DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRAPATI SAMBHAJI NAGAR

NAAC Re-accredited 'A' Grade

National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry

Specialization:

Organic Chemistry

Choice Based Credit and Grading System
Effective from Academic Year 2024-25

Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry
Dr. Babasaheb Ambedkar Marathwada

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PREFACE

National Education policy 2020 has been intensely debated policies come into existence. In January, 2020 UGC has given the guideline for Learning outcome based curriculum framework (LOCF)work towards more holistic experience for the students . while focussing not just on knowledge delivery in higher education but also on the application of knowledge through field and laboratory work and emphasis on application of knowledge to real life experiences, LOCF is student-centric education in the context of development of personal, social, professional and acquired knowledge requirements in their career and life building, which focuses on measuring student performance through outcomes. It includes the knowledge, skills and attitudes enhancement in the students .

The aspects of LOCF is all-round development of the students, skill acquisition outside chosen subjects and research were undetermined but NEP has changed all of these in one stroke. The prominent features of the NEP framework are:

- Student centric education
- Flexibility in postgraduate programmes
- Multiple entry and exit points
- Skill based & outcome base education
- Credit based evaluation system
- Academic bank credits

It also focuses on evaluation of outcomes of the program by considering the knowledge, skill and behaviour of a students after completion of two year program. The educational triangle of Teaching-Learning and Evaluation process is the unique features of the OBE approach. The curriculum practices such as Competency based curriculum, Tailor-made curriculum development, spades, curriculum principles, Blooms Taxonomy and further use of assessment methodologies like, Norm-reference testing and Criterion reference testing, etc is being practiced since decades. It is also interesting to know that, globally, different countries and universities adopts the curriculum development models /approaches such as, CDIO (Conceive-Design-Implement-Operate), Evidence based education systems approach, etc as the scientific and systematic approaches in curriculum design.

Maharashtra state government and the authorities of Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhaji Nagar has decided to implement National Education policies -2020 from the academic year 2023-24 for postgraduate program with outcome based education

As per guideline of OBE the department has prepared curriculum for Master of science in chemistry with specialization Inorganic chemistry, Organic Chemistry, Physical Chemistry and self supported Analytical Chemistry . The OBE syllabus will help to improve the quality and employability of the Post-graduates of the university department.

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1.	**Vision Statement:** A Master of Science (M.Sc.) in Chemistry is a postgraduate degree that provide students with in-depth knowledge, research skills, and practical expertise in the field of chemistry. Some of key points of our M. Sc. Chemistry program are mentioned below: 1. Comprehensive Core Curriculum: Our course having a strong core curriculum covering fundamental principles in organic, inorganic, physical, analytical, and drug chemistry. This foundational knowledge is crucial to build a solid understanding of the discipline. 2. Specialization Options: To cater to the diverse interests of students, students have option to select different specialization. We are offering three specializations viz, Analytical Chemistry, Drug Chemistry and Organic Chemistry. By choosing a specialization, students can focus on topics that align with their career aspirations and research interests. 3. Research Emphasis: Research is a crucial aspect of an M.Sc. Chemistry program. Students have opportunities to work on research projects under the guidance of experienced faculty members. This hands-on experience will enhance critical thinking, problem-solving skills, and laboratory techniques. 4. Modern Analytical Techniques: The course will provide the training or interpretation in modern analytical techniques, such as spectroscopy, chromatography, mass spectrometry, and so on. Proficiency in these techniques is vital for conducting advanced research and for industry applications. 5. Green Chemistry and Sustainability: Incorporation of principles of green chemistry and sustainability into the curriculum will promote awareness of environmental impact and encourage students to develop eco-friendly solutions. Overall, the vision for M.Sc. Chemistry course is to produce well-rounded, skilled, and ethical chemists who can contribute meaningfully to scientific advancements and societal needs
2.	**Mission Statement** The mission of the M.Sc. Chemistry program is to provide advanced education and training in the field of chemistry. Student will get the understanding of chemical principles, analytical techniques, and specialized knowledge in various sub-disciplines. The program aims to foster critical thinking, research skills, and ethical practices among students, enabling them to contribute significantly to scientific advancement, innovation, and societal needs. Further, program focus is to encourage the students to stand in competitive examinations in the field of chemistry such as NET, SET and GATE and contribute to the academic field. To bring sustainable progress of society by nurturing chemistry with responsibilities. To create and maintain programs of excellence in the areas of research, education and public outreach. It will produce students who are knowledge in chemistry and can think critically. To develop the researcher and scientist in chemical science through post-graduate education and research programme. To develop the competent manpower with technology-based experimentation methodologies and value-

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	based practices for business and industries. To undertake projects to solve field base problems. To provide student centric learning facilities for the development of overall personality of learner.
3.	**Eligibility Criteria :** Candidate has passed Bachelor's Degree Examination with Chemistry as one of the major subject, eligible for M. Sc. (Chemistry) for all three specializations. Further, B.Sc. Forensic Science student is eligible only for Analytical Chemistry specialization
4.	**Assessment and Evaluation: 40 % internal & 60% university exam**
5.	**Duration of Course Programme : Two years**
6.	**Credit Allotted for two year master programme in chemistry :** 88 Credit Semester - I : 22 Semester -II : 22 Semester -III : 22 Semester -IV : 22
7.	**Program Objectives:** M. Sc. in Chemistry program aims to provide the following objectives: 1. Provide the Advanced Knowledge: The program aims to provide the core/basic concepts in chemistry, including organic, inorganic, physical, and analytical chemistry, while also exploring interdisciplinary areas. 2. Provide the Research Skills: Students will get the research-oriented environment in the department and learns the laboratory techniques and methodologies required in the research. 3. Create Analytical Thinking: We will encourage the students to create analytical thinking and encouraging to approach complex challenges with creativity and scientific reasoning. 4. Ability of Communication and Collaboration: In the program, students will work on their abilities to present and discuss scientific ideas clearly and work collaboratively with others
8.	**Program Outcomes:** The program outcomes (PO's) are the statement of competencies/ abilities. POs are the statement that describes the knowledge and the abilities the post-graduate will have by the end of program studies. i).In-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.

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	ii). Apply/implement interface between on the one hand, the history of chemistry and natural science and, on the other hand, issues pertaining to the areas of modern technology, health, and environment. iii). Skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques. iv). Skill in examining specific phenomena theoretically and/or experimentally. v). Generation of new scientific insights or to the innovation of new applications of chemical research.
9.	**Course Program outcome** Course Program Outcomes are developed through the curriculum (curricular/co-curricular-extra-curricular activities). The program outcomes are attained through the course implementation. As an educator, one must know, **"To which POs his/her course is contributing?"**. So that one can design the learning experiences, select teaching method and design the tool for assessment.

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Two Years Master of Science in Chemistry Programme

Subject : Chemistry

Specialization : Organic Chemistry

(Semester III & IV)

(Effective from 2024-25)

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Illustrative Credit distribution structure for Two Years Programme with Multiple Entry and Exit options

Class: M.Sc. Second Year Semester: III[rd] Specialization Subject: Organic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	OCHET- 600	DSC-15 (org. Chem.)	4	-	4	-	10T	49	60	100
	OCHET- 601	DSC-16 (org. Chem.)	4	-	4	-		20	60	100
	OCHET- 602	DSC-17 (org. Chem.)	2	-	2	-		20	30	50
	OCHEL- 603	DSC-18 (org. Chem. Lab course)	-	4	-	2	4P	20	30	50
	OCHEL- 604	DSC-19 (org. Chem. Lab course)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	OCHETE-605	DSE-9 (org. Chem)	2	-	2	-	4T	20	30	50
	OCHETE-606	DSE-10 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-607	DSE-11 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-608	DSE-12 (org. Chem)	2	-	2	-		20	30	50
Research Project	OCHE-RP-649	Research Project -1	-	8	-	4	4P	40	60	100
Total			**14**	**16**	**14**	**08**	**22**	**220**	**330**	**550**

Course code Nomenclature :

DSC-Discipline Specific Core course, **DSE**- Discipline Specific Elective, **T**-Theory, **L**- Laboratory course, **OCHET**- Organic Chemistry Theory Core course , **OCHEL**- Organic Chemistry Laboratory Core course, **OCHETE**- Organic Chemistry Elective Course, **OCHE-RP**- Organic Chemistry Research Project

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Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Organic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	OCHET- 650	DSC-20 (org. Chem.)	4	-	4	-	10T	40	60	100
	OCHET-651	DSC-21 (org. Chem.)	4	-	4	-		40	60	100
	OCHET-654	DSC-22 (org. Chem.)	2	-	2	-		20	30	50
	OCHEL-655	DSC-23 (org. Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	OCHETE-656	DSE-13 (org. Chem)	2	-	2	-	4T	20	30	50
	OCHETE-657	DSE-14 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-658	DSE-15 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-659	DSE-16 (org. Chem)	2	-	2	-		20	30	50
Research Project	OCHETE-RP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			**14**	**16**	**14**	**08**	**22**	**220**	**330**	**550**

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Semester-III

Course Name: Structural Elucidation by Spectral Methods

Course Code:OCHET-600

Course type: DSC-15

Total contact hours: 60 h (04 h/Week) **Credits:** 04 **Marks:**100

Course Outcomes:

On the completion of course, students will be able to:

1. Review elementary concepts of nuclear magnetic resonance spectroscopy and delve into spin-spin couplings, factors affecting coupling constants, and spin systems like AB, AX, and ABX.
2. Explore techniques such as INEPT, INADEQUATE, and the Nuclear Overhauser effect.
3. Grasp elementary concepts of ^{13}C NMR spectroscopy, including chemical shifts for various carbon types and the impact of substituents on these shifts.
4. Understand the fundamentals of mass spectrometry, including ion production methods, ion analysis, factors affecting fragmentation, and the interpretation of mass spectra.
5. Explore fragmentation patterns for various functional groups and phenomena like the molecular ion peak and McLafferty rearrangement.
6. Grasp the principles of Mössbauer spectroscopy, understanding factors influencing line position and shape, including the isomer effect and quadrupole splitting.
7. Integrate UV, IR, ^{1}H NMR, ^{13}C NMR and Mass data to solve complex and deduce thre structure.

UNIT-I: Nuclear Magnetic Resonance Spectroscopy (^{1}H NMR) **[12 h]**

Elementary ideas (Recapitulation); Spin-spin couplings, Different types of couplings, factors affecting on coupling constants, Karplus equation, Spin systems (AB, AX, ABX, AMX), Rate processes, spin decoupling, shift reagents, Nuclear Overhauser effect (NOE), INEPT and INADEQUATE.

UNIT-II: ^{13}CNuclear Magnetic Resonance Spectroscopy **[12h]**

Elementary ideas, instrumental problems, chemical shifts (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbons); Effect of substituents on chemical shifts.

UNIT-III: Mass Spectroscopy **[12h]**

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Introduction, ion production (EI, CI, FD and FAB), ion analysis, ion abundance, factors affecting on fragmentation, fragmentation of different functional groups, molecular ion peak, isotopic peaks, metastable peak, Nitrogen rule, McLafferty rearrangement, Retro-Diels-Alder reaction.

UNIT-IV **[12h]**

Problems based on joint applications of UV, IR, ^{1}H NMR, ^{13}C NMR and Mass spectroscopy.

UNIT-V **[12h]**

Mossbauer spectroscopy: Principle, factors affecting the line position and shape, isomer effect and Quadrupole splitting iron salt like compounds, complexes, carbonyl compounds (temperature dependence of isomer shift and Quadrupole splitting in simple compound and coordination, polynuclear complexes), Numericals. **Electron Spin Resonance Spectroscopy:** Introduction, principle of ESR spectroscopy, presentation of spectrum, hyperfine splitting in various structures, hyperfine splitting diagram of representative examples, factors affecting the magnitude of 'g' values, Zero field splitting, Kramer's degeneracy, Anisotropy in the hyperfine coupling constant, electron delocalization, instrumentation and applications.

Reference Books:

1. Introduction to Spectroscopy: D. L. Pavia, G. M. Lampman, G. S. Kriz
2. Spectrometric Identification of Organic Compounds: R. M. Silverstein & F. X. Webster
3. ^{13}C NMR Spectroscopy: G. C. Levy, R. L. Lichter, G. L. Nelson
4. Spectroscopic Methods in Organic Chemistry: D. H. Williams & I. FlemmingAbsorption
5. Spectroscopy of Organic Compounds: V. M. Parikh
6. Mass Spectrometry: K. G. Das & James
7. Coordination Chemistry by Experimental Methods: K. Barger
8. Coordination Chemistry vol. I: E. Martell
9. Physical Methods for Chemistry: R. S. Drago
10. Structural Methods in Inorganic Chemistry: E. A. V. Ebsworth& D. W. H. Rankin
11. Organic Structure Analysis: Philips Crews

Semester-III

Course Name: Reagents in Organic Synthesis

Course Code:OCHET-601

Course type: DSC-16

Total contact hours: 60 h (04 h/Week) **Credits:** 04 **Marks:**100

Course Outcomes:

On the completion of course, students will be able to:

1. Exploremetal and non-metal basedoxidising agents for functional group transformations.

2. Understand the selectivity in the reagents for carrying oxidations
3. Learn the utility of the reagents
4. Explore the suitable methods to carry out oxidation and dihydroxylation
5. Explore the synthetic utility of various hydride transfer reagents for reduction of functional groups
6. Understand the preparation and applications of organic reagents for different types of reactions
7. Utilize the various organometallic reagents for carbon-carbon bond formations
8. Achieve the preparation of ylides and their synthetic utlity]

UNIT-I Oxidation **[18 h]**

(a) Oxidation of alcohol to aldehyde, ketone or acid: Jones reagent, Collins reagent, Fetizones reagent, PCC, PDC, PFC, Activated MnO_2, Chromyl chloride (Etard reaction), TEMPO, CAN, NMO,

(b) DMSO activated oxidation of alcohols to carbonyls: Kornblum oxidation, Moffatt-Pfitzner oxidation, Parikh-Doering oxidation, Albert-Goldman oxidation, Swern oxidation and Corey-Kim oxidation

(c) Oxidative cleavage of Carbon-Carbon double bonds: $KMnO_4$, Ozonolysis.

(d) Oxidations using SeO_2, PhSeBr and related applications of the reagents.

(e) Selective cleavages at functional groups: Cleavage of glycols, IO^-_4, $Pb(OAc)_4$.

(f) Dihydroxylation of alkenes: (i) OsO4; Milasdihydroxylation, Upjohn dihydroxylation and Johnson-Leimux reaction (ii) Ruthenium tetroxide

UNIT-II Reductions **[12 h]**

(a) Catalytic Hydrogenation under homogeneous and heterogeneous conditions; Reduction of alkenes, alkynes, nitriles, oximes and nitro compounds; (b) Reduction of carbonyls, acids, amides, esters, lactones, lactams, cynides, imines by boron and aluminium based reagents such as $LiAlH_4$, $LiBH_4$, $Li(OEt)_3AlH$, $NaBH_4$, $Ca(BH_4)_2$, $Zn(BH_4)_2$, DIBAL-H, BH_3.THF complex, Catechol borane, Disiamylborane, Thexylborane, IP_2BH, IP_cBH_2 (c) Reduction of carbonyls to hydrocarbons: Clemenson reduction, Wolf-Kishner reduction (d) Birch reduction and related reactions

UNIT-III Organic Reagents **[12 h]**

Preparation and synthetic applications of: DCC, EDC, DDQ, 1,3 Dithiane, LDA, DMDO, Iodoxybenzoic acid, Dess-Martin Periodinane, Diazomethane, Lawesson's reagent.

UNIT-IV **[06 h]**

Ylides and Enamines

Ylides: Preparation and their synthetic applications along with their stereochemical aspects of

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(i) Phosphorous ylides: Wittig, Wittig-Horner, Horner-Wadsorth-Emmons reactions

(ii) Sulphur ylides: Corey-Chaykovskyepoxidation, cyclopropanation and aziridination reactions

Enamines: Generation & application in organic synthesis with mechanistic pathways, stork enamine reaction.

UNIT-V Formation of Carbon-Carbon bonds via organometallic reagents **[12 h]**

Synthesis and applications of organo Lithium, Magnesium, Titanium, Cerium, Copper, Chromium, Zinc, Boron, Silicon, Cadmium, Palladium, Tin

Reference Books:

1. Organic Chemistry: Clayden, Greeves, Warren and Wothers
2. Stereochemistry of Organic Compounds (Principle and application): D. Nasipuri
3. Stereochemistry of Organic compounds: Ernest L. Eliel / Samuel H. Wilen
4. Organic Synthesis: W. Carruthers
5. Organic Reagents: Fieser&Fieser
6. Organic Synthesis: M. B. Smith
7. Advanced Organic Chemistry; Part A and B: F. A. Carey & R. J. Sundberg
8. Modern Organic Synthesis: An Introduction: G. S. Zweifel& M. H. Nantz
9. A Guidebook To Mechanism In Organic Chemistry: Peter Sykes
10. Organic Synthesis Concepts, Methods, Starting Materials: J. Fuhrhop, G. Penzlin
11. Organic Chemistry: An Intermediate Text: Robert V. Hoffmann
12. Advanced Organic Chemistry: Jerry March
13. Organic Synthesis: R. O. C. Norman and Coxan
14. Name Reactions: Jie Jack Li

Semester-III

Course Name: Pericyclic Reactions and Free Radicals

Course Code:OCHET-602

Course type: DSC-17

Total contact hours: 30 h (02 h/Week) **Credits:** 02 **Marks:**50

Course Outcomes:

On the completion of course, students will be able to:

1. Understand the photochemical and thermal reactions
2. Classify the various types of pericyclic reactions
3. Apply the orbital correlation and frontier molecular orbital methods for pericyclicreactions
4. Predict the stereochemical outcome of pericyclic reactions

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5. Understand various free radical reactions

UNIT-I:Pericyclic Reactions-I **[10 h]**

Features and classification of pericyclic reactions, Phases, nodes and symmetry properties of molecular orbital in ethylene, 1,3-butadiene, 1,3,5-hexatriene. Allylcation, allyl radical, pentadienylcation and pentadienyl radical. Thermal and photochemical reactions.

Electrocyclic reactions: Woodward-Hoffmann selection rules for electrocyclic reactions. Explanation for the mechanism of electrocyclic reactions by: (i) Symmetry properties of HOMO of open chain partner; (ii) Conservation of orbital symmetry and orbital symmetry correlation diagram and (iii) Huckel-Mobius aromatic and antiaromatic transition state method.

UNIT-II:Pericyclic Reactions-II **[10 h]**

Cycloaddition reactions: Diels-Alder reaction. Woodward-Hoffmann selection rules for cycloaddition reactions. Explanation for the mechanism of cycloaddition reactions by 1) Conservation of orbital symmetry and orbital symmetry correlation diagrams 2) Fukui Frontier Molecular Orbital (FMO) theory and (3) Huckel-Mobius aromatic and antiaromatic transition state method. Endo-exo selectivity in Diels-Alder reaction and it's explanation by FMO theory. Examples of cycloaddition reactions.

Sigmatropic reactions: Selection rules for [i,j] shifts. Cope, degenerate Cope and Claisen rearrangements. Explanation of sigmatropic reactions by (i) symmetry properties of HOMO (ii) Huckel-Mobius aromatic and antiaromatic transition state method. Introduction to chelotropic reactions and the explanation of mechanism by FMO theory.

UNIT-III:Free radical reactions **[10 h]**

Introduction, generation, stability, reactivity, characteristics, structural and stereo chemical properties of free radicals, Persistent free radicals.

Reaction of free radicals: Addition, substitutions, fragmentations, Oxidations and reductions, Detection of free radicals, Homolysis and free radical displacement. Radical chain reactions, Addition and rearrangements, radical cyclization, reactivity of aliphatic and aromatic substrates at bridgehead, Coupling of alkynes and arylation of aromatic compound by diazonium salt, Sandmeyer reaction, Hunsdieker reaction, Allylic halogenations, McMurry reaction, Acyloin condensation, Birch reduction, Bouveault-Blank reduction.

Reference Books:

1. Advanced Organic Chemistry Part A & Part B: F. A. Carey & R. J. Sundberg

2. Advanced Organic Chemistry: Jerry March
3. Organic Chemistry: Clayden, Greeves, Warren &wother.
4. Organic Chemistry: Stanley H. Pine
5. Organic Synthesis: W. Carruthers
6. Organic Synthesis: Norman and Coxon

Semester-III

Course Name: Organic Chemistry Laboratory Course

Course Code:OCHEL-603

Course type: DSC-18

Total contact hours: 60 h (04 h/Week) **Credits:** 02 **Marks:**50

Course Outcomes:

On the completion of course, students will be able to:

1. Understand the multistep organic synthesis
2. Explore the theoretical knowledge to predict the mechanism of reactions
3. Explore the purification techniques
4. Allow carry out various reactions
5. Determine the overall yield of the reaction

Contents:

Preparations involving at least two stage based on name reactions, condensations, cyclo-condensations, reagents and rearrangements (as covered under the theory). Separation purification of the product is desired.

1. Preparation of sulphanilamide from acetanilide
2. Preparation of benzilic acid from benzoin
3. Preparation of acetanilide from acetophenone via Beckmann rearrangement
4. Preparation of Benzanilide from Benzophenone via Beckmann rearrangement
5. Preparation of para-nitroaniline from aniline
6. Preparation of para-bromoaniline from aniline
7. Preparation of epoxyketone from chalcone
8. Anthanilic acid to 2-Iodoxybenzoic acid

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Reference Book:

1. Practical Organic Chemistry: Vogel

Semester-III

Course Name: Organic Chemistry Laboratory Course

Course Code:OCHEL-604

Course type: DSC-19

Total contact hours: 60 h (04 h/Week) **Credits:** 02 **Marks:**50

Course Outcomes:

On the completion of course, students will be able to:

1. Understand the the use of green chemistry principles
2. Explore the use of microwave and ultrasound irradiation technique for the synthesis
3. Explore the purification techniques
4. Carry out various reactions
5. Utilize the knowledge of spectroscopic techniques for structure ilucidation

Part-A: Preparations involving one stage based upon the green synthetic protocols (as covered in theory syllabus). (Minimum 10 experiments)

Experiments will be based on use of Microwave and Ultrasound, Mild catalysts, Mechanochemistry, Water as solvent and solvent-free reactions.

1. Knoevenagel condensation
2. Hantzsch condensation
3. Biginelli condensation
4. Pechmann condensation
5. Preparation of 1, 1-bis-2-naphthol)
6. Various Multicomponent reactions

Part-B Structure elucidation of organic compounds and drugs by spectral analyses

Use of UV, IR, ^{1}H NMR, ^{13}C NMR and Mass. A minimum of 40 representative examples should be discussed.

Reference Books:

1. Spectrometric Identification of Organic Compounds: R. M. Silverstein and others (8th Ed. Wiley)

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2. Monograph on Green ChemistryLaboratory Experiments: Green Chemistry Task ForceCommittee, DST

Semester-III

Course Name: Organic Photochemistry and Green Chemistry

Course Code: OCHETE-605

Course type: DSE-9

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

CourseOutcomes:

On the completion of course, students will be able to:

1. Understand the photochemical and thermal reactions
2. Classify the various types ofphotochemical reactions
3. Predict the stereochemical outcome of photochemical reactions
4. Understand the concept of green chemistry
5. Utilize the knowledge of Microwave and Ultrasound assisted reactions for bioactive molecules

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UNIT-I:Photochemistry-I **[10 h]**

Photochemistry of (π, π^*) transitions: Excited state of alkenes, cis-trans isomerisation, photochemistry state, electrocyclisation and Sigmatropic rearrangements, di π-methane rearrangement.

Intermolecular reactions: photocycloadditions, photodimerasation. Photoaddition reactions. Excited states of aromatic compounds, photodimerisation of benzene, photosubstitution reactions of aromatic compounds and Photo-Fries rearrangement.

UNIT-II:Photochemistry-II **[10 h]**

Photochemistry of (n, π^*) transitions: Excited state of carbonyl compounds, Norrish-I and Norrish-II

Addition to C-C multiple bonds: Paterno-Buchi reaction, photochemistry of alkyl peroxides, hypohalites and nitriles. Barton reaction. Photochemistry of azo compounds, diazo compounds,

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azides and diazonium salts. Singlet oxygen-photo oxygenation reactions. Ene reaction, formation of dioxetanes and endoperoxides. Chemiluminescent reactions. Oxidative coupling.

UNIT-III:Green Chemistry **[10 h]**

Green chemistry, relevance and goals, Anastas' twelve principles of green chemistry-Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

Microwave and Ultrasound assisted organic synthesis

Activation and specific effects of microwave and ultrasound irradiations, Neat reactions, solid supports reactions, Functional group transformations, condensations reactions, oxidations, reductions reactions, multi-component reactions.

Use of Ionic liquids

General synthesis and properties of ionic liquids, applications in various organic transformations, multicomponent reactions.

Reference Books:

1. Green Chemistry-Designing Chemistry for the Environment. Paul T. Anastas& Tracy C. Williamson.
2. Green Chemistry-Frontiers in benign chemical synthesis and processes. Paul T. Anastas& Tracy C. Williamson
3. Advanced Organic Chemistry Part A & Part B: F. A. Carey & R. J. Sundberg
4. Advanced Organic Chemistry: Jerry March
5. Organic Chemistry: Clayden, Greeves, Warren &wother.
6. Organic Chemistry: Stanley H. Pine
7. Organic Synthesis: W. Carruthers
8. Organic Synthesis: Norman and Coxon

Semester-III

Course Name: Synthetic Organic Chemistry

Course Code: OCHETE-606

Course type: DSE-10

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

CourseOutcomes:

On the completion of course, students will be able to:

1. Understand the types of reactions and rearrangements

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2. Predict the applications of named reactions and rearrangements in organic synthesis particularly natural products and drugs.
3. Allow to utilize the concept of carbon-carbon single and multiple bonds
4. Understand the concept of Multicomponent reactions and their utlity

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UNIT-I: Name Reactions-I **[10 h]**

Arndt-Eistert, Hunds-Diecker reaction, Baeyer-Villiager, Dakin, Gabriel synthesis, Michael, Darzen, Prins, Henry, Reimer-Tiemann, Hoffmann–Loffler–Freytag, Dieckmann cyclization, Chichibabin, Vilsmeier, Ene, Ullmann reaction, Mannich, Strecker amino acid synthesis. Bamford-Steven, Baylis-Hillmann, Corey-Fuchs Reaction, Julia olefination, Mukaiyamaaldol, Mitsunobu, Peterson olefination, Corey-Winter olefination,

UNIT-II: Name Reactions-I I **[10 h]**

Woodward and Prevost dihydroxylation, Shapiro, Ritter, Stille, Heck, Sonogashira, Suzuki, Duff, Chugaev, Petasis, McMurry reaction and Coupling. Ring closing metathesis (Grubb's metathesis), Aldol-Tishchenko (Evans-Tishchenko reaction), Ugi, Passerini, Biginelli, Hantzsch condensation.

UNIT-II: Name Rarrangements **[10 h]**

Pummerer, Payne, Eschenmoser fragmentation, Brook, Wagner-Meerwein, Wolf, Semipinacol, Epoxide rearrangement with lewis acid, Dienone-Phenol rearrangement, Tiffeneau-Demjanov, Favorskii, von Richter, Wittig, Neber, Smiles, Fries, Curtius, Lossen, Schmidt, Steven, Hofmann, Iodolactonisation.

Reference Books

1. Organic Synthesis: M. B. Smith
2. Advanced Organic Chemistry; Part A and B: F. A. Carey & R. J. Sundberg
3. Modern Organic Synthesis: An Introduction: G. S. Zweifel& M. H. Nantz
4. A Guidebook To Mechanism In Organic Chemistry: Peter Sykes
5. Organic Synthesis Concepts, Methods, Starting Materials: J. Fuhrhop, G. Penzlin
6. Organic Chemistry: An Intermediate Text: Robert V. Hoffmann
7. Advanced Organic Chemistry: Jerry March
8. Organic Synthesis: R. O. C. Norman and Coxan
9. Name Reactions: Jie Jack Li
10. Name Reactions and Reagents in Organic Synthesis: B. P. Mundy, M. G. Ellerd, F. G. Favaloro

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Semester-III

Course Name: Bioorganic and Enzyme Chemistry

Course Code: OCHETE-607

Course type: DSE-11

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

Course Outcomes:

On the completion of course, students will be able to:

1. Understand the concept of bioorganic chemistry
2. Know about the types of enzymes, structures.
3. Understand the applicability of various enzymes

UNIT-I:Introduction to Bioorganic chemistry **[10 h]**

Basic concepts, Proximity effects in organic chemistry, Molecular adaptation, Molecular recognition.

UNIT-II:Enzyme Chemistry **[10 h]**

Introduction, Nomenclature, Classification and Extraction of enzymes, Introduction to catalysis and enzymes; Multifunctional catalysis, Intramolecular Catalysis, Mechanism of enzyme action, Factors responsible for enzyme specificity, Enzyme activity and kinetics (MichaelisMenten and Lineweaver–Burk plots), Enzyme Inhibitions (Reversible and irreversible), Structure, Mechanism of action and applications of α-Chymotrypsin, Ribonuclease, lysozyme and Carbopeptidase-A. Enzymes in synthetic organic chemistry. [Additions, eliminations, substitutions, condensations, cyclocondensations, oxidations, reductions and rearrangement reactions are to be covered]

UNIT-III:Co-Enzyme Chemistry **[10 h]**

Chemical structures of co-enzymes and cofactors, Oxidoreduction (NAD^+, $NADP^+$), Pyridoxal phosphate (PLP), Thiamine pyrophosphate (TPP), Biotin (CO_2 carrier), Haemoglobin (O_2-carrier), Flavin (FMN, FAD, $FADH_2$), Oxene Reactions, Lipoic acid, Mechanisms of reactions catalyzed by co-factors.

Reference Books

1. Bioorganic chemistry (A chemical approach to enzyme action): Hermann Dugas
2. Biotransformation in Organic chemistry: K. Faber
3. Enzyme structure and Mechanism: Alan Fersht.
4. Enzyme catalysis in organic synthesis vol.1: KarlheinzDrauz and Herbert Waldmann.
5. Bioorganic, Bioinorganic and supramolecular chemistry: P. S. Kalsi and J. P. Kalsi.

Semester-III

Course Name: Emerging Topics in Organic Chemistry

Course Code: OCHETE-608

Course type: DSE-12

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

Course Outcomes:

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

1. Understand the concepts of multicomponent reactions and their mechanisms.
2. Understand the tandem reactions in organic synthesis.
3. Apply the principles of click chemistry in drug discovery, biology and materials chemistry.
4. Discuss the flow chemistry, micro reactors, separation techniques and process chemistry in organic synthesis.

UNIT-I Advanced Multicomponent Reactions **[10 h]**

Recent Developments in the multicomponent reactions (MCRs): General Approaches of MCRs, Synthesis of different heterocyclic compounds using 3, 4 and 5 component reactions, MCRs using homogeneous and heterogeneous catalysts.

UNIT-IIClick and Flow Chemistry **[10 h]**Importance of Click chemistry, Applications of click chemistry in drug discovery, biology and materials chemistry.

Recent advances in Flow chemistry and Micro reactors,

UNIT-IITandem Reactions **[10 h]**

Tandem (cascade/domino) reactions in Organic Synthesis, Metal Carbenes in Organic Synthesis, N-heterocyclic carbenes in organic synthesis, Hypervalent iodine reagents in organic synthesis.

Reference Books:

1. Multicomponent Reactions: Concepts and Applications for Design and Synthesis, Raquel P. Herrera, Eugenia Marqués-López, John Wiley & Sons. 2015, 1st Edition.
2. Click Reactions in Organic Synthesis, Srinivasan Chandrasekaran, John Wiley & Sons, 2016, 1st Edition.
3. Domino Reactions in Organic Synthesis, Lutz F. Tietze, Gordon Brasche, KerstenGericke, John Wiley & Sons, 2006
4. Microreactors in Organic Synthesis and Catalysis, Ed. by Thomas Wirth Title, John Wiley & Sons, 2008

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Semester-III

Course Name: Research Project-I

Course Code: OCHERP-649

Course type: Project

Total contact hours: 120 h (08 h/Week) **Credits: 04** **Marks: 100**

Course Outcomes:

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

1. Know how to carry out literature survey by using various search engines and database
2. Handle various chemicals, solvents, instruments and others
3. Perform reactions, monitoring by TLC
4. Purification techniques
5. Understand the structure of organic compounds by using spectral techniques

Research project will be assigned to the students on the basis of theory components, such as Multicomponent reactions, use of ionic liquids/surfactants in organic synthesis, Microwave/ Ultrasound assisted synthesis of bioactive molecules etc.

Literature Survey, Studies of Reactions, Synthesis, Mechanism, Standardization of Reaction Conditions, New Synthetic Methods etc

Note: Student should attend the National/International Conference in this semester and present their project work (if possible)

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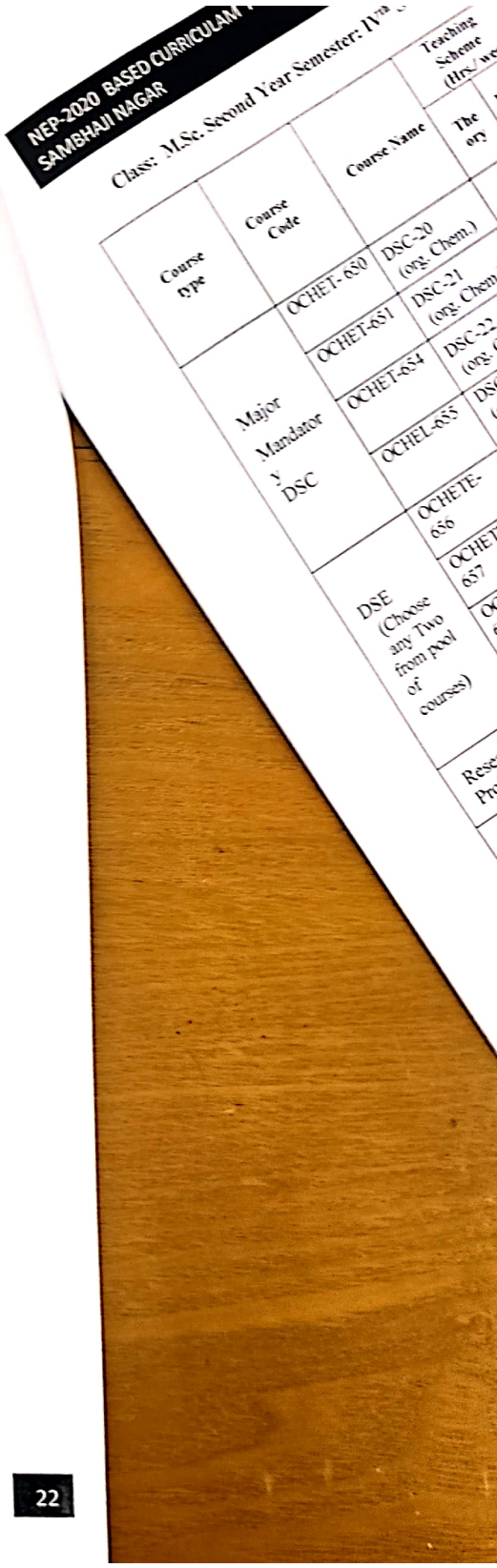

Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Organic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	OCHET- 650	DSC-20 (org. Chem.)	4	-	4	-	10T	40	60	100
	OCHET-651	DSC-21 (org. Chem.)	4	-	4	-		40	60	100
	OCHET-654	DSC-22 (org. Chem.)	2	-	2	-		20	30	50
	OCHEL-655	DSC-23 (org. Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	OCHETE-656	DSE-13 (org. Chem)	2	-	2	-	4T	20	30	50
	OCHETE-657	DSE-14 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-658	DSE-15 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-659	DSE-16 (org. Chem)	2	-	2	-		20	30	50
Research Project	OCHETE-RP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			**14**	**16**	**14**	**08**	**22**	**220**	**330**	**550**

Course code Nomenclature :
DSC-Discipline Specific Core course, **DSE**- Discipline Specific Elective, **T**-Theory, **L**- Laboratory course, **OCHET**- Organic Chemistry Theory Core course , **OCHEL**- Organic Chemistry Laboratory Core course, **OCHETE**- Organic Chemistry Elective Course, **OCHE-RP**- Organic Chemistry Research Project,

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Semester-IV

Course Name: Organic synthesis: Retrosynthetic approach

Course Code: OCHET-650

Course type: DSC-20

Total contact hours: 60 h (04 h/Week) **Credits: 04** **Marks: 100**

Course Outcomes:

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

1. Under the basic concepts of reyrosyntheticabnalysis
2. Describe disconnection approaches applied on synthetic strategies and mechanism prediction.
3. Understand the use of protecting groups
4. Allow to disconnect the molecules by using different strategies
5. Explore the various reactions for designing the synthesis of target molecules
6. Allow to construct the various rings
7. Utilize the knowledge of retrosynthestic analysis and synthesis for natural products, drugs and complex molecules

UNIT-I Disconnection Approach **[12 h]**

An introduction to synthons, synthetic equivalents, disconnection approach, functional group interconversions, importance of order of events in organic synthesis, one and two group C-X disconnections, selective organic transformations: chemoselectivity, regioselectivity, stereoselectivity, enentioselectivity, Reversal of polarity, cyclization reactions, amine synthesis.

UNIT-II Protecting Groups **[12 h]**

Protection and deprotection of hydroxyl, carbonyls in aldehydes and ketones, amines, carboxylic acids, alkenes and alkynes.

UNIT-III *C-C Disconnections* **[12 h]**

(i) One group C-C Disconnections:

Alcohols (including stereoslectivity), carbonyls (including regioselectivity), Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

(ii) Two group C-C Disconnections:

Diels-Alder reactions, 1,3difunctionalized compounds and α, β-unsaturated compounds, control in carbonyl condensations, 1,5 difunctionalized compounds, Michael addition and Robinson annelation.

UNIT-IV Ring Synthesis **[12 h]**

Introduction to ring synthesis, saturated heterocycles, synthesis of 3, 4, 5 and 6 membered rings, rearrangements and photochemistry in synthesis, aromatic heterocycles.

UNIT-V Complex molecules **[12h]**

Synthetic routes based on retrosynthetic analysis for following molecules: Longifoline, Reserpine, Juvabione, Aphidicoline, Taxol.

Reference Books:

1. Organic Synthesis: The Disconnection Approach: Stuart Warren
2. Designing Organic Synthesis: Stuart Warren
3. Organic Synthesis: Strategy and Control: Paul Wyatt and Stuart Warren
4. The Logic of Chemical Synthesis: E. J. Corey and Xue-Min Chelg
5. Classics in Total Synthesis I, II and III: K. C. Nicolaou and others
6. Organic Synthesis Concepts, Methods, Starting Materials: J. Fuhrhop, G. Penzlin
7. Some Modern Methods of Organic Synthesis: W. Carruthers
8. Organic Synthesis: M. B. Smith
9. Principles of Organic Synthesis: R. Norman and J. M. Coxan.
10. Advanced Organic Chemistry: Jerry March
11. Organic Chemistry: Clayden, Greeves, Warren and Wothers

Semester-IV

Course Name: Chemistry of Natural Products and Asymmetric Synthesis

Course Code: OCHET-651

Course type: DSC-21

Total contact hours: 60 h (04 h/Week) **Credits: 04** **Marks: 100**

Course Outcomes:

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

1. Understand the concept of structure elucidation of natural compounds
2. Build the synthetic schemes of natural products and bioactive molecules
3. Analyze the stereochemistry of drug molecules
4. Apply the knowledge of biosynthesis in total synthesis of organic molecules.
5. Design new synthetic methodologies
6. Understand the concepts involved in asymmetric synthesis

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UNIT-I:Terpenoids& Carotenoids **[12 h]**

Classification, Nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule, Structure determination, stereochemistry, and synthesis of the following representative molecules: Citral, Geraniol, α-Terpineol, Menthol, Farnesol, Zingiberene, Phytol, Abietic acid and β-Carotene.

UNIT-II:Alkaloids **[12 h]**

Occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants.Structure, stereochemistry and synthesis of the following:Ephedrine, (+)-coniine, nicotine, atropine, Quinine and Morphine.

UNIT-III:Steroids **[12 h]**

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Bile acids, Androsterone, Testosterone, Estrone, Progestrone.

UNIT-IV:Asymmetric Synthesis-I **[12 h]**

Chiral pool, Chiral auxiliary, Enantio- &Diastereoselective synthesis, Chiral reagent and chiral catalyst including CBS reagent, NADH, Asymmetric hydrogenation including BINAP,

UNIT-V:Asymmetric Synthesis-II **[12h]**

Hydroboration- Ipc_2BH, $IpcBH_2$, Asymmetric epoxidation- (+) DET & (-) DET, Sharpless, Jacobson, Asymmetric dihydroxylation- $(DHQD)_2PHAL$& $(DHQ)_2PHAL$, Felkin-Anh model, Zimmermann-Traxler transition state model, Prolinecatalyzed asymmetric reactions

Reference Books

1. The Organic Chemistry of Drug Design and Drug Action: R. B. Silverman, Academic press.
2. Natural Products: Chemistry and Biological Significance: J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthrope and J. B.Harborne, Longman, Essex.
3. Organic Chemistry: Vol. II, I. L. Finar, ELBS.
4. New Trends in Natural Product Chemistry: Atta-ur-Rahman and M. I. Choudhary, Harwood Academic publishers.
5. Stereochemistry of Organic Compounds (Principle and application): D. Nasipuri
6. Stereochemistry of Organic compounds: Ernest L. Eliel / Samuel H. Wilen
7. Advanced Organic Chemistry; Part A and B: F. A. Carey & R. J. Sundberg
8. Organic Chemistry: Clayden, Greeves, Warren and Wothers
9. Organic Synthesis: M. B. Smith

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Semester-IV

Course Name: Heterocyclic Chemistry

Course Code: OCHET-652

Course type: DSC-22

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

Course Outcomes:

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

1. Classify heterocyclic compounds and their nomenclature
2. Understand the physical and chemical properties of simple and fused heterocyclic compounds
3. Apply the knowledge of heterocyclic chemistry to synthesize the natural products and drug molecules
4. Distinguish aromatic and homoaromatic compounds using spectral data

UNIT-I **[10 h]**

Nomenclatures of all types of heterocycles, Classification of heterocycles: as aromatics based upon various membered ring systems.

UNIT-II **[10 h]**

General synthetic routes based on name reactions, reactivities, utilities and wherever possible spectral analyses of the following class of heterocycles.

Four membered: Azitidines, including β- lactums.

Five membered: Thiazoles, Oxazoles, Pyrazoles and Imidazoles.

Six membered: Pyridines, Pyrimidines.

UNIT-III **[10 h]**

Fused heterocycles: Flavones, Chromones, Coumarines, Indoles, Quinolines, Benzodiazepines, and Phenothiazines.

Reference Books:

1. Heterocyclic Chemistry: vol. I, II, III: R. R. Gupta, M. Kumar and M. Gupta
2. Heterocyclic Chemistry: Joules and Mills
3. Modern heterocyclic Chemistry: L. A. Paquette (Benjamin)
4. Organic Chemistry: Jonathan Clayden

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Semester-IV

Course Name: Organic Chemistry Laboratory Course

Course Code: OCHEL-653

Course type: DSC-23

Total contact hours: 60 h (04 h/Week) **Credits: 02** **Marks: 50**

Course Outcomes:

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

1. Understand the principles involved in separation and purification techniques
2. Analyze the functional groups in organic molecules
3. Understand the principles involved in separation of ternary mixtures
4. Obtain practical experience in the separation and identification of individual compounds in the ternary mixtures
5. Develop the knowledge and skills in the synthetic organic chemistry useful for industrial applications

Qualitative analysis of ternary mixtures.

In a mixture at least one liquid one water soluble compound be given. (minimum 08 mixtures)

(i) Separation of Ternary Mixture

(ii) Identification of Two Components

(iii) Element Detections

(iv) Functional Groups

(v) Physical Constant

(vi) Derivatives

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Semester-IV

Course Name: Introduction to Medicinal Chemistry

Course Code: OCHETE-654

Course type: DSE-13

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

Course Outcomes:

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

1. Understand basic concepts of drug discovery.
2. Apply the concepts in lead discovery.
3. Identify the importance of Lipinski rule and bioisosterism.
4. Understand the concept of Pharmacokinetics and Pharmacodynamics

UNIT-I: Basic consideration of drug activity **[10 h]**

Definition and Introduction of following terms-Drug, Prodrug, Hard and Soft drugs, agonists, antagonists, affinity, efficacy, potency, isosterism, bioisosterism, pharmacophores, lead molecule, lethal dose (LD50) and effective dose (ED50) (i) Factors affecting bioactivity, (ii) Theories of drug activity, (iii) Structure activity relationship (SAR), QSAR (2D and 3D method) and Hantzsch equation (iv) Drug receptor mechanism.

UNIT-II Pharmacokinetics **[10 h]**

(i) Drug absorption, Distribution and deposition of drugs.

(ii) Excretion and elimination of drugs, Bioavailability.

UNIT-IIIPharmacodynamics **[10 h]**

(i) Mechanism of drug action: Enzyme stimulation and enzyme inhibition, antimetabolites, membrane active drugs, chelation; (ii) Drug metabolism and inactivation: Factors affecting drug metabolism, pathways of drug metabolism [Metabolicreaction (Phase I) and conjugation reaction (Phase II)].

Reference Books:

1. FOYE'S Principles of Medicinal Chemistry VIth Edition: Thomas L. Lemke, David A. Williams, Victoria F. Roche and S. William Zito.
2. Introduction of Medicinal Chemistry:A. Gringuage, Wiley-VCH.
3. Synthesis of Essential Drugs:R. S. Vardanyan and V. J. Hruby.
4. Volumes of Burger's Medicinal Chemistry: M. E. Wolf, JohnWiley.
5. Medicinal Chemistry: David J. Triggle.
6. Essentials of Medicinal Chemistry IInd: AndrejusKorolkovas, WileyVCH.

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Semester-IV

Course Name: Drug Synthesis

Course Code: OCHETE-655

Course type: DSE-14

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

Course Outcomes:

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

1. Understand classification of drugs.
2. Explore the knowledge of pharmacokinetics and dynamicsof the drugs
3. Understand the mode of action of drugs.
4. Explore the knowledge of synthetic organic chemistry to drug synthesis

UNIT-IClassification of Drugs **[06 hrs]**

The detail contents of the each class of the drugs.

UNIT-II Drug Synthesis-I **[12 hrs]**

Synthesis and Utilities of the following drug molecules (at least one convenient synthetic route with possible mechanism) from following classes:

I. Anti inflammatory Drugs: (a) Naproxen (b) Ibuprofen (c) Oxaprozin (d) Diclofenac Sodium (e) Rofecoxib (f) Celecoxib.

II. Anti-hypertensive Drugs: (a) Verapamil (b) Captopril (c) d-sotalol (d) Atenolol (e) Diltiazem (f) Semotiadilfumarate.

III. Drugs acting on CNS: (a) CNS Stimulant :Dextro-amphetamine

(b) Respiratory Stimulant :Doxapram

(c) CNS anti-depressant : (i) Chlorpromazine (Antipsychotic) (ii) Diazepam (Anxiolytic)

(iii) Phenobarbitol (Antiepileptic)

UNIT-III Drug Synthesis-II **[12 hrs]**

IAnesthetic Drugs:

(a) General : Ketamine (b) Local : (i) Lidocaine (ii) Procaine

II. Antibiotics: (a) Chloramphenicol (b) Ampicillin (c) Amoxycillin (d) Cefepime (e) Cefpirome (f) Antimycobactrial: Ethambutol (g) Antiviral: Acyclovir (h) Antimicrobial: Sulfamethoxazole

III. Antidiabetics :(a) Troglitazone (b) Chlorpropamide (c) Tolbutamide

IV. Antineopastic Drugs: (a) Antagonist: Fluorouracil (b) Alkylating agents: i) Chlorambucil (ii) Cis-Platin

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Reference Books:

1. FOYE'S Principles of Medicinal Chemistry VIth Edition: Thomas L. Lemke, David A. Williams, Victoria F. Roche and S. William Zito.
1. Introduction of Medicinal Chemistry:A. Gringuage, Wiley-VCH.
2. Synthesis of Essential Drugs:R. S. Vardanyan and V. J. Hruby.
3. Volumes of Burger's Medicinal Chemistry: M. E. Wolf, JohnWiley.
4. Medicinal Chemistry: David J. Triggle.
5. Essentials of Medicinal Chemistry IInd: AndrejusKorolkovas,

Semester-IV

Course Name: Polymer Chemistry

Course Code: OCHETE-656

Course type: DSE-15

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

Course Outcomes:

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

1. Understand the basic concepts in Polymer chemistry.
2. Learn the determination of molecular weight and properties of polymers.
3. Know about the polymer processing and polymerization techniques.
4. Explore synthesis and applications of commercial polymers and conducting polymers.

UNIT-I Basic Concepts **[10 h]**

Hours) Monomers, repeat units, degree of polymerization, Linear, branched and network polymers, Addition polymerization, Condensation polymerization, Mechanism of free radical, cationic and anionic polymerization and co-ordination polymerization. Ziegler- Natta catalyst. Kinetics of free radical, cationic, anionic and co-polymerisation. Determination of Reactivity ratio, Reactivity ratio and co-polymerisation behavior.

UNIT-II Molecular Weight, Physical Properties, Polymer Processing & Techniques[10 h]

Concept of Average molecular weight, number- average, weight- average molecular weight and viscosity- average molecular weights. Determination of molecular weight - viscosity, light scattering, osmotic and ultracentrifugation methods.

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Polymers processing- Plastics, elastomers and fibres. Compounding, Processing techniquescalendaring, die casting, injection molding, thermofoaming and fibre spinning. Polymerization techniques- Bulk polymerization, solution polymerization, suspension polymerization, emulsion polymerization and melt polycondesation.

UNIT-IIICommercial Polymers **[10 h]**

Synthesis and applications of polyethylene, polyvinyl chloride, polyamide, polyester, phenol resins, epoxy resins, silicone polymers, polybenoxazoles, polyimidazole, polyurethane, polymethylmethacrylate, poly(tetrafluoro ethylene) and polyacrylonitrile.

Reference Books:

1. Organic Polymer Chemistry: K. J. Saunders
2. Textbook of Polymer Science: F.W. Billmeyer,Wiley Student Edition, 3rdEdition.
3. Polymer Science: V.R. Gowariker, N. V. Viswanathan, J. Sreedhar

Semester-IV

Course Name: Advanced Spectroscopy

Course Code: OCHETE-657

Course type: DSE-16

Total contact hours: 30 h (02 h/Week) **Credits: 02** **Marks: 50**

Course Outcomes:

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

1. Analyze the concepts of ^{19}F spectroscopy in determining the structures of molecules.
2. Apply the principles of 2D NMR spectroscopy in resolving the structures of organic molecules.
3. Discuss the principle of 31P and mass spectrometry and their applications.
4. Solve the structures of organic compounds using spectral data.

UNIT-I 2D-NMR spectroscopy **[10 h]**

Principles of 2D NMR, Classification of 2D-experiments.Correlation spectroscopy (COSY) HOMOCOSY (^1H-^1H COSY) , TOCSY (Total CorrelationSpectroscopy), Hetero COSY (^1H, ^{13}C COSY, HMQC), long range ^1H, ^{13}C COSY (HMBC),Homonuclear and Heteronuclear 2D-J-resolved spectroscopy, ROESY, NOESY and 2DINADEQUATE experiments and their applications.

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UNIT-II ^{19}F NMR spectroscopy: **[10 h]**

Introduction, ^{19}F chemical shifts, spin-spin coupling,coupling constants. Homonuclear couplings, Applications of ^{19}F NMR involving coupling with ^{19}F, ^{1}H and ^{31}P: 1, 2 dichloro-1, 1 difluoro ethane, BrF_5, SF_4, PF_5, ClF_3, IF_5, CF_3CH_2OH.

UNIT-III ^{31}P NMR spectroscopy: **[10 h]**

^{31}P chemical shifts, coupling constants. Applications of ^{31}PNMR involving coupling with ^{31}P, ^{19}F, ^{1}H and ^{13}C: Simple molecules ^{31}P, P_4S_3, H_3PO_4, H_3PO_3,H_3PO_2 and HPF_2.

Reference Books:

1. Introduction to Spectroscopy, Donald Pavia, G. M. Lampman, George S. Kriz, Thomson/Brooks/Cole, 2001, 3rd Edition.
2. Organic Spectroscopy, William Kemp, Palgrave Publishers, 2007, 3rd Edition.
3. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, Wiley, 2014, 8th Edition.

Semester-IV

Course Name: Research Project-II

Course Code: OCHERP-699

Course type: Project

Total contact hours: 120 h (12 h/Week) **Credits: 06** **Marks: 150**

Course Outcomes:

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

1. Know how to carry out literature survey by using various search engines and database
2. Handle various chemicals, solvents, instruments and others
3. Perform reactions, monitoring by TLC
4. Purification techniques
5. Understand the structure of organic compounds by using spectral techniques

Research project will be assigned to the students on the basis of theory components, such as Multicomponent reactions, use of ionic liquids/surfactants in organic synthesis, Microwave/ Ultrasound assisted synthesis of bioactive molecules etc.

Literature Survey, Studies of Reactions, Synthesis, Mechanism, Standardization of Reaction Conditions, New Synthetic Methods etc

Note: Student should participate in National/International Conference and Present the Project work.

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