Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA
(An Autonomous College)

Reaccredited by NAAC with 'A+' Grade

New Syllabus For

Master of Science

Part - II

Organic Chemistry

Syllabus

to be Implemented from June, 2022 onward

Structure of Course

M.Sc. Part II Semester III

Theory			
Course No. and Course code	**Title of Course**	**No. of lectures Per week**	**Credits**
MOCT-301	Organic Reaction Mechanism	4	4
MOCT-302	Advanced Spectroscopic Methods	4	4
MOCT-303	Advanced Organic Synthesis	4	4
Elective Course			
MOCT-304A or MOCT- 304B	Drugs And Heterocycles Or Biomolecular Organic Chemistry	4	4
Practical			
MOCP 305	Practical course V: Lab V	16	4
MOCP 306	Practical course VI: Lab VI	16	4
		48	24

M.Sc. Part II Semester IV

Theory			
Course No. and Course code	**Title of Course**	**No. of lectures Per week**	**Credits**
MOCT-401	Theoretical Organic Chemistry	4	4
MOCT-402	Stereochemistry	4	4
MOCT-403	Chemistry Of Natural Products	4	4
Elective Course			
MOCT-404A or MOCT-404B	Applied Organic Chemistry Or Environmental Chemistry	4	4
Practical			
MOCP 405	Practical course VI: Lab VII	16	4
MOCP 406	Practical course VII: Lab VIII	16	4
		48	24

M.Sc. II: Evaluation structure

Semester III and IV

Paper code	**Theory**			**Practical**			**Total**
	ESE	ISE	Total	ESE	ISE	Total	
Theory paper - I	60	ISE-I = 10 ISE-II = 10 (Online test) Activity = 20 (Book review) Total = 40	100	--	--	--	100
Theory paper - II	60	ISE-I = 10 ISE-II = 10 (Online test) Activity = 20 (Home assignment) Total = 40	100	--		--	100
Theory Paper - III	60	ISE-I = 10 ISE-II = 10 (Online test) Activity = 20 (Survey/Seminar) Total = 40	100	--	--	--	100
Theory paper - IV	60	ISE-I = 10 ISE-II = 10 (Online test) Activity = 20 (Group discussion / Innovative idea presentation) Total = 40	100	--	--	--	100
Practical paper - I	--	--	--	60	Journal = 10 Student performance = 10 Activity = 20 (case study/survey report) Total = 40	100	100
Practical paper - II	--	--	--	60	Journal = 10 Student performance = 10 Activity = 20 (model presentation/project) Total = 40	100	100
Total	**240**	**160**	**400**	**120**	**80**	**200**	**600**

SEMESTER III
MOCT 301: ORGANIC REACTION MECHANISM

Course Objectives: Student will able to:-

1. Study the different organic reactions with mechanisms.
2. Understand the pericyclic reaction mechanism.
3. Study the changes in the reaction with different interactions to get final products.
4. Study the concepts of photochemical actions

Credits = 4	**SEMESTER-III** **MOCT 301: ORGANIC REACTION MECHANISM**	**No. of hours per unit/ credits**
Credit –I UNIT I	**Methods of determining reaction mechanism**	**(15)**
	Kinetic Methods: Order and Molecularity, Methods of following reaction rates, Types of reactions: 1st, 2nd and 3rd order reactions; Reversible, Consecutive and Parallel reactions. Energy of Activation, Entropy of Activation, Effect of Ionic strength, Solvent effect and Kinetic isotopic effect. **Non-Kinetic Methods:** Identification of reaction products, Testing of the possible intermediates, Trapping of the intermediates, Isotopic labeling, Reaction catalysis, Cross- over experiments, Stereochemical studies and Use of physical properties. Hammett and Taft equations.	
Credit –1 UNIT II	**Pericyclic reactions**	**(15)**
	Molecular orbital symmetry, Frontier orbital of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system, classification of pericyclic reaction, Wood-ward Hoffman correlation diagrams, FMO and PMO approach, electrocyclic reactions, conrotatory and disrotatary motions, 4n , 4n+2 and allyl systems, cycloaddition, and supra and antara facial additions, 4n and 4n+2 systems, 2+2 additions of ketenes, 1,3-dipolar cycloaddition and chelotropic reactions, sigmatropic rearrangement , supra and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties,(3,3) and (5,5) sigmatropic rearrangement and Claisen and Cope and Aza Cope rearrangement, Ene reaction.	
Credit –1 UNIT III	**Name Reactions**	**(15)**
	A) Mechanism, Stereochemistry, migratory aptitude, (application	

	using complicated example): Dienone –phenol, Favorskii, Baeyer-Villiger, Petasis reaction, Wolff, Smile's, Mukaiyama esterification, Mitsunobu reaction, Baylis Hillman reaction, Wacker process, Eschenmoser fragmentation, Julia olefination. B) Protection and deprotection of the following functional groups: hydroxyl, carbonyl, amino and carboxyl with applications.	
Credit –1 UNIT IV	**Photochemistry**	**(15)**
	Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions, photo dissociation gas phase photolysis, photochemistry of alkynes, intermolecular reactions of the olefinic bonds, geometrical isomerism, cyclisation reactions, rearrangements of 1,4 and 1,5-dienes, photochemistry of carbonyl compounds, intramolecular reactions of carbonyl compounds saturated cyclic and acyclic α, β-unsaturated compounds, cyclohexadienones, intermolecular cycloaddition reactions, dimerisation and oxitane formation, photochemistry of aromatic compounds, photo fries reactions of anilides, photo fries rearrangements. Singlet molecular oxygen reactions, photochemistry of vision.	

Course Outcomes: Student should be able to:-

1. Understand kinetic and non-kinetic methods of reaction mechanism.
2. Demonstrate the pericyclic reactions by models of molecular orbits.
3. differentiate stereochemistry, migratory aptitude of different reactions.
4. Solve combined problems based on basic concept of photochemistry and photochemical reactions.

References:-

1. Peter Sykes, A guide book to mechanism in organic chemistry, (orient- Longmans), [Unit-I:36-42,]
2. Michael B.Smith,Jerry March,March's Advanced Organic Chemsitry(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]

Further Reading..

7. Jagdamba Singh and jaya Singh, Photochemistry and Pericyclic reactions, 3rd revised edition,[Unit-II 3,60,84,111,Unit-IV 269,184-228]
8. R. K. Bansal, Organic reaction mechanism, (McGraw Hill)[Unit-I 97,99]

MOCT 302: ADVANCED SPECTROSCOPIC METHODS

Course Objectives: Student will able to:-

1. Study the basic principles of UV and IR spectrometers.
2. understand the basic concepts in ^{1}H NMR spectroscopy.
3. study the principal and basic concepts of mass spectroscopy for identify organic compounds.
4. understand ^{13}C- NMR spectroscopy and understand the structure determination of organic compounds using UV, IR, NMR and Mass spectroscopic data.

Credits= 4	**SEMESTER-III** **MOCT 302: ADVANCED SPECTROSCOPIC METHODS**	**No. of hours per unit/ credits**
Credit –I UNIT I	**Ultraviolet Spectroscopy and IR Spectroscopy**	**(15)**
	a) Ultraviolet Spectroscopy Woodward- Fisher rules for conjugated dienes and carbonyl compounds; Calculation of λ max. Ultraviolet spectra of aromatic and heterocyclic compounds, Steric effect in biphenyls. **b) IR Spectroscopy** Characteristic vibrational frequencies of alkanes; alkenes; alkynes; aromatic compounds; alcohols; ethers; phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds [ketones; aldehydes; esters; amides; acids; anhydrides; lactones; lactams and conjugated carbonyl compounds] Effect of hydrogen bonding and solvent effect on vibrational frequencies; overtones; combination bands and Fermi resonance. FT-IR of gaseous; solids and polymeric materials.	

Credit –1 UNIT II	**NMR Spectroscopy**	**(15)**
	General introduction and definition; 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 mercaptons]; chemical exchange; effect of deuteration; complex spin-spin interaction between two; three; four; and five nuclei [first order spectra]; virtual coupling. Stereochemistry; hindered rotation; Karplus curve variation of coupling constant with dihedral angle. Simplification of complex spectra; nuclear magnetic double resonance; shift reagent; solvent effect. Fourier transform technique, nuclear Overhauserer effect [NOE] Resonance of other nuclei-F;P. INEPT and INADEQUATE.	
Credit –1 UNIT III	**Mass Spectrometry**	**(15)**
	Introduction, various methods of ionization (EI, CI, FD,FAD and MALDI), factors affecting fragmentation, ion analysis, analyzers (Magnetic sector mass analyzers, Quadrupole mass analyser,Time of Flight mass analyser), Detectors**,** ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement, nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination**.**	
Credit –1 UNIT IV	**Carbon-13 NMR Spectroscopy**	**(15)**
	a) General considerations; chemical shift [aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl compounds]; problems associated with ^{13}C, FT-NMR, proton decoupled off resonance. b) Introduction to two dimentional spectroscopic methods, COSY,NOESY,HETCOR c) 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. Understand 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.]

Further Reading..

7. Jafee and Orchin, Theory and application of U.V.[Unit-I]
8. K. Benjamin. Mass spectroscopy. [Unit III]
9. Beynon J H, The mass spectra of organic molecules. [Unit III]
10. Wehli F.W, Marchand A. P. Interpretation of carbon 13 NMR (J. Wiley) [Unit IV]

MOCT 303: ADVANCED ORGANIC SYNTHESIS

Course Objectives: Student will able to-

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

Credits= 4	**SEMESTER-III** **MOCT 303: ADVANCED ORGANIC SYNTHESIS**	**No. of hours per unit/ credits**
Credit –1 UNIT I	**Green chemistry**	**(15)**
	A. Introduction, basic principles of green chemistry. Designing a green synthesis: Green starting materials, green reagents, green solvents and reaction conditions, green catalysts. Use of the following in green synthesis with suitable examples: Green reagents: dimethylcarbonate, polymer supported reagents. Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts, phase transfer catalysts.	

	B. Green solvents: 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. C. Microwave assisted synthesis: reactions in water, reactions in organic solvents, solvent free reactions. Ultrasound assisted reactions. Comparison of traditional processes versus green processes in the syntheses.	
Credit –1 UNIT II	**Application of the reagents and reaction in synthesis.**	**(15)**
	Complex metal hydrides, sodium cyanoborohydride, lithium diisopropyl amide (LDA) Dicyclohexyl carbodiimide(DCC), Trimethylsilyl iodide, PPA, Diazomethane, ozone, phase transfer catalyst, Woodward-Prevost hydroxylation, Barton and Shapiro reaction, Hoffmann – Loffler-Fretag, Peterson synthesis, Selenium dioxide, Dess-Martin periodinane, periodic acid and iodo isobenzyl diacetate, organ catalysis and Grub'scatalysts.	
Credit –1 UNIT III	**Applications of metals and non-metals in organic synthesis**	**(15)**
	Pd (Heck arylation, carboxylation, allylic activation, still coupling, sonogoshira reaction and their importance, Kumada coupling,Neigishi coupling) Hg, Cu, Sn, Pt, Rh	
Credit –1 UNIT IV	**Disconnection approach**	**(15)**
	An introduction to Synthons and synthetic equivalents, disconnection approach, functional group interconversions. One group C-X and two group disconnections in1, 2; 1,3 1, 4 & 1, 5-difunctional compounds, Retro - synthesis of alkene, acetylenes and aliphatic nitro alcohols and carbonyl compounds, amines. Importance of the Order of events in organic synthesis, Chemo selectivity, Regioselectivity. Protecting groups, Diels-Alder reaction, Michael addition and Robinson annulation. Retrosynthesis of aromatic heterocycles, 3, 4, 5 & 6 membered carbocyclic and heterocyclic rings. Reversal of polarity (Umpolung).	

Course Outcomes: Student should be able to: -

1. understand 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].

Further Reading...

6. P. E. Realand, Organic synthesis, [Unit I].
7. Stone & West, Advances in organometallic Chemistry.[Unit III]

Elective Papers:

MOCT-304A : DRUGS AND HETEROCYCLES

Course Objectives: Student will able to: -

1. study computational approach in drug designing of a molecule.
2. Understand the synthesis of five, six, membered etc heterocycles with respect to mechanistic approach.
3. study synthesis of fused heterocyclic compounds and six membered heterocycles.
4. understand synthetic methods for drugs.

Credits= 4.	**SEMESTER-III** **MOCT-304 A : DRUGS AND HETEROCYCLES**	**No. of hours per unit/ credits**
Credit –1 UNIT I	**Drug discovery and design**	**(15)**
	(A) Development of new drugs, procedures followed in drug design, concepts of prodrugs and soft drugs. Theories of drug activity, Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Isosterism and bio isosterism in drug design.	

	(B) Computational Chemistry Introduction, applications in organic synthesis and its role in drug delivery.	
Credit –1 UNIT II	**Heterocyclic Chemistry-I**	**(15)**
	a) Five and six membered heterocycles with two heteroatoms: Synthesis, reactivity, aromatic character and importance of following heterocyclic rings: Pyrazole, Imidazole, Pyrimidine, diazines. **b) Five and Six membered Heterocycles with more than two Heteroatoms** 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.	
Credit –1 UNIT III	**Heterocyclic Chemistry-II**	**(15)**
	a) Benzofused Heterocycles Synthesis and reactions of benzopyrroles, benzofurans, benzothiophenes, Benzoxazole, Benzthiazole, and Quinoline, Benzimidazole **b) 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.	
Credit –1 UNIT IV	**Synthesis of drugs**	**(15)**
	A) Study of Antibiotics Preparation of semi synthetic penicillin, conversion of penicillin into cephalosporin, general account of tetracycline & macrocyclic antibiotics (no synthesis). B) **Synthesis** **a) Antimalerials:** Trimethoprim. **b) Analgesic & Antipyretics:** Paracetamol, Meperidine, methadone, Aminopyrine. **c) Anti- inflammatory:** Oxyphenylbutazone, Diclophenac, Indomethacin. **d) Antitubercular& antileprotic:** Dapsone **e) Anaesthetics :**Lidocaine, Thiopental. **f) Antihistamines:** Diphenyl hydramine. **g) Tranquilizers:** Diazepam, Trimeprazine.	

	h) Anti AIDS: General study **i) Cardiovascular:** Synthesis of dilliazem, quinidine, methyldopa, atenolol, oxyprenol. **j) Anti-neoplastic drugs:** Cancer chemotherapy, Synthesis of mechloraethamine, cyclophosphamide, Mephalan, uracils, mustards. Recent development in cancer chemotherapy. Hormones and natural products.	

Course Outcomes: Student should be able to:-

1.understand the QSAR technique for drug synthesis.
2. Demonstrate the synthesis and applications of the heterocyclic compounds with two heteroatoms.
3. Demonstrate the synthesis and applications of the heterocyclic compounds with one heteroatom..
4. Demonstrate the synthetic 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].

Further Readings…

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]

MOCT-304 B: BIMOLECULAR ORGANIC CHEMISTRY

Course Objectives: Student will able to: -

1. understand properties and applications of Amino acids, peptides and proteins.
2. Study chemistry of enzyme and their applications in organic synthesis.
3. understand the preparation and applications of organic smart materials.
4. study basic concepts, properties of Lipid

Credits-4	**SEMESTER-III** **MOCT-304B:BIMOLECULAR ORGANIC CHEMISTRY**	**No. of hours per unit**
Credit –1 **UNIT I**	**Amino acids, peptides and proteins**	**(15)**
	Chemical and enzymatic hydrolysis of proteins to peptides, amino acids equencing. Secondary structure of proteins, forces responsible for holding of secondary structures, α- helix, β-sheets, super secondary structure. Tertiary structure of protein: folding and domain structure. Quaternary structure. Nucleic acids: Structure and function of physiologically important nucleotides (c-AMP, ADP, ATP) and nucleic acids (DNA and RNA), replication, genetic code, protein biosynthesis, mutation. Chemical synthesis of oligonucleotides: Phosphodiester, Phosphotriester, Phosphoramidite and H-phosphonate methods including solid phase approach. Computational study of proteins.	
Credit –1 **UNIT II**	**Enzymes**	**(15)**
	Chemistry of enzymes: Introduction, nomenclature, classes and general types of reactions Catalyzed by enzymes. Properties of enzymes: i) Enzyme efficiency / catalytic power ii) Enzyme specificity; Fischer's 'lock and key' and Koshland 'induced fit' hypothesis. Concept and identification of active site. Factors affecting enzyme kinetics: Substrate concentration, enzyme concentration, temperature, pH, product concentration etc. Reversible and irreversible inhibition. Mechanism of enzyme action: transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Mechanism of chymotrypsin catalyzed hydrolysis of a peptide bond.	

Credit –1 UNIT III	**Organic Smart Materials**	**(15)**
	Introduction, shape memory material (SMM) and shape memory technology (SMT), types of smart materials: Piezoelectric, Shape-memory alloys and shape-memory polymers, Photovoltaic materials or optoelectronics, Electroactive polymers (EAPs), Magnetostrictive, Smart inorganic polymers, Temperature-responsive polymers, Halochromic materials, Chromogenic systems, thermochromic materials, Ferrofluids, Photomechanical materials, Polycaprolactone (polymorph), Self-healing materials, Magnetocaloric materials, Thermo electric materials, Chemoresponsive materials. Classification of photomechanical organic crystals based on photo reactions. Applications	
Credit –1 UNIT IV	**Lipids**	**(15)**
	Fatty acids, essential fatty acids, structures and function of triglycerides, glycerophspholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins composition and function, role in arthrosclerosis. Properties of lipid aggregates – micelles, bilayers, liposomes and their possible biological functions. Biological members .Fluid mosaic model of membrane structure. Lipid metabolism - β-oxidation of fatty acids	

Course Outcomes: Student should be able to:-

1. Prepare model of Amino acids, peptides and proteins.
2. Demonstrate chemistry of enzyme and their applications in organic synthesis.
3. Understand the preparation and applications of organic smart materials.
4. understand basic concepts and properties of Lipids.

References:-

1. A. L. Lehinger, Principles of Biochemistry, Worth Publications. [Unit I].
2. L. Stryer, W. H. Freeman, Biochemistry, [Unit I,II].
3. J. David Rawn, Neil Patterson, Biochemistry, [Unit I,II]
4. Voet and Voet, Biochemistry, John Wiley[All units]
5. E. E. Conn and P. K. Stumpt, Outlines of Biochemistry. JohnWiley.[All Units]

MOCP-305: PRACTICAL COURSE – V: LAB – V

Course Objectives: Student will be able to:-

1. study process of qualitative analysis of ternary mixture using semi microanalysis technique.
2. understand knowledge about the nature, solubility of different organic compounds.
3. understand the handling of minute quantity of mixture.
4. study the Hickman head distillation assembly.

PRACTICAL COURSE:

MOCP-305 Organic Chemistry Practical V(Lab-V)

Credit –4	MOCP-305 Organic Chemistry Practical V(Lab-V)	No. of hours (60)
	1. Qualitative Analysis Separation, purification and identification of compounds of ternary mixtures using semi microanalysis, TLC, column chromatography and chemical tests. IR spectra to be used for functional group identification. Assign theoretical value of ^{1}H NMR, ^{13}C NMR and Mass Spectroscopy of chemical compounds of ternary mixture. **2.** Analysis of commercially available active organic compound and its comparison with natural compounds which is extracted from natural sources. **3.** Case Study.	

Course Outcome: Student should be able to:-

1. Understand the separation method of ternary mixture by microscale technique.
2. differentiate the separation of ternary mixture .
3. Understand the purification techniques of liquid compounds

4. Solve the theoretical value of ^{1}H NMR, ^{13}C NMR and Mass Spectroscopy of chemical compounds of ternary mixture.

RECOMMONDED BOOKS:

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.
4. Blat, Organic Synthesis Collective Volumes.

MOCP-306: PRACTICAL COURSE – VI: LAB – VI

Course Objectives: Student will be able to:-

1. Study the two steps preparations of important Organic products
2. understand the number of spectral problems.
3. study Microwave and ultrasonicator like advance techniques.
4. understand the applications of pharmaceutically important product

Credit – 04	MOCP-306 Organic Chemistry Practical VI(Lab-VI)	No. of hours per unit (60)
	Quantitative analysis **(A) Two step Preparations (Any three)** 1) Benzaldehyde→Benzalacetophenone→Epoxide 2) 4-Nitro toluene → 4-Nitro benzoic acid → 4-Amino benzoicacid 3) Cyclohexanone→ Phenyl hydrazone→1,2,3,4-Tetrahydrocarbazole 4) Hydroquinone →Hydroquinonediacetate→ 1,2,4-Triacetoxybenzene 5) Acetanilide → p-Acetamidobenzenesulphonyl chloride → P. Acetamidobenzenesulphonamide 6) p-Amino phenol → p-Acetyl amino phenol → p-Ethoxyacetanilide 7) Hippuric acid →Azalactone→ 4-Benzylidene 2-phenyloxazol-5-one 8) p-Cresol → p-Cresyl benzoate → 2-Hydroxy-5-methylbenzophenone 9) Phthalimide→ N-Benzylphthalimide→Benzylamine 10) o-Nitroaniline→ o-Phenylenediamine→Benzimidazole 11) Benzyl cyanide→ p-Nitrobenzylcyanide→p-Nitro phenyl aceticacid 12) Hydroquinone →Hydroquinonediacetate→ 2,5 Dihydroxy acetopheneone 13) Cyclohexanone→ Enamine→2-Acetylcyclohexanone 14) α-Pinene→Disiamylborane→Pinanol 15) Preparation of Benzanilidefrombenzophenone 16) Preparation of N-Bromosuccinimide	

	17) Sandmeyer reaction: p-Nitroiodobenzene from p-nitroaniline 18) Acetylation: Mannitolhexaacetate from mannitol 19) Claisen-Schmidt reaction: Dibenzalacetone from benzaldehyde 20) Oxidation: Fluorenone from fluorene 21) Acetylation: Acetyl ferrocene from ferrocene 22) Synthesis of acetanilide from aniline. 23) Preparation of Bis indole methylene by ultrasound method 24) Microwave assisted synthesis of derivatives of Barbituric acid. **25) Any other suitable expt. may be added** **B. Structure elucidation by using given spectral data as well as perform its retrosynthetic analysis.** **C. Project work**	

Course Outcome: Student should be able to:-

1. Demonstrate the lab synthesis of two step preparations of different reactions.
2. Understand the monitoring of reaction by using TLC.
3. Solve spectral problems by given spectra of different compounds.
4. Calculate number of moles of any compound.

RECOMMONDED BOOKS:

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.
4. Blat, Organic Synthesis Collective Volumes.

M. Sc. II: SEMESTER IV

MOCT 401: Theoretical Organic Chemistry

Learning Objectives: Student will able to:-

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

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Credits = 4	**SEMESTER-IV** **MOCT 401: Theoretical Organic Chemistry**	**No. of hours per unit/ credits**
Credit –II UNIT I	**Free radical reactions**	**(15)**
	Types of free radical reactions, detection by ESR, free radical substitution mechanism, mechanism at an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in attacking radicals. The effect of solvent on reactivity. Allylic hydrogenation (NBS), oxidation of aldehydes to carboxylic acids, auto oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salt, Sandmeyer reaction. Free radical rearrangement, Hunsdiecker reaction.	
Credit –II UNIT II	**Supramolecular Chemistry**	**(15)**
	Host-Guest approach, Chiral recognition, Ionophores, Crown ethers, cryptands, Micelles, Cyclodextrins, calixarenes. Annulenes and heteroannulenes, fullerence C_{60},tropone, tropoloneazulene, fulvene, tropylium salts, ferrocene, Three and five membered systems. Crown ether complexes, catenanes and rotaxanes, bonding in fullerenes	
Credit –1 UNIT III	**Molecular Orbital Theory**	**(15)**
	Aromaticity in benzenoids, alternant and non-alternant hydrocarbon, Huckels rule, energy level of pi- molecular orbital and concept of aromaticity, calculation of energies of orbitals cyclic and acyclic systems. Determination energies and stabilities of different systems	

	calculation of charge densities PMO theory and reactivity index.	
Credit –1 UNIT IV	**Kinetics and thermodynamic controlled reactions**	**(15)**
	Energetics of reaction, Kinetics of reaction, 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.	

Course Outcomes: Student should be able to:-

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

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]

MOCT 402: Stereochemistry

Course Objectives: Student will be able to:

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

Credits= 4	**SEMESTER-IV** **MOCT 402: Stereochemistry**	**No. of hours per unit/ credits**
Credit –I UNIT I	**Stereochemistry of acyclic and alicyclic compounds**	**(15)**
	A) Conformation and reactivity in acyclic compounds and cyclohexenes. **(5)** Stability and Reactivity of diastereo isomers. **Curtin-Hammett**	

	principle. **B) Some aspects of the stereochemistry of ring systems: (5)** Stereoisomerism and determination of the configuration of alicyclic rings; Stability of rings and ease of rings formation **C) The shapes of the rings other than six membered: (5)** Shapes of five, six, and seven membered rings. Conformational effects In medium sized rings, Concept of 'I' strain.	
Credit –1 UNIT II	**Stereochemistry of the ring system, conformation and configuration**	**(15)**
	a) Fused and bridged rings: (8) **Fused bi cyclic ring systems:** Types of fused ring systems, Cis and trans- Decalins, Perhydroanthracene, Perhydrophenanthrene; **Bridged rings**: Types of bridged ring systems, Nomenclature, stereo chemical restrictions and Bredt's rule. **b) O.R.D. and C.D.: (7)** Types of curves, circular dichroism**,** Determination of the conformation and configuration, The Octant rule and axial halo ketone rule.	
Credit –1 UNIT III	**Stereochemistry of compounds containing no chiral carbon atoms and diastereoisomerism (Geometrical isomerism)**	**(15)**
	a) Stereochemistry of Allenes, Spiranes and Biphenyls, Assignment of configuration. (8) **b)** Configuration of diastereomers (Geometrical isomerism) based on physical and chemical methods**.** (7)	
Credit –1 UNIT IV	**Newer methods of stereo selective synthesis.**	**(15)**
	Introduction and Stereo selective and Stereospecific reactions; 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 Felkin Anh rule use of calculations of optical purity and enantiomeric excess.	

Course Outcomes: Student should be able to:-

1. Demonstrate the ball and sticks models of conformational approach to acyclic and alicyclic systems.
2. Demonstrate the circular dichroism, fused and bridged rings.
3. differentiate 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].

MOCT 403: Chemistry of Natural Products

Course Objectives: Student will be able to:-

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

Credits = 4	**SEMESTER-IV** **MOCT 403: Chemistry of Natural Products**	**No. of hours per unit/ credits**
Credit –1 UNIT I	**Introduction of natural products and Terpenoids**	**(15)**
	a) Introduction of natural products **(3)** Classification and isolation methods. **b) Terpenoids** **(12)** **c)** Structure, stereochemistry and synthesis of carvone, abietic acid, zingiberene, α-santonin, β-cuparenone and β- caryophyllene.	
Credit –1 UNIT II	**Alkaloids and Prostaglandins**	**(15)**
	a) Alkaloids **(10)** Structure, stereochemistry, synthesis and biosynthesis of the following: Morphine, Reserpine and Epidrin. **b) Prostaglandins** **(05)** Occurrence, nomenclature, classification, biogenesis and physiological effects, Synthesis of PGE2 and PGF2	

Credit –1 UNIT III	**Steroids**	**(15)**
	Occurrence, nomenclature, basic skeleton, Diels hydrocarbon. Study of the following: hormones, Cholesterol, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone and cortisone (only synthesis)	
Credit –1 UNIT IV	**Biogenesis**	**(15)**
	a) **Terpenoids**: mono, sesqui, di- and triterpenoids, cholesterol. b) **Alkoloids**: Derived from ornithine, lysine, tyrosine, tryptophan, pyridine, and indole type alkoloids. **b) Shikimate pathway**– cinnamic acids, lignans, coumarins, flavonoids, isoflavonoids and quinines **c) Vitamins** Synthesis and structure of **biotin** and vitamin **B_1, B_2, B6: biological** functions of Vitamin **B_6, D** and **E**.	

Course Outcomes: Student should able to:-

1. Perform 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. Understand classification, biogenesis and physiological effects of natural products, steroids, vitamin's etc.

REFERENCE BOOKS:

1. I. 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].

Elective Papers:
MOCT 404 A: Applied Organic Chemistry

Course Objectives: Student will be able to:-

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

Credits = 4 .	**MOCT 404 A : Applied Organic Chemistry**	**No. of hours per unit/ credits**
Credit –1 UNIT I	**Dyes and Intermediates**	**(15)**
	Classification and synthesis of important dye intermediates by using nitration, sulphonation, diazotization reactions. Commercial processes for azo-dyes, reactive dyes, optical brighteners, thermal sensitive dyes, dispersed dyes and reactive dyes.	
Credit –1 UNIT 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.	
Credit –1 UNIT 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	
Credit –1 UNIT IV	**Polymers**	**(15)**
	Mechanism of polymerization. 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 be 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. differentiate fundamental mode of action, structure and synthesis of agrochemicals
4. Understand the polymers with respect to synthesis and applications.

References:

1. Allan, Color Chemistry.[unit-I]
2. K. Venkataraman, Chemistry of Synthetic Dyes Vol- 1 to7[unit-I]
3. Abrahart, Dyes & their intermediates.[unit-I]
4. N. N. Melikov, The Chemistry of Pesticides and formulations.[unit-III]
5. K. H. Buchel, Chemistry of Pesticides.[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 Polymer Chemistry.[unit-IV]
9. J. M. G. Cowie, Blackie, Physics & Chemistry of Polymers.[unit-IV]
10. P. H. Groggins, Unit Processes in Organic Synthesis.[unit-I]

11. B. Biollot & P. V. Wells, Perfumary Technology.[unit-II]
12. M. Ash & I. Ash, A formulary of Cosmetic Preparations.[Unit-II]

MOCT 404-: B Environmental Chemistry

Course Objectives: Student will be able to:-

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

Credits =04	**MOCT 404-B: Environmental Chemistry**	**No. of hours per unit**
Credit –1 UNIT I	**Introduction to Environmental Chemistry**	**(15)**
	Concept and scope of environmental chemistry, Environmental terminology and nomenclatures, Environmental segments, The natural cycles of environment (Hydrological, Oxygen, Nitrogen)	
Credit –1 UNIT II	**Atmosphere, Hydrosphere and Lithosphere**	**(15)**
	Atmosphere: Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in atmosphere; Chemistry of ozone layer. Hydrosphere:Complexation in natural water and waste-water, 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.	
Credit –1 UNIT III	**Chemical Toxicology**	**(15)**
	Toxic chemicals in the environments, Impact of toxic chemicals on	

	enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur oxides.	
Credit –1 UNIT 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. differentiate Concept and scope of environmental chemistry.
2. Demonstrate Atmosphere, Hydrosphere and Lithosphere
3. Understand the chemical toxicology.
4. Understand causes and treatments of air and water pollution.

1. Reference Books:

1. G.W. Vanloon, S.J. Duffer, Environmental Chemistry,` A Global Perspective, Oxford University Press.[All units]
2. F.W. Fifield and W.P.J. Hairens, Environmental Analytical Chemistry, 2nd Edition Black Well Science Ltd.[All units]
3. Colin Baird, Environmental Chemistry, W.H. Freeman and Company, New York [All units]
4. A.K. De, Environmental Chemistry, 4th Edition New Age International Private Ltd., New Delhi. [All units]
5. Peter O. Warner, Analysis of Air Pollutants, 1st Edition (1996), John Wiley, New York. [All units]
6. S.M. Khopkar, Environmental Pollution Analysis, 1st Edition (1993), Wiley Estern Ltd., New Delhi. [All units]
7. S.K. Banerji, Environmental Chemistry, 1st Edition (1993), Prentice-Hall of India, New Delhi.[All units]

MOCP-405: PRACTICAL COURSE – VII: LAB – VII

Course Objectives: Student will be able to:-

1. Study the three-step preparation of important organic compounds.
2. understand multicomponent synthesis.
3. Study the applications of Sandmeyer reaction.
4. Understand applications of IR spectroscopy.

Credit – 04	MOCP-405 Organic Chemistry Practical VII(Lab-VII)	No. of hours (60)
	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. Multicomponent synthesis. B. Identification of functional groups in Organic compound by IR spectroscopy. **C.** Case study:	

Course Outcome: Student should be able to:-

1. perform purification of organic compounds by recrystallization method
2. Demonstrate the lab synthesis of three step preparations of different reactions.
3. understand sandmeyer reaction in the synthesis of important products.
4. Understand different functional groups present in the synthesized product

RECOMMONDED BOOKS:

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.
4. Blat, Organic Synthesis Collective Volumes.

MOCP-406: PRACTICAL COURSE – VIII: LAB – VIII

Course Objectives: Student will be able to:-

1. study the Kjeldahl's method of nitrogen estimation.
2. Understand the messenger method of sulfur estimation.
3. study recent methods of synthesis.
4. understand HPLC instrumentation and its application for pharmaceutical analysis.

Credit = 04	MOCP-406 Organic Chemistry Practical VIII(Lab-VIII)	No of hours (60)
	1. Estimation of Sulphur and Nitrogen. **2. 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 using salicyl aldehyde, and ethyl acetate in presence of base. C. Synthesis of dihydropyrimidones- Biginelli reaction: acid-catalyzed three component reaction between vanillin, ethyl acetoacetate and thiourea. D. Synthesis of acetanilide from aniline. **3. Analysis of Paracetamol tablet by HPLC.** **4. Analysis of Ibuprofen tablet by HPLC.** **5.Project work** **6.Study tour**	

Course Outcome: Student should be able to:-

1. Understand assembling and use of Kjeldahl's apparatus for estimation of nitrogen.
2. Demonstrate the lab synthesis of three step preparations of different reactions.
3. Demonstrate estimation of sulfur and nitrogen.
4. analyze the organic compound using HPLC technique.

RECOMMONDED BOOKS:

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.
4. Blat, Organic Synthesis Collective Volumes.