॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

Established on 17th September, 1994. Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा–या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४–२५ पासून राष्ट्रीय शैक्षणिक धोरणानुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदव्यूत्तर द्वितीय वर्षाच्या अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या बैठकीतील विषय क्रमांक १५/५९–२०२४ च्या ठरावाअन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील एम. एस्सी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

1) M. Sc. II year - Analytical Chemistry (Affiliated College)
2) M. Sc. II year - Biochemistry (Affiliated College)
3) M. Sc. II year - Organic Chemistry (Affiliated College)
4) M. Sc. II year - Physical Chemistry (Affiliated College)
5) M. Sc. II year - Inorganic Chemistry (Affiliated College)
6) M. Sc. II year - Analytical Chemistry (Campus)
7) M. Sc. II year - Industrial Chemistry (Campus)
8) M. Sc. II year - Medicinal Chemistry (Campus)
9) M. Sc. II year - Organic Chemistry (Campus)
10) M. Sc. II year - Physical Chemistry (Campus)
11) M. Sc. II year - Polymer Chemistry (Campus)
12) M. Sc. II year - Computer Management (Affiliated College)
13) M. Sc. II year - Computer Sciene (Affiliated College)
14) M. Sc. II year - Software Engineering (Affiliated College)
15) M. Sc. II year - System Administration & Networking (Affiliated College)
16) M. Sc. II year - Computer Application (Campus)
17) M. Sc. II year - Computer Network (Campus)
18) M. Sc. II year - Computer Science (Campus)
19) M. Sc. II year - Zoology (Campus)
20) M. Sc. II year - Zoology (Affiliated College)
21) M. Sc. II year - Physics (Campus)
22) M. Sc. II year – Physics (Affiliated College)

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२४–२५/993
दिनांक १३.०६.२०२४

डॉ. सरिता लोसरवार
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : १) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAMANAND TEERTH
MARATHWADA UNIVERSITY, NANDED - 431 606

Two Years Post Graduate Degree Program in Chemistry

(Faculty of Science and Technology)

Revised Syllabi as per NEP-2020 for

M.Sc. Second Year

CHEMISTRY

(For Affiliated Colleges)

To be implemented from
Academic year 2024 - 2025

Framed by
BOARD OF STUDIES IN CHEMISTRY

Syllabus for M. Sc. Chemistry, Second Year

Semester – III

As Per NEP- 2020

To be implemented from

Academic Year 2024-2025

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SCHECT1501

Title of the Course: Advanced Spectroscopic Methods

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- Students are acquainted with various spectroscopic techniques to elucidate the known and unknown organic molecules.
- Students are familiar with the ultra-violet and visible spectroscopy by determining the absorption maximum of various dienes, enones and aromatic organic compounds.
- Student develops the detail knowledge to get the different peaks of functional groups in organic molecules by infra-red spectroscopy.
- Students understand the importance and applications of proton magnetic resonance spectroscopy for determination of structure of unknown organic compounds.
- Students are recognizable with CMR to authenticate the position of carbon atom in organic molecules.
- Students identified the structure of compounds by fragmentation of various classes of organic molecules.

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**UV-VIS AND IR SPECTROSCOPY:**	**17**
	1.1	**UV-Vis Spectroscopy:** Fieser-Woodward rules for conjugated dienes and carbonyl compounds, Fieser-Kuhn rules for polyenes. UV spectra of aromatic compounds and heteroaromatic compounds. Calculation of max for the benzene derivatives (R-C6H4-Co-G) by A. I. Scott empirical rules.	
	1.2	**IR spectroscopy:** Recapitulation, Characteristic vibration 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, Anhydride, Lactose, Lactams and Conjugated Carbonyl compounds. Factors affecting group frequencies: overtones, combination bands and Fermi-resonance. FITR and sampling techniques.	
2.0		**Module 2: ^{1}H NMR AND ^{13}C NMR SPECTROSCOPY:**	
	2.1	General introduction and definitions, Chemical shift, Spin-spin interaction, Shielding mechanism of measurement of chemical shift	

		values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehyde and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto). Factors affecting chemical shift. Deuterium exchange. Spin-spin coupling, factors affecting coupling constant. Complex spin-spin interaction between two and three nuclei. Simplification of complex spectra, nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique. Nuclear Over-Hauser effect (NOE). Resonance of other nuclei; ^{19}Fand ^{31}P.	**18**
	2.2	**^{13}C NMR Spectroscopy:** Resolution and multiplicity of ^{13}C NMR, ^{1}H-decoupling, noise decoupling, broad band decoupling; Deuterium, fluorine and phosphorus coupling; NOE signal enhancement, off-resonance, proton decoupling, Structural applications of CMR.	
3.0		**MASS SPECTROMETRY**	**10**
	3.1	**Mass Spectrometry:** Theory, instrumentation and modifications; Unit mass and molecular ions; Important terms- singly and doubly charged ions, metastable peak, base peak, isotropic mass peaks, relative intensity, FTMS, etc. Recognition of M+ ion peak.	
	3.2	General fragmentation rules: Fragmentation of various classes of organic molecules, including compounds containing oxygen, sulfur, nitrogen and halogens; α, β-, allylic and benzylic cleavage, McLafferty rearrangement.	
4.0		**Module 4: Structural Problems:**	**15**
	4.1	Combined problems on UV, IR, NMR and Mass spectral data for structure determination.	
	4.2	Elucidation of structure of organic molecules using spectra (IR, PMR&CMR).	
		Total	**60**

Course outcomes:

1. Know the use electronic spectroscopy to determine absorption maximum in dienes, enones and aromatic compounds.
2. Know the applications of IR spectroscopy for functional group determination.
3. Learn the structure elucidation of organic compounds by PMR spectroscopy.
4. Gathering basic knowledge to know the position of carbon in carbon compounds.
5. Recognize the molecular mass of the organic molecule by fragmentation pattern.
6. Know the complete structure of compounds using UV, IR, PMR, CMR and Mass spectroscopic methods.

Reference Books:

1. Spectroscopic Identification of Organic Compounds, R. M. Silverstern, G. C.Bassler and T. C. Morril.
2. Introduction to NMR spectroscopy, R. J. Abraham, J. Fisher and P. Loftus.
3. Application of spectroscopy of organic compounds, J. R. Dyer.
4. Spectroscopy of organic compounds, P. S. Kalsi.
5. Organic Spectroscopy, William Kamp.
6. Organic Chemistry, R. T. Morrison and R. N. Boyd.
7. Practical NMR spectroscopy, M. L. Martin, J. J. Delpench and G. J. Martin.
8. Spectroscopic methods in organic Chemistry, D. H. William, I. Fleming.
9. Fundamentals of Molecular spectroscopy, C.N.Banwel.
10. A Handbook of Spectroscopic Data of Chemistry, B. D. Mistry.
11. Elementary Organic Spectroscopy, Y. R. Sharma.

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SCHECT1502

Title of the Course: Organic Synthesis-I

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- Highlight the mechanisms, conditions, and applications of various rearrangement reactions.
- To cover important name reactions including coupling reactions, C=C bond forming reactions etc and to provide details about the reaction conditions, mechanisms, and synthetic applications.
- Discuss common reagents used in organic synthesis such as strong acids, bases, reducing agents, and oxidizing agents and to explain the selectivity and reactivity of these reagents in various organic transformations.

Curriculum Details: SCHECT1502: Organic Synthesis-I

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**TRANSFORMATIONS AND REARRANGEMENTS:**	**16**
	1.1	General Mechanistic Consideration, Nature of migration, migratory aptitude, stereochemical aspects and Memory Effects of following rearrangements.	
	1.2	Introduction types and classification of rearrangements.	
	1.3	Rearrangement to Electron Deficient Carbon: Pinacol-pinacolone, Seminacol, Wagner-Meerwein, Benzillic acid, Wolf (Arndt–Eistert's Synthesis), Rupe and Demjanov, Dienone–phenol and Pummerer rearrangement.	
	1.4	Rearrangement to Electron Rich Carbon: Favorskii, Wittig, Neber and Steven's rearrangements.	
	1.5	Rearrangement to Electron Deficient Nitrogen: Hoffman, Curtius, Schimdt, Lossen and Beckmann rearrangements, Eschenmoser fragmentation.	
	1.6	Rearrangement to Electron Deficient and Electron Rich Oxygen: Baeyer-Villiger rearrangement, Brook Rearrangement, Payne rearrangement.	
2.0		**SELECTIVE ORGANIC REACTIONS**	**16**
	2.1	C=C forming reactions: Horner-Wordworth-Emmons, Shapiro, Bamford-Stevens, McMurry, Julia-Lythgoe, Peterson olefination, Henry, Corey-Winter olefination reactions, Chugaev Elimination, Corey-Fuchs Reaction.	

	2.2	Transition metal catalysed reactions: Negishi, Suzuki, Buchwald-Hartwig Cross coupling, Stille, Kumada, Heck, Chan-Lam coupling reactions, Ullmann reaction and Ring Closing Metathesis (RCM) (Grubb's metathesis).	
	2.3	Formylation Reactions**:** Reimer-Tiemann, Vilsmeier–Haack reaction, Duff reaction, Etard's Reaction	
	2.4	Epoxide Forming Reactions: Corey-Chaykovsky, Darzen.	
	2.5	Multi-component Reactions: Ugi, Passerini, Biginelli and Mannich reaction.	
	2.6	Other Important Reactions: Simmon-Smith reaction, Balis-Hillman reaction, Mitsunobu reaction **(Self learning)***	
3.0		**Module-III: Oxidation**	
	3.1	Alcohols to carbonyl compounds: Chromium (VI) oxidants, Dimethyl sulfoxide and its modifications (Swern Oxidation), Mangnese (IV) oxide, Silver carbonate, Hypervalent iodine (III) and (V) reagents Dess-Martin Periodinate (DMP). Cerric Ammonium Nitrate (CAN).	**14**
	3.2	Alkenes to diols: Oxidation by potassium permanganate, Osmium tetraoxide and its streochemical consideration, Prevost oxidation and Woodward modifications.	
	3.3	Oxidative cleavage of 1,2-diols: Periodic acid. Lead Tetra acetate	
	3.4	Oxidation of allylic and benzylic C-H bonds**:** NBS, DDQ, Chloranil, SeO_2.	
4.0		**Module-IV: Reduction and Reagents**	
	4.1	Metal hydride reductions: Sodium borohydride, Sodium cyanoborohydride, Sodium triacetoxy borohydride (STAB), $LiAlH_4$, BH_3, Red-Alumina	**14**
	4.2	Hydrogenolysis: Use of tri-n-butyl tin hydride, Pd/C, BBr_3, HX.	
	4.3	Some Other Important Reduction Reactions Involving Metal and Non-Metal: Birch reduction, Clemmensen reduction, Wolff-Kishner and Diimide reductions.	
	4.4	**Reagents in Organic Synthesis:** Amide bond forming Reagents: N,N'-Dicyclohexylcarbodiimide (DCC), 1-Ethyl-3-(3-dimethylaminopropyl)carbodiimide (EDC.HCl), N,N'-Diisopropylcarbodiimide (DIC), Poly phosphoric acid (PPA). Methylating Agents: Diazomethane, Methyl Iodide, Dimethyl sulfate, Dimethyl carbonate. Some other Important Reagent: Alkyl Lithium, LDA, 1,3 Dithiane, Lawesson's reagent.	
		Total	**60**

Course outcomes:

1. To provide understanding, experimental condition and synthetic applications of rearrangements covering electron-deficient carbon, oxygen, nitrogen: Beckmann Rearrangement Converts oximes to amides. Curtius Rearrangement converts acyl azides to isocyanates. Schmidt Reaction Converts carboxylic acids to amine etc.
2. To cover all modern synthetic organic transformations using transition metal catalysis such as Palladium-catalyzed coupling reaction which include Heck, Suzuki, Negishi, Steele, Kumada, Chan lam. Also, to provide deeper understanding of formylation reaction and epoxide forming reactions with their mechanistic investigation.
3. To provide knowledge of traditional and modern oxidizing agents used for organic reactions which covers chemo selectivity and regio selectivity of oxidation of alcohol to carbonyl, alkene to diole, allylic and benzylic hydrocarbon to respective carbonyl product using suitable oxidizing agents.
4. Discuss reagents for conversion of carbonyl to alcohol with chemo selectivity such as $NaBH_4$, $LiBH_4$, STAB, LAH etc. Also, metal catalyzed homogeneous and heterogeneous reduction in presence and absence of metal has been considered.

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SCHECT1503

Title of the Course: Natural Products

[No. of Credits: 2 Credit] **30 Periods**

Course objectives:

Introduction to different natural products, and their

- To study the Biogenesis of Natural Products.
- To study the Structure elucidation and synthesis of Carotenoid, Terpenoids and steroids.
- Physiological effects of prostoglandins, pyretheroids

Curriculum Details: SCHECT1503: Natural Product

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**TERPENOIDS AND CAROTENOIDS:**	**08**
	1.1	Classification, nomenclature, Occurrence, isolation, isoprene rule	
	1.2	Structural determination, stereochemistry and biogenesis of the following molecules Citral, Camphor, Menthol, Farnesol, Zingiberene, Abietic acid. Biosynthesis of terpenoids.	
2.0		**STEROIDS:**	**08**
	2.1	Occurrence, Nomenclature, Basic Skeleton, Diel's hydrocarbon and Stereochemistry.	
	2.2	Structural determination and synthesis of Cholesterol, Bile acid, Androsterone, Testosterone, Oestrone, Aldosterone and Progesterone.	
3.0		**VITAMINS:**	**06**
	3.1	Classification, Occurrence Chemistry of Vitamins A, Vitamin C and Vitamin E. Deficiency syndromes etc.	
	3.2	Structure elucidation and synthesis of Vitamin-A	
4.0		**ALKALOIDS**	**08**
		Structural determination, stereochemistry and synthesis of quinine and morphine	
		Total	**30**

Course outcomes:

The students will understand the constitution of different natural products such as

1. Structure elucidation, degradation, applications, stereochemistry of Terpenoids, Steroids.
2. Synthetic methods for total synthesis of natural products.
3. Medicinal Application of different natural products.

Reference Books:

1. Natural products : Chemistry and Biological significance, J. Mann, R. S.

Davidson, J. B. Hobbs, D. V., Banthropde & J. B. Harborne.

2. Organic Chemistry, vol-2, I. L. Finar,ELBS.

3. Stereoselective synthesis: a practical Approach, M. Nogrudi.

4. Rodd's Chemistry of carbon compounds, Ed. S. Coffey.

5. Chemistry, Biological and Pharmacological properties of Medicinal plants from

the Americans, Ed. Kurt. Hostettmann, M. P. Gupta and A. Marston.

6. Introduction to Flavonoids, B. A. Bohm.

7. Neco trends in natural products Chemistry, Ata-ur-Rahaman and M. I. Choudhary.

8.Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J. B. Hobbs, D. V. Banthrope and J. B Harborne, Longman, Essex.

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - III)

Elective Theory Course

Course Code – SCHEET1501

Title of the Course: Medicinal Chemistry

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- Learn basic principles involved in drug discovery and designing process
- To know the role of medicinal chemist in development of medicinal agents
- Learn insight knowledge to analyze and perform SAR and QSAR
- Learn how to analyze and perform SAR of Antimicobacterial drugs, Antibiotics, Coagulants and Anticoagulants

Curriculum Details: SCHEET1501: Medicinal Chemistry

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**CONCEPTS OF MEDICINAL CHEMISTRY, CLASSIFICATION OF DRUGS**	**10**
	1.1	**Concepts of Medicinal Chemistry:** Important terminologies in Medicinal Chemistry: Drugs, Pharmacy, Pharmaceutics, Toxicology; Pharmacodynamic agents, Pharmacophore, Pharmacodynamics, metabolites and antimetabolites, Chemotherapy. Mechanism of chemotherapeutic actions: 1) Biological defences 2) Chemical defences. a) Surface active agent, b) Metabolic antagonism. Assay of Drugs: Chemical assay, Biological assay, Immunological assay.	
	1.2	**Classification of Drugs:** i) Classification of drugs on the basis of therapeutic action. a) Chemotherapeutic agents, b) Pharamacodynamic agents. iii) Differentiate medicine and drugs.	
2.0		**DRUG DESIGN**	**20**
	2.1	**Drug Discovery:** i) Introduction, Procedure followed in drug design. a) Drug discovery without a lead, b) Lead discovery, rational approaches to lead discovery iii) Lead modification: Drug design and development, a) Identification of the active part: The pharmacophore, b) Functional group modification, c) Structure-activity relationship, Qualitative versus quantitative approaches- advantages and disadvantages d) Structure modification to increase potency and the therapeutic index; 1) Homologation, 2) Chain branching, 3) Ring-chain transformation., 4) Bioisosterism, 5) Combinatorial chemistry.	

		iv) Structural modification to increase oral bioactivity. 1) Electronic effect, 2) The Hammet equation, 3) Lipophilicity effect.	
	2.2	**Concept of prodrugs and soft drugs:** a) Prodrugs: i) Prodrugs designing, types of prodrugs, ii) Prodrug formation of compounds containing various chemical groups, Prodrugs and drug delivery system b) Soft drugs: i) Soft drug concept ii) Properties of soft drugs	
	2.3	**Theories of drug activity:** Drug-receptor interactions, receptor theories and drug action, i) Occupancy theory, ii) Rate theory, iii) Induced theory; LD-50 and ED-50, Therapeutic index	
	2.4	**QSAR method:** Introduction, Methods used in QSAR studies, Hansch method, Free-Wilson method (Mathematical derivations of equations excluded), Advantages and disadvantages of free approach, Computer based methods of QSAR related to receptor binding, Physico-Chemical properties, Lipophilicity, Electronic parameters, Steric substituent constants, Experimental determination of partition coefficients.	
	2.5	**Molecular docking**: Rigid docking, flexible docking, manual docking; Advantages and disadvantages of flex-X, flex-S, Autodock and Dock softwares, with successful examples.	
	2.6	**Structure based drug design:** i) Process of structure based drug design, ii) Deactivation of certain drug, iii) Determination of the structure of the protein, iv) Design of inhibitors.	
	2.7	**Molecular modelling using computers** i) Introduction ii) Uses of molecular modelling: a) Manual use, b) Further-computer programming iii) Artificial Intelligence Methods in molecular modelling c) X-ray crystallography.	
	2.8	**Design of Enzyme inhibitors** i) Introduction, ii) Competitive inhibitors, iii) Active-site directed irreversible inhibition of enzymes, iv) Suicide enzyme inactivation. Drug action through enzyme inhibition. Theories of enzyme inhibition and inactivation, Enzyme activation of drugs and prodrugs.	
	2.9	**Nucleic acids:** Nucleic acids (NA) as targets for drug action, NA-interactive agents, Classes of drugs that interact with nucleic acids, Intercalation, NA-alkylation, NA-strand breaking and their importance in drug action.	
	2.91	New developments Gene therapy and drug resistance.	
	2.92	Informatics methods in drug design: Brief introduction to bioinformatics, cheminformatics, their relation to drug design as per the topics discussed above.	
3.0		**PHARMACOKINETICS AND PHARMACODYNAMICS**	
	3.1	**A] Pharmacokinetics:** a) Drug absorption, b) Distribution, c) Elimination d) Disposition; Chemistry of ADME and toxicity properties of drugs.Uses of pharmacokinetics in drug development process. **B] Pharmacodynamics** a) Introduction, Elementary treatment of enzyme inhibition, b) Membrane active drug, c) Sulphonamides	
	3.2	**Drug metabolism:** Introduction, Oxidation, Reduction, Hydrolysis, Conjugation, Significance of drug metabolism in Medicinal Chemistry	
	3.3	**Antimicobacterial drugs:** A] Antitubercular drugs: Introduction. Mechanism of action of anti-tuberculosis drugs, Targets for anti-	

		tuberculosis drug development, Mechanism of drug-resistance in tuberculosis a) First-line agents (Primary tubercular drugs): Structure and activity of streptomycin and dihydrostreptomycin, Synthesis and SAR of 4-amino salicylic acid and isoniazid. b) Second line agents (Secondary antitubercular agents): Structure and activity of Rifampicin, Cycloserine, Viomycin, Enthionamide, Ethambutol, Thioacetazone. (Synthesis of Cycloserine and Ethambutol expected.	**15**
	3.4	Antileprotic drugs Chaulmoogra and hydnocarpus oil, Multidrug therapy, SAR of sulphones, Dapsone (DDS), Acedapsone, Solapsone, Diaminodipheylthiourea, Rifampicin. (Synthesis of Acedapsone expected)	
4.0	**A**	**ANTIBIOTICS**	
	4.1	Introduction, classification of antibiotics, 2. Cell wall synthesis, 3. Mechanism of action of antibiotics, a) Inhibition of cell-wall synthesis, b) Inhibition of bacterial protein synthesis, c) Disorganization of the cytoplasmic membrane, d) Interference in the bacterial nucleic acid synthesis, e) Inhibition of the tetrahydro-folate biosynthesis I) Cell wall synthesis inhibitors (β-Lactam antibiotics): Synthesis of Penicillin-V, Penicillin-G, amoxicillin, ampicilin from 6-APA, cephalexin, Structure and activity of benzyl penicillin, semisynthetic penicillin, cephalosporin, Mode of action of penicillin and cephalosporin. II) Protein synthesis inhibitors: Structure activity of tetracycline and synthesis of chlortetracycline, Synthesis and SAR of chloramphenicol, Mode of action of chloroamphenicol.	**15**
	4.2	**Coagulants and Anticoagulants**: Mechanism of blood clotting, Coagulant, Vitamin-K, Vitamin-K analogues, anticoagulant, Action of anticoagulant, Heparin, Coumarin derivatives, Synthesis of 4-hydroxy coumarin, Dicoumarol, Structure and activity coumarin derivatives.	
		Total	**60**

Course outcomes:

1) Understand key component of drug discovery process and drug designing
2) Understanding the role of medicinal chemist in development of medicinal agents
3) Have understanding about functional group modification and their utility in SAR and QSAR.
4) Analyze the recent research articles related with drug design of antimycobacterial agents and antibiotics.

References books

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- Fourth Edition Graham L. Patrick Oxford Press
4. Principles of medicinal chemistry (Vol. I and II)-S. S. Kadam, K. R. Mahadik and K. G. Bothara (Niraliprakashan)
5. Burger's Medicinal Chemistry, Drug Discovery and Development, 8 Volume Set(Burger's Medicinal Chemistry and Drug Discovery) Donald J. Abraham and David P. Rotella
6. An introduction to drug design-S. S. Pandeya and J. R. Dimmock (New age international)
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
9. Pharmacological basis of therapeutics-Goodman and Gilman's (McGraw Hill)

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - III)

Elective Theory Course

Course Code – SCHEET1502

Title of the Course: Applied Chemistry

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- To learn and analyze and predict the properties of materials based on their atomic and molecular structures.
- To explore various methods for synthesizing materials with tailored properties for specific applications.
- To develop an understanding of the principles governing non-covalent interactions to predict and design supramolecular structures with desired properties.
- To cover prevention of environment, It is better to prevent waste than to treat or clean up waste after it is formed.
- To highlight significance of atom economy, synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
- To introduce practicable, synthetic methods to igenerate substances that possess little or no toxicity to human health and the environment.
- Chemical products should be designed to effect their desired function while minimizing their toxicity.

Curriculum Details: SCHEET1502: Applied Chemistry

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**SUPRA-MOLECULAR CHEMISTRY**	**15**
	1.1	Properties of covalent bond, bond length, inter-bond angles, force constant, bond and molecular dipole moments, molecular and bond polarizability, bond dissociation enthalpy, entropy, Intermolecular forces, hydrophobic effects, Electrostatics, induction, dispersion and resonance energy, magnetic interactions, magnitude of interaction energy, force between microscopic bodies, medium effects, hydrogen bond, Principles of molecular association and organization as exemplified by in biological macromolecules like enzymes, nucleic acids, membrane and model systems like micelles and vesicles, molecular receptors and design principles.	
	1.2	Cryptands, cyclophanes, calixeranes, cyclodextrins. Supramolecular reactivity and catalysis. Molecular channels and transport processes. Molecular devices and nontechnology.	
	1.3	Non covalent interaction including π-π stacking in Porphyrin, Nano carbon and alike systems.	

2.0		**ORGANIC MATERIAL CHEMISTRY**	**15**
	2.1	Molecular electronics: molecular materials for electronics and molecular scale electronics.	
	2.2	Molecular properties, molecular arrangement and molecular interactions, piezoelectric and pyroelectric organic materials	
	2.3	Molecular magnets based on transition metal complexes and organic ferromagnets.	
	2.4	Molecular magnets based on transition metal complexes and organic ferromagnets, organic non-linear optical materials	
	2.5	Photochromic organic materials and their classes; conducting polymers: polyacetylene, polypyrrole, polyaniline and polythiophene	
	2.6	conductive change transfer materials: TTFTCNQ, metal–dithiolate systems, fullerenes. Langmuir-Blodgett films, molecular electronic logic and architectures.	
3.0		**CHEMISTRY IN FORENSIC SCIENCE**	**15**
	3.1	Introduction: Profile of a forensic laboratory, Forensic Scientists' role and quality control, Crime-scene investigation, Collection and preserving physical evidences and evidentiary documentation, Future prospects of forensic analysis	
	3.2	Real Case Analysis: Liquor analysis, Trap-case analysis, Petroleum product analysis, Fire and Debris analysis, Injuries, Firearm wounds, Asphyxia and stress analysis (only analytical identifications).	
4.0		**FORENSIC TOXICOLOGY**	**15**
	4.1	Analysis of various types of poisons (corrosive, irritant, analgesic, hypnotic, tranquillizer, narcotic, stimulants, paralytic, anti-histamine, domestic and industrial (gaseous and volatile) poisoning and food poisonings),	
	4.2	Explosive and explosion residue analysis, Lethal drug analysis (sampling, sealing, packing, laboratory methods of testing, reporting the analysis results, court evidence and medico-legal aspects for the consideration of chemical data as a proof for crime), Importance of physiological tests in forensic toxicology	
		Total	**60**

Course outcomes:

1. P.J. Vander Put, Inorganic Chemistry of Materials, Plenum Press, New York, 1998.
2. M.C. Petty, M.R. Bryce and D. Bloor, Editors an Introduction to Molecular Electronics, Edward Arnold, London 1995.
3. Supramolecular Chemistry- Concepts and perspectives by J.M. Lehn
4. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5 Paper 14: Organic chemistry IV Advance organic synthesis, supramolecular chemistry and carbocyclic ring.
5. W.J. Welcher (Ed.), Scott's Standard Methods of Chemical Analysis, Vol. III A, 6th Edition (1966), and vol. III B, 5th Edition (1975), Van Nostrand Reinhold Co. London.
6. Peter Fordham, Non-destructive Testing Techniques, 1st edition (1968), London Business Publications Ltd., London

7. W. Horwitz, Official Methods of Analysis, 11th Edition (1970), Association of Official Analytical Chemists, Washington DC.
8. K. Simpson and B. Knight, Forensic Medicine, 9th Edition (1985), Edward Arnold Publishers Ltd., London.

Course outcomes:

1) Equip students with knowledge of forensic science for national importance and their carrier opportunity
2) Develop innovative solutions for chemical synthesis and production that adhere to the principles of forensic science analysis.
3) Develop proficiency in analyzing the structure and properties of materials using advanced techniques.
4) Apply knowledge to design and develop new materials with specific properties for various applications.
5) Understand the principles of molecular recognition and apply them to design functional supramolecular systems
6) Analyse complex systems formed by non-covalent interactions to predict and control their properties and functions

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - III)

Major Practical Course

Course Code – SCHECP 1501

Title of the Course: Synthesis of Organic Molecules (Any Fifteen)

[No. of Credits: 2 Credit] **60 Periods**

Course objectives:

- To trained the multistage synthesis of organic molecules.
- Become skilled for the synthesis of drug molecules in the laboratory.
- Gain the practical knowledge of organic synthesis by microwave irradiations.
- Chemical products should be designed to effect their desired function while minimizing their toxicity.
- To explore solvent free reactions

Curriculum Details: SCHECP1501: Synthesis of Organic Molecules

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**MULTISTAGE SYNTHESIS**	
	1.1	Benzophenone→ benzopinacol→ benzopinacolone	
	1.2	Benzoin → benzil→ benzilic acid	
	1.3	Benzaldehyde→ chalcone → chalcone epoxide	
	1.4	Acetanalide→ 4-bromoacetanalide → 4-bromoaniline.	
	1.5	Cyclohexanone→ cyclohexanoneoxime→ caprolactone	
	1.6	Anthranilic acid → o-chlorobenzoic acid → N-phenyl anthranilic acid.	
2.0		**SYNTHESIS OF DRUG MOLECULES**	
	2.1	Synthesis of anaesthetic drug Benzocaine.	
	2.2	Synthesis of anticancer drug 6-methyl uracil	
	2.3	Synthesis of antibacterial drug sulfanilamide	
	2.4	Synthesis of anti-epileptic drug antypyrine.	
	2.5	Synthesis of anti-convulsant drug Phenytoin	
3.0		**USE OF MICROWAVES IN ORGANIC SYNTHESIS**	
	3.1	The Hantzchdihydropyridine synthesis from aldehydes, ethyl acetoacetate and ureain microwave irradiation (Synthetic Letters, 8, 1296-1298, 2001; Synthetic Communications, 31, 425-430, 2001)	
	3.2	Synthesis of coumarin by Knoevenagel synthesis using salicyladehyde, ethylacetatein presence of base in microwave irradiation (J. Chem. Res. (S), 468-469,1998).	
	3.3	Synthesis of dihydropyrimidones from Biginelli Reaction by acid-catalyzed, threecomponentreaction between an aldehyde, ß-ketoester and urea	

		(Tetrahedron, 2005, 61, 4275-4280).	
4.0		**SOLVENT FREE ORGANIC SYNTHESIS**	
	4.1	Pinacol coupling reaction	
	4.2	Reformatsky reaction/Luche reaction	
	4.3	Biginelli reaction	
	4.4	Claisen reaction	
	4.5	Phenol bromination using N-bromosuccinimide	
		Total	**60**

Course outcomes:

1. Learn basics practical knowledge of multistage synthesis of organic molecules.
2. Learn fundamentals of organic synthesis in drug discovery.
3. Learn about the one-pot organic synthesis by microwave techniques.
4. Learn about modern synthetic transformation using green chemistry approach.

Note:

1. Synthesis is carried out in molar quantities (Less than 5 gm).

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.

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - III)

Major Practical Course

Course Code – SCHECP 1502

Title of the Course: Mixture Analysis (Any Fifteen)

[No. of Credits: 2 Credit] **60 Periods**

Course objectives:

1. To study the qualitative analysis of ternary mixture in organic chemistry.
2. To understand the analysis of organic compounds by spectral techniques

Curriculum Details: SCHECP1501: Mixture Analysis

1. 0		**MULTISTAGE SYNTHESIS**	
		Qualitative Analysis (At least 10 Organic Mixtures): Semi-micro Qualitative Analysis of Ternary Mixtures (Solids; Two Solids and One Liquid, 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 Theoritical Spectral Data (IR, 1H NMR & 13C NMR).	
		Total	**60**

Course outcomes:

Outcomes:

Learn basics practical knowledge of qualitative analysis.
Become skilled at organic compounds determination.

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - III)

Research Project Course

Course Code – SCHERP 1501

Title of the Course: Research Project

[No. of Credits: 4 Credit] **120 Periods**

Course objectives:

1. To train the students with different experimental and analytical skills considering opportunities in academic and industrial research.
2. To gain the knowledge of referring research journals, writing research articles and submit the dissertation report.

Curriculum Details: SCHECP1501: Research Project

1. 0		**MULTISTAGE SYNTHESIS**	
		Literature Survey, Studies of Reactions, Synthesis, Mechanism, Isolation of Natural Products, Standardization of Reaction Conditions, New Synthetic Methods etc.	
		Total	**120**

Note:

1. External and Internal Examiners will examine this project jointly at the time of Practical examination.
2. The students will have to give at least one seminar in each semester in their subject of specialization is compulsory.
3. Project work must be carried out only in specialized branch.
4. All synthesized organic compounds should be submitted at the time of University Examination.
5. The project work carried out during the year should be presented in power point presentation in presence of University Examiners.

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SCHECT1551

Title of the Course: Organic Synthesis-II

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- To learn and gather the information of disconnection of functional group in organic transformations.
- To study the protection and deprotection approach for functional group.
- To learn the C-C bond disconnections in various organic molecules.
- To develop synthetic routes based on retrosynthetic analysis for molecules.
- To study different aspects of asymmetric synthesis chiral and its applications.
- To understand modern organometallic reagents.

Curriculum Details: SCHECT1551: Organic Chemistry-II

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**RETRO SYNTHETIC APPROACH**	**15**
	1.1	Grounding of organic chemistry for understanding retrosynthesis, Retrosynthetic analysis and designing of thesynthesis;Disconnection approach: An introduction to synthons, synthetic equivalents, disconnection approach, functional group interconversions.	
	1.2	Importance of order of events in organic synthesis, one and two group C-X disconnections, selective organic transformations,	
	1.3	Chemoselectivity, regioselectivity, stereoselectivity, enentioselectivity, Reversal of polarity, cyclization reactions, amine synthesis.	
	1.4	Protecting Groups: Protection and deprotection of hydroxyl, carbonyls in aldehydes and ketones, amines, carboxylic acids, alkenes and alkynes.	
2.0		**C-C DISCONNECTIONS**	**15**
	2.1	One group C-C Disconnections: Alcohols (including stereoslectivity), carbonyls (including regioselectivity), Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.	
	2.2	Two group C-C Disconnections: Diels-Alder reactions, 1,3difunctionalized compounds and α, β-unsaturated compounds, control in carbonyl condensations, 1,5 difunctionalized compounds, Michael addition and Robinson annelation.	
3.0		**ASYMMETRIC SYNTHESIS**	**15**
	3.1	The Significance of Chirality and Stereoisomeric Discrimination, Conditions for Asymmetry,	
	3.2	Chiral pool, Chiral auxiliary, Chiral reagent and chiral catalyst Enantio- & Diastereoselective synthesis.	

	3.3	Diastereoselective Reactions involving Cram and Felkin-Ahn model.	
	3.4	Chiral reactions using CBS reagent, NADH, Asymmetric	
	3.5	epoxidation- (+) DET & (-) DET, Sharpless, Jacobson,	
	3.6	Asymmetric hydrogenation including BINAP, Hydroboration-Ipc2BH, IpcBH2	
	3.7	Asymmetric dihydroxylation- (DHQD)2PHAL & (DHQ)2PHAL.	
4.0		**ORGANOMETALLIC REAGENTS IN ORGANIC SYNTHESIS**	
	4.1	Metathesis: Schrock and Grubbs catalyst, Olefin cross coupling (OCM), ring closing (RCM) and ring opening (ROM) metathesis, application in polymerization and synthesis of small organic molecules.	**15**
	4.2	N-Heterocyclic Carbene NHC	
	4.3	Click chemistry: criterion for click reaction, Sharpless azides cycloadditions	
	4.4	Applications of organo, Magnesium, Lithium, Titanium, Boron, Silicon, Cadmium, Zinc based Reagents in organic synthesis.	
	4.5	Organometallic C-H bond activation using Pt, Pd, Ni	
		Total	**60**

Course outcomes:

1) To persuade the subject specific knowledge as well as relevant understanding of the Retrosynthesis
2) The academic and professional skills required for Chemistry-based professions.
3) Learning experiences gained from this Disconnection approach is important for industrial purpose.
4) Provide deeper understanding and knowledge of Asymmetric synthesis including chiral reagent, chiral catalyst etc.
5) Modern and recent organometallic reagents for organic transformation has been introduced.

References

1) Organic Synthesis: The Disconnection Approach: StuartWarren
2) Designing Organic Synthesis: StuartWarren
3) Organic Synthesis: Strategy and Control: Paul Wyatt and StuartWarren
4) The Logic of Chemical Synthesis: E. J. Corey and Xue-MinChelg
5) Classics in Total Synthesis I, II and III: K. C. Nicolaou andothers
6) Organic Synthesis Concepts, Methods, Starting Materials: J. Fuhrhop, G.Penzlin
7) Some Modern Methods of Organic Synthesis: W.Carruthers
8) Transition Metals for Organic Synthesis Volume 1 Edited by M. Beller and C. Bolm WILEY-VCH Verlag GmbH & Co. KGaA ISBN: 3-527-30613-7
9) Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press),
10) Organic synthesis – Michael B. Smith
11) Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007).
12) Organic Synthesis Using Transition Metals, by Roderick Bates, Second Edition, A John Wiley & Sons, Ltd., Publication.

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SCHECT1552

Title of the Course: Advanced Heterocyclic Chemistry

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- Emphasis is given on the most important heterocyclic systems, such as pyridines, quinolines, isoquinolines, pyrroles, furanes, tiophenes, indoles, pyrimidines, purines, imidazoles, aziridines and oxiranes.
- For each group, ring synthesis, chemical properties and characteristic reactions will be discussed.
- Aromaticity applied to heterocyclic compounds, general methods for ring synthesis (by a number of cyclisation and cycloadditon reactions) as well as different systems for nomenclature will be presented.

Curriculum Details: SCHECT1551: Advanced Heterocyclic Chemistry

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**NOMENCLATURE AND NON-AROMATIC HETEROCYCLES**	**20**
	1.1	Systematic nomenclature system (Hantzsch-Widman system).Trivial nomenclature system. Fusion nomenclature system and Replacement nomenclature system.	
	1.2	Non-Aromatic Heterocycles: Synthesis, reactivity, and importance of the following ring systems.Azirines, Oxaranes, Thiiranes,Diazirenes, Diaziridines and Azetidines.	
2.0		**FIVE AND SIX-MEMBERED HETEROCYCLES WITH TWO AND MORE HETERO ATOMS:**	**20**
	2.1	Five and Six-membered Heterocycles with Two Hetero Atoms: Synthesis, reactivity, aromatic character and importance of the following heterocycles: Pyrazole, Imidazole, Oxazole, Thiazole, Pyrimidine and Pyrazine.	
	2.2	Heterocycles with More Than Two Hetero Atoms : Synthesis, reactivity, aromatic character and importance of the followingheterocycles: Triazoles, Oxadiazoles, Thiadiazoles and Triazines.	
3.0		**LARGER RING AND OTHER HETEROCYCLES:**	**10**
	3.1	Synthesis and reactivity of Azepines, Oxepines and Thiepines. Synthesis of Benzoazepines, Benzooxepines, Benzothiepines, Azocines and Azonines.	
4.0		**BANZANELLATED AZOLES AND HETEROCYCLES WITH RING-JUNCTION NITROGEN:**	**10**
	4.1	Banzanellated azoles: Synthesis and chemical properties of Benzimidazoles, Benzoxazoles and Benzothiazoles.	
		Total	**60**

Course outcomes:

1) This course aims at giving a fundamental theoretical understanding of heterocyclic chemistry, including alternative general methods for ring synthesis and application of such methods for the preparation of specific groups of heterocyclic systems.
2) The student will get familiar with particular properties and reactions for the most important heterocycles as well as different systems of nomenclature.

References books

1. Heterocyclic Chemistry, T. L. Gilchrist.
2. An Introduction to the Chemistry of Heterocyclic compounds, R. M. Acheson.
3. Heterocyclic 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 by R. R. Gupta, M. Kumar, V. Gupta
8. Heterocyclic Chemistry-IIIrdEdt.by Raj K Bansal

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - IV)

Elective Theory Course

Course Code – SCHEET1551

Title of the Course: Bio-Organic and Green Chemistry

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- To study the applications of Enzymes
- To study the applications of Nucleic Acids
- Principles of Green Chemistry.
- Applications of Green Reagents and Ionic Liquids.

Curriculum Details: SCHEET1551: Bio-Organic and Green Chemistry

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**ENZYME CHEMISTRY**	**15**
	1.1	Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Baker's yeast catalyzed reactions, Applications of enzymes in food and drug chemistry.	
	1.2	Mechanism of Enzyme Action: Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Example of some typical enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.	
	1.3	Co-Enzyme Chemistry: Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.	
2.0		**NUCLEIC ACIDS:**	**15**
	2.1	Introduction, hydrolysis of nucleic acids, Structure physical and chemical properties of the heterocyclic bases-adenine, guanine. Cytosine, Uracil and Thiamine. Structure and synthesis of nucleosides and nucleotides.	
	2.2	Deoxyribose nucleic acid (DNA): Primary, secondary, tertiary structure of DNA.Structure of RNA. Types of RNA-mRNA, rRNA and tRNA. Purines and pyrimidine bases of nucleic acids and their preparation.	
	2.3	Lipids: Fatty acids, essential fatty acids, structures and functions of triglycerols, glycerophospho lipids, spingolipids, lipoproteins, composition and function, role in atherosclerosis.	

3.0		**INTRODUCTION TO GREEN CHEMISTRY**	
	3.1	Introduction, Need for Green Chemistry, Principles, Concept of atom economy and scope. Atom economy in addition, substitution, elimination and rearrangement reactions. Inception to green chemistry. Introduction to alternative approaches. Green Chemistry in Pharmaceuticals, pesticides, polymers, computer chips etc. Solvent free reactions-principle, scope, utility of solvent free conditions, controlling solvent free reactions. Phase changes, optimum reaction temperatures, miscibility of reactants and catalysts. Basic principles of green synthesis. Different approaches to green synthesis.	**15**
	3.2	Use of green reagents in green synthesis-dimethyl carbonate, polymer supported reagents- peracids, chromic acids.	
	3.3	Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts. Applications of zeolites.	
	3.4	Phase transfer catalyst in green synthesis: Aliquat 336, benzyltrimethyl ammonium chloride (TMBA), Tetra-n-butyl ammonium chloride.	
	3.5	Advantages of PTC reactions to green synthesis:Applications of PTC's in C-alkylation, n-alkylation, s-alkylation, Darzens reaction, Williamsons synthesis and Wittig reaction.	
4.0	**A**	**AMICROWAVE INDUCED AND ULTRASOUND ASSISTED GREEN SYNTHESIS.**	
	4.1	Introduction to synthetic organic transformations under microwave.	**15**
	4.2	Microwave assisted reactions in water: Hoffman elimination, hydrolysis, oxidation, saponification reactions.	
	4.3	Microwave assisted reactions in organic solvents: Esterification reactions, Fries rearrengment, Orthoester Claisen rearrangement, Diels-Alder reaction, decarboxylation.	
	4.4	Ultrasound assited reactions: Introduction, substitution reactions, addition, oxidation, reduction reactions.	
	B	**Ionic liquids as green solvents and use of biocatalysis**	
	4.5	Ionic liquids as green solvents-Green solvents, reactions in acidic ionic liquids and in neutral ionic liquids (Hydrogenation, Diels-Alder reaction, O-alkylation and N-alkylation).	
	4.6	Biocatalysts in organic synthesis: Introduction, i) Biochemical Oxidation and reduction (microbial)-production of fine chemicals, vitamins and amino acids. i) by microorganisms-production of penicillins,streptomycin and chloremphenicol.	
		Total	**60**

Course outcomes:

The students will understand

1. The basic Principles of Green Chemistry,
2. Applications and uses of green catalysts and Reagents.
3. Use of Ionic Liquids and PTC in Green Synthesis.

4. Applications of Enzymes and Nucleic acids.

References books

List of Books:

1. Natural products: Chemistry and Biological significance, J.Mann, R.S.Davidson, J.B.Hobbs, D.V., Banthropde & J. B. Harborne, Longm, an, Essex.
2. Organic Chemistry, vol-2, I. L. Finar, ELBS.
3. Stereoselective Synthesis: A practical Approach, M. Nogrudi, VCH.
4. Organic Synthesis in water, Paul A. Grieco Blackie.
5. Biochemistry, voet and Voet, John Wiley.
6. Green Chemistry, theory and practice, Paul T. Anastas and John C. Warner.
7. New Trends in Green chemistry, V. K. Ahluwalia and M. Kidwai.
8. Organic Synthesis: Special techniques, V. K. Ahluwalia and Renu Aggarwal
9. Biochemistry, J. David Rawn. Neil Patterson.
10. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag
11. Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall
12. Enzyme Structure and Mechanism, A. Fersht, W. H. Freeman
13. Heterocyclic chemistry by Joule and Mills.
14. Modern Heterocyclic chemistry by L. A. Paquette, Benjamin.
15. Advanced organic chemistry by – Carry and Sundberg
16. Biochemistry by-U.Satyanarayana and U.Chakrapani

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - IV)

Elective Theory Course

Course Code – SCHEET1552

Title of the Course: Medicinal Chemistry

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- Learn basic principles involved in Anti-cancer and Anti-AIDS agents, Hypoglycemic agents, Cardiac drugs, antiviral antimalarials.
- To know the role of medicinal chemist in development of medicinal agents for analgesic agents, Anti-inflammatory drugs, Anaesthetics, depressants, Anticonvulsant agents,Drug acting on Gastrointestinal tact infections
- Learn how to analyze and perform SAR of Anti-cancer Agents, Hypoglycemic agents,Cardiac drugs, Antimalarials, Analgesic and Anti-inflammatory drugs, Anaesthetics, Psychoactive Drugs
- Learn how to file the patents

Curriculum Details: SCHEET1552: Medicinal Chemistry

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**ANTI-CANCER AGENTS, ANTI-AIDS AGENTS AND ANTI – DIABETIC AND CARDIOVASCULAR AGENTS**	**20**
	1.1	A] Anti-cancer Agents (Anti-neoplastic agents):Introduction, Cancer or tumor, Types of tumor, Terminology: Neoplasma, Sarcoma, Carcinoma, Blastoma, Cancers of blood, Metastases. Mechanism of tumor formation, Treatment of cancer: a) Surgery, b) Photo radiation, c) Radation therapy, d) Immunology, e) Cancer Chemotherapy. Role of alkylating agents and antimetabolites in the treatment of cancer, i) Alkylating agents, Mustard gas, nitrogen mustards (General methods of preparations), Mechloethamine, melphalan (synthesis) and chlorambucil (synthesis), ii) Antimetabolites, Synthesis and structure activity of 6-mercaptopurine, 5-flurouracil. Brief discussion regarding use of hormones, natural products, carcinolytic antibiotics and mitotic inhibitors.	
	1.2	B] Anti-AIDS agents: Introduction, structure and life cycle of the AIDS virus, Mechanism of action of anti-HIV drugs, Targets for anti-HIV drug development, Taxol and Azedothymidine (AZT) derivatives.	
	1.3	A: Insulin and Hypoglycemic agents. 10P Introduction, Types of diabetics, Insulin and its preparation, Storage, secretion, and function of insulin, SAR and mechanism action of Sulphonyl urea and Biguanides, Sweeting agents: Saccharin and p-Phenyl urea (Dulcin), (Synthesis of sodium saccharin expected). B] Cardiac drugs: Introduction, Mycocardial cell, Molecular basis of mycocardial contraction, cardiovascular diseases, pathophsiology heart failure.i) Cardiotonic (Cardiac glycosides): Structure and activity of glycosides, ii) Antianginal drugs. Types of angina pectoris, Mechanism of	

		action of antianginal drugs.	
	1.4	Classification of antianginal drugs, a) Nitrates and nitrites, b) Non-nitrate. SAR of Diperidamol, Khellin, Xanthines and Papavarine, iii) Antiarrhythmic drugs: Synthesis and SAR of guanidine, procainamide, iv) β-Adrenergic blocking agents: Synthesis and SAR of propranolol and isoproterenol, v) Calcium channel blockers: Structure activity of 1,4-dihydropyridines, synthesis of Verapamil and Diltiazem, vi) Antihypertensive drug: Primary and secondary hypertension agents like Rauwolfia alkaloids, Synthesis and structure activity of methyldopa, Clonidine, Hydralazin	
2.0		**ANTIVIRAL AGENTS, ANTIMALARIALS**	**10**
	2.1	Antiviral Agents: Introduction, Classification of antiviral agents, viral diseases, viral replication and transformation of cells, SAR of amantadine hydrochloride and interferons. Coronavirus: Introduction, genome structure and life cycle, COVID-19 drug development.	
	2.2	Antimalarials: Introduction, life cycle of plasmodia, chemotherapy of malaria, Mechanism of action of anti-malarial drugs, Targets for anti-malarial drug development, Mechanism of drug-resistance in malaria types of antimalarial drugs. SAR of 8-aminoquinoline derivatives, 4-aminoquinoline derivatives, pyrimidine and biguanide derivatives. Synthesis of pamaquine, primaquine, santoquine, camaquine, and pyrimethamine and chloroquine phosphate (expected).	
3.0		**ANALGESIC AND ANTI-INFLAMMATORY DRUGS**	**20**
	3.1	**Analgesics:** i) SAR of piperidine, meperidin, methadone, and 6, 7-benzomorphans ii) Synthesis of mepiridine, methadone and 6, 7-benzomorphans (expected) II) Anti-inflammatory drugs: Introduction, classification on non-steroidal anti-inflammatory drugs, SAR of methyl salicylate, aspirin, iodomethazone, mefenamic acid, phenyl butazone, oxyphenbutazone, naproxen, rofecoxib, celecoxib, Synthesis of ibuprofen and phenylbutazone. III) Treatment of Gout:-Introduction, synthesis and uses of Allopurinol. B] Antifungal agents. Introduction, SAR and synthesis of Fluconazole.	
	3.2	**Drugs acting on CNS:** A) Anaesthetics: i) General anaesthetics: Synthesis of methohexital, structure activity of divinyl ether, nitrous oxide, Pentothal. ii) Local anaesthetics: Introduction, development of local anaesthetics, classification (according to chemical structure), a) Procaine and related amino benzoic acid, b) Stovain and its analogues, c) Lidocaine and its analogues, d) Synthesis and SAR of procaine, lidocaine and stovaine B) Depressants: Introduction i) Sedative and hypnotics, SAR of aldehydes, ketones and sulphones ii) Anticonvulsant: Introduction, Structure and activity of substituent barbiturates. Synthesis of Phenobarbital sodium (expected), Hydantoins: General synthesis and SAR of hydantoins. C) Antipsychotic agents (Neuroleptic agents): Selective modifier of CNS (Tranquillizers) Introduction, Classification, i) Phenothiazine derivatives: SAR and synthesis of chloropromazine and related compounds. ii) Butyrophenones derivatives: Synthesis of haloperidol, spiroperidol. SAR of butyrophenones derivatives iii) Central nervous system stimulants (Antidepressants): Introduction Tricyclic system with central seven membered ring: Dibenzepine and related compounds, SAR of dibenzepine	

		derivatives Synthesis of imipramine, amitriptyline, Chloropromazine and Diazepam.	
		Antimicobacterial drugs: Antitubercular drugs: Introduction. Mechanism of action of anti-tuberculosis drugs, Targets for anti-tuberculosis drug development, Mechanism of drug-resistance in tuberculosis a) First-line agents (Primary tubercular drugs): Structure and activity of streptomycin and dihydrostreptomycin, Synthesis and SAR of 4-amino salicylic acid and isoniazid. b) Second line agents (Secondary antitubercular agents): Structure and activity of Rifampicin, Cycloserine, Viomycin, Enthionamide, Ethambutol, Thioacetazone. (Synthesis of Cycloserine and Ethambutol expected.	
4.0		**INTELLECTUAL PROPERTY RIGHT (IPR) and**	
	4.1	Intellectual property right (IPR): 10P Manual of patent practices and procedure, Introduction, Patentable subject matter, Application for patents, Patent application under PCT, Publication and examination of application	
	4.2	Agents for organ imagine OR Diagnostic agents. Introduction, Classification, Radiopagues agents (contrast media), Water soluble and Water insoluble contrast media.Synthesis of Metrizamide, Iopanoic acid and Pyropylidone.Diognostic chemicals: i) Drugs used to test kidney functions, ii) Drugs used to test liver functions, iii) Agents used to test gastric function, iv) Agents used to test cardiac function	**10**
	4.3	Drug acting on Gastrointestinal tract (Drug acting on GIT). Introduction, a) Gastric antacid: i) Treatment of gastric hyperacidity, ii) H2-receptor antagonists Synthesis of Ranitidine (Zantac) and Famotidine. b) Ulcerative colitis. c) Antispansmodics agents (Spasmolytic agents), d) Anthelmintic agents: Introduction, anthelmintic agents, synthesis of mebendazole.	
		Total	**60**

Course outcomes:

Understand key components of drug discovery of Anti-cancer and Anti-AIDS agents, Hypoglycemic agents, Cardiac drugs, antiviral antimalarial agents

References books

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.
5) Medicinal chemistry (Vol. I and II)-Burger
6) An introduction to drug design-S. S. Pandeya and J. R. Dimmock (New age international)
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
9) Pharmacological basis of therapeutics-Goodman and Gilman's (McGraw Hill)
10) Manual of patent practice and procedure-Patent office, India (2005)

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - IV)

Major Practical Course

Course Code – SCHECP 1551

Title of the Course: Physico-Organic Estimations (Any Fifteen)

[No. of Credits: 4 Credit] **60 Periods**

Course objectives:

- To train the students in estimation of organic molecules.
- Gain the practical knowledge to estimate the drug molecules by instrumentation methods.

Curriculum Details: SCHECP1551: Synthesis of Organic Molecules

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**ESTIMATION OF DRUGS BY TITRIMETRIC**	
	1.1	Assay of Aspirin	
	1.2	Assay of Ibuprofen	
	1.3	Assay of Analgin	
	1.4	Determination of Chloride in Ringer Lactate solution for Injection	
	1.5	Determination of Calcium ions in Calcium Gluconate Injection.	
2.0		**ISOLATION OF NATURAL PRODUCTS**	
	2.1	Isolation of caffeine from tea leaves. b) Isolation of piperine from black pepper	
	2.2	Isolation of β-carotene from carrots d) Isolation of lycopene from tomatoes	
	2.3	Isolation of limonene from lemon peel	
	2.4	Isolation of euginol from cloves	
3.0		**ESTIMATION OF DRUGS BY INSTRUMENTAL METHODS**	
	3.1	Assay of sulfanilamide by Potentiometry.	
	3.2	Assay of Riboflavin by Colorimetry.	
	3.3	Assay of Diazepam by UV-Vis Spectrophotometer.	
	3.4	Assay of Riboflavin by UV-Vis Spectrophotometer.	
	3.5	Estimation of carbohydrates, amino acids, proteins by UV-Vis spectrophotometer	
	3.6	Assay of ascorbic acid by Colorimetry.	
	3.7	Determination of Hammett constants and determine its substitution effect. i) Benzoic acid, ii) P-Nitro Benzoic acid, iii) P-Methoxy Benzoic acid, iv) PMethyl 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)	
		Total	**60**

Course outcomes:

1. Gain the knowledge of estimation of drugs by Titrimetric.
2. Learn about the Isolation of natural products.
3. Develops the techniques for the estimation of drugs by Instrumental Methods.

References books

1. Moden 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
4. The systematic identification os organic compounds by R.L.Shriner&D.Y.Curtin
5. Semi-microqualitative 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.

8. 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.

National Education Policy 2020

M.Sc. Chemistry, II Year (Semester - IV)

Research Project Course

Course Code – SCHERP 1502

Title of the Course: Research Project

[No. of Credits: 6 Credit] **180 Periods**

Course objectives:

3. To train the students with different experimental and analytical skills considering opportunities in academic and industrial research.
4. To gain the knowledge of referring research journals, writing research articles and submit the dissertation report.

Curriculum Details: SCHECP1501: Research Project

1. 0		**MULTISTAGE SYNTHESIS**	
		Literature Survey, Studies of Reactions, Synthesis, Mechanism, Isolation of Natural Products, Standardization of Reaction Conditions, New Synthetic Methods etc.	
		Total	**180**

Note:

1. External and Internal Examiners will examine this project jointly at the time of Practical examination.
2. The students will have to give at least one seminar in each semester in their subject of specialization is compulsory.
3. Project work must be carried out only in specialized branch.
4. All synthesized organic compounds should be submitted at the time of University Examination.
5. The project work carried out during the year should be presented in power point presentation in presence of University Examiners.