich carbon, electron deficient nitrogen and aromatic rearrangements. • To provide basic theoretical understanding of heterocyclic chemistry, improving general methodology for different kind of ring synthesis which implies the new heterocyclic systems by changing the functionality with respective positions in skeleton. • To understand the concept of combinatorial chemistry. Synthesis of drug molecules through multi component reactions and parallel synthesis of drug molecules and their intermediates.

Course Content		
Unit	Description	Weightage* (%)
1.	**VITAMINS AND STEROIDS** (A) Vitamins: Structure determination, Synthesis and biochemical functions of Vitamin A, Vitamins B1 and B2, Vitamin H (B) Steroids: Introduction to Sterols: Structure determination of cholesterol and ergosterol, Biosynthesis of sterols,	25

	Stereochemistry of steroids, Bile acids: General and Structure.	
2.	**MOLECULAR REARRANGEMENT** **(A) Rearrangement involving migration to electron deficient carbon:** (i) Demajnov rearrangement (ii) Benzil-Benzilic acid rearrangement (iii) Meyer schuster rearrangement **(B) Rearrangement involving migration to electron rich carbon**: (i) Favorskii rearrangement (ii) Neber rearrangement **(C) Rearrangement involving migration to electron deficient nitrogen**: (i) Stieglitz rearrangement (ii) Curtius rearrangement **(D) Aromatic rearrangements**: (i) Migration around the aromatic nucleus: Jacobsen rearrangement (ii) Migration of group from the side chain to the nucleus: Orton rearrangement, Hoffmann-Martius rearrangement **(E) Rearrangement involving migration from oxygen to ring**: (i) Fries rearrangement (ii) Claisen rearrangement	25
3.	**HETEROCYCLIC CHEMISTRY-2** (a) Synthesis, reactivity, aromatic character and importance of following : Pteridine, Triazine, Phthalazine, Naphthyridine, Phenoxazine, Quinoline, Isoquinoline, Benzopyrazole, Benzimidazole. (b) Fused Heterocycles as medicinal approach. (Five and six membered with two heterocyclic ring)	25
4.	**COMBINATORIAL CHEMISTRY** Introduction, Combinatorial synthesis for Drug Optimization, Drug discovery, Solid Phase Techniques, Methods of parallel synthesis and Mixed Combinatorial Synthesis, Deconvolution, linkers, Structure Determination and limitations, Assays and Screening of Combinatorial libraries, Examples of Combinatorial chemistry.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	To learn biochemical function of vitamins, classification & structural elucidation.To learn basic skeleton of steroids, structural elucidation of cholesterol, ergosterol, bile acids, their interrelation of each other and their physiological activities.
2.	To learn about type of rearrangement, migrating aptitude, ring expansion, contraction, strain theory, isotopic effect, effect of other groups with reference to functional group and their application.
3.	To learn about basic concept, synthesis and application of heterocyclic chemistry, aware about heterocyclic systems, types of heterocyclic rings, application of heterocycles in medicinal chemistry.
4.	To learn about combinatorial chemistry. Application of combinatorial chemistry in drug synthesis including intermediates, parallel synthesis to get a class of drug molecule.

Reference Books Recommended:

1. Organic synthesis using transition metals-Roderick Bates (Wiley)
2. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
3. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
4. Organic synthesis – Michael B. Smith
5. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)
6. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken
7. Organic synthesis- Robert E Ireland
8. Heterocyclic Chemistry- J A Joule and Smith
9. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt
10. Heterocyclic Chemistry, 4th Edition by J. A. Joule & K. Mills, Published by Chapman & Hall (1995)
11. Principles of modern heterocyclic chemistry, Edited by Leo A. Paquette, Published by Pearson Benjamin Cummings (1968)
12. Heterocyclic Chemistry, 3rd Edition by Thomas L. Gilchrist, Published by Prentice Hall (1997)
13. The Structure & Reactions of Heterocyclic Compounds, Edited by Michael Henry Palmer, Published by Edward Arnold (1967)
14. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.

15. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako
16. Organic Synthesis, Jagdamba Singh & L.D.S. Yadav, 6th edition, Pragati Prakashan (2010).
17. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976)
18. Advance Organic Chemistry, Reaction Mechanism and Structure by Jerry March, 4th ed. John Wiley & Sons, 19927. An introduction to the chemistry of heterocyclic compounds-R M Acheso
19. An introduction to the chemistry of heterocyclic compounds-R M Acheso
20. Fundamentals of Medicinal Chemistry by G Thomas.
21. Foye's principle of medicinal chemistry, 5th edition by David A. Williams and Thomas L. Lenke.
22. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry, 11th edition, John H. block, John M. Beal
23. Chemistry of Vitamins – S. F. Dyke.
24. Natural Products Chemistry, Vol. I & II, K. Nakanishi.
25. The Molecules of Nature, J. B. Hendrickson.
26. Selected Organic Synthesis: Ian Fleming.
27. Chemistry of Natural Products, N. R. Krishnaswamy.
28. The Chemistry of Natural Products, K. W. Bentley. Vol. I – V

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Semester IV
Paper 1II

Course Code		Title of the Course	HORMONAL AND PHARMACOKINETIC AGENTS
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand hormonal drugs and various Anti-Thyroid agents. SAR, Classification and MOA of given class of compounds and their synthesis. To learn Contraceptive agents, classification, MOA, synthetic and therapeutic usage. • To understand drugs acting on gastrointestinal tract, learn about Anti-ulcerative and Anti-diarrheal drugs, classification Structural

	variations of gastric acid secretion inhibitors, SAR. • To understand drugs acting on respiratory tract, learn about Antitussive and Antiasthmatic agents including classification, therapeutic uses, mechanism of Action of Sympathomimetics. • To learn about types of anti infective drugs and sulfonamides , their classification, general structures, effect of substituent, SAR, synthesis and uses.

Course Content		
Unit	Description	Weightage* (%)
1.	**HORMONAL DRUGS** Anti-Thyroid agents: Introduction, Classification, Mode of action, Problems related to Thyroid hormone. Insulin and Oral Hypoglycemic Agents (Anti-diabetic agents or drugs affecting sugar metabolism): General classification, Diabetic mellitus (Type I & II), Variants of Insulin. Contraceptive agents: Introduction, Classification, Oral contraceptives, spermicides, Mode of action, steroids as contraceptives. Synthesis and therapeutic uses of only the following: Carbimazole, Methimazole (Tapazele), Glybomuride, Chlorporpamide, Glipizide, Metformin, Norethindrone, Norgestrel.	25
2.	**DRUGS ACTING ON GASTROINTESTINAL TRACT** Anti-ulcerative drugs: Introduction, Classification, Structural variations of gastric acid secretion inhibitors, SAR of H2-receptor Antagonists. Anti-diarrheal: Types of Anti- diarrheal agents, Anti- diarrheal interaction (a) Synthesis and therapeutic uses of only the following: Cimetidine (Tagamet), Ranitidine (Zantac), Nizatidine, Omeprazole (Omez), Rabeprazole.	25
3.	**DRUGS ACTING ON RESPIRATORY TRACT** General introduction and Classification of Antitussive, Respiratory stimulants. Antiasthmatic agents: β2-Adrenergic agonists, Mechanism of Action of Sympathomimetics. Synthesis and therapeutic uses of the following: Dextromethorphan HBr, Doxapram (Carbopram), Caffeine, Nikethamide (Coramine), Tiagabin, Adrenaline, Isoprenaline, Clidinium Bromide	25
4.	**LOCAL ANTI INFECTIVE DRUGS and SULFONAMIDES**	25

	(a) Anti – Mycobacterial agents: General Introduction of Tuberculosis & Leprosy-disease, Treatment, Classification, Mode of action, adverse effect of Anti TB agents & Anti–leprotic agents. (b) General classification, mode of action and SAR of Sulfonamides (c) Synthesis and therapeutic uses of only the following: Ethionamide, Ethambutol, DDS (Dapsone), Pyrazinamide, Sulfamethoxine (Sufadoxine), Sulfamethoxy-Pyrazine (Sulfalene), Succinyl sulfathiazole (Sulfasuxidine), Nitrofurazone.	

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understanding of hormonal drugs, classification of anti thyroid agents, hypoglycemic and hyperglycemic agents. Different types of diabetic mellitus and synthesis of given class of compounds. To learn Contraceptive agents, classification, MOA, synthetic and therapeutic usage.
2.	Learning about GI class of drug, their classification, synthesis and uses of the given drug molecules.SAR and MOA of GI class of drugs. SAR of receptor antagonist.
3.	Learning drugs acting on respiratory tract, Antitussive and Antiasthmatic agents including classification, therapeutic uses MOA of Sympathomimetics
4.	Learn general classification of anti-mycobacterial, anti TB agents and anti leprotic, their mode of action and synthesis of selected drug molecules. Learn general classification of sulphonamides, their structural variations, mode of action and synthesis of selected drug molecules.

Reference Books Recommended:

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5,

Edited by ManFred E. Wolff (John Wiley & Sons, inc., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The Pharmaceutical Basis of Therapeutics by Goodman and Gilman (The Macmillan Co.).
8. The Organic Chemistry of Drug Synthesis, Vol. I, II & III (1980), Ed. By D. Lednicer and L. A. Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor) (Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvighyan, Dr. Anamik Shah, University Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi., Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoy and Dr. V. R. Shenoy Multitech Publishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.
14. Textbook of Medicinal Chemistry, Volume I & II, Alagarsamy, 2010, Elsevier Publication.

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Semester IV
Paper IV

Course Code		Title of the Course	Chemotherapeutic Agents
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand anti malarial drug, life cycle of plasmodium, general classification, their structural variation, synthesis and uses.

	• To understand cancer, types of cancer, drug molecule used as anti cancer/ antineoplastic agents, their classification. Synthesis and use of given drug molecules. • To understand life cycle of virus. Various classes of enzymes, general structure of anti viral and anti-HIV agents, structural variation, synthesis and uses. • To understand non-lactam antibiotics learn about Macrolide, medicinal importance, clinical uses, pharmacological applications.

Course Content		
Unit	Description	Weightage* (%)
1.	**ANTIMALARIALS AGENTS** Antimalarials: Introduction, Types, Life cycle of plasmodium, drug resistance, General classification, SAR of 4- and 8-aminoquinolines and Structure variation in Sesquiterpene Lactones, mode of action. Synthesis and therapeutic uses of only the following: Mefloquine, Chloroquine, Primaquine, Pyrimethamine (Daraprim), Quinacrine.	25
2.	**ANTINEOPLASTIC AGENTS (CANCER CHEMOTHERAPY)** Introduction to cancer, types, Causes & Treatment of cancer, Metastasis, Drug Resistance, Targets of anticancer agents, adverse effects of cancer therapy (in brief) General classification of antineoplastic agents, Cell Cycle-Specific (CCS) and Non Cell Cycle-Specific (CCS) Agents, Mode of action. Synthesis and therapeutic uses of only the following: Mechlorethamine, Cyclophosphamide, Melphalan, 6-Mercaptopyrine, Trimetrexate, Cytarabine, chlorambucil.	25
3.	**ANTIVIRAL AGENTS** Introduction, Types & classes of viruses, Classification of antiviral agents, mechanism of action, Antiviral Compounds for DNA Viruses & Selected RNA Virus Infections other than HIV (Influenza A and B Viruses, Hepatitis C Virus) Anti-HIV Drugs: Introduction, HIV Infection and its Pathological Effects, HIV Structure and life cycle, HIV drugs in clinical use, Development of Drug Resistance. Synthesis and therapeutic uses of only the following: Amantadine, Acyclovir, Zidovudine, Indinavir, Ritonavir	25

4.	**NON-LACTUM ANTIBIOTICS** a) Antibiotics that interfere with biosynthesis of bacterial cell walls. b) Non-lactum antibiotics: Tetracyclin (Structural variations and SAR) c) Macrolide antibiotics, Amino glycoside antibiotics and d) Non-lactum antibiotics: Medicinal importance/ clinical uses/ pharmacological applications of the following: Bacitracin, Vancomycin, Cycloserine, Erythromycin, Lincomycin, Chloramphenicol, Novobiocin. Synthesis and therapeutic uses of only the following: Chloramphenicol, Ciprofloxacin, Metronidazole.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignment etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn life cycle of malaria, types of plasmodia, general structure of anti malarial agents, structural variation among them, mode of action, synthesis and uses of selected drug molecules.
2.	To learn about cancer, types of cancer, classification of anti cancer drugs, chemotherapy, synthesis and uses of specified antineoplastic agents.
3.	Understand life cycle of virus. Identification of enzymes responsible for replication of virus, mechanism of drug action. Synthesis and uses of selected drug molecules.
4.	Understand antibiotics, their classification, general structure, non-lactum antibiotics, next generation antibiotics, SAR, synthesis and uses of selected drug molecules.

Reference Books Recommended:

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5, Edited by ManFred E. Wolff (John Wiley & Sons, inc., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).

3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The Pharmaceutical Basis of Therapeutics by Goodman and Gilman (The Macmillan Co.).
8. The Organic Chemistry of Drug Synthesis, Vol. I, II & III (1980), Ed. By D. Lednicer and L. A. Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor) (Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvighyan, Dr. Anamik Shah, University Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi., Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoy and Dr. V. R. Shenoy Multitech Publishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.
14. Textbook of Medicinal Chemistry, Volume I & II, Alagarsamy, 2010, Elsevier Publication.

On-line resources to be used if available as reference material
On-line Resources

Master of Science, Pharmaceutical Chemistry
Practicals
Semester - IV

Course Code		Title of the Course	
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for carrying out multistep synthesis based on some name reactions. • Understand nature of reaction and establishment of reaction condition with mechanism

	• To learn about the calculation of mole ratio for each reaction. • Able to interpret structure of organic compounds from spectra like UV, IR, NMR and Mass. • Isolation of product, purification and confirmation of the product. • To understand the purpose of green synthesis.

Course Content

1	Preparation or organic compounds	4- Credit
2	Isolation	
3	Spectral Interpretation	4- Credit
4	Viva-Voce	

Preparation of industrially important compounds by following: (any six)

1. Sulfanilamide from via p-acetamido benzene sulphonyl chloride and acetamido benzene-sulfonamide.
2. Acridone from anthranilic acid via o-chloro benzoic acid and N-phenylanthranilic acid
3. Benzocaine from p-nitro toluene via p-nitro benzoic acid and p-amino benzoic acid.
4. Anthrone from phthalic anhydride via o-benzoyl benzoic acid and anthraquinone.
5. 4-Methyl-7-hydroxy-8-acetyl coumarin from resorcinol via 4-methyl-7-hydroxycoumarin and 4-methyl-7-acetyl coumarin.
6. Phenacetin from P-amino phenol via p-acetyl aminophenol.
7. Benzanilide from benzene via Benzophenone and Benzophenonoxime.
8. 2-phenyl Indole from acetophenone via acetophenone phenylhydrazone
9. p-Nitro chloro benzene from acetanilide via p-nitro acetanilide and p-nitroaniline.

Isolation of phytochemicals from their natural sources.

1. Caffeine from Tea
2. Curcumin from turmeric
3. Lycopene from tomato
4. Casine from milk
5. Tannins from Walnuts
6. Nicotine from tobacco

Spectral Exercise (Minimum 10 from syllabus)

Structure interpretation of organic compounds from spectra (UV, IR, NMR and Mass)

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, carry out experiments at each step according to the respective practical, interpretation of spectra and deduce the structure.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics to carry out reactions, nature of reaction and calculation of mole ratio.
2.	Establish mechanism and monitoring reaction at specified reaction condition.
3.	Learn to work-up after the completion of reaction, purification.
4.	Understanding of the compounds obtained by isolation process, their purification and confirmation of the structure.
5.	Understand the calculation with reference to respective factors.
6.	Learn to interpret structure of organic compounds from given spectra.
7.	Appreciate good laboratory practices.

Recommended References:

1. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. , P. W. G. Smith, A. R. Tatchell (Pearson Education).
2. Comprehensive practical organic chemistry: Preparation and Quantitative analysis, V. K. Ahluwalia, Renu Agarwal (Universities Press).
3. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
4. L. D. Field, S. Sternhell, J. R. Kalman - Organic Structures from Spectra-Wiley(2013)
5. Quantitative analysis by Arther I.Vogel
6. Quantitative analysis by V.K.Ahluwalia
7. Quantitative analysis by Mann and sanders

On-line resources to be used if available as reference material
On-line Resources