

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 : 2020 – 21

(Effective from June – 2019)



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M.Sc.(Organic Chemistry) SEMESTER – III

(SEMESTER-III)					
Subject code	Subject Name	Credit	Int. Marks	Ext. Marks	Total Marks
M18CHOC301	Stereochemistry (Core)	4	30	70	100
M18CHOC302	Advanced Organic Chemistry (Core)	4	30	70	100
M18CHOC303	Separation Techniques (Core)	4	30	70	100
M18CHE1304	Medicinal Chemistry (Elective)	4	30	70	100
M18CHOP305	Practical	6	-	150	150
M18CHOV306	Viva Voce	2	-	50	50
M18CHOS307	Research Writing and Presentation	2	-	50	50
Total Credits		30	Total Marks		650

(SEMESTER-IV)					
Subject code	Subject Name	Credit	Int. Marks	Ext. Marks	Total Marks
M18CHOC401	Organic Synthesis: A Disconnection Approach(Core)	4	30	70	100
M18CHOC402	Chemistry of Synthetic Drugs(Core)	4	30	70	100
M18CHOC403	Heterocyclic Chemistry(Core)	4	30	70	100
M18CHOC404	Modern Spectroscopy (Elective)	4	30	70	100
M18CHOP405	Practical	6	-	150	150
M18CHOV406	Viva Voce	2	-	100	100
Total Credits		24	Total Marks		650

M18CHOC301 : Stereochemistry (Core)

Unit-1

[12 Hrs]

(a) Fundamental of stereochemistry and chirality

Isomerism, tetrahedron geometry and concept of chirality, Isomers, Classification of stereoisomerism, Optical isomerism, Projection formulae and their interconversion. Classification of stereoisomers based on energy and symmetry criterion. Various types of configurational nomenclature of stereocenters (one, two similar and two dissimilar stereocenters). Ring and \square and diastereoisomerism-Variou methods of nomenclature for acyclic and cyclic systems-cis-trans, E-Z, syn and anti. Stereoisomerism Without a stereogenic carbon: Axial chirality (bi-phenyl, allenes, spiranes, trans-cyclooctene), planar chirality (ansa compounds, paracyclophanes), helicity (hexahelicene).

(b) Racemic mixtures and modification

Theories of racemization, resolution of racemic mixtures, optical purity & enantiomeric excess.

Unit-2

[12 Hrs]

(a) Prochirality and prostereoisomerism

prostereoisomerism and prochirality-introduction Topicity: Examples of homotopic & heterotopic ligands, pro-R and pro-S nomenclature. Examples of Homotopic & Heterotopic faces, Re-Si nomenclature system.

(c) Conformations and stereoisomerism in acyclic system

Conformations, klyne-prelog terminology for torsional angle. Physical methods of conformational analysis. Conformations and reactivity of acyclic molecules like butane, n-pentane, halogeno alkanes, acetaldehyde, propionaldehyde 1,3-butadiene and C-Hetero bond.

Unit-3 : Conformational analysis and reactivity of cyclic system**[12 Hrs]**

- 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 diastereoisomerism.
- Conformation of bridge systems-Bicyclo[2,2,1] heptane and Bicyclo[2,2,2]octane. Exo. Endo nomenclature, bredt's rule.
- Conformation Heterocycles -piperidines-pyramidal inversion and ring inversion.
- Conformation of sugar (Fisher, haworth and chair), epimers, anomers, Epimerization, anomeric effect and mutarotation.

Unit-4 : Stereospecific and Stereoselective reactions-I**[12 Hrs]**

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

(a) Aliphatic nucleophilic substitution reactionsIntroduction, Stereochemistry of S_N1 & S_N2 reaction mechanism, The S_Ni mechanism, Mixed S_N1 & S_N2 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-5 : Stereospecific and Stereoselective reactions-II**[12 Hrs]****(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.

Reference Books:

1. Kalsi, P. S. (2011, Seventh edition) Stereochemistry Confirmation and Mechanism. New Delhi: New Age International (P) Limited. (ISBN: 81-224-2356-6).
2. Subrata Sen Gupta (2014), Basic Stereochemistry of organic molecules. New Delhi: Oxford University press. (ISBN: 978-0-19-945163-0).
3. Finar, I. L. (1989, Fifth edition) Organic Chemistry: Vol -2: Stereochemistry and the Chemistry of Natural Products. Harlow: Longman. (ISBN: 0-582-05916-X).
4. Clayden Jonathan; Greeves Nick, Warren Stuart (2012, Second edition) Organic Chemistry. Oxford: Oxford University Press (ISBN: 0199270295).
5. Eliel, Ernest L., Wilen, Samuel H. (1994) Stereochemistry of Organic Compounds. Hoboken: Wiley-Blackwell (ISBN: 0471016705).
6. Nogradi, M. (2008, Second revised and updated edition) Stereoselective synthesis: A practical approach. Weinheim: Wiley VCH. (ISBN: 978-3-527-61568-1).
7. Kalsi, P. S. (2012, Fourth edition) Organic Reactions Stereochemistry and Mechanism (Through Solved Problems). New Delhi: New Age International (P) Limited. (ISBN : 9788122417661).

M18CHOC302 : Advanced Organic Chemistry (Core)**Unit-1 : Pericyclic reactions and concerted mechanism-I****[14 Hrs]**

- 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 $4n\pi$ system and $(4n+2)\pi$ system. Examples of different electrocyclic reactions and their stereochemistry.

Unit-2 : Pericyclic Reactions and Concerted Mechanism-II**[14 Hrs]**

- **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.

Unit-3 : Asymmetric synthesis

[12 Hrs]

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

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

Unit-4 : Synthesis of natural products-I

[10 Hrs]

Introduction, definition, classification, importance and total synthesis of following alkaloids:

- Phenanthrene group: Morphine, Heroin, Codeine
- Indole group: Reserpine
- Quinoline group: Quinine
- Pyridine groups: Ricinine
- Pyrrolidine group: Nicotine
- Tropane alkaloids: Atropine, Cocaine
- Phenylethylamine: Adrenaline

Unit-5 : Synthesis of natural products-II

[10 Hrs]

Introduction, importance and total synthesis of:

- Purines bases: Uric acid, Purine, Adenine, Guanine
- Xanthine bases: Xanthine, Hypoxanthine, Caffeine, Theobromine, Theophylline
- Pyrimidines: Uracil, Thymine and Cytosine
- Nucleic acids: Introduction, structure of nucleic acid, structure difference between DNA & RNA. Synthesis of Nucleosides and Nucleotides

Reference Books

1. Vinay P. Sharma & Rakesh Kumar. Pericyclic reactions and organic photochemistry, Pragati Prakashan, 2008, Meerut- (ISBN-978-81-8398-632-8)
2. Finar, I. L. (1989, Fifth edition) Organic Chemistry: Vol -2: Stereochemistry and the Chemistry of Natural Products. Harlow: Longman. (ISBN: 0-582-05916-X).
3. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, 1st Ed., Oxford University Press, 2001.
4. László Kürtip; Barbara Czako (2004, First edition) Strategic Applications of Named Reaction in Organic Synthesis. Philadelphia: Elsevier Publishing company (ISBN: 9780124297852).
5. M.B. Smith & J. March, March's Advanced Organic Chemistry, 5th Ed., John Wiley & Sons, New York, 2001.
6. Peter Sykes, A Guide book to Mechanism in Organic Chemistry, 6th Ed., Orient Longman, Ltd., New Delhi, 1997.

M18CHOC303 : Separation Techniques (Core)

Unit-1 : Adsorption and Partition Chromatography

[12 Hrs]

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

Unit-2 : Planar Chromatography

[12 Hrs]

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

Unit-3 : Gas Chromatography

[12 Hrs]

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

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

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

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

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.

M18CHE1304 : Medicinal Chemistry (Elective)**Unit-1 : Drug design and development****[12 Hrs]**

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

Unit-2 :**[12 Hrs]****(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-3 : Pharmacokinetics**[12 Hrs]**

Introduction, route of drug absorption, distributions of the drug and factor affecting. Drug metabolism, concept of drug excretion.

Unit-4 : Pharmacodynamics**[12 Hrs]**Receptors and drug action: Types of receptors, theories of drug-Receptor interactions, biotransformation of the drug, phase I & II reactions, concept of bioassay and definition of IC₅₀, LD₅₀, ED₅₀, MIC and EC₅₀, GI₅₀.**Unit-5 :****[12 Hrs]****(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.

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 N: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 Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.

M.Sc. (Organic Chemistry) SEMESTER-III
M18CHOP305 : Practical
Practical Detail

Unit-1 : Organic Synthesis**[9 Hrs]****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-Carbethoxycoumarin from Salicyldehyde

Unit-2 : Separation Technique**[3 Hrs]****Extraction, isolation and TLC analysis of natural products:**

1. Eugenol from clove
2. Caffeine from Tea
3. Cinnamaldehyde from Cinnamon
4. Nicotine from Tobacco
5. Curcumin from Turmeric powder
6. Carotenoids from Tomato

Reference Books

1. Brian S. Furniss (1989, Fifth edition) Vogel's Textbook of Practical Organic Chemistry. Hoboken: John Willey & 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)

M.Sc. (Organic Chemistry) SEMESTER-III

M18CHOV306 : Viva Voce [50 Marks]

Comprehensive viva voce based on core & elective courses

M18CHOS307 : Research Writing & Presentation

Research proposal Writing preparation (Minimum 5000 words):

[50 Marks]

- Explanation of various research funding agencies(UGC, DBT, DST, CSIR, SERB, GJCOST) & their research support schemes.
- 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.)
- Assign organic chemistry based research problems and its literature review.
- Preparation and submission of one research proposal for any one funding agency.
- Presentation (ppt) of the prepared research proposal including all aspects.

M.Sc. (Organic Chemistry) SEMESTER-IV

M18CHOC401 : Organic Synthesis: A Disconnection Approach

Unit-1

[12 Hrs.]

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

[12 Hrs.]

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

[12 Hrs.]

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

[12 Hrs.]

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.

Unit-5

[12 Hrs.]

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).

M18CHOC402 : Chemistry of Synthetic Drugs

Unit-1

[14 Hrs.]

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

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
4. Mesylate
5. Neuraminidase Inhibitors For Influenza: Oseltamivir Phosphate (Tamiflu), Zanamivir.
6. Antimycobacterial (TB)drugs: Isoniazid, Ethambutol

Unit-2

[12 Hrs.]

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.

Diuretics drugs

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

1. Thiazides(Benzothiadiazines): Chlorothiazide, Hydrochlorothiazide
2. Carbonic-Anhydrase Inhibitors: Acetazolamide, Ethoxzolamide
3. Miscellaneous Sulphonamide Diuretics: Indapamide
4. Miscellaneous Diuretics- Triamterene

Unit-3

[10 Hrs.]

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.

Non-sedating antihistamines

1. Histamine blocker: Citrizine, fexofenadine

Unit-4

[12 Hrs.]

Analgesic and Non-steroidal anti-Inflammatory drugs (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.
6. Pyrazolones and pyrazolodiones: Phenazone (Antipyrine), Phenylbutazone.

Unit-5

[12 Hrs.]

Anaesthetic drugs

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

General Anaesthetics:

1. Inhalation Anaesthetics: Halothane, Chloroform.
2. Intravenous Anaesthetics: Ketamine Hydrochloride.
3. Basal Anaesthetics: Tribromoethanol, Paraldehyde.

Local Anesthetic

1. The Esters: Benzocaine, Cyclomethycaine
2. Piperidine or Tropane Derivatives: α -Eucaine, Benzamine
3. The Amides: Lignocaine
4. Miscellaneous Type: Pramoxine

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. 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.
2. Synthesis of Essential Drugs by R.S. Vardanyan and V.J. Hruby, Elsevier, ISBN: 978-0-444-52166-8.
3. Medicinal Chemistry by Ashutosh Kar, New Age International (P) Ltd, ISBN : 978-81-224-2305-7.
4. Burger's Medicinal chemistry and drug discovery, Sixth edition by Donald J. Abraham, John Wiley and Sons, Inc.

M18CHOC403 : Heterocyclic Chemistry

Unit-1

[12 Hrs.]

1. **Nomenclature of heterocyclic compounds**
2. **Heterocyclic analogues of cyclopropane and cyclobutane**
 - a. Preparation and properties of aziridine, oxirane, thiirane, Azetidione.
 - b. Preparation of 1,2-diazetidione, 1,2-dioxetane, 1,3-dithietane.

Unit-2

[12 Hrs.]

- Heterocyclic analogues of cyclopentane and its fused ring system**
- a. Preparation and properties of pyrrole, furan, thiophene.
 - b. Preparation and properties of indole, benzofuran, benzothiophene.
 - c. Preparation of isoindole, indolizine, isatin.

Unit-3

[12 Hrs.]

1. **Heterocyclic analogues of benzene**
 - Preparation and properties of pyridine and pyran.
2. **Compounds with two heteroatoms in a six membered ring and its fused ring system**
 - Preparation of pyridazine, pyrimidine, pyrazine, thiazine, dioxane, Morpholine, phthalazine, quinazoline, quinaxoline, phenothiazine.

Unit-4

[12 Hrs.]

- Heterocyclic analogues of naphthalene and its fused ring system**
- a. Preparation and properties of quinoline, isoquinoline, acridine.
 - b. Preparation of benzopyran, benzopyran-2-one and benzopyran-4-one.

Unit-5

[12 Hrs.]

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

Reference Books

1. Heterocyclic Chemistry by R.K. Bansal, New age international (ISBN-13: 978-8122412123)
2. Heterocyclic chemistry by J.A. Joule, K. Mills (2010, First edition) John Wiley & Sons, Inc., Hoboken, New Jersey, (ISBN 978-1-405-13300-5).
3. Modern Heterocyclic Chemistry by Julio Alvarez-Builla, Juan Jose Vaquero, and Jose' Barluenga, Wiley-VCH publication (ISBN 978-3-527-33201-4)
4. Name reaction in Heterocyclic chemistry by Jie Jack Li, Wiley-interscience (ISBN 0-471-30215-5).
5. The Chemistry of Heterocycles by Theophil Eicher and Siegfried Hauptmann, Wiley-VCH publication (ISBN 3-527-30720-6).
6. Handbook of Heterocyclic chemistry by A. R. Katritzky, Pergamon-Elsevier (ISBN 0-08-042998-2)

M18CHOC404 : Modern Spectroscopy

Unit-1

[10 Hrs.]

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 (ie. unsaturated carbonyl compounds) (3) aromatic carbonyl system.

Unit-2

[08 Hrs.]

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

[08 Hrs.]

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

[14 Hrs.]

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

[20 Hrs.]

Nuclear Magnetic Resonance Spectroscopy-II

^{13}C NMR: Introduction, Principle, chemical shift, application and problems of ^{13}C -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).

M.Sc. (Organic Chemistry) SEMESTER-IV

M18CHOP405 : Practical Detail

Lab Hours: - 14

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

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):

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

c) Estimation of Drugs:

- Drug estimations by titrimetric method (3 Practicals)
- Drug estimations by colorimetry (3 Practicals)
- Drug estimations by spectrophotometry (3 Practicals)

Reference Books

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)

M18CHOV406 : Viva Voce [100 Marks]

Comprehensive viva voce based on core & elective courses