Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara(Autonomous)

Lead College

Of

Karmaveer Bhaurao Patil University, Satara

Syllabus for
Master of Science

Part-II

Organic Chemistry

Syllabus to be implemented w.e.f.June 2024

As per NEP-2020

1. Title: Organic Chemistry

2. Year of Implementation:

The syllabus will be implemented from June, 2024 onwards.

3. Preamble:

This syllabus is framed to give advanced knowledge of Chemistry to post graduate students at first year of two years of M.Sc. degree course. The goal of the syllabus is to make the study of chemistry, interesting and encouraging to the students for higher studies including research. The new syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking in to consideration the level and capacity of students

Credit Framework for M.SC.II

Structure of Course M.Sc. Part II Semester III

Level	Semester	Course Code	Course Title	No. of Lectures per week	Credits 4
		Discipline Specific Course (DSC)*(Mandatory)*			
6.5	III	MOCT-531	Organic Reaction Mechanism	4	4
		MOCT-532	Advanced Spectroscopic Methods	4	4
		MOCT-533	Advanced Organic Synthesis	4	4
		Discipline Specific Elective (Choose any one among two)			
		MOCT-534 E-I MOCT-534 E-II	Drugs And Heterocycles E-I Drugs And Heterocycles E-II	2	2
		MOCT-535	Research Project	12	6
		MOCT-536	Lab III(Based on MOCT 531, 532,and 533)	4	2
		Total			**22**

Structure of Course M.Sc. Part II Semester IV

Level	Semester	Course Code	Course Title	No. of Lectures per week	Credits 4
		Discipline Specific Course (DSC)*(Mandatory)*			
6.5	IV	MOCT-541	Theoretical Organic Chemistry	4	4
		MOCT-542	Stereochemistry	4	4
		MOCT-543	Chemistry Of Natural Products	4	4
		Discipline Specific Elective (Choose any one among two)			
		MOCT-544 E-I MOCT-544 E-II	Applied Organic Chemistry Environmental Chemistry	4	4
		MOCT-545	On Job Training (OJT)	8	4
		MOCT-546	Lab IV(Based on MOCT 541, 542,and 543)	4	2
		Total			**22**

Level 6.5
M.Sc.Part–II, Semester III
Discipline Specific Course (DSC)*(Mandatory)*

Credits 4	MOCT 531: ORGANIC REACTION MECHANISM	Hours 60

Course Objectives: Student should be able to:-

1) Acquire knowledge of Kinetic and non-Kinetic methods of reaction mechanism.
2) Understand the pericyclic reactions and their mechanism.
3) Learn to predict the product of name of reactions.
4) Study the concepts of photochemistry.

Unit No	Title and Syllabus	Hours allotted
I	**Methods of determining reaction mechanism**	15
	A)Kinetic Methods: 1.A.1 Order and Molecularity 1.A.2 Methods to determine reaction rates 1.A.3 Types of reactions: 1^{st}, 2^{nd} and 3^{rd} order reactions 1.A.4 Reversible, Consecutive and Parallel reactions 1.A.5 Energy of Activation 1.A.6 Entropy of Activation 1.A.7 Effect of Ionic strength 1.A.8 Solvent effect and Kinetic isotopic effect. **B)Non-Kinetic Methods:** 1.B.1 Identification of reaction products. 1.B.2 Testing of the possible intermediates. 1.B.3 Trapping of the intermediates. 1.B.4 Isotopic labeling. 1.B.5 Reaction catalysis. 1.B.6 Cross- over experiments. 1.B.7 Stereochemical studies and Use of physical properties. 1.B.8 Hammett and Taft equations	
II	**Pericyclic reactions**	15
	2.1.Molecular orbital symmetry. 2.2.Frontier orbital of ethylene, 1,3- butadiene, 1,3,5-hexatriene And allyl system. 2.3.Classification of pericyclic reaction. 2.4.Wood-ward Hoffman correlation diagrams. 2.5.FMO and PMO approach. 2.6.Electrocyclic reactions, conrotatory and disrotatary motions 4n ,4n+2 and allyl systems. 2.7.Cycloaddition, and supra and antara facial additions, 4n and 4n+2systems, 2+2 additions of ketenes, 1,3-dipolar cycloaddition. 2.8.Chelotropic reactions. 2.9.Sigmatropic rearrangement, supra and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties,(3,3) and (5,5) sigmatropic rearrangement Claisen and Cope and Aza Cope rearrangement, Ene reaction.	

III	**Name Reactions and Rearrangement**	**15**
	Mechanism, Stereochemistry, migratory aptitude, (application using complicated example): 3.A.1. Dienone –phenol,Favorskii, Baeyer-Villiger, Petasis reaction, Wolff, Smile's, Mukaiyama esterification, Mitsunobu reaction, Baylis Hillman reaction, Wacker process, Eschenmoser fragmentation, Julia olefination. 3.A.2.Barton and Shapiro reaction,Hoffmann – Loffler-Fretag ReactionPeterson synthesis	
IV	**Photochemistry**	**15**
	4.1.Effect of light intensity on the rate of photochemical reactions. 4.2.Types of photochemical reactions, photo dissociation gas phase Photolysis. 4.3.Photochemistry of alkynes. 4.4.Intermolecular reactions of the olefinic bonds. 4.5.Geometrical isomerism. 4.6.Cyclisation reactions. 4.7.Rearrangements of 1,4 and 1,5-dienes. 4.8.Photochemistry of carbonyl compounds, intramolecular reactions of carbonyl compounds, saturated cyclic and acyclic α, β-unsaturated compounds. 4.9.Cyclohexadienones 4.10. Intermolecular cycloaddition reactions, dimerisation and Oxitane formation. 4.11. Photochemistry of aromatic compounds, photo fries reactions Of anilides, photo fries rearrangements. 4.12. Singlet molecular oxygen reactions 4.13. Photochemistry of vision.	

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

1) Understand kinetic and non-kinetic methods of reaction mechanism.
2) Demonstratethe pericyclic reactions by models of molecular orbitals.
3) Predict stereochemistry, migratory aptitude of different reactions.
4) Solve problems related to photochemical reactions.

References

1. Peter Sykes, A guide book to mechanism in organic chemistry, (orient- Longmans), [Unit-I:36-42,]
2. Michael B.Smith,JerryMarch,March's Advanced Organic Chemistry(New Jersey-John wiley and sons)[Unit-I:301]
3. Jie Jack Li,Name Reaction fourth edition(USA-Springer),[Unit-III: 12, 30, 190, 206, 214, 309, 365, 379, 436,564,590)
4. N.J. Urro, Molecular photochemistry, W. A. Benjamin, [Unit IV].
5. B. S. Gould, Mechanism and structure in Organic Chemistry, (Holt Reinhart winston), [Unit-I:All book]
6. Clayden, Greeves, Warren, Organic chemistry 1st edition, [Unit-I :319,Unit-II: 914, 922, 929, 934, 946,947),Unit-III:984,988,990,992]

Credits 4	MOCT 532: ADVANCED SPECTROSCOPIC METHODS	Hours 60

Course Objectives: Student will able to:-

1) Understand the basic principles of UV and IR spectroscopy.
2) Recall the basic concepts in ^{1}H NMR spectroscopy.
3) Acquire the principal and basic concepts of mass spectroscopy.
4) Learn the structure determination of organic compounds using UV, IR, NMR and Mass spectroscopic data.

Unit No	Title and Syllabus	Hours allotted
I	**Ultraviolet Spectroscopy and IR Spectroscopy**	15
	A)Ultraviolet Spectroscopy 1.A.1.Woodward- Fisher rules for conjugated dienes and carbonyl compounds 1.A.2.Calculation of λ max. 1.A.3.Ultraviolet spectra of aromatic and heterocyclic compounds. 1.A.4. Steric effect in biphenyls. **B) IR Spectroscopy** 1.B.1. Characteristic vibrational frequencies of alkanes; alkenes; alkynes; aromatic compounds; alcohols; ethers; phenols and amines. 1.B.2.Detailed study of vibrational frequencies of carbonyl Compounds[ketones; aldehydes; esters; amides; acids; anhydrides; lactones;lactams and conjugated carbonyl compounds] 1.B.3.Effect of hydrogen bonding and solvent effect on vibrational frequencies 1. B.4.Overtones; combination bands and Fermi resonance. 1.B.5.FT-IR of gaseous; solids and polymeric materials.	
II	**NMR Spectroscopy**	15
	2.1.General introduction and definition. 2.2.Chemical shift; spin –spin interaction; shielding mechanism of Measurement chemical shift values and correlation for protons bonded to carbons[aliphatic; olefinic; aldehydic and aromatic] and other nuclei [alcohols; phenols; enols; acids; ammines; amides and mercaptans]; chemical exchange; effect of deuteration; complex spin-spin interaction between two; three; four; and five nuclei.[first order spectra]; virtual coupling. Stereochemistry; hindered rotation; 2.3.Karplus curve variation of coupling constant with dihedral angle. Simplification of complex spectra; nuclear magnetic double resonance; shift reagent; solvent effect.	

	2.4.Fourier transform technique, nuclear Overhauserer effect [NOE]Resonance of other nuclei-F;P. INEPT and INADEQUAT	
III	**Mass Spectrometry**	**15**
	3.1.Introduction 3.2.Various methods of ionization (EI, CI, FD, FAD and MALDI) 3.3.Factors affecting on fragmentation 3.4.Analyzers (Magnetic sector mass analyzers, Quadrupole mass analyser,Time of Flight mass analyser) 3.5.Detectors 3.6.Ion abundance 3.7.Mass spectral fragmentation of organic compounds, common functional groups 3.8.Molecular ion peak, metastable peak, McLafferty rearrangement, 3.9.Nitrogen rule. 3.10. High resolution mass spectrometry. 3.11. Examples of mass spectral fragmentation of organic Compounds With respect to their structure determination.	
IV	**Carbon-13 NMR Spectroscopy & combined Spectral Problems**	**15**
	4.1.General considerations; chemical shift [aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl compounds] 4.2.Problems associated with ^{13}C, FT-NMR, proton decoupled off resonance.Introduction to two dimentional spectroscopic methods, COSY,NOESY,HETCOR 4.3.Structural problems based on combined spectroscopic techniques (including reaction sequences)	

Course Outcome: Student should able to

1. Understand operating system and problems based on UV and IR spectroscopy.
2. Explain NMR peaks for organic compounds.
3. Demonstrate working of Mass spectrometry.
4. Solve combined problems based on IR, NMR,^{13}C Spectroscopy and Mass spectrometry.

REFERENCE BOOKS:

1. V.M. Parikh, Application spectroscopy of organic molecules. (Mehata) [All units]
2. D. L. Pavia, Lampman, Kriz, Vyvyan Spectroscopy, Indian edition [Unit-I: 394,409, 31-35,43,47,52-73. Unit-II: 420,421,435. Unit-III: 105-176,359.Unit-IV: 177-231]
3. Silverstein and Basslar, Spectroscopic identification of organic compounds [Unit-I:82-87, Unit-II 3,10,17. Unit-III 127-203. Unit-IV 217,278.]
4. P.S. Kalsi Spectroscope of organic compounds (New age publisher) [All units]
5. W. Kemp, Organic Spectroscopy ELBS [Unit-I: 259,261,26,58-74. Unit-II: 288,289,307. Unit-III:135,111. Unit-IV:224.]
6. Clayden, Greeves, Warren, Wothers, Organic Chemistry [Unit-I: 65,72,169,367. Unit-II: 50,72. Unit-III: 72,243.

Credits4	MOCT 533: ADVANCED ORGANIC SYNTHESIS	Hours 60

Course Objectives: Student will able to-

1) Understand green techniques in synthetic organic chemistry.
2) Learn preparation of synthetic reagents and their applications in organic synthesis.
3) Explain the metals and nonmetals and their applications in organic synthesis.
4) Study the logical thinking and imagination for disconnection.

Unit No	Title and Syllabus	Hours allotted
I	**Green chemistry**	15
	A.Introduction basic principles of green chemistry. 1.A.1. Designing a green synthesis: Green starting materials, green reagents, green solvents and reaction conditions, green catalysts. 1.A.2. Use of the following in green synthesis with suitable examples: Green reagents: dimethyl carbonate, polymer supported reagents. Green catalysts: Acid catalysts, oxidation catalysts & basic catalysts. **B. Green solvents:** 1.B.1.**Ionic liquids:** Synthesis of ionic liquids Applications in alkylation, hydroformylations, expoxidations, synthesis of ethers, Friedel-craft reactions, Diels-Alder reactions, Knoevenagel condensations, Wittig reactions, Phase transfer catalyst, Synthesis, applications. 1.C.1. **Microwave assisted synthesis:** reactions in water, reactions in inorganic solvents, solvent free reactions. **1.D.1. Ultrasound assisted reactions.** 1.E.1.Comparison of traditional processes versus green processes in the Synthesis.	
II	**Reagents and Their Application in synthesis.**	15
	2.1.Complex metal hydrides 2.2.Sodium cyanoborohydride 2.3.lithium diisopropyl amide (LDA) 2.4.Trimethylsilyl iodide 2.5.Ozone 2.6.Phase transfer catalyst 2.7. Woodward-Prevost hydroxylation 2.8.Dess-Martin periodinane 2.9.Periodic acid and iodoisobenzylDiacetate 2.10. Grub's catalysts.	

III	**Applications of metals and non-metals in organic synthesis**	**15**
	3.1.Pd (Heck arylation, carboxylation) 3.2.Allylic activation 3.3.Still coupling 3.4.Sonogoshira reaction and their importance 3.5.Kumada coupling 3.6.Neigishi coupling) 3.7.Hg, Cu, Sn, Pt, Rh	
IV	**Disconnection approach**	**15**
	A. Protection and deprotection of the following functional groups: Hydroxyl, carbonyl, amino and carboxyl with applications. B. An introduction to Synthons and synthetic equivalents. 4.B.1 Disconnection approach. 4.B.2 Functional group interconversions. 4.B.3 One group C-X and two group disconnections in1, 2; 1,3, 1, 4 & 1, 5-difunctional compounds. 4.B.4 Retro - synthesis of alkene, acetylenes and aliphatic nitro Alcohols and carbonyl compounds, amines. 4.B.5 Importance of the Order of events in organic synthesis 4.B.6 Chemo selectivity, Regioselectivity,Diels-Alder reaction, Michael addition and Robinson annulation. 4.B.7 Retrosynthesis of aromatic heterocycles, 3, 4, 5 & 6 membered carbocyclic and heterocyclic rings 4.B.8 Reversal of polarity (Umpolung).	

Course Outcomes: Student should be able to: -

1. Implements the green synthetic technique.
2. Demonstrate practical applications of the reagents.
3. Understand the applications of metals and nonmetals in organic synthesis.
4. Solve the problems based on retrosynthetic approach.

References: -

1. S. Warren, Designing of organic synthesis.- [Unit IV]
2. Carruthres, Some modern methods of organic synthesis, [Unit-II:443,378-392.Unit-III:75,89,365].
3. H.O. House, Modern synthetic reaction. [Unit II,III]
4. Fieser&Fieser, Reagent in organic synthesis. [Unit II, III].
5. R.O.C. Norman, Principle of organic synthesis, [Unit II,III].
6. P. E. Realand, Organic synthesis, [Unit I].
7. Stone & West, Advances in organometallic Chemistry.[Unit III]

Discipline Specific Elective(DSE)*(Elective)*

Credits 2	MOCT-534 E-1: DRUGS AND HETEROCYCLES-I	Hours 30

Course Objectives: Student will able to: -

1. Learn to develop approach for drug designing of a molecule.
2. Understand the synthesis of five, six, membered etc. heterocycles with respect to mechanistic approach. And study synthesis of fused heterocyclic compounds and six membered heterocycles.

Unit No	Title and Syllabus	Hours allotted
I	**Drug discovery and design**	15
	A.Development of new drugs: 1.A.1 Procedures followed in drug design 1.A.2 Concepts of prodrugs and soft drugs. Theories of drug Activity, Quantitative structure activity relationship. 1.A.3 History and development of QSAR. 1.A.4 Concepts of drug receptors **B.Synthesis of following drugs:** 1.B.1 Study of Antibiotics Preparation of semi synthetic penicillin, conversion of penicillin into cephalosporin, general account of tetracycline & macrocyclic antibiotics (no synthesis). **C. Synthesis of Following Drugs:** 4.C.1 **Antimalerials:** Trimethoprim. 4.C.2 **Analgesic & Antipyretics:** Paracetamol, Meperidine, methadone, Aminopyrine. 4.C.3 **Anti-inflammatory:** Oxyphenylbutazone, Diclophenac, Indomethacin. 4.C.4 **Antitubercular&antileprotic:** Dapsone 4.C.5 **Anaesthetics :**Lidocaine, Thiopental	
II	**Heterocyclic Chemistry-I**	15
	A. Introduction and Classification of Heterocycles: **B. Five and six membered heterocycles with two heteroatoms:** 2.B.1 Synthesis, reactivity of following heterocyclic rings: Imidazole, Pyrimidine, diazines. **C.Five membered Heterocycles with more than two Heteroatoms** 2.C.1. Synthesis and reactions of triazines ,-1,2,3-triazole, 1,2,4-triazole,1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,5-oxadiazole. D. **Benzofused Heterocycles:** 2.D.1. Synthesis and reactions of benzofurans, benzothiophenes, Benzoxazole, Benzthiazole, and Quinoline,Benzimidazole	

Course Outcomes: Student should be able to:-

1. Apply the QSAR technique for drug synthesis.
2. Demonstrate the synthesis and applications of the heterocyclic compounds with two Hetero atom

References:-

1. A. Kar, Medicinal Chemistry, (Wiley East), [Unit I, IV]
2. W. O. Foye, Principals of medicinal chemistry. [Unit I:101.Unit-IV:1033 1073–1077 1073]
3. Wilson, Gisvold&Dorque, Text book of organic medical and pharmaceuticalChemistry, [Unit-I:919].
4. R. M. Acheson, An introduction to chemistry of heterocyclic compounds. (Interscience).Joule & , Heterocyclic chemistry, (Van Nostrand), [Unit-III: 488,545. Unit-II 449,451]
5. R. K. Bansal, Heterocyclic chemistry, (Wiley E), [Unit-II :400,408]
6. R. R. Gupta, M. Kumar and V. Gupta, Heterocyclic Chemistry, Springer Veriag, Vol-1-3, [Unit III, II].
7. M. H. Palamer,The structure and reactions of heterocyclic compounds, [Unit III, IV]
8. A. R. Katritzky, Advances in Heterocyclic chemistry. (A.P.), [Unit III, II].

Credits 2	**MOCT-534 E-II: DRUGS AND HETEROCYCLES-II**	**Hours 30**

Course Objectives: Student will able to: -

1. Learn computational applications Drug design and synthesis of some important drug molecules.
2. Demonstrate the preparation and applications of heterocyclic compounds

Unit No	**Title and Syllabus**	**Hours allotted**
I	**Synthesis of Drugs**	**15**
	1.A.1.Introduction of Drugs. 1.A.2.Introduction of Computational Chemistry and its role in , Synthesis and in drug delivery. **Synthesis of Drugs:** **1.B.1Antihistamines:** Diphenylhydramine. **1.B.2.Tranquilizers:** Diazepam, Trimeprazine. **1.B.3.Anti AIDS:** General study **1.B.4.Cardiovascular:** Synthesis of dilliazem, quinidine, methyldopa, atenolol, oxyprenol. **1.B.5Anti-neoplastic drugs:** Cancer chemotherapy, Synthesis of mechloraethamine, cyclophosphamide, Mephalan, uracils, mustards. Recent development in cancer chemotherapy. Hormones and natural products.	
II	**Heterocyclic Chemistry-II**	**15**
	A. Six membered Heterocycles with one heteroatom Synthesis and reactions of pyrilium salts and pyrones and their comparison pyridinium and thiopyrylium salts and pyridones. Synthesis and reactions of coumarins, chromones.	

Course Outcomes: Student should be able to:-

1. Demonstrate the synthesis and applications of the heterocyclic compounds with one Heteroatom.

2. Demonstrate the synhetic mechanism of drugs.

References:-

1. A. Kar, Medicinal Chemistry, (Wiley East), [Unit I, IV]
2. W. O. Foye, Principals of medicinal chemistry. [Unit I:101.Unit-IV:1033 1073–1077 1073]
3. Wilson, Gisvold&Dorque, Text book of organic medical and pharmaceutical chemistry, [Unit-I:919].
4. R.M. Acheson, An introduction to chemistry of heterocyclic compounds.(Interscience).Joule & , Heterocyclic chemistry, (Van Nostrand), [Unit-III:488,545. Unit-II 449,451]
5. R. K. Bansal, Heterocyclic chemistry, (Wiley E), [Unit-II :400,408]
6. R. R. Gupta, M. Kumar and V. Gupta, Heterocyclic Chemistry, Springer Veriag, Vol-1-3, [Unit III, II].

Credits 6	**MOCT 535- Research Project**	**Hours 180**
	Student will undertake research in specific area of his major/core with an advisory supported by teacher/faculty member. Students are required to take 6 credits to research project for semester III under the guidance of faculty members.	

Credit 2	**Title and Syllabus**	**Hours 60**
	MOCP-536 Organic Chemistry Practical III(Lab-III)	
	1. Qualitative Analysis Separation, purification and identification of compounds of ternary mixtures using semi microanalysis, and chemical tests. (2 days for each mixture, each mixture requires 6 hrs),Total 5 Mixtures will be covered	**30 hrs**
	(A) Two step Preparations (Any Four) 1. Preparation of m-nitroaniline from nitrobenzene. 2. Preparation of Benzanilide from Benzophenone. 3. Preparation of Bisindole methylene by ultrasound method. 4. Microwave assisted synthesis of derivatives of Barbituric acid. 5. Synthesis of acetanilide from aniline. 6. **Any other suitable expt. may be added** B) Structure elucidation by using given spectral data as well as perform its retrosynthetic analysis.	**30 hrs**

Course Outcome: Student should be able to:-

1. Understand the separation method of ternary mixture by microscale technique.
2. Illustrate the separation of ternary mixture.
3. Recognize the purification techniques of liquid compounds
4. Assign theoretical value of ^{1}H NMR, ^{13}C NMR and Mass Spectroscopy of chemical compounds of ternary mixture.

References:

1. I. Vogel, Textbook of Practical Organic Chemistry.
2. Mann &Saunders, Practical Organic Chemistry.
3. H. T. Clarke, A Handbook of Quantitative & Qualitative Analysis.
4. Blat, Organic Synthesis Collective Volumes.

M.Sc.Part–II, Semester IV

Discipline Specific Course(DSC)*(Mandatory)*

Credits 4	MOCT 541: Theoretical Organic Chemistry	Hours 60

Learning Objectives: Student will able to:-

1) Understand the aromaticity concept of non-benzoic system.
2) Learn the supra molecular chemistry with various molecules.
3) Demonstrate the difference between the kinetic and thermodynamic controlled reactions with applications
4) Elaborate free radical reactions and their applications in organic synthesis

Unit No	Title and Syllabus	Hours allotted
I	**Molecular Orbital Theory**	**15**
	1.1.Aromaticity in benzenoids 1.2.Alternant and non-alternant hydrocarbon 1.3.Huckels rule 1.4.Energy level of pi- molecular orbital and concept of Aromaticity, 1.5.Calculation of energies of orbitals cyclic and acyclic systems. 1.6.Determination energies and stabilities of different systems 1.7.Calculation of charge densities PMO theory and reactivity index.	
II	**Supramolecular Chemistry**	**15**
	2.1.Host-Guest approach 2.2.Chiral recognition, Ionophores 2.3.Crown Ether and its complexes 2.4.Cryptands, Micelles 2.5.Cyclodextrins,calixarenes 2.6.Annulenesand heteroannulenes 2.7.FullerenceC_{60} 2.8.Tropone ,tropolone azulene 2.9.Fulvene 2.10.Tropylium salts 2.12.Ferrocene 2.15.Catenanes and rotaxanes	
III	**Kinetics and thermodynamic controlled reactions**	**15**
	3.1. Energetics of reaction, Kinetics of reaction 3.2. Investigation of reaction mechanism. Kinetic and thermodynamic control in case of Nitration and Sulphonation of naphthalene, Wittig, Enolization, Friedel-Crafts and Diels Alder reactions, Addition of HCl to conjugated diene and Michel addition	
IV	**Free Radical Reactions**	**15**
	4.1.Types of free radical reactions 4.2.Detection by ESR	

	4.3.Free radical substitution mechanism 4.4. Mechanism at an aromatic substrate 4.5.Neighboring group assistance 4.6.Reactivity for aliphatic and aromatic substrates at a bridgehead 4.7.Reactivity in attacking radicals 4.8.The effect of solvent on reactivity. 4.9.Allylic hydrogenation (NBS), 4.10. Oxidation of aldehydes to carboxylic acids, 4.11. Auto oxidation 4.12. Coupling of alkynes and arylation of aromatic compounds by diazonium salt, 4.13. Sandmeyer reaction. 4.14. Free radical rearrangement 4.15. Hunsdiecker reaction.	

Course Outcomes: Student should be able to:-

1. Imbibe the MOT and the concept of aromaticity.
2. Demonstrate the supra molecules with their structural explanation.
3. Solve problems based on kinetic and thermodynamic controlled reactions.
4. Understand the free radical reactions with different examples.

REFERENCE BOOKS:

1. Lehar and Merchand, Orbital Symmetry, [Unit II, III]
2. R. B. Wood ward and Hoffman, Conservation of orbital symmetry. [Unit III]
3. Ginsburg, Non benzenoid aromatic compound, [Unit I, IV]
4. E. Clerk, The aromatic sextet, [Unit III].
5. Lloyd, Carbocyclic non- benzenoid aromatic compounds, [Unit III]
6. W. B. Smith, Molecular orbital methods in organic chemistry. [Unit III]

Credits 4	**MOCT 542: Stereochemistry**	**Hours 60**

Course Objectives: Student will be able to:

1. Learn conformational approach to acyclic and alicyclic systems.
2. Understand stereochemistry of Fused and bridged rings.
3. Illustrate the stereochemistry of Allenes, Spiranes and Biphenyls.
4. Know the newer methods of stereo selective synthesis.

Unit No	**Title and Syllabus**	**Hours allotted**
I	**Stereochemistry of acyclic and alicyclic compounds**	**15**
	1.A.1 Conformation and reactivity in acyclic compounds and cyclohexenes. **1.A.2** Stability and Reactivity of diastereo isomers. **Curtin-Hammett principle**. **B Some aspects of the stereochemistry of ring systems:** 1.B.1.Stereoisomerism and determination of the configuration of alicyclic rings 1.B.2.Stability of rings and ease of rings formation **C.The shapes of the rings other than six membered:** 1.C.1.Shapes of five, six, and seven membered rings. 1.C.2.Conformational effects In medium sized rings, Concept of 'I'	

	strain.	
II	**Stereochemistry of the ring system, conformation and configuration**	**15**
	A)Fusedand bridged rings: (8) 2.A.1. **Fused bi cyclic ring systems:** Types of fused ring systems 2.A.2. Cis and trans- Decalins 2.A.3. Perhydroanthracene 2.A.4. **Bridged rings**: Types of bridged ring systems 2.A.5. Nomenclature 2.A.6. stereo chemical restrictions 2.A.7. Bredt's rule. **B) O.R.D. and C.D.: (7)** 2.B.1 Types of curves 2.B.2 Circular dichroism 2.B.3 Determination of the conformation and configuration 2.B.4 The Octant rule and axial halo ketone rule.	
III	**Stereochemistry of compounds containing no chiral carbon atoms and diastereoisomerism (Geometrical isomerism)**	**15**
	A) Stereochemistry of Allenes, Spiranes and Biphenyls, Assignment of configuration B) Configuration of diastereomers (Geometrical isomerism) based on physical and chemical methods**.**	
IV	**Newer methods of stereo selective synthesis.**	**15**
	4.A.1. Introduction and Stereo selective and Stereospecific reactions 4.A.2. Enantio selective synthesis(chiral approach) reactions with hydride donors, hydroboration, catalytic hydrogenation via chiral Hydrazones and oxazolines, Sharpless epoxidation,Diels Alder Selective synthesis,Aldol and related reactions including Cram's rule and FelkinAnh rule use of calculations of optical purity and enantiomeric excess.	

Course Outcomes: Student should be able to:-

1. Show the ball and sticks models of conformational approach to acyclic and alicyclic systems.
2. Demonstrate the circular dichroism, fused and bridged rings.
3. Illustrate the stereochemistry of Allenes, Spiranes and Biphenyls.
4. Solve problems based on the conceptual fact of stereo selective synthesis.

References:-

[1] E.L. Eliel, Stereochemistry of carbon compounds, [All units].
[2] D. Nasipuri, Stereochemistry of organic compounds, [All units].
[3] P.S. Kalsi: Stereochemistry, Conformation and Mechanism, [All units].
[4] Carl Djerassi, Optical Rotatory Dispersion, [Unit II]
[5] P. Crabbe : Optical Rotatory Dispersion and C.D. [Unit II].

Credits 4	MOCT 543: Chemistry of Natural Products	Hours 60

Course Objectives: Student will be able to:-

1. Understand the naturally occurring organic molecules.
2. Study synthesis and stereochemistry of alkaloid molecules
3. Learn the synthesis of steroids, terpenoids, prostaglandins, etc.
4. Illustrate the natural product through a biogenesis approach.

Unit No	Title and Syllabus	Hours allotted
I	**Introduction of natural products and Terpenoids**	15
	1.A.1 Introduction of natural products Classification and isolation methods. **1.A.2** Terpenoids structure, stereochemistry and synthesis of carvone, abietic acid, zingiberene, α-santonin, β-cuparenone and β- caryophyllene.	
II	**Alkaloids and Prostaglandins**	15
	2.A1. Alkaloids (10) Structure, stereochemistry, synthesis and biosynthesis of the following: Morphine, Reserpine and Epidrin. 2.A2. Prostaglandins (05) Occurrence, nomenclature, classification, biogenesis and physiological effects, Synthesis of PGE2 and PGF2.	
III	**Steroids**	15
	3.1.Occurrence 3.2.Nomenclature 3.3.Basic skeleton 3.4.Diels hydrocarbon 3.5.Study of the following: hormones, Cholesterol, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone and cortisone (only synthesis)	
IV	**Biogenesis**	15
	4.1.Terpenoids: mono, sesqui, di- and triterpenoids, cholesterol. 4.2.Alkoloids: Derived from ornithine, lysine, tyrosine, tryptophan, Pyridine,andindole type alkoloids. 4.3.Shikimate pathway– cinnamic acids, lignans, coumarins, Flavonoids, isoflavonoids and quinines 4.4.Vitamins:Synthesis and structure of biotin and vitamin B1, B2, B6: Biologicalfunctions of Vitamin B6, D and E.	

Course Outcomes: Student should able to:-

1. Illustrate the extraction and purification of natural products and terpenoids.
2. Demonstrate the classifications, structure and synthesis of alkaloids.
3. Understand different structure, stereochemistry, synthesis and biosynthesis of stereoids

4. Explain classification, biogenesis and physiological effects of natural products, steroids, vitamin's etc.

References:-

1. Finar, Organic chemistry Vol. I and II, [All units].
2. Manskey and Holmes, Alkaloids [Unit I]
3. P. D B. Mayo, The chemistry of natural products.Simonson, Terpenes, [Unit I]
4. Fieser and Fieser, Steriods, [Unit III].
5. Peter Bernfield, The biogenesis of natural products, [Unit IV].

Credits 4	**MOCT 544 E-1: Applied Organic Chemistry**	**Hours 60**

Course Objectives: Student will be able to:-

1. Study the commercial synthesis of different dyes.
2. learn the synthesis and application of different perfumery based compounds
3. Realize different types of Agrochemicals used for the pest control.
4. Engross different process of polymers synthesis.

Unit No	**Title and Syllabus**	**Hours allotted**
I	**Dyes and Intermediate**	**15**
	1.1. Classification and synthesis of important dye intermediates by Using nitration, sulphonation, diazotization reactions. 1.2.Commercial processes for azo-dyes, reactive dyes, optical brighteners, Thermal sensitive dyes, dispersed dyes and reactive dyes.	
II	**A) Synthesis and applications of perfumery, B) Synthesis and Applications of pharmaceuticals and C) Sugar based chemicals.**	**15**
	A) Synthesis and applications of perfumery 2-Phenylethanol, vanillin and other food flavours, synthetic musk and ionones. **B) Synthesis and applications of pharmaceuticals:** Beridryl, Oxyphenbutazone & Ethambutol **C)Sugar based chemicals:** Manufacture of furfural from bagasse, Citric acid from molasses, acetic acid, butane aldehyde &butyl acetate from ethanol	
III	**Agrochemicals**	**15**
	A. Carbamate pesticides: Introduction and synthesis of carbaryl, carbofuran, Baygon, Aldicarb, Ziram, Zineb. B. Organophosphorus pesticides: Malathion, monocrotophos, dimethoate, phorate, mevinphos, chloropyriphos. C. Natural and synthetic pyrethroids: Isolation and structures of natural allethrin, fenvalerate, cypermethrin. D. Plant growth regulators: General survey and synthesis of simple compounds and applications. E. Insect repellents: General survey, synthesis and applications.	

	F. Juvenile harmone: introduction & structures JHA importance synthesis G.Pheromones: introduction, examples, and importance in IPM. Synthesis of juvabione bombykol, grandisol and disparlure	
IV	**Polymers**	**15**
	4.1 Mechanism of polymerization. 4.2 Study of polyesters polyamides, PVC, polystyrene, polyvinyl acetate and polyvinyl alcohol, polyethenes, viscose rayon, synthesis of polyethylene, polypropylene. Synthetic rubbers: Styrene-butadiene, butyl poly isoprene, phenol formaldehyde resin. Plasticizers and anti - oxidants for polymers, natural polymers: starch and cellulose	

Course Outcomes: Student should able to:-

1. Understand formation of Dyes and Intermediates with its applications.
2. Demonstrate the classification, synthesis and analysis of perfumery, pharmaceuticals and sugar based chemicals.
3. Illustrate fundamental mode of action, structure and synthesis of agrochemicals
4. Explain the polymers with respect to synthesis and applications.

References:-

1. Allan,ColorChemistry.[unit-I]
2. K. Venkataraman, Chemistry of Synthetic Dyes Vol- 1 to7[unit-I]
3. Abrahart, Dyes &theirintermediates.[unit-I]
4. N. N. Melikov, The Chemistry of Pesticides andformulations.[unit-III]
5. K. H. Buchel, Chemistry ofPesticides.[Unit-III]
6. R. Clemlyn, Pesticides.[unit-III]
7. K. H. Buchel, Chemistry of Pesticides.[Unit-III]
8. H. R. Alcock and F. W. Lambe, Contemporary PolymerChemistry.[unit-IV]
9. J. M. G. Cowie, Blackie, Physics & Chemistry ofPolymers.[unit-IV]
10. P. H. Groggins, Unit Processes in OrganicSynthesis.[unit-I]
11. B. Biollot& P. V. Wells,PerfumaryTechnology.[unit-II]
12. M. Ash & I. Ash, A formulary of CosmeticPreparations.[Unit-II]

Credits 4	**MOCT 544-E-II: Environmental Chemistry**	**Hours 60**

Course Objectives: Student will be able to:-

1. Study basic principles of environmental chemistry.
2. Acquire knowledge of Atmosphere, Hydrosphere and Lithosphere .
3. Grasp concept chemical toxicology.
4. Study Air Pollution, Water Pollution and water treatment.

Unit No	**Title and Syllabus**	**Hours allotted**
I	**Introduction to Environmental Chemistry**	**15**
	1.1.Concept and scope of environmental chemistry, Environmental terminology and nomenclatures	

	1.2.Environmental segments, The natural cycles of environment (Hydrological, Oxygen, Nitrogen)	
II	**Atmosphere, Hydrosphere and Lithosphere**	**15**
	2.1.Atmosphere: Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in atmosphere. 2.2. Chemistry of ozone layer. Hydrosphere: Complexation in natural water and waste-water. 2.3.Micro-organisms in aquatic chemical reactions, Eutrophication, Microbiology mediated redox reactions. Lithosphere: Inorganic and organic components in soil, acid-base and ion-exchange reactions in soil, micro and macronutrients, nitrogen pathways and NPK in soil.	
III	**Chemical Toxicology**	**15**
	3.1.Toxic chemicals in the environments, Impact of toxic chemicals on enzymes 3.2. Biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur oxides.	
IV	**Air Pollution, Water Pollution and water treatment**	**15**
	A.Air Pollution Particulates, Aerosols, SO_x, NO_x, CO_x and hydrocarbon, Photochemical smog, Air-quality standards **B.Water Pollution and water treatment.** Water-quality parameters and standards: physical and chemical parameters, Dissolved oxygen, BOD, COD, Total organic carbon, Total nitrogen, Total sulfur, Total phosphorus and Chlorine, Chemical speciation (Pb, As, Hg)	

Course Outcomes: Student should be able to:-

1. Illustrate Concept and scope of environmental chemistry.
2. Demonstrate Atmosphere, Hydrosphere and Lithosphere
3. Explain the chemical toxicology.
4. Elucidate causes and treatments of air and water pollution.

References:-

1. Peter O. Warner, Analysis of Air Pollutants, 1st Edition (1996), John Wiley, New York. [All units]
2. S.M. Khopkar, Environmental Pollution Analysis, 1st Edition (1993), Wiley Estern Ltd., New Delhi. [Allunits]
3. S.K. Banerji, Environmental Chemistry, 1st Edition (1993), Prentice-Hall of India, New Delhi.[All units]

Credits 4	**MOCT-545:On job Training**	**Hours 120**
	OJT Will provide the opportunities for internship with local/regional industries, business organization, health and allied areas, local government, etc. So that undergoes 4 Credit work-based learning /OJT/Internship.	

Credits 2	MOCP-546: PRACTICAL COURSE – VII: LAB – VII	Hours 60

Course Objectives: Student will be able to:-

1. Study the three-step preparation of important organic compounds.
2. Carry out multicomponent synthesis.
3. Study the applications of Sandmeyer reaction.
4. Understand Sulphur and Nitrogen estimation Procegure..

	Title and Syllabus	
	MOCP-546 Organic Chemistry Practical VII(Lab-VII)	
	A. Three stage organic preparations 1. Preparation of Anthranilic acid. 2. Preparatin of p-Amino benzoic acid. 3. Preparation of p-Chloro nitrobenzene by Sandmeyer reaction. 4. Preparation of p- Iodo nitrobenzene by Sandmeyer reaction. 5. Any other suitable experiment may be added **B.Estimation of Sulphur and Nitrogen.** **C.Green methods of synthesis (Microwave and ultrasonic technique)** A. Synthesis of Schiff's base from aniline and p-anisaldehyde in the presence of lime juice. B. Synthesis of coumarin by Knoevenagel reaction usin salicyl aldehyde, and ethyl acetate in presence of base. C. Synthesis of dihydropyrimidones- Biginelli reaction: acid catalyzed three component reaction between vanillin, ethylacetoacetate and thiourea. D. Synthesis of acetanilide from aniline.	

Course Outcome: Student should be able to:-

1. Carry out purification of organic compounds by recrystallization method
2. Demonstrate the lab synthesis of three step preparations of different reactions.
3. Apply sandmeyer reaction in the synthesis of important products.
4. Identify Nitrogen and sulphur percentage from the unknown sample.

References:-

1. A. I. Vogel, Textbook of Practical Organic Chemistry.
2. Mann &Saunders, Practical Organic Chemistry.
3. H.T. Clarke, A Handbook of Quantitative & Qualitative Analysis.Blat, Organic Synthesis Collective Volumes. Education(UnitIII)
4. A. I. Vogel, 1980 *A Text book of Qualitative Inorganic Analysis*-Longman Sc& Tech, (UnitI,II,IV)