

College of Computer, Science & Information Technology - Junagadh

AFFILIATED TO BHAKTA KAVI NARSINH MEHTA UNIVERSITY



◆ Syllabus ◆

Master of Science

in

CHEMISTRY

[Semester - III & IV]

Academic Year : 2024 – 25

(Effective from June – 2023)



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Credit Structure

SEMESTER-III					
Course Group	Subject Name	Credit	Int. Marks	Ext. Marks	Total Marks
Core	Stereochemistry & Asymmetric Synthesis	4	30	70	100
Core	Heterocyclic Chemistry & Pericyclic Reactions	4	30	70	100
Core	Medicinal Chemistry	4	30	70	100
Core	Modern Spectroscopy	4	30	70	100
Practical	Practical & Viva Voce	6	-	100	100
Skill Enhance. Course	Research Project Proposal & Viva Voce	2	-	100	100
Total Credits		24	Total Marks		600

SEMESTER-IV					
Course Group	Subject Name	Credit	Int. Marks	Ext. Marks	Total Marks
Core	Organic Synthesis: A Disconnection Approach	4	30	70	100
Core	Separation Techniques	4	30	70	100
Dissertation/Practical	Dissertation/Project or Practical	12	-	200	200
Self Study	Dissertation/Project Viva Voce or Practical Viva Voce	4	-	100	100
Total Credits		24	Total Marks		500

M.Sc. SEMESTER-III

OC-301 : Stereochemistry and Asymmetric Synthesis

Unit-1 : **[Teaching Hrs. 12]**

- (a) **Projections:** Wedge-dash, Fischer, Newman, Sawhorse, Zigzag projections and their interconversions for compounds having two or more stereocenter.
- (b) **Stereoisomerism without a stereogenic carbon.**
Axial chirality (bi-phenyl, allenes, spiranes), planar chirality (ansa compounds, paracyclophanes, trans-cyclooctene), helicity (hexahelicene).
- (c) **Racemic mixtures and modification**
Theories of racemization, resolution of racemic mixtures, optical purity & enantiomeric excess.

Unit-2 : **[Teaching Hrs. 12]**

- (a) **Prochirality, pro-stereoisomerism**
Pro-stereoisomerism and prochirality-introduction Topicity: Examples of homotopic & heterotopic ligands, pro-R and pro-S nomenclature. Examples of Homotopic & Heterotopic faces, Re-Si nomenclature system.
- (b) **Conformational analysis and reactivity:**
- Conformations, klyne-prelog terminology for torsional angle, conformation analysis and reactivity of acyclic molecules like butane, n-pentane, halogeno alkanes, acetaldehyde, propionaldehyde 1,3-butadiene and C-Hetero bond.
 - Conformations of cyclohexane, mono and di-substituted cyclohexane ring systems. Effect of conformation on reactivity of cyclohexanes.
 - Conformations of fused ring systems-decalin and decalones and its diastereomerism.
 - Conformation of bridge systems-Bicyclo[2,2,1] heptane and Bicyclo[2,2,2]octane. Exo. Endo nomenclature, bredt's rule.
 - Conformation of sugar (Fisher, haworth and chair), epimers, anomers, Epimerization, anomeric effect and mutarotation.

Unit-3 : **[Teaching Hrs. 12]**

Stereospecific and Stereoselective reactions-I

Stereospecific and stereoselective reactions, general methods of synthesis and asymmetric induction.

(a) Aliphatic nucleophilic substitution reactions

Introduction, Stereochemistry of SN1 & SN2 reaction mechanism, The SNi mechanism, Mixed SN1 & SN2 reaction, ambient nucleophile, Regioselectivity, Neighboring group participation.

(b) Elimination Reactions

- Introduction, Mechanism E1, E2 and E1cB, Stereochemistry of E2-anti-elimination reaction, E2-syn-elimination.

Unit-4 : **[Teaching Hrs. 12]**

Stereospecific and Stereoselective reactions-II

(a) Addition Reaction of Carbonyl

Stereochemistry addition of carbonyl compounds (Cram's rule and Felkin Anh models), Stereochemistry of metal hydride reduction of carbonyl. Stereoselective aldol reactions.

(b) Addition Reaction of Olefins

Stereochemistry of addition of olefins: dihydroxylation (manganese, osmium based), Hydroboration & oxymercuration, Woodward & Prevost reagent.

Unit-5 : **[Teaching Hrs. 12]**

Asymmetric synthesis

Methods of asymmetric induction, substrate, reagent and catalyst-controlled reaction:

- Asymmetric oxidation from: mCPBA & Henbest effect, halo-hydrine, Sharpless, and Shi reagents.
- Asymmetric ring opening of epoxide from: Grignard reagent, super-Grignard reagent, dialkylcuprates, LAH, NaBH₄, DIBAL, OH⁻/H₂O and HBr.
- Chiral-auxiliary controlled stereoselection: Evans oxazolidinones, asymmetric synthesis of amino acids from chiral auxiliary.

Reference Books

1. Kalsi, P. S. (2012, Fourth edition) Organic Reactions Stereochemistry and Mechanism (Through Solved Problems). New Delhi: New Age International (P) Limited. (ISBN: 9788122417661).
2. Subrata Sen Gupta (2014), Basic Stereochemistry of organic molecules. New Delhi: Oxford University press. (ISBN: 978-0-19-945163-0).
3. Modern Methods Of Organic Synthesis By W. Carruthers. Cambridge university press.(ISBN: 0521-77097-1)
4. Aziridines and Epoxides in Organic Synthesis Edited by Andrei K. Yudin, Wiley-VCH (ISBN-13 978-3-527-31213-9)
5. Finar, I. L. (1989, Fifth edition) Organic Chemistry: Vol -2: Stereochemistry and the Chemistry of Natural Products. Harlow: Longman. (ISBN: 0-582-05916-X).
6. Clayden Jonathan; Greeves Nick, Warren Stuart (2012, Second edition) Organic Chemistry. Oxford: Oxford University Press (ISBN: 0199270295).
7. Eliel, Ernest L., Wilen, Samuel H. (1994) Stereochemistry of Organic Compounds. Hoboken: Wiley-Blackwell (ISBN: 0471016705).
8. Nogradi, M. (2008, Second revised and updated edition) Stereoselective synthesis: A practical approach. Weinheim: Wiley VCH. (ISBN: 978-3-527-61568-1).

OC-302 : Heterocyclic Chemistry and Pericyclic Reactions

Unit-1 :

[Teaching Hrs. 12]

- (a) **Nomenclature of heterocyclic compounds**
- (b) **Heterocyclic analogues of cyclopentane and its fused ring system**
 1. Preparation and properties of pyrrole, furan, thiophene.
Preparation and properties of indole, benzofuran, benzothiophene.

Unit-2 :

[Teaching Hrs. 12]

- (a) **Heterocyclic analogues of benzene and its fused ring system**
 1. Preparation and properties of pyridine and pyran.
 2. Preparation and properties of quinoline, isoquinoline, acridine.
 3. Preparation of benzopyran, benzopyran-2-one and benzopyran-4-one.
- (b) **Compounds with two heteroatoms in a six membered ring**

Preparation of pyridazine, pyrimidine, pyrazine, dioxane, Morpholine, phthalazine, quinazoline, quinaxoline, phenothiazine.

Unit-3 :

[Teaching Hrs. 12]

- (a) **Compounds with two heteroatoms in a five membered ring**
 1. Preparation & properties of pyrazole, oxazole, thiazole.
 2. Preparation of imidazole, isoxazole, isothiazole.
- (b) **Compounds containing more than two heteroatoms**
 2. Preparation of triazole, oxadiazole, thiadiazole, triazenes.

Unit-4 :

[Teaching Hrs. 12]

Pericyclic reactions and concerted mechanism-I

- General introduction and classification of pericyclic reaction, symmetry properties of molecular orbitals - ethylene, 1,3 - butadiene, 1,3,5-hexatriene and allylic systems. Concept of frontier molecular orbital (HOMO and LUMO) under thermal and photochemical conditional.
- **Electrocyclic reaction:** Conrotatory and disrotatory motions of orbitals, prediction about feasibility of electrocyclic reaction: FMO approach, conservation of orbital symmetry-correlation diagram approach and perturbational molecular orbital (PMO) or Huckel-Mobius (H-M) approach.
- Selection rule for electrocyclic ring-closing & ring-opening reaction (thermal or photochemical) for $4n$ system and $(4n+2)$ system. Examples of different electrocyclic reactions and their stereochemistry.

Unit-5 :

[Teaching Hrs. 12]

Pericyclic Reactions and Concerted Mechanism-II

- **Cycloaddition reactions:** (2+2) cycloaddition through antarafacial and suprafacial modes, selection rules for cycloaddition by FMO & correlation diagram approach Diels-alder reaction: (4+2) exo and endo-addition, reactivity and regioselectivity. 1,3-Dipolar cycloaddition reactions, cheletropic reactions & selection rule for thermal condition.

- **Sigmatropic rearrangements:** Suprafacial and Antarafacial shifts of hydrogen, selection rule for thermal and photochemical conditions, [1,3] & 1,5-sigmatropic shift of Hydrogen, [3,3] and [5,5] sigmatropic rearrangements, Claisen and Cope rearrangements, aza-Cope rearrangements, Sommelet-Hauser rearrangement.

Reference Books

1. Vinay P. Sharma & Rakesh Kumar. Pericyclic reactions and organic photochemistry, Pragati Prakashan, 2008, Meerut- (ISBN-978-81-8398-632-8)
2. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, 1st Ed., Oxford University Press, 2001.
3. Heterocyclic Chemistry by R.K. Bansal, New age international (ISBN-13: 978-8122412123)
4. Heterocyclic chemistry by J.A. Joule, K. Mills (2010, First edition) John Wiley & Sons, Inc., Hoboken, New Jersey, (ISBN 978-1-405-13300-5).
5. Modern Heterocyclic Chemistry by Julio Alvarez-Builla, Juan Jose Vaquero, and Jose' Barluenga, Wiley-VCH publication (ISBN 978-3-527-33201-4)
6. Name reaction in Heterocyclic chemistry by Jie Jack Li, Wiley-interscience (ISBN 0-471-30215-5).
7. The Chemistry of Heterocycles by Theophil Eicher and Siegfried Hauptmann, Wiley-VCH publication (ISBN 3-527-30720-6).
8. Handbook of Heterocyclic chemistry by A. R. Katritzky, Pergamon-Elsevier (ISBN 0-08-042998-2)

OC-303 : Medicinal Chemistry

Unit-1 :

[Teaching Hrs. 12]

Drug design and development

History and development of medicinal chemistry, drugs and their important, drug discovery, clinical trials, lead discovery, lead discovery from natural sources, lead discovery through: Random screening, non-random (or targeted or focused) screening, drug metabolism studies, clinical observations, rational approaches to drug discovery.

(a) Lead modification

Identification of the active part: The pharmacophore, functional group modification. structure-activity relationships, privileged structures and drug-like molecules, structure modifications to increase potency and the therapeutic index, homologation, chain branching, ring-chain transformations and bioisosterism.

(b) QSAR

Introduction to quantitative structure-activity relationships (QSARs), lipophilicity, partition coefficients (P), lipophilic substitution constants (p), electronic effects, the hammett constant (s), steric effects, the taft steric parameter (Es), molar refractivity (MR), other parameters. hansch analysis, craig plots, the topliss decision tree.

Unit-2 :

[Teaching Hrs. 12]

(a) Prodrug

Concept, structure and classification of prodrug. Use of prodrugs: Masking taste or odour, minimizing pain at site of injection, alteration of drug solubility, overcome absorption problems, prevention of pre-systemic metabolism, longer duration of action diminish local and systemic toxicity.

(b) Combinatorial chemistry

The Principle and design of combinatorial chemistry, Pool and split method for peptide synthesis, Parallel synthesis, Furka's mix and split technique, Solid support method.

Unit-3 :

[Teaching Hrs. 12]

(a) Drugs acting on cancer

Introduction to diseases, classification of anticancer drugs and synthesis of the following classes of the drugs:

- (1) DNA alkylating agents: Estramustine, Cisplatin
- (2) Enzyme Inhibitors: Anastrozole, Sorafenib, sunitinib

(b) Drugs acting on infectious diseases

Introduction to diseases, classification of acting on infectious diseases and synthesis of the following classes of the drugs:

- (1) Quinolone Antibiotics: Levofloxacin, Moxifloxacin.
- (2) Triazole Antifungals: Itraconazole, Fluconazole.
- (3) Non-Nucleoside HIV Reverse Transcriptase Inhibitors: Nevirapine, Delavirdine Mesylate.
- (4) Neuraminidase Inhibitors For Influenza: Oseltamivir Phosphate (Tamiflu), Zanamivir.
- (5) Antimycobacterial (TB) drugs: Isoniazid, Ethambutol

Unit-4 :**[Teaching Hrs. 12]****(a) Drugs acting on cardiovascular disorder**

Introduction to diseases, classification of drugs acting on Cardiovascular disorder and synthesis of the following classes of the drugs:

- (1) Hypertension: Losartan Potassium, Telmisartan.
- (2) Calcium Channel Blockers For Hypertension: Nifedipine, Amlodipine
- (3) Second-Generation Hmg-CoA Reductase Inhibitors: Rosuvastatin, Atorvastatin.

(b) Analgesic and Non-steroidal anti-Inflammatory dugs (NSAIDs):

Introduction to diseases, classification of anti-inflammatory drugs and synthesis of the following classes of the drugs:

- (1) Heteroarylacetic acid analogues: Indomethacin, Sulindac,
 - (2) Arylacetic acid analogues: Ibuprofen, Diclofenac sodium.
 - (3) Arylpropionic acid analogues: Ketoprofen, Indoprofen.
 - (4) Naphthalene acetic acid analogues: Naproxen.
 - (5) Salicylic acid analogues: Aspirin, Benorilate.
- Pyrazolones and pyrazolodiones: Phenazone (Antipyrine), Phenylbutazone.

Unit-5 :**[Teaching Hrs. 12]****(a) Drugs acting central nervous system**

Introduction to diseases, classification of drugs acting on Central Nervous System, synthesis of the following classes of the drugs:

- (1) Antidepressant: Venlafaxine, Duloxetine.
- (2) Insomnia: Zolpidem, Zaleplon, Indiplon.
- (3) Antiepileptic: Gabapentin.
- (4) Attention Deficit Hyperactivity Disorder: Amphetamine.

(b) Non-sedating antihistamines

Histamine blocker: Citirizine, fexofenadine

(c) Anti-diabetic drugs:

Introduction to diseases, classification of hypoglycemic drugs acting and synthesis of the following class of the drugs:

- (1) Type 2 Diabetes: Rosiglitazone, Pioglitazone
- (2) Sulphonamide-Hypoglycemic agents: Tolbutamide, Glyburide,
- (3) Guanidine: Metformin

Reference Books

1. Fundamentals of Medicinal Chemistry by Gareth Thomus, Wiley-VCH- 2003, (ISBN 0-470- 84306-3)
2. The practice of Medicinal Chemistry by Camille G. Wermurth, Third edition-Academic Press-(ISBN-0-12-744481-5).
3. Medicinal Chemistry by Ashutosh Kar, New age international-4th edition (ISBN:978-81-224-2305-7).
4. Principles of Medicinal Chemistry by S. S. Kadam, Mahadik, Bothera, Nirali Publication, 11th edition.
5. Drugs from Discovery to approval by Rick N.G., Wiley-Blackwell-second edition.
6. An Introduction to Drug Design, S. S. Pandey and J.R. Dimmock, New Age International.
7. Burger's Medicinal Chemistry and Drug Discovery, Sixth Edition, Ed.M.E.vWolff, John Wiley.
8. The Art of Drug Synthesis by Douglas S. Johnson and Jie Jack Li, John Wiley & Sons, Inc., Hoboken, New Jersey, ISBN 978-0-471-75215-8.
9. Synthesis of Essential Drugs by R.S. Vardanyan and V.J. Hruby, Elsevier, ISBN: 978-0-444-52166-8.

OC-304 : Modern Spectroscopy

Unit-1 :**[Teaching Hrs. 10]****Introduction to spectroscopic techniques**

Types of analytical techniques, introduction of instrumental methods and its classification, overview of spectroscopic methods based on wave length regions of electromagnetic radiation, properties of electromagnetic radiation.

UV Spectroscopy

Introduction, theory of ultra violet spectra, instrumentation, type of transition in organic molecules; auxochrome, chromophore; explanation of bathochromic shift and hypsochromic shift, hyper chromic effects, types of bands, effect of solvent, application of UV spectra. Calculation of λ -max (1) dienes and conjugated dienes (2) enones and dienones (i.e. unsaturated carbonyl compounds) (3) aromatic carbonyl system.

Unit-2 :**[Teaching Hrs. 08]**

Infrared Spectroscopy: Introduction to IR and FTIR, principle & theory of Infrared absorption spectrometry, infrared sources and transducers, sample handling, instrumentation, interpretation of IR spectra, applications and limitations of IR spectroscopy.

Unit-3 :**[Teaching Hrs. 08]****Mass Spectroscopy**

Introduction, principle, theory and components of mass spectrometers, different ionization and detection techniques, recording and resolution of mass spectrometer, types of ions produced in mass spectrometer, interpretation of mass spectra of selected compounds /API, Applications of Mass spectrometry, Introduction to ICP-MS.

Unit-4 :**[Teaching Hrs. 14]****Nuclear Magnetic Resonance Spectroscopy-I**

Introduction, NMR active nuclei, Basic Theory, NMR Spectrometer, internal Standard & solvent.

¹H NMR (PMR): Principle, Chemical shift, Magnetic anisotropy, spin-spin coupling (multiplicity), applications & problems of Nuclear magnetic resonance spectroscopy.

Unit-5 :**[Teaching Hrs. 20]****Nuclear Magnetic Resonance Spectroscopy-II**

¹³C NMR: Introduction, Principle, chemical shift, application and problems of ¹³C – NMR.

Introduction to 2D NMR, Application of COSY, NOESY, HSQC, HMBC

Structure Elucidation: Structure determination and distinction of various isomeric compounds through spectroscopic techniques (UV, IR, Mass, NMR & 2D-NMR)

Reference Books

1. Martin, M. L., Delpuech, J. J. and Martin, G. J. (1980) Martin *Practical* Nmr Spectroscopy. Weinheim: John Wiley & Sons Ltd. (ISBN: 0471258652).
2. Silverstein, Robert M., Webster, Francis X., Kiemle, David J., Bryce, David L. (2014, Eighth edition) Spectrometric identification of Organic Compounds. Weinheim: John Wiley & Sons Ltd. (ISBN: 978-0-470-91401-4).
3. Abraham, R. J., Fisher, J. and Loftus, P. (1988) Introduction to NMR Spectroscopy. Weinheim: John Wiley & Sons Ltd. (ISBN: 0471918946).
4. Dyer, J. R. (1965) Application of absorption Spectroscopy of Organic Compounds. Upper Saddle River: Prentice Hall.
5. Williams, D. H., Fleming, I. (2007, Sixth edition) Spectroscopic Methods in Organic Chemistry. New Delhi: Tata McGraw-Hill. (ISBN: 007711812X).
6. Kalsi, P. S. (2006, Sixth edition) Spectroscopy of Organic Compounds. New Delhi: New Age International Pvt. Ltd. (ISBN: 8122415431).
7. Breitmaier E. (2002, Third edition) Structure elucidation by NMR in Organic Chemistry-A Practical approach. Weinheim: John Wiley & Sons Ltd. (ISBN: 978-0-470-85007-7).

OP-305 : Practical & Viva Voce

Unit-1 :**[Teaching Hrs. 09]****Multi-step synthesis / Synthesis of Medicinally important moieties (with TLC monitoring of Reaction):**

1. Benzophenone to Benzanilide
2. 4-Bromoaniline from Acetanilide
3. 4-Iodonitrobenzene from 4-Amino-nitrobenzene
4. o-Iodobenzoic acid from Phthalic anhydride
5. Acridone from o-Chlorobenzoic acid
6. Hydantoin from Glycine
7. 5-Hydroxy-1, 3-benzoxathiol-2-one from hydroquinone
8. Benzimidazole from o-Phenylenediamine
9. Dibenzylacetone from Acetone
10. Barbituric acid from Urea
11. β-D-Glucopyranose penta-acetate from alpha-D-Glucose
12. 3-Carboethoxycoumarin from Salicylaldehyde

Group B: Instrumentation analysis (50 Marks):

1. Determination of λ max of given samples by visible spectrophotometer.
2. Determination of λ max of given samples by UV-Vis spectrophotometer.
3. Evaluation of effect of solvents on given sample and to identify the type of shift by UV-Vis spectrophotometer.
4. Control of absorbance and limit of stray light on UV-Vis spectrophotometer.
5. Calibration of polarimeter.
6. Specific rotation determination by polarimeter.
7. Estimation of metal from various water samples by flame photometer.
8. Estimation of metals from various drug samples by flame photometer.
9. Estimation of metals from various soil samples by flame photometer.
10. Determination of bleaching index (DOBI) of palm oil by UV-Vis spectrophotometer.
11. Demonstrative practicals of IR and fluorescence spectroscopy.

Reference Books

13. Brian S. Furniss (1989, Fifth edition) Vogel's Textbook of Practical Organic Chemistry. Hoboken: John Wiley & Sons (ISBN: 0-582-462363).
14. Arthur I. Vogel. (second edition) Elementary practical organic chemistry: Small scale preparations. Pearson (ISBN: 978-81-317-5686-7).
15. V.K. Ahluwalia and Renu Aggarwal (University Press), Comprehensive practical organic chemistry: Preparations and qualitative analysis (ISBN: 978-81-7371-273-9)
16. Raj K. Bansal (new age international-5th edition). Laboratory manual of organic chemistry (ISBN: 978-81-224-2930-5)

OP-306 : Research Project Proposal & Viva Voce

Research proposal Writing Guideline (Minimum 5000 words) (100 Marks):

1. Explanation of various research funding agencies (UGC, DBT, DST, CSIR, SERB, GJCOST) & their research support schemes.
2. Training on how to write various aspects of research proposal in given format with one example. (Title, description of problem, review of related work, national & international status, rationale for taking up project, objective of proposal, methodology, references, year-wise work plan, budget estimation etc.)
3. Assign chemistry-based research problems and its literature review.
4. Preparation and submission of one research proposal for any funding agency.
5. Presentation (ppt) of the prepared research proposal including all aspects.
6. Viva voce will be based on the research proposal and its various aspects.

M.Sc. SEMESTER-IV

OC-401 : Organic Synthesis: A Disconnection Approach

Unit-1 : [Teaching Hrs. 12]

Retrosynthesis-A Disconnection Approach-

Introduction of disconnection analysis, Common terminology and explanation, representation of disconnection analysis, Concept of synthon (Acceptor and donor, umpolung) and synthetic equivalents (Reagent). Planning a synthesis- convergent vs linear synthesis, criteria of good disconnection.

- Disconnection of aromatic compounds: Functional group based strategies- functional group addition (FGA), order of events, functional group interconversion (FGI), Functional group removal (FGR) and dummy groups.

Unit-2 : [Teaching Hrs. 12]

Functional groups relationships & scaffold construction

- One group C-C & C-X disconnection: Retrosynthesis of alcohols, olefins and carbonyl compounds.
- Two group C-C disconnection: Disconnections in 1,3-dioxygenated skeletons, preparation of β -hydroxy carbonyl compounds, α,β -unsaturated carbonyl compounds, 1,3-dicarbonyls, 1,5-dicarbonyls and application of Mannich reaction.

Unit-3 : [Teaching Hrs. 12]

Illogical Two Group Disconnections (Umpolung)

- Disconnection and synthesis 1-hydroxy carbonyl, 1,2-diol, 1,2-dicarbonyl, 1,4-dicarbonyl and 1,6-dicarbonyl compounds.

Unit-4 : [Teaching Hrs. 12]

Disconnection & Synthesis of Acyclic, Cyclic Hetero-Compounds

- Ring synthesis-application of Diels-alder cycloaddition reaction.
- Synthesis of saturated oxygen and nitrogen containing ring system.
- Disconnection strategies for 5 & 6 member heterocycles with two or three heteroatoms.
- Synthesis of heterocycles using multicomponent reaction strategy.

Unit-5 : [Teaching Hrs. 12]

Chemoselectivity & Protecting Groups

Introduction, three types of control, chemoselectivity examples and rules, chemoselectivity by (i) reactivity (ii) reagent, examples of chemoselectivity in synthesis. Protection of organic functional groups, protecting reagents and removal of protecting groups.

Reference Books

1. Warren, S.; Wyatt, P. (2008, Second edition) Organic Synthesis: The Disconnection Approach. Weinheim: Wiley. (ISBN: 978-0-470-71236-8).
2. Warren, S. (1978) Designing Organic Syntheses: A Programmed Introduction to the Synthon Approach. Weinheim: Wiley. (ISBN: 978-0-471-99612-5).
3. Carruthers, W.; Coldham, Iain (2004, Fourth Edition) Modern Methods of Organic Synthesis. Cambridge: Cambridge University Press. (ISBN: 9780521778305).
4. Jurgen Fuhrhop, Gustav Penzlin (2008) Organic synthesis-concept methods-starting materials- Weinheim: Wiley. (ISBN: 3-527-29074-5).

OC-402 : Separation Techniques

Unit-1 : [Teaching Hrs. 12]

Adsorption and Partition Chromatography

History, introduction, classification, principles, experimental, factors affecting adsorption & partition chromatography.

Unit-2 : [Teaching Hrs. 12]

Planar Chromatography

Principle, basic theory, technique & applications of : Paper chromatography, thin layer chromatography and high performance thin layer chromatography.

Unit-3 :**[Teaching Hrs. 12]****Gas Chromatography**

Basic theory, instrumentation, working and applications of GC, GC-MS & HS-GC.

Unit-4 :**[Teaching Hrs. 12]****Liquid Chromatography**

Basic theory, instrumentation, working and applications of HPLC & LC-MS.

Unit-5 :**[Teaching Hrs. 12]****Extraction Techniques**

Introduction, types of extraction (LLE, SSE, LSE), extraction methods (maceration, infusion, digestion, decoction, percolation, solvent extraction, Soxhlet extraction, counter current extraction, sonication, supercritical fluid extraction, steam distillation) and application.

Reference Books

1. Sethi, P. D. (2013) Sethi HPTLC: High Performance Thin Layer Chromatography: Quantitative Analysis of Pharmaceutical Formulations 3 Volume Set. New Delhi: CBS Publishers & Distributors Pvt. Ltd. (ISBN: 9788123922799).
2. Stahl, E. (1969, Second edition) Thin-Layer Chromatography: A Laboratory Handbook. New Berlin: Springer. (ISBN: 978-3-642-88488-7).
3. Heftmann, E. (2004, Sixth edition) Fundamentals and applications of chromatography and related differential migration methods - Part A (Journal of Chromatography Library). Philadelphia: Elsevier Publishing Company. (ISBN: 0444511075).
4. Skoog, D. A., West D. M., Holler, F. J., Crouch, Stanley R. (2013, Ninth edition) Fundamentals of Analytical Chemistry. Boston: Cengage Learning. (ISBN: 0495558281)
5. Instrumental Methods of Analysis by B. K. Sharma, Goel Publisher, Meerut.

OP-403 : Dissertation/Project or Practical

- All the students of M.Sc. Organic Chemistry will have option to undertake a research dissertation or practical during semester- IV.
- The student shall pursue his/her dissertation/project work under **university recognized research guide** only.

Dissertation/Project Detail (200 Marks):

- The student will be given the option of selecting a research problem in a preferred area that falls within the discipline of courses undertaken.
- The dissertation/project work could be conducted at the institute or recognized research laboratory. In case the student carry out research work at other research laboratory, a NOC,
- Presence report and certificate of place of work from the concern laboratory should be submitted along with the thesis.
- At the end of the semester, the student is required to submit his/her results in the form of a dissertation thesis. A student must submit 3 copies of his/her dissertation at the time of evaluation duly signed by candidate, guide and head of the institution. The thesis should include plagiarism certificate duly signed by candidate, guide and head of the institution.
- The format of the Dissertation thesis/project should be as under:
 - (a) The thesis should be typewritten on A4 size paper printed on both side in Times New Roman font with 12 size.
 - (b) A margin of at least 1.5 cm must be left at the left side of each page and a margin of 1.0 cm on the top, bottom, and right side of each page.
 - (c) The dissertation thesis shall arrange in the following sequence: Title, introduction of research problem, aims and objectives of the research undertaken, result and discussion, experimental section with characterization of compounds including spectral analysis, conclusion, and latest references as per the scopus index research journal format.
- The evaluation (Thesis & Viva) of the dissertation/project work will be carried out during university practical examination by external examiner.

OR

Practical Details (200 Marks):

(a) Synthesis of Medicinally important privileged scaffolds (with TLC monitoring of Reaction) (50 Marks):

1. 2-Phenylindole from acetophenone
2. 2,3-biphenylbenzopyrine
3. 2,4,5-Triphenyl-1H-imidazole
4. Benzilidene 2-methyloxazol 5-one.
5. 3-Methyl-5-pyrazolone
6. 2-hydroxy-4-methyl quinoline
7. 7-hydroxy-2-methylchromone
8. 5,5-diphenyl hydantoin
9. 2,2'-(4-nitrophenylazanediy)diethanol
10. Dihydropyrimidine (DHPM) derivative

(b) Synthesis of Drug(TLC monitoring of Reaction) (50 Marks):

1. Sulphanilamide
2. Benzocaine
3. Paracetamol
4. Methylsalicylate

(c) Separation Chemistry (100 Marks):

1. Organic mixture separation by column chromatography **(Minimum 3)**.
2. Inorganic mixture separation by column chromatography **(Minimum 3)**.
3. Organic mixture separation and determination of R_f value by TLC **(Minimum 3)**.
4. Inorganic mixture separation and determination of R_f value by TLC **(Minimum 3)**.
5. Extraction of Eugenol from clove
6. Extraction of Caffeine from Tea
7. Extraction of Cinnamaldehyde from Cinnamon
8. Extraction of Nicotine from Tobacco
9. Extraction of Curcumin from Turmeric powder
10. Extraction of Carotenoids from Tomato

Reference book

1. Brian S. Furniss (1989, Fifth edition) Vogel's Textbook of Practical Organic Chemistry. Hoboken: John Wiley & Sons (ISBN: 0-582-462363).
2. Arthur I. Vogel. (second edition) Elementary practical organic chemistry: Small scale preparations. Pearson (ISBN: 978-81-317-5686-7).
3. V.K. Ahluwalia and Renu Aggarwal (University Press), Comprehensive practical organic chemistry: Preparations and qualitative analysis (ISBN: 978-81-7371-273-9)
4. Raj K. Bansal (new age international-5th edition). Laboratory manual of organic chemistry (ISBN:978-81-224-2930-5)

OP-404 : Dissertation/Project Viva Voce or Practical Viva Voce

- Dissertation/project viva voce will be carried out in the form of a presentation of his/her dissertation thesis. The presentation should include brief introduction, objective of research, scheme of research problem, result & discussion, spectra of compounds and conclusion of the present study.

OR

- Comprehensive viva voce based on practical and core courses.