Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of Two Year Post Graduation Degree

Undergraduate Programme of Science and Technology

M.Sc. in Chemistry

Board of Studies

In

Chemistry

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

w.e.f. June, 2024-25

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **M.Sc. Chemistry** Programme to be effective from the **Academic Year 2024-25.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date:

Place: Latur

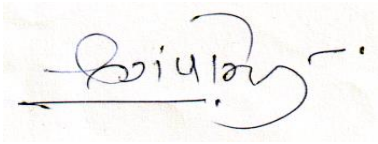
NEP Cell
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **M.Sc. in Chemistry** Programme to be effective from the **Academic Year 2023-24.**

Date :

Place: Latur



Prof. Dhananjay Palke

Chairperson
Board of Studies in Chemistry
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Members of Board of Studies in the Subject Chemistry

Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
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2	**Prof. Vijay Bhosale** Department of Chemistry, Yeshwant Mahavidyalaya, Nanded. Mo.No.9403067252	Member	V.C. Nominee
3	**Prof. S. P. Hangiragekar Department of** Chemistry, Shivaji University, Kolhapur Mo.No.9890363931	Member	Academic Council Nominee
4	**Dr. Bapu B. Shingate** Department of Chemistry, Dr. B. A. M. U. Aurangabad Mo.No.9850298591	Member	Academic Council Nominee
5	**Prof. S. B. Patwari** Chemistry, Laal Bhadur Shastri, Mahavidyalaya, Dharmabad Mo.No.9067583746	Member	Expert from outside for Special Course
6	**Dr. Pinak M. Chincholkar** Springer Nature Technology & Publishing Solutions. Tower 8 and 9 Magarpatta City, Hadapsar. Pune. Mo.No.9823966381	Member	Expert from Industry
7	**Dr. R. V. Hangarge** Department of Chemistry, Tai Golwalkar Mahavidyalaya, Ramtek. Mo. No. 9075641697	Member	P.G. Alumni
8	**Dr. K. I. Momin** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
9	**Dr. K. C. Tayade** Assistant Professor,	Member	Faculty Member

Sr. No.	Name	Designation	In position
	Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512		
10	**Mr. M. S. Sudewad** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
11	**Dr. K. D. Sawant** Department of Botany , Rajarshi Shahu Mahavidyalaya, (Autonomous) Latur 413512	Member	Member from same Faculty

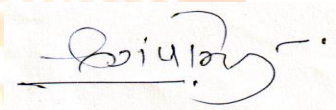
From the Desk of the Chairperson…

The Department of Chemistry was established in the academic year 1971-72. Need of Chemist, is at the forefront of the noteworthy growth in industries, the college took initiative in starting the B.Sc. Chemistry Program from 1971-72 at Undergraduate (B.Sc.) level. Now, this course is successfully flourishing the need of industries by availing Chemist with sound subject knowledge. Also, Post graduate Program in Chemistry started from Academic Year 2014-2015. From Academic Year 2023-24 we are implementing National Education Policy-2020 (NEP-2020) & Started B.Sc. (Honors/Research) Chemistry Programme to be effective from the same academic year. Department has well equipped laboratories with number of sophisticated instruments. In 2006-07, UGC recognized this department as a "Star Department" in the college and awarded CPE status.

The B.Sc. Chemistry Programme is designed to give sound knowledge and understanding of Chemistry to undergraduate students of the B.Sc. Degree course. The goal of the Programme is to make the study of Chemistry as stimulating, interesting, and relevant as possible. The curriculum is prepared with the aim of making the students capable of studying Chemistry in academic and industrial courses. Also, to expose the students to Chemistry and build up their interest in various fields of chemistry. The new and updated Curriculum is based on National Education Policy-2020 (NEP-2020) Guidelines which includes multiple entries & multiple Exit & interdisciplinary approach with vigor and depth. The curriculum is designed on the basis of Feedbacks & suggestion given by Various Stakeholders and by considering the syllabi of Competitive examination like, IIT-JAM, NET, SET, GATE examinations, UGC model curriculum, syllabi of different entrance examinations and syllabi of other Universities.

Our Vision to evolve as a world class dynamic center of higher education disseminating knowledge rigorously at affordable cost and to emerge as a premier centre that promotes technological competence and democratic values.

* "Pursuit of Excellence" in higher education to make our students globally competent.
* Enable students to develop as responsible citizens with human values.
* Provide value and need based education.
* Develop scientific attitude among students.



Prof. Dhananjay Palke
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Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

PG Skeleton in Accordance with NEP 2020

Structure for Two Year M.Sc. Chemistry

Year Leve	Sem	Major 24-28(22-26) per sem 46-56 for two years		Lab Course	RM	OJT/ FP	RP	Cum .Cr	Marks	Degree
		Mandatory	Elective							
I 6.0	I	Major VII 3 Cr Advanced Spectroscopic Method (Cr 03) DSC II 3 Cr Organic Chemistry-I (Cr 03) DSC III 3Cr Physical Chemistry-I (Cr 03)	MEC I 3 Cr Analytical Methods in Chemistry-I (Cr 03) Or Molecular Spectroscopy (Cr 03)	LC-I 1 Cr LC-II 1 Cr LC-III 1 Cr LC-IV 1 Cr	RMC 4 Cr Research Methodology	*NA*	*NA*	20 Cr	Theory : 03 Cr. = 75 M. Lab Course 01 Cr. = 50 M. Total Marks: 600	**PG Diploma (After 03 Year UG Degree)**
	II	DSC IV 3 Cr Inorganic Chemistry-I (Cr 03) DSC V 3 Cr Organic Chemistry-II (Cr 03) DSC VI 3 Cr Physical Chemistry-II (Cr 03)	DSE II 3 Cr Analytical Methods in Chemistry-II Cr 03) Or Fundamentals of Polymer Chemistry (Cr 03)	LC-V 1 Cr LC-VI 1 Cr LC-VII 1 Cr LC-VIII 1 Cr	*NA*	OJT I 4 Cr/ FP I 4 Cr	*NA*	20 Cr	OJT/FP : 04 Cr.= 100 M. Total Marks: 600	
	Total	**Major 18 Cr**	**DSE 06 Cr**	**Lab. Course 04**	**RMC 04 Cr**	**OJT/ FP 04 Cr**	**NA**	**40 Cr**		
Exit Option: PG Diploma with 40 Credits After 03 YearUG Degree										
II 6.5	III	DSC VII 3 Cr Advanced Spectroscopic Methods (Cr 03) DSC VIII 3 Cr Organic Synthesis-I (Cr 03)	DSE III 3 Cr Medicinal Chemistry(Cr 03) Or Polymer Science (Cr 03)	LC-IX 1 Cr LC-X 1 Cr LC-XI 1 Cr LC-XII 1 Cr	*NA*	*NA*	RP I 4 Cr	20 Cr	RP I & RP II: 01 Cr. = 25 M	PG Degree (After 03 Year UG Degree)

		DSC IX 3 Cr Chemistry of Natural Products (Cr 03)								
	IV	DSC X 3 Cr Organic Synthesis-II (Cr 03) DSC XI 3 Cr Stereochemistry (Cr 03) DSC XII 3Cr Advanced Heterocyclic Chemistry (Cr 03)	DSE IV 3 Cr Supramolecular & Green Chemistry (Cr 03) Or Quality Assurance and Quality Control, Method of Analytical Development and Validation (3Cr)	**LC-XIII** 1 Cr **LC-XIV** 1 Cr **LC-XV** 1 Cr **LC-XVI** 1 Cr	*NA*	*NA*	RP II 6 Cr	**22 Cr**		
	Total	**DSC 18 Cr**	**DSE 06 Cr**	**Lab. Course 08**	**NA**	**NA**	**RP 10 Cr**	**42 Cr**		
Cum. Total of I & II Year		**DSC 36 Cr**	**DSE24Cr**	**Lab. Course 16**	**RMC 04 Cr**	**OJT/ FP 04 Cr**	**RP 10 Cr**	**40+42 =82**		**82 Credits**
		Exit Option: Two Years 04 Sem. PG Degree with 82 Credits After 03 YearUG Degree								

Abbreviations:

1.	DSC	: Discipline Specific Course
2.	RMC	: Research Methodology Course
3.	OJT	: On Job Training(Internship/Apprenticeship)
4.	FP	: Field Project
5.	RP	: Research Project
7.	Cum. Cr	: Cumulative Credit

Programme Outcomes (POs) for M.Sc. Programme	
PO 1	**Academic Competence** Possess in-depth knowledge in Chemistry and allied subjects.
PO 2	**Scientific Outlook** Acquire a thorough knowledge about basic theoretical concepts and experimental aspects of Chemistry to identify, formulate, investigate and analyze the scientific problems.
PO 3	**Personal and Professional Competence** Basic competence, systematic and coherent understanding of fundamental concepts in chemistry and related fields.
PO 4	**Entrepreneurial Competence:** An opportunity to contribute effectively in the laboratory, field, and professional environments and also to grab an employment. Competency to establish independent startup/innovation center etc.
PO 5	**Research Competence** Foster research and analytical skills in basic and applied research with the ability to undertake multidisciplinary and transdisciplinary research.

Programme Specific Outcomes (PSOs) for M.Sc. Chemistry (Honors/Research)	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	Have firm foundations in the fundamentals and application of current chemical and scientific theories.
PSO 2	integrate their knowledge from each of these areas with critical thinking skills in order to become problem solvers
PSO 3	Be proficient in the chemistry laboratory, especially with respect to the abilities to follow and understand general laboratory practice guidelines, including safety. Perform qualitative & Quantitative chemical analyses. Perform chemical synthesis & Understand and use modern chemical instrumentation.
PSO 4	Find gainful employment in industry or government, be accepted at graduate or professional schools (law, medicine, etc.), or find employment in school systems as instructors or administrators.
PSO 5	Demonstrate a systematic or coherent understanding of the fundamental concepts, principles and processes underlying the academic field of chemistry, its different subfields (analytical, inorganic, organic and physical), and its linkages with related disciplinary areas/subjects;
PSO 6	Demonstrate a procedural knowledge that creates different types of professionals in the field of chemistry and related fields such as pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.;
PSO 7	Demonstrate a skills related to specialisation areas within chemistry as well as within subfields of chemistry (analytical, inorganic, organic and physical), and other related fields of study, including broader interdisciplinary subfields (life, environmental and material sciences).
PSO 8	Apply appropriate methodologies in order to conduct chemical syntheses, analyses or other chemical investigations; and apply relevant knowledge and skills to seek solutions to problems that emerge from the subfields of chemistry as well as from broader interdisciplinary subfields relating to chemistry;
PSO 9	Use chemical techniques relevant to academia and industry, generic skills and global competencies, including knowledge and skills that enable students to undertake further studies in the field of chemistry or a related field, and work in the chemical and nonchemical industry sectors.
PSO 10	Undertake hands on lab work and practical activities which develop problem solving abilities required for successful career in pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.

Semester - III

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Chemistry

Course Type : MMC VII
Course Title : Advanced Spectroscopic Method
Course Code : 602CHE3101
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1 To study principles and theories of UV-VIS and, IR advanced spectroscopic methods.
LO2 To study ^{1}H- NMR spectroscopic methods for the analysis of organic compounds.
LO3 To study ^{13}C-NMR spectroscopic method and combined application of spectroscopic methods for the structure elucidation of organic compounds.
LO4 To study Mass Spectrometric technique for organic compounds.

Course Outcomes:

After completion of the course, students will be able to-
CO1 Write principles, theories and of UV-VIS and IR advanced spectroscopic method.
CO2 Analyze organic compound by using 1H-NMR spectroscopic method.
CO3 Determine the structure of organic compound by combined applications of UV-VIS, IR, 1H-NMR, 13C-NMR and Mass Spectroscopic method.
CO4 Determine mass fragmentation of organic compounds.

Unit No.	Title of Unit & Contents	Hrs.
I	**UV-VIS and IR Spectroscopy**	**12**
	1. Introduction: Spectroscopy, electromagnetic radiation, and its characteristic, electromagnetic spectrum. 2. UV-VIS Spectroscopy, Various Electronic transitions 3 Transmittance, Absorbance, Laws of Absorption, UV-VIS Spectrum. 4. Terms used in UV-VIS Spectroscopy: Chromophores, Auxochromes, Bathochromic and Hypsochromic shifts, Hyperchromic and Hypochromic effect. 5 Rules for calculation of λmax for Conjugated dienes, polyenes, enones and aromatic compounds, Application of U.V. Spectroscopy. 6. IR Spectroscopy: Introduction, molecular vibration, fundamental modes of vibration, Hookes law, presentation of IR spectra, functional group region, finger print region, overtones; combination bands and Coupled vibrations, Fermi resonance. 7. Interpretation of IR Spectra of Alkanes, Alkenes, alkynes, aromatic hydrocarbons, 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 on vibrational frequencies.	
	Unit Outcomes: UO 1. Define- the terms and state laws in UV-VIS and IR Spectroscopy. UO 2. Calculate λmax of Conjugated dienes, polyenes, enones and aromatic compounds and interpret IR Spectrum.	
II	**^{1}H- NMR Spectroscopy**	**10**
	1. General introduction and definition, Magnetic properties of nucleus, magnetic moment and magnetic field PMR spectroscopy	

Unit No.	Title of Unit & Contents	Hrs.
	2. Principle of NMR spectroscopy, Precessional motion, orientation of nucleus. 3. Equivalent and non equivalent proton, shielding and deshielding of protons, Chemical shift, spin-spin splitting or interaction, Spin multiplicity 4. 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 mercapto]; Fourier Transform technique; Nuclear Over Hauser effect [NOE], NOSY, COSY, ^{1}H - ^{1}H Correlation, ^{1}H - ^{13}C Correlation.	
	Unit Outcome: UO 1. Determine number of signals and spin multiplicity of signal in ^{1}H-NMR Spectrum. UO 2. Interpret the ^{1}H –NMR Spectrum from given data.	
III	**^{13}C- NMR Spectroscopy and Combine Applications**	**12**
	1. ^{13}C NMR Spectroscopy 2. Resolution and multiplicity of ^{13}C NMR, 1H-decoupling 3. Noise decoupling, broad band decoupling; 4. NOE signal enhancement, off- resonance, proton decoupling, 5. Calculations of chemical shift [Saturated,Unsaturated (Olefinic & Acetylenic) and substituted aromatic Carbon atom] 6. Structural applications of CMR. DEPT. 7. Structural problems based on combined spectroscopic techniques.	
	Unit Outcomes: UO1 Calculate Chemical shift of ^{13}C NMR signal in alkanes, alkenes, alkenes and aromatic compounds. UO2 Determine the structure of organic compound from given spectroscopic data.	
IV	**Mass Spectrometry**	
	1. Introduction- ion production- EI, CI, FD and FAB. 2. Factors affecting fragmentation, ion analysis, ion abundance. 3. Mass spectral fragmentation of organic compounds, common functional groups. 4. Molecular ion peak, Base peak, Metastable peak, Rules for Fragmentation, McLafferty rearrangement, nitrogen rule and Hydrogen deficiency index. 5. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination..	
	Unit Outcomes: UO1 Define –Molecular ion peak, Base peak, State and explain Nitrogen Rule. UO2 Predict the fragmentation of organic compounds..	

Learning Resources:

1. V.M. Parikh, Application spectroscopy of organic molecules.
2. D.W. Williams and Flemming, Spectroscopic methods of organic compounds.

3. Silverstein and Basallar, Spectroscopic identification of organic compounds.
4. Orption Spectroscopy of Organic Molecules (J. Wiley)
5. P.S. Kalsi Spectroscope of organic compounds (New age publisher)
6. J.R. Dyer. Application of absorption spectroscopy of organic compounds.
7. Jackman and Sterneil , Application of NMR spectroscopy
8. J.D. Roberts, Nuclear magnetic resonance (J.Wiley)
9. Jafee and Orchin, Theory and application of U.V,
10. K. Benjamin. Mass Spectroscopy
11. Beynon J H et.al, Mass spectra of organic molecules.
12. Wehli F.W, Marchand A. P. Interpretation of carbon 13 NMR (J. Wiley)
13. W. Kemp, Organic Spectroscopy ELBS
14. Das and Jame , Mass Spectroscopy..
15. Organic Spectroscopy Y. R .Sharma
16. Organic Spectroscopy Pavia

Course Type : Lab Course –IX
Course Title : Lab Course (Based on MMC VII)
Course Code : 602CHE3104
Credits : 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives

LO1 Tounderstandanalysisofternarymixturesoforganiccompoundbyseparationwith physical methods.

LO2 Learn about chromatographic Separation (TLC) techniques.

Course Outcomes

After completion of course the student will be able to

CO1 Students will able to separate ternary mixture and can analyse each component of the mixture.

CO2 Perform chromatographic techniques (TLC) for Separation.

I	Practicals	30 Hours
	Qualitative Analysis (At least 05 Organic Mixtures): Semi-micro Qualitative Analysis of Ternary Mixtures (Two Solids and One Liquid) containing single/poly functional compounds by Chemical and Physical Method with Chromatographic Separation (TLC) for purity of all three components and its Expected Theoretical Spectral Data (IR, ^{1}H NMR &^{13}C NMR).	

Note:

1. Synthesis is carried out in molar quantities (Less than 5gm).
2. Reaction with possible mechanism.
3. Calculate theoretical and practical %yield.
4. Product conformation by physical constant and TLC.
5. Give expected spectral data (IR and NMR) of starting material, intermediate and final product.
6. All the prepared organic compounds should be stored as a sample and present at the time of University examination.

Course Type : MMC VIII
Course Title : Organic Synthesis-I
Course Code : 602CHE3102
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives

LO1 To understand the general mechanistic consideration, nature of migration, migratory aptitude of various rearrangements
LO2 To learn mechanism, stereochemistry and synthetic applications of selective organic reactions.
LO3 Understand about different oxidative processes.
LO4 To know about different reductive processes.

Course outcomes

After completion of course the student will be able to-

CO1 Understand the general mechanistic consideration, nature of migration, migratory aptitude Learn mechanism, stereochemistry.
CO2 Learn synthetic applications of Stork Enamine, Chichibabin, and Diels-Alder reactions etc.
CO3 Understand about Oxidative cleavage of 1,2-diols, oxidation of allylic and benzylic C-H bonds
CO4 Know about different Catalytic hydrogenation, Wolff-Kishner and diimide reductions.

Unit No.	Title of Unit & Contents	Hrs.
I	**Rearrangements:**	**12**
	General Mechanistic Consideration, Nature of migration, migratory aptitudeMemory Effects of following rearrangements: b) Rearrangement to Electron Deficient Carbon: Pinacol - pinacolone, Wagner- Meerwein, Benzillic acid, Wolf (Arndt–Eisterts Synthesis) Rupe and Demjanov rearrangements. c) Rearrangement to Electron Deficient Nitrogen: Hofmann, Curtius, Schimdt, Lossen and Beckmann rearrangements d) Rearrangement to Electron Deficient Oxygen: Baeyer-Villiger rearrangement. e) Rearrangement to Electron Rich Carbon: Fovorskii, Wittig, Neber andSteven's rearrangements. f) Aromatic Rearrangement: Fries, Claisen and Benzidine	
	Unit Outcome: UO1 Write the mechanism of Rearrangement reactions. UO2 Identify the name of rearrangements reaction from given chemical eqation.	
II	**Selective Organic Reactions:**	**11**
	Mechanism, Stereochemistry and Synthetic Applications of following reactions a) Stork Enamine, Chichibabin, Diels-Alder, Bucherer, Ullmann, Chugaev, Biginelli, Prins, Hunsdiecker Reactions, Arbuzov reaction, Bamford - Stevens reaction, Baylis – Hillman reaction, Dakin reaction, Darzen's reaction.	

Unit No.	Title of Unit & Contents	Hrs.
	b) Negishi, Suzuki, Stille, Kumada, Heck coupling reactions	
	Unit Outcome: UO1 Define Coupling Reaction. UO2 Explain stereochemistry of various name reaction .	
III	**Oxidation Reaction:**	**11**
	Introduction, different oxidative processes. 1 Alcohols to carbonyl compounds: Chromium (VI) oxidants, Dimethyl sulfoxide and its modifications (Swern Oxidation), Mangnese (IV) oxide, Silver carbonate, Oppenauer oxidation. 2 Alkenes to epoxide: Peroxide induced epoxidation-epoxidation by H2O2, hydroperoxides and peroxy acids. 3 Alkenes to diols: oxidation by potassium permanganate, Osmium tetraoxide, Prevost oxidation and Woodward modifications. 4 Oxidative cleavage of 1,2-diols: Periodic acid, Lead Tetra acetate. 5 Oxidation of allylic and benzylic C-H bonds: NBS, DDQ, Chloranil, SeO2.	
	Unit Outcomes: UO1 Differentiate regioselectivity & chemoselectivity of reagents. UO2 Predict mechanism of oxidation reaction.	
IV	**Reduction Reaction:**	**11**
	Introduction, different reductive processes. 1 Catalytic hydrogenation: Homogeneous and heterogeneous catalytic reductions. Dissolving metal reductions including Birch reduction, Lindlar reduction, Luche reduction 2 Metal hydride reductions: Nucleophilic metal hydrides, LiAlH4, and NaBH4. 3 Non-metallic reductions: Wolff-Kishner and diimide reductions. 4 Electrophilic metal hydrides: BH3 and DIBAL-H	
	Unit Outcomes: UO1 Differentiate Homogeneous and heterogeneous Catalytic hydrogenation. UO2 Analyse reduction of carbonyls by using different reagents.	

Learning Resources:

1. Designing Organic Synthesis – S. Warren, Willey
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press
3. Modern synthetic reactions, H.O. House, W.A. Benjamin
4. Advanced Organic Reactions, Reactions, Mechanisms and Structure, J. March, Wiley
5. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional
6. Advanced Organic Chemistry Part – B. F. A. Carey and R. J. Sundberg, Plenum P.
7. Organic Reaction and Their mechanisms, P.S. Kalsi, New Age International Publishers.
8. Protective Groups in Organic Synthesis, T.W. Greene and P. G. M. Wuts. IInd Edition, John Wiley and Sons1991.
9. Organic synthesis: The Disconnection Approach, sturat Warren, John Wiley and sons.

Course Type : Lab. Course-X
Course Title : Lab. Course (Based on MMC VIII)
Course Code : 602CHE3106
Credits : 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1 To understand the Physico organic estimations of drugs by titrimetric methods.

LO2 To learn the skill in estimation of drugs by instrumental methods.

Course Outcomes:

After completion of course the student will be able to-

CO1 Analyse the Physico organic estimations of drugs.

CO2 Operate various instruments for the estimation of drugs.

I	Practicals	30 Hours
	1 Estimation of Drugs by Titrimetry: (At least three) a) Assay of Aspirin. b) Assay of Ibuprofen. c) Assay of Analgin. d) Determination of Chloride in Ringer Lactate solution for Injection. e) Determination of Calcium ions in Calcium Gluconate Injection. **2 Estimation of Drugs by Instrumental Methods: (At least Two)** a) Assay of sulfanilamide by Potentiometry. b) Assay of Riboflavin by Colorimetry. c) Assay of ascorbic acid by Colorimetry. d) Assay of Diazepam by UV-Vis Spectrophotometer. e) Assay of Folic acid by colorimetry.	

Note:

1. All required solutions must be prepared by the students.
2. In examination one experiment is on Instrumental and one should be on non instrumental.

References

1. Modern Experimental organic chemistry by Royston M. Robert, John C. Gilbert, Lyuu B. Rodewald & Alan S. Wingrove, Saunder International Edition
2. Advanced practical organic chemistry by N.K. Vishnoi
3. Experimental organic chemistry by L. M. Harwood & C. I. Moody, Blackwell Scientific Publications.
4. The systematic identification os organic compounds by R.L. Shriner & D.Y. Curtin
5. Semi-micro qualitative organic analysis by N.D. Cheronis, J.B. Entrikin& E. M. Wodnett
6. Small scale organic preparation by P.J. Hill
7. Vogel's textbook of practical organic chemistry by ELBS, Longmann.

Course Type : MMC IX
Course Title : Chemistry of Natural Products
Course Code : 602CHE3103
Credits : **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1 To learn general methods of structure determination, isoprene rule and synthesis of Terpenoids & Carotenoids.

LO2 To understand nomenclature, occurrence, isolation, classification and synthesis of alkaloids

LO3 To know isolation, structure determination and synthesis of steroids.

LO4 To learn nomenclature and general methods of structure determination, and synthesis of Anthocyanins and Flavones.

Course Outcomes:

After completion of course the student will be able to-

CO1 Learn general methods of structure determination, isoprene rule and synthesis of Citral, Menthol, Camphor, Phytol etc.

CO2 Understand nomenclature, occurrence, isolation, classification and synthesis of Ephedrine, atropine, Quinine and Morphine.

CO3 Know isolation, structure determination and synthesis of cholesterol, Androsterone.

CO4 Lear nomenclature and general methods of structure determination, and synthesis of cyanin, Hirsutidin chloride, Flavones and Flavonols.

Unit No.	Title of Unit & Contents	Hrs.
I	**Terpenoids & Carotenoids:**	**14**
	Classification, Nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule Structure determination, stereochemistry, and synthesis of the following representative molecules: Citral, Menthol, Camphor, Phytol, Abietic acid and β-Carotene.	
	Unit Outcomes: UO1 Determine the Structure of Citral, Menthol , Phytol, etc. UO2 Identify Isolation methods .	
II	**Alkaloids:**	**11**
	Definition, nomenclature and, occurrence, isolation, classification based on nitrogen heterocyclic ring. Structure, stereochemistry and synthesis of the following: Ephedrine, atropine, Quinine and Morphine.	
	Unit Outcome – UO1 Determine the structure and synthesis of Alkaloids UO2 Predict the stereochemistry of alkaloids.	
III	**Steroids:**	**13**
	Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of cholesterol, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone.	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcomes: UO1 Determine the isolation method, structure & synthesis of Steroids UO2 Predict the stereochemistry of Steroids.	
IV	**Anthocyanins and Flavones:**	**07**
	Occurrence, nomenclature and general methods of structure determination. Synthesis of cyanidin chloride, cyanin, Hirsutidin chloride, Flavones (Kostanecki and Baker- Venkataraman approaches), Flavonols.	
	Unit Outcomes: UO1 Determine the structure, synthesis of Anthocyanins and Flavones. UO2 Predict the stereochemistry of Anthocyanins and Flavones.	

Learning Resources:

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,
3. J. B. Hobbs, D.V. Banthrope and J. B. Harborne, Longman, Essex.
4. Organic chemistry, Vol. 2, I. L. Finar, ELBS.
5. Introduction to Flavonoids, B.A. Bohm, Harwood Academic publishers
6. New Trends in natural product chemistry, Atta-ur-Rahman and M.I. Choudhary,

Course Type : Lab Course –XI
Course Title : Lab Course (Based on MMC IX)
Course Code : 602CHE310
Credits : 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives

LO1 Understanding the analysis of ternary mixtures (three solids) organic compound by separation with chemical method.

LO2 Learn about chromatographic Separation (TLC) techniques.

Course outcomes

After completion of course the student will be able to

CO1 Students will able to separate ternary mixture and can analyse each component of the mixture.

CO2 Perform chromatographic techniques (TLC) for Separation.

I	Practicals	30 Hours
	Qualitative Analysis (At least 05 Organic Mixtures): Semi-micro Qualitative Analysis of Ternary Mixtures (Three Solids) containing single/poly functional compounds by Chemical Method with Chromatographic Separation (TLC) for purity of all three components and its Expected Theoretical Spectral Data (IR, ^{1}H NMR &^{13}C NMR).	

Note:

1. Synthesis is carried out in molar quantities (Less than 5gm).
2. Reaction with possible mechanism.
3. Calculate theoretical and practical %yield.
4. Product conformation by physical constant and TLC.
5. Give expected spectral data (IR and NMR) of starting material, intermediate and final product.
6. All the prepared organic compounds should be stored as a sample and present at the time of University examination.

Course Type : MEC III
Course Title : Medicinal Chemistry
Course Code : 602CHE3201
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1 Introduction of Medicinal chemistry and its terminology
LO2 Drug designing, SAR and study of pro and soft drugs.
LO3 Synthesis, properties and uses of different drugs.
LO4 Study of different antibiotics, their synthesis and mode of action.

Course Outcomes:

After completion of course the student will be able to-

CO1 Introduce Medicinal chemistry and its terminology like pharmacodynamic agents, pharmacophore, pharmacodynamics, etc.
CO2 Know about Drug designing methods, SAR and study of Pro and Soft drugs.
CO3 Write Synthesis, properties and uses of analgesic, antipyretic, antacids, antimalerial etc drugs.
CO4 Learn about different antibiotics, their synthesis and mode of action.

Unit No.	Title of Unit & Contents	Hrs.
I	**Concepts of Medicinal Chemistry:**	15
	1) Important terminology in medicinal chemistry: Drugs, Pharmacy,Pharmaceutics,Toxicology; Pharmacodynamic agents, Pharmacophore, Pharmacodynamics, metabolite and antimetabolites, chemotherapy. 2) Mechanism of chemotherapeutic actions: 1) Biological defences 2) Chemical defences. A) Surface active agent, B) Metabolic antagonism. 3) Assay of Drugs: 1. Chemical assay 2. Biological assay, 3. Immunological assay, LD-50 and ED-50	
	Unit Outcomes: UO1 Define different terms like Drug, Pharmacophore, Toxicology, etc. UO2 Explain Assay of drugs.	
II	**Drug Discovery; Concept of pro drugs and soft drugs**	10
	A) Drug Discovery. i) Introduction ii) Procedure followed in drug design. iii) Lead modification: Drug design and development a) Identification of the active part: The pharamcophore, b) Functional group modification, c) Structure-activity relationship, d) Structure modification to increase potency and the therapeutic index; 1) Homologation, 2) Chain branching, 3) Ring-chain transformation. 4) Bioisosterism.	

Unit No.	Title of Unit & Contents	Hrs.
	B) Concept of pro drugs and soft drugs. a) Pro drugs: i) Pro drugs designing, types of pro drugs, ii) Pro drug formation of compounds containing various chemical groups. b) Soft drugs: i) Soft drug concept ii) Properties of soft drug.	
	Unit Outcomes: UO1 Explain the Steps of Drug Designing. UO2 Differentiate Prodrugs and Soft Drugs.	
III	**Study of the drugs**:	**10**
	1. Analgesic and antipyretic- Paracetamol, aminopyrene 2. Anti-inflammatory- Ibuprofen, oxyphenbutazone, indomethacin, etc. 3. Anesthetic- Lidocaine, thiopental, mechanism of action 4. Antihistamine- Phenobarbiton, diphenylhydramine, mechanism of action 5. Anti-AIDS drugs- Cause and antiaids drugs 6. Antimaleria- Trimethuprim	
	Unit Outcomes: UO1 Differentiate anesthetic, antihistamines, antimalerial drugs. UO2 Write Synthesis, properties and uses of analgesic, antipyretic, antimalerial drugs.	
IV	**Anti micobacterial drugs**	**10**
	1 Anti tubercular drugs: Introduction: i) First-line agents (Primary tubercular drugs): Structure and activity of streptomycin and dihydro-streptomycin, Rifampicin. Synthesis and SAR of 4-amino salicylic acid and isoniazid. ii) Second line agents (Secondary anti tubercular agents): Structure and activity of, Cycloserine, Enthionamide, Ethambutol, (Synthesis of Cycloserine and Ethambutol expected) 2 Antileprotic drugs: Chaulmoogra and hydrocarpus oil, Multidrug therapy, SAR of ulphones, Dapsone (DDS), Acedapsone, (Synthesis of Acedapsone expected) 3 Antibiotics. Drugs: i) Cell wall synthesis inhibitors (β-Lactams antibiotics): Synthesis of Penicillin-G, amoxicillin, ampicilin from 6-APA, ii) Structure and activity of benzyl penicillin, semi-synthetic penicillin, Mode of action of penicillin. iii) Protein synthesis inhibitors: Synthesis and SAR of chloramphenicol, Mode of action of chloramphenicol.	
	Unit Outcomes: UO1 Explain the mode of action of different drugs. UO2 Write the synthesis of different Antimicobial drugs.	

Learning Resources:

1. Medicinal chemistry-William O. Foye
2. T. B. of Organic medicinal and pharmaceutical chemistry-Wilson and Gisvold's (Ed. Robert F. Dorge)
3. An introduction to medicinal chemistry-Graham L. Patrick
4. Principles of medicinal chemistry (Vol. I and II)-S. S. Kadam, K. R. Mahadik and K. G.

Bothara (Nirali prakashan)
5. Medicinal chemistry (Vol. I and II)-Burger
6. An introduction to drug design-S. S. Pandeya and J. R. Dimmock (New ageinternational)
7. The organic chemistry of drug design and drug action-R. B. Silverman (Academic Press)
8. Strategies for organic drug synthesis and design-D. Lednicer Wiley

Course Type : Elective III
Course Title : Advanced Polymer Chemistry
Course Code :
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1 To understand the concepts of Petroleum based raw materials, types and source of crude oils

LO2 To know about Chain/step growth polymers, Nomenclature of polymers, names based on source.

LO3 To familiarize with, H-T and H-H polymerization, ATRP, RAFT and nitroxidemediated polymerization.

LO4 To understand about basic concepts of cationic and anionic methods of polymerization, Ring opening polymerization.

Course Outcomes:

CO1 The concepts of Petroleum based raw materials, types and source of crude oilsacetylene and derivatives, propylene andderivatives

CO2 Types of polymers. linear, branched, hyperbranched, star branched dendrimers.

CO3 Experimental determination of rate of polymerization. Initiation by free radical, redox, photochemical, ionizing radiation and thermal methods.

Unit No.	Title of Unit & Contents	Hrs.
I	**RAW MATERIALS AND INTERMEDIATES FOR POLYMERS**	**10**
	Petroleum based raw materials: Crude oil, natural gas, petroleum hydrocarbons, types and source of crude oil, refining various petroleum fractions, cracking (thermal and catalytic), knock and octane rating, petrochemical as building blocks, Acetylene and derivatives, propylene and derivatives, butane/butene, butadiene fractions, BTX and their derivatives: Polymer feed stocks (monomers, solvents), petroleum industry Carbon monoxide, Carbon dioxide as building block for monomers and polymers	
	Unit Outcomes: UO1 Define Polymers & Polymerization UO2 Describe Different Types of Polymers	
II	**CLASSIFICATION OF POLYMERS**	**15**
	Addition- condensation, (Chain/step growth polymers) organic-inorganic, natural-synthetic, polarnonpolar with suitable examples, types of polymers. linear, branched, hyperbranched, star branched dendrimers, semiladder, ladder, crosslinked, and layer-latties- polymers. Nomenclature of polymers, names based on source, based on structure (IUPAC and Non IUPAC) Trade names.	
	Unit Outcomes: UO1 Discuss Different Techniques of Polymerization. UO2 Describe Mechanism of Different Polymerization.	
III	**RADICAL CHAIN POLYMERIZATION**	**10**

Unit No.	Title of Unit & Contents	Hrs.
	Structural arrangement of monomer units, propagation modes, H-T and H-H polymerization, mechanism and kinetics: energetics, experimental determination of rate of polymerization. Initiation by free radical, redox, photochemical, ionizing radiation and thermal methods, efficiency of initiator in transfer reactions, retardation, autoacceleration. Controlled radical polymerization. ATRP, RAFT and nitroxide mediated polymerization.	
	Unit Outcomes: UO1 Determination of Molecular Weight of polymer. UO2 Nomenclature of polymers	
IV	**CHAIN POLYMERIZATION**	**10**
	Basic concepts of cationic and anionic methods of polymerization, distinguishing between radical and ionic polymerization. Group transfer polymerization. Ring opening polymerization, mechanism of ROP of cyclic ethers, cyclic amides and cyclosiloxanes; Ring opening metathesis polymerization.	
	Unit Outcomes: UO1 Describe properties of polymers. UO2 Explain Manufacturing of Polypropylene, polystyrene, Poly methylmethacrylate, etc.	

Learning Resources:

1. P. Rempp and E.W. Merill Polymer Synthesis Huethig and WepfVerlag,Basel
2. Polymer Synthesis Theory and Practice D. Braun, H. Cherdrown and H.Ritter Springer,Heidelberg (2001) ISBN 3-540–41697-8
3. Principles of Polymer Chemistry, 2Nd Ed. A Ravve Kluwer Academic Publisher (2000) ISBN 0-306-48368-7
4. Organic Chemistry of Synthetic High Polymers R.W. Lenz Interscience Publishers, New York (1967)
5. Principles of Polymer Chemistry, P. J.Flory.
6. Principles of Polymerization, G. Odian, John Wiley & Sons (1981).
7. Polymer Chemistry, B.Vollmert, Springer Verlag (1973) 22. StructureProperty Relationship in Polymers, R. B. Seymour and C. E. CarraherJr.
8. Fundamental Principles of Polymeric Materials, S. L.Rosen.
9. Principles of Polymer Engineering, N. G. Mecrum, C. P. Buckley, C. B.Bucknall.
10. Introduction to Physical Polymer Science, L. H.Sperling.
11. Polymer Processing Fundamentals, T. A.Osswald.
12. Commercial Polymer Blends, L. A.Utracki.
13. Polymer Chemistry, M. G. Arora & M. Singh, (AmolPublPvt.Ltd. New Delhi- 110002)

Semester - IV

Course Type : MMC -X
Course Title : Organic Synthesis- II
Course Code : 602CHE4101
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1 To learn how to design a new route for synthesis of various reactions.
LO2 To understand Retro- synthesis of aromatic heterocyclic 5 and 6 memberedrings.
LO 3 To familiarize with protection and deprotection of functional groups.
LO4 Know about the role of various reagents in synthetic methods.

Course Outcomes:
After completion of course the student will be able to-
CO1 Design a new route for synthesis of various reactions.
CO2 Use Retro- synthetic methods in synthesis of aromatic 5 and 6 membered heterocyclic compounds.
CO3 Familiarize with protection and deprotection of functionalgroups.
CO4 Apply the role of LDA, DCC, DDQ, trimethylsilyl iodide etc. reagents in organic synthesis.
CO5 Gain the concepts of magnetic nature of different substance.

Unit No.	Title of Unit & Contents	Hrs.
I	**Disconnection approach:**	**12**
	An introduction to Synthons and synthetic equivalents, disconnection approach, functional group inter conversions. One group C-X and two group disconnections in 1,2,1,3 -,1,4-& 1,5- di functional compounds , Retro- synthesis of Alkene ,acetylenes and aliphatic nitro Alcohols and carbonyl compounds, amines , the importance of the order of events in organic synthesis, chemoselectivity, regioselectivity. Diels Alder reaction, Michael addition and Robinson annulation. Retro- synthesis of aromatic Heterocycles and 5 and 6 membered carbocyclic and heterocyclic rings. Reversal of polarity (Umpolung).	
	Unit Outcomes: UO1 Define the basic term like synthon and synthetic equivalents. UO2 Explain Umpolung effect.	
II	**Protection and Deprotection of Groups:**	**11**
	1 Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl 2 Application of the following in synthesis Merrifield resin, polymeric reagents. Solid phase synthesis of polypeptide &oligonucleotides, electro organic synthesis, enzyme catalyzed reaction in synthesis & resolution of racemic mixtures.	
	Unit Outcome: UO1 Explian the protection and deprotection of functional groups. UO2 Define solid phase synthesis.	
III	**Reagents & Reactions in Synthesis:**	**11**

Unit No.	Title of Unit & Contents	Hrs.
	Complex metal hydrides, lithium dialkylcuprate, lithium diisopropylamide (LDA) Dicyclohexylcarbodiimide (DCC), Trimethylsilyl iodide, tributyltin hydride, peracids, lead tetra acetate, PPA, Diazomethane , ozone phase transfer catalyst, Barton and Shapiro, Hoffmann – Loffler- Freytag , Peterson synthesis , selenium dioxide, crown ethers, DDQ, Dess-Martin periodinane, Fetizons reagent, Lambardo reagent, Tebbe reagent, AIBN, 9-BBN.	
	Unit Outcomes: UO1 Analyse the reactivity of different reagents. UO2 Explain the selectivity of reagents.	
IV	**Transition Metal Complexes in Organic Synthesis:**	**11**
	1. Applications of following Transition Metals in Organic Synthesis Fe, Mn, Ni, Cr, Ti, Pd. 2. Application of following metal complexes in organic synthesis Co, Hg, Zn, Rh, Tl and Si.	
	Unit Outcomes: UO1 Discuss the application of Transition Metals in organic synthesis. UO2 Explain the application of following metal complexes in organic synthesis Pd, Hg, Rh, Tl and Si.	

Learning Resources:

1. S.Warren: Designing of Organic Synthesis
2. J. Fuhrhop& G. Penzlin. : Organic synthesis (2nd ed.)
3. Carruthres: Some modern methods of organicsynthesis.
4. H.O.House: Modern syntheticreaction.
5. Fieser&Fieser : Reagent in organicsynthesis
6. R.O.C.Norman: Principle of organicsynthesis
7. Carey &Sundharg: Advanced organicChemistry
8. P.E. Realand: Organicsynthesis
9. Bartan and Ollis : Comprehensive organicChemistry
10. R. Admas: Organicreactions
11. Stone & West: Advances in Organometallic Chemistry
12. C.W. Bird: Transition metal intermediate in organic synthesis
13. Swan & black: Organometallic in organic synthesis.
14. A. Mitra: Synthesis of prostaglandins
15. John Apsimon: Total synthesis of natural products
16. M. K. Mathur, C. K. Narang& R.E. Williams: Polymers as aid in organic synthesis
17. P. Hodge & D.C. Sherrington: Polymer supported reaction in organic synthesis.
18. C.J.Gray: Enzyme Catalysed reactions
19. T.W. Green & P.G.M. Wats : Protecting groups in organic Chemistry
20. T.Shona: Electroorganic Chemistry
21. Weber &Gokel : phase transfer catalyst in organic synthesis.

Course Type : Lab. Course XIII
Course Title : Lab. Course (Based on MMC-X)
Course Code : 602CHE4104
Credits : 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1 To perform the semi-micro qualitative analysis of ternary mixtures containing single/poly functional compounds by Chemical and Physical Method.

LO2 To check the purity of compounds by performing TLC method.

Course Outcomes:

After completion of course the student will be able to-

CO1 Perform semi-micro qualitative analysis of ternary mixtures.

CO2 Check purity of compounds by TLC.

I	Practicals	30 Hours
	Qualitative Analysis (At least 05 Organic Mixtures): Semi-micro Qualitative Analysis of Ternary Mixtures (One Solid and Two Liquids) containing single/poly functional compounds by Chemical and Physical Method with Chromatographic Separation (TLC) for purity of all three components and its Expected Theoretical Spectral Data (IR, 1H NMR &13C NMR).	

Course Type : MMC XI
Course Title : Stereochemistry
Course Code : 602CHE4102
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1 To understand the basic concept of stereochemistry, sterio chemical principles.
LO2 To familiarize with newer methods of sterioselective synthesis.
LO3 To know about conformational analysis and stereochemistry of ring systems.
LO4 To learn about stereochemistry of fused and bridged rings

Course Outcomes:

After completion of course the student will be able to-

CO1 Define the basic concept of stereochemistry like chirality, sterio chemical principles like enantiometric and distereomeric relationship, D & L, R & S and E & Z nomenclature.
CO2 Elaborate the newer methods of sterioselective synthesis like Regioselective,, Chemoselective, Stereospecific & stereoselective reactions etc.
CO3 Determine the stability & reactivity of cyclohexane, monosubstituted and disubstituted cyclohexanes.
CO4 Predict the stability & reactivity of fused, bridged rings & discuss O.R.D. and C.D Spectra.

Unit No.	Title of Unit & Contents	Hrs.
I	**Basic concepts in Stereochemistry:**	**12**
	Introduction: definition-Stereoisomerism 1. Molecular symmetry and concept of Chirality. Simple or proper axis of symmetry, plane of symmetry, centre of symmetry, improper or alternating or rotation reflection axis of symmetry. 2. Stereo chemical principles: enantiometric relationship, distereomeric Recemic Modification and Resolution. Prochiral relationship.	
	Unit Outcomes: UO1 Explain types of symmetries. UO2 Assign D/L, R/S & E/Z system of configuration.	
II	**Newer methods of stereoselectivesynthesis:**	**12**
	Regioselective and Chemoselective reactions, Stereospecific and stereoselective reactions, Enantioselective synthesis (chiral approach) reactions with hydride donors, Bromination, hydroboration, catalytic hydrogenation via chiral hydrazones and oxazolines. Sharpless epoxidation. Diels Alder selective synthesis, use of calculations of optical purity and enantiomeric excess, Introduction of optical activity in absence of chiral carbon (biphenyls, spiranes and allenes) assignment of configuration, Configuration of distereomers based on physical and chemical methods. Dynamic Stereochemistry	
	Unit Outcome: UO1 Identify Regioselective and Chemoselective reactions. UO2 Calculate the optical purity&specific rotation of optically active compound.	
III	**Conformational analysis:**	**11**
	1. Conformational analysis of cyclohexane, mono substituted and disubstituted cyclohexane 2. Some aspects of the stereochemistry of ring systems: Stereoisomerism and determination of configuration Stability of rings and ease of	

Unit No.	Title of Unit & Contents	Hrs.
	ringsformation) 3. The shapes of the rings other than six membered: Shapes of five and sevenmembered rings. Conformational effects in medium sized rings, Concept of I strain.	
	Unit Outcomes: UO1 Define Conformational Analysis &Determine Stability. UO2 Explain the Concept of I strain & feasibility of reaction.	
IV	**Stereochemistry of Fused and Bridged Rings:**	**10**
	1. Fused and bridged rings: Fused bicyclic ring systems :Cis and trans decalins and perhydrophenanthrene. Bridged rings, Nomenclature stereoichemical restrictions, and The Bredt's rule,Reactivities. 2. O.R.D. and C.D.: Types of curves, the axial haloketone rule. The Octant rule. Determination of conformation andconfiguration.	
	Unit Outcomes: UO1 Predict the stability & reactivity of fused, bridged rings. UO2 Discuss O.R.D. and C.D Spectra.	

Learning Resources:

1. E.L. Eliel : Stereochemistry of carboncompounds
2. D. Nasipuri : Stereochemistry of organiccompounds
3. P.S. Kalsi: Stereochemistry: conformation andMechanism.
4. Eliel, Allinger, Angyal and Morrison : Conformationalanalysis
5. Hallas: Organicstereochemistry
6. Mislow and Benjamin: Introduction tostereochemistry.
7. H. Kagan : Organicstereochemistry.
8. Carl Djerassi ; Optical rotatorydispersion.
9. P. Crabbe : Optical rotatory dispersion andC.D.

Course Type : Lab. Course XIV
Course Title : Lab. Course (Based on MMC-XI)
Course Code : 602CHE4105
Credits : 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1 To develop the skill in the synthesis of different antibacterial, anticancer, anti- convulsant drugs.

LO2 To use ultrasound techniques in the synthesis of heterocyclic compounds.

Course Outcomes:
After completion of course the student will be able to-
CO1 Synthesize different drugs like antibacterial, anticancer, anti- convulsant etc.
CO2 Use ultrasound techniques in the synthesis of heterocyclic compounds.

I	Practicals	30 Hours
	Section-A: (Instrumental) 1. **Synthesis of Drug Molecules (At least Four)** a) Synthesis of anaesthetic drug Benzocaine. b) Synthesis of anticancer drug 6-methyluracil. c) Synthesis of antibacterial drug sulfanilamide. d) Synthesis of anti-epileptic drug antypyrine. e) Synthesis of anti-convulsant drug Phenytoin. f) Hantzch dihydropyridine synthesis from aldehydes, ethyl aceto acetate and urea. g) Synthesis of coumarin by Knoevenagel synthesis using salicyladehyde, ethyl acetate in presence of base h) Synthesis of Dihydropyrimidones from Biginelli Reaction by acid-catalyzed, three component reaction between an aldehydes, ß-ketoester and urea.	

Note:

1. Synthesis is carried out in molar quantities (Less than 5gm).
2. Reaction with possible mechanism.
3. Calculate Theoretical and practical %yield.
4. Product conformation by Physical constant and TLC.
5. Give expected spectral data (IR and NMR) of starting material, intermediate and final product.
6. All the prepared organic compounds should be stored as a sample and present at the time of University examination.

Course Type : MMC XII
Course Title : Advanced Heterocyclic Chemistry
Course Code : 602CHE4103
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:
LO1 To outline the role of heterocycles,their spectral characteristics ,reactivity.
LO2 To understands the synthesis and aromatic character ofheterocycles.
LO3 To knows the synthesis of IndoleQuinoline, Isoquinoline, Benzothiapene etc.

Course Outcomes:
After completion of course the student will be able to:
CO1 Describe the role of heterocycles,their spectral characteristics , reactivity.
CO2 Write the synthesis of Azirines, Oxaranes, Thiiranes, Diazirenes , Pyrazole, Imidazole, Oxazole etc.
CO3 Discuss the synthesis ,reactivity and aromaticity of Triazoles, Oxadiazoles, Thiadiazoles,Triazines, tetrazole, furazan.
CO4 Elaborate the synthesis and reactivity of Indole Quinoline, Isoquinoline, Benzothiapene etc.

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Heterocycles and Small (3 and 4) membered Heterocycles :**	**11**
	Nomenclature (HantzschWidman System), spectral characteristics, reactivity and aromaticity of monocyclic, fused and bridged heterocycles, Different types of strains, interactions and conformational aspects on nonaromatic heterocycles. Synthesis, reactivity and importance of the following ring systems, Azirines, Oxiranes, Thiiranes, Diazirines, Diaziridines, Azetidines.	
	Unit Outcomes: UO1 Discuss the role of heterocycles,their spectral characteristics &reactivity. UO2 Explain the synthesis and reactivity of Azirines, Oxiranes, Thiiranes, Diazirenes etc.	
II	**Five and six-membered heterocycles with two heteroatoms:**	**11**
	Synthesis, reactivity, aromatic character and importance of the following heterocycles: Pyrazole, Imidazole, Oxazole, Thiazole, Pyrimidine, Pyrazine, Oxazine, and Thiazine.	
	Unit Outcome: UO1 Explain the synthesis and reactivity of Pyrazole, Imidazole, Oxazole etc. UO2 Determine aromatic character of following heterocycles: Pyrazole, Imidazole, Oxazole, Thiazole, Pyrimidine, Pyrazine, Oxazine.	
III	**Heterocycles with more than twoheteroatoms:**	**12**
	Synthesis, reactivity, aromatic character and importance of the following heterocycles: Triazoles, Oxadiazoles, Thiadiazoles, Triazines, tetrazole, furazan.	
	Unit Outcomes: UO1 Explain the synthesis and reactivity of Triazoles, Oxadiazoles, Thiadiazoles,Triazines, tetrazole, furazan. UO2 Determine aromatic character of following heterocycles: Triazoles,	

Unit No.	Title of Unit & Contents	Hrs.
	Oxadiazoles, Thiadiazoles,Triazines, tetrazole, furazan.	
IV	**Larger ring andBenzofusedheterocycles:**	**11**
	Synthesis and reactivity of Indole Quinoline, Isoquinoline, Benzothiapene, Benzofuran Azepines, Oxepines and Thiepines, Synthesis and rearrangement of Diazepines, Synthesis of Benzoazepines, Benzodiazepines, Benzooxepines, Benzothiepines, Azocines, and Azonines.	
	Unit Outcomes: UO1 Discuss the synthesis and reactivity of Indole Quinoline, Isoquinoline, Benzothiapene, Benzofuran Azepines, Oxepines. UO2 Explain Synthesis and rearrangement of Diazepines, Synthesis of Benzoazepines, Benzodiazepines, Benzooxepines, Benzothiepines, Azocines, and Azonines.	

Learning Resources:

1. Heterocyclic Chemistry, T. L. Gilchrist.
2. An Introduction to the Chemistry of Heterocyclic compounds, R. M. Acheson.
3. Heterocylic chemistry, J. A. Joule & K. Mills.
4. Principals of Modern Heterocyclic Chemistry, A. Paquette.
5. Heterocyclic Chemistry, J. A. Joule &Smith.
6. Handbook of Heterocyclic Chemistry, A. R. Katritzky.
7. Heterocyclic Chemistry R. K. Bansal.

Course Type : Lab Course XV
Course Title : Lab Course (Based on MMC-XII)
Course Code : 602CHE4106
Credits : 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives

LO1 To develop the skill in the isolation and purification of natural products like beta carotene, piperine, licopene.

LO2 To estimate the amount of drug sample by instrumental methods.

Course outcomes

After completion of course the student will be able to

CO1 Develop the skill in the isolation and purification of natural products like beta carotene, piperine and lycopene.

CO2 Perform assay of drugs.

Practical No.	Practical
1	**1 Isolation of natural products. (At least three)** a) Isolation of caffeine from tealeaves. b) Isolation of piperine from black pepper c) Isolation of β-carotene from carrots d) Isolation of lycopene from tomatoes e) Isolation of limonene from lemon peel f) Isolation of euginol from cloves **2 Estimation of Drugs by Instrumental Methods: (At least Two)** g) Assay of Riboflavin by UV-Vis Spectrophotometer. h) Estimation of carbohydrates, amino acids, proteins by UV-Vis spectrophotometer. i) Determination of Hammett constants and determine its substitution effect. **i) Benzoic acid, ii) p-Nitro Benzoic acid, iii) p-Methoxy Benzoic acid, iv) p Methyl benzoic acid, v) p-chloro benzoic acid.** (Out of two compounds one compound must be benzoic acid and another should be substituted benzoic acid is given to the students)

Note:

1. All required solutions must be prepared by the students.
2. In examination one experiment is on Instrumental and one should be on non instrumental.

References:

1. Modern Experimental organic chemistry by Royston M. Robert, John C. Gilbert, Lyuu B. Rodewald & Allan S. Wingrove, Saunder International Edition
2. Advanced practical organic chemistry by N. K. Vishnoi
3. Experimental organic chemistry by L. M. Harwood & C. I. Moody, Blackwell Scientific Publications.
4. The systematic identification of organic compounds by R. L. Shriner & D. Y. Curtin
5. Semi-micro qualitative organic analysis by N.D. Cheronis, J. B. Entrikin & E. M. Wodnett
6. Small scale organic preparation by P. J. Hill
7. Vogel's textbook of practical organic chemistry by ELBS, Longmann.

Course Type : MEC IV
Course Title : Applied Organic chemistry
Course Code : 602CHE4201
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1 Introduction of supra molecular chemistry
LO2 To know in detail about structural features of carbohydrate and vitamins
LO3 To learn about green synthetic routes of reactions

Course Outcomes:
After completion of course the student will be able to:
CO1 Learn about supra molecular chemistry and structures of supra molecules like nucleic acid, crown ether, cyclophanes, calixarenes
CO2 Describe in detail about structural features of carbohydrate & vitamins
CO3 Familiarize with role of green reagents in organic synthesis
CO4 Elaborate about green synthetic routes of reactions.

Unit No.	Title of Unit & Contents	Hrs.
I	**Supramolecular Chemistry**	**10**
	i) Principles of molecular associations and organizations a exemplified in biological macromolecules like nucleic acids, proteins and enzymes. ii) Synthetic molecular receptors: receptors with molecular cleft, molecular tweezers, receptors with multiple hydrogen sites. iii) Structures and properties of crown ethers, cyclophanes, calixarenes, Synthesis of crown ethers, cryptands and calixarenes.	
	Unit Outcomes: UO1 Explain the concept of supramolecular Chemistry. UO2 Describe the structure and Synthesis of Crown ether, Calixarenes and Cryptands.	
II	**Carbohydrates and Vitamins**	**15**
	1. **Carbohydrates** Introduction to naturally occurring sugars: Deoxysugars, amaminosugars, branched sugars, structure elucidation of lactose, D-glucosamine and mesoinositol (synthesis not expected), Structural features and applications of inositol, starch, cellulose, and heparin. 2. **Vitamins** Classification, sources, biological functions, deficiency diseases and synthesis of A, B1, B2, B6, and E.	
	Unit Outcomes: UO1 Elaborate structure and Synthesis of Carbohydrates. UO2 Describe Various types of Vitamins.	
III	**Green Chemistry**-I:	**10**
	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:	

Unit No.	Title of Unit & Contents	Hrs.
	1. Green reagents: dimethyl carbonate. 2. Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts, phase transfer catalysts [benzyltrimethyl ammonium chloride (TMBA), Tetra-n-butyl ammonium chloride. 3. Green solvents: water, ionic liquids, deep eutectic solvents, supercritical carbon dioxide.	
	Unit Outcomes: UO1 Describe the Basic 12 Principles of Green Chemistry. UO2 Explain the role of Green Reagents and Green Solvents in Organic Synthesis.	
IV	**Green Chemistry-II**	**10**
	1. Solid phase peptide synthesis. 2. Microwave assisted synthesis: reactions in water, reactions in organic solvents, solvent free reactions 3. Ultrasound assisted reactions. 4. Multi-component reaction	
	Unit Outcomes: UO1 Describe Solvent free Synthesis using Microwave. UO2 Explain Solid phase peptide synthesis.	

Learning Resources:

1. Bioorganic, Bioinorganic and Supramolecular chemistry, P.S. Kalsi and J. P.Kalsi. New Age International Publishers
2. Supramolecular Chemistry; Concepts and Perspectives, J. M. Lehn, VCH.
3. Crown ethers and analogous compounds, M. Hiraoka, Elsevier,1992.
4. Large ring compounds, J. A. Semlyen, Wiley-VCH,1997
5. Enzyme catalysis in organic synthesis, 3rd edition. Edited by Karlheinz Drauz,
6. Biochemistry, Dr U Satyanarayan and Dr U Chakrapani, Books and Allied (P)Ltd.
7. The Organic Chemistry of Enzyme-Catalysed Reactions, Academic Press, By Richard B. Silverman
8. Enzymes: Practical Introduction to structure, mechanism and data analysis, By Robert A. Copeland, Wiley-VCH, Inc.
9. The Organic Chemistry of Biological Pathways By John McMurry, Tadhg Begley by Robert and company publishers.
10. Biochemistry By Lehninger
11. Bioorganic Chemistry- A practical approach to Enzyme action, H. Dugas and C. Penny. Springer Verlag,1931
12. Biochemistry: The chemical reactions in living cells, By E. Metzler. Academic Press.
13. Principals of biochemistry by Horton.
14. Green Chemistry: An Introductory Text,2ndEdition, Published by Royal Society of Chemistry, Authored by Mike Lancater
15. Green chemistry, Theory and Practical, Paul T. Anastas and John C. Warner.
16. New trends in green chemistry By V. K. Ahulwalia and M. Kidwai, 2ndedition, Anamaya Publishers, New Delhi.
17. An introduction to green chemistry, V.Kumar, Vishal Publishing Co.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Chemistry

Course Type : MEC IV
Course Title : Dyes and Intermediates
Course Code : 602CHE4201
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1 To understand the concepts of Commercial processes for Azo dyes, reactive dyes.
LO2 To know about Diazotization, mechanism and different methods of diazotization, Evaluation of dyes.
LO3 To familiarize with Fluorescent Whitening Agents, Types of Fibres And Basic Operations In Dyeing Process.

Course Outcomes:

On completion of this course, the student will be able to:

CO1 Concepts of Commercial processes for Azo dyes, reactive dyes, thermal sensitive dyes, dispensesdyes.
CO2 Synthesis of Monoazo dyes, Bisazo dyes and Azoic dyes. Evaluation ofdyes
CO3 Theory of fluorescence–Classification of FWA, Various methods of dyeing, Different classes of organic pigments andsynthesis.

Unit No.	Title of Unit & Contents	Hrs.
I	**Dyes and Intermediates**	**10**
	Synthesis of important dye intermediates. Commercial processes for Azo dyes, reactive dyes, optical brighteners, thermal sensitive dyes, dispenses dyes.	
	Unit Outcomes: UO1 Define Dyes and intermediates. UO2 Describe Different Types of Dyes.	
II	**AZODYES**	**15**
	General Introduction: Diazotization, mechanism and different methods of diazotization and laws of coupling, General introduction, classification and synthesis of Monoazo dyes, Bisazo dyes and Azoic dyes. Evaluation of dyes. Synthesis of the following: Disperse Red 13, Acid Blue 92, Mordant Black 11, Acid Black 1, Acid Blue 113, Direct Blue 15, Direct Violet 1, Direct Red 28, Naphthol AS-BR, Fast Orange GGD.	
	Unit Outcomes: UO1 Discuss Different Methods of Diazotiazation. UO2 Describe Snthesis of Different Dyes.	
III	**Fluorescence Whitening Agents & Fibers**	**10**
	1. Fluorescent Whitening Agents Introduction, Theory of fluorescence–Classification of FWA and synthesis of important member of each class and their uses.	

Unit No.	Title of Unit & Contents	Hrs.
	2. Types of Fibres And Basic Operations In Dyeing Process Types of fibres: Natural, semisynthetic and synthetic, Dyeing and Interactions: Ionic Interactions, Hydrogen bond, Van der Waal's Interactions and Covalent Interactions. Basic Operations in Dyeing Process: Preparation of the fibres, Preparation of the dyebath, application of the dyebath and finishings, Various methods of dyeing: Direct dyeing, Vat dyeing, Mordant dyeing, Disperse dyeing and Formation of dye on the fibre, Dyeing of wool with the acid dyes, Dyeing with the reactive dyes, Fastness properties: Colour fastness, Light fastness, Sublimation fastness and Burnt gas fumes fastness.	
	Unit Outcomes: UO1 Describe fluorescent whitening agents. UO2 Types of fibres and dyeing process.	
IV	**Heterocyclic Dyes & Pigments**	**10**
	1. Heterocyclic Dyes Pyrazolone dyes, cyanine dyes, dyes containing azine, oxazine and thiazine ring systems. Thiazole dyes. 2. Pigments Different classes of organic pigments and synthesis. Synthesis of only the following: Basic Yellow 11, Basic Orange 21, Safranine B, Rosinduline GG, Sirius Supra Blue FFRL, Brilliant Alizarin Blue 3R, Sirius Supra Yellow RT, Acid Yellow 19, Copper Phthalocyanine, Sirius Supra Light Green FFGL.	
	Unit Outcomes: UO1 Describe Properties of heterocyclic Dyes. UO2 Explain Classes of organic pigments and synthesis.	

Learning Resources:

1. The chemistry of synthetic Dyes, Vol. I to VII by Venkataraman, Academic Press,New York.
2. Chemistry of Synthetic Dyes & Pigments by Lubs.
3. Dyes and their intermediates by E. N. Abrahart.
4. Handbook of synthetic dyes and pigments, Vol. I & II by K. M.Shah.
5. Industrial Dyes by Klans Hunger, Germany byWiley-VCH.
6. DevelopmentintheChemistryandtechnologyofOrganicDyesbyJ.Griffiths,Blackwell Sci. Pub., Oxford, London.
7. Principles of colour Technology by Fred W. Billmeyer and Max Saltzman, John Wiley & Sons.

Course Type : Lab. Course- XVI
Course Title : Lab. Course (Based on MEC-IV)
Course Code : 602CHE3203
Credits : 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1 Learn green approach for the Organic synthesis.
LO2 Synthesis of aspirin ,coumarin, Hydrazone ,dihydropyrimidone by green material.
LO3 Famalarization with ultrasound techniques, microwave synthesizer in the synthesis of Organic compounds.

Course Outcomes:

After completion of course the student will be able to-

CO1 Learned green approach for the Organic synthesis.
CO2 Synthesize aspirin coumarin, Hydrazone ,dihydropyrimidone by green material.
CO2 Operate Ultrasound techniques, microwave synthesizer in the Organic synthesis .

I	Practicals	30 Hours
	1 Hantzch dihydropyridine synthesis from aldehydes, ethyl aceto acetate and urea. 2 Synthesis of coumarin by Knoevenagel reaction using salicyladehyde, ethyl acetate in presence of base . 3 Synthesis of Dihydropyrimidones from Biginelli Reaction by acid-catalyzed, three component reaction between an aldehydes, ß-ketoester and urea. 4 Efficient Grignard Reaction under sealed vessel conditions . 5 Rapid three step synthesis of a channel blocker analogue . 6 Sugar identification of osazone formation . 7 Knoevenagel reaction by microwave synthesis. 8 Direct ethylation of benzylic amines with insitu formed ethylene. 9 Ash catalytic synthesis of hydrazone. 10 Ionic Liquids as Green Solvents: Performing Diels-Alder reactions using ionic liquids as solvents 11 Microwave-Assisted Organic Synthesis: Synthesis of aspirin using microwave irradiation 12 Green Reductions: Reducing ketones to alcohols using sodium borohydride in aqueous ethanol	

Note:

1. Synthesis is carried out in molar quantities (Less than 5gm).
2. Reaction with possible mechanism.
3. Calculate Theoretical and practical %yield.
4. Product conformation by Physical constant and TLC.
5. Give expected spectral data (IR and NMR) of starting material, intermediate and final product.
6. All the prepared organic compounds should be stored as a sample and present at the time of University examination.