

FOURTH SEMESTER
ORGANIC CHEMISTRY SPECIALIZATION
Ch-401 OC: ADVANCED STEREOCHEMISTRY AND RETROSYNTHETIC
ANALYSIS

52 Hours

UNIT-I

13h

Advanced Stereochemistry – I

Optical activity in the absence of chiral atoms

Chirality in biphenyls, adamantanes, ansa compounds, cyclophanes, *trans*-cyclooctene, catenanes, rotaxanes and helicenes. Assignment of R, S- configuration to these classes of compounds.

Optical activity due to the presence hetero atoms

Chirality of organic compounds due to the presence of silicon, nitrogen, phosphorous, arsenic and sulphur atoms. Determination of R,S-configuration of these compounds using CIP rules.

Transannular reactions

Conformational analysis of medium rings.

Transannular reactions: Hydrolysis of medium ring epoxides and bromination of C₈-C₁₀ cyclic dienes.

UNIT-II

13h

Advanced Stereochemistry – II

Determining absolute and relative configuration

- i). Chemical correlation of configuration: Methods without involving the chiral centre. Chemical transformation involving the chiral centre. Chemical correlation involving diastereomers.
- ii). Methods based on comparison of optical rotation: Distance rule, Rule of shift, Rule of optical superposition, Mill's rule, Method based on molecular rotation difference
- iii) The method of quasi-racemate.
- iv) Use optical rotatory dispersion curves: α -axial haloketone rule and its applications, octant rule (application of these rules in the determination of absolute configuration of substituted cyclohexanones, decalones and cholestanones).
- v) Method based on anomalous X- ray scattering.

UNIT-III

13h

Retrosynthetic analysis

Protecting groups

Principle of protection of alcohols, amines, acids and carbonyl groups

Disconnection approach

Introduction to synthons, and synthetic equivalents, disconnection approach. Basic principles and terminologies used in disconnection approach. One group C-X and two group C-X disconnections. Chemoselectivity, reversal of polarity, cyclisation reactions.

One group and C-C two group disconnections: Synthesis of alcohols, carbonyl compounds and alkenes. Use of acetylides and aliphatic nitro compounds in organic synthesis. Diels-Alder

reaction, 1,3-difunctionalised compounds, α,β -unsaturated compounds, carbonyl compounds condensations, 1,5- difunctionalised compounds. Michael addition and Robinson annelation.

UNIT-IV

13h

Retrosynthetic analysis and synthetic route for some complex molecules

Juvabione, aromadendrene, longifolene, cortisone, reserpine, vitamin-D, lycorane alkaloids and Prelog-Djerassi lactone.

SUGGESTED BOOKS

1. Stereochemistry, V R Dani, Asian books, New Delhi, 2015.
2. Principles of organic synthesis, R. Norman and J. M. Coxon, 3rd edition, CRC Press, 2015.
3. Organic synthesis: Concepts, methods and starting materials, 3rd edition, J-H. Furhlop and G. Li, Wiley-VCH, 2014.
4. Organic chemistry Volumes 1 and 2, 6th edition. I. L. Finar, Pearson – New Delhi, 2012.
5. Advanced organic chemistry, J. March, 4th Edn. John Wiley, 2008.
6. Stereochemistry D J Morris, RSC, Cambridge, 2001
7. Stereochemistry of organic compounds- Principle and applications, D. Nasipuri, 2nd edition, New Age International Publishers, 2001.
8. Stereochemistry, Nasipuri, D, New Age, 1999.
9. Advanced organic chemistry Part B, F. A. Carrey and J. Sundberg, Plenum Press, 1999.
10. Stereochemistry – conformation and mechanism, P S Kalsi, New Age International, Bangalore 1999.
11. Some modern methods of Organic Synthesis, W. Caruthers, Cambridge Uni. Press London, 2nd edition, 1998.
12. Organic synthesis, C. Willis and M. Wills, Oxford University Press, 1995.
13. Stereochemistry of carbon compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley & Sons, 1994.
14. Organic Chemistry, R. E. Ireland Prentice-Hall India, New Delhi, 1975.
15. Organic synthesis: The synthon approach, S. Warren, John Wiley & Sons, New York, 1st edition.. 1983.
16. Designing organic synthesis: A disconnection approach, S. Warren, John Wiley & Sons, New York, 2nd edition, 1987.
17. Stereochemistry, Potapov, MIR, Moscow, 1984.
18. Stereochemisry, E L Eliel, TMH, New Delhi, 1984.

C-402 OC: CHEMISTRY OF NATURAL PRODUCTS

52 Hours

UNIT-I

13h

Terpenoids

Classification, nomenclature, occurrence and isolation. Isoprene rules. Stereochemistry of citral, farnesol, limonene, 1,8-cineole, menthols and borneols. Correlation of configurations of terpenoids.

Structure elucidation of camphene, α -pinene, β -caryophyllene, α -santonin and gibberillic acid. Synthesis and biosynthesis of the following:

Linalool, α -terpineol, fenchone, eudesmol, abietic acid. Commercial synthesis of camphor.

Biosynthesis of squalene and cyclisation of squalene into α -lanosterol and friedelene.

Carotenoids

Methods of isolation. Structural relationship of α -, β - and γ -carotenes. Structure elucidation and synthesis of β -carotene.

UNIT-II

13h

Alkaloids

Definition, nomenclature, occurrence, isolation, classification, General methods of structure elucidation. Synthesis and biosynthesis of the following alkaloids:

Ephedrine, hygrine, coniine and cocaine. Cinchona alkaloids: Cinchonine and quinine.

Opioid alkaloids: Morphine, codeine, thebiene and heroin.

Structure elucidation and synthesis of papaverine, reserpine and ergotamine. Photochemical synthesis of Nuciferine, coradyline and tylophorine.

UNIT-III

13h

Porphyrins

Structure elucidation and synthesis of haemin, chlorophyll-a and vitamin-B₁₂ (synthesis of Vitamin-B₁₂ from cobyric acid).

Nucleic acids

Introduction, components of nucleic acids, nucleosides, nucleotides and oligonucleotides. Structure elucidation and synthesis of nucleosides and nucleotides.

Chemical synthesis of oligonucleotides: Protecting groups for hydroxy group in sugar, amino group in the base and phosphate functions. Methods of formation of internucleotide bonds: DCC, phosphodiester approach, phosphotriester approach, phosphite triester and phosphoramidite methods. Solid phase synthesis of oligonucleotides.

UNIT-IV

13h

Prostaglandins

Introduction, nomenclature, classification and biological role of prostaglandins. Structure elucidation and stereochemistry of PGE₁, PGE₂ and PGE₃. Synthesis of PGE₁ and PGE₂ by Corey's and Stork's approaches. Synthesis of PGE₃ by Upjohn's approach. Synthesis of

prostacyclin I₂ and thromboxane B₂. Biosynthesis of prostaglandins.

Insect pheromones

Introduction, classification. Pheromones in pest control. Syntheses of (one synthesis should be stereoselective synthesis)

- i) Grandisol (component of boll weevil pheromone)
- ii) Farnal (trail pheromone of pharaoh's ants)
- iii) Brevicomins (pheromone from *Dendroitis brevicomis*)
- iv) (+)- Disparlure (gypsy moth sex pheromone).
- v) 3,11-Dimethyl-2-nonacosanone (pheromone of German cockroaches).
- vi) Bombykol (sex pheromone of silkworm moth).
- vii) Multistriatin (Elm bark beetle sex pheromone).

SUGGESTED BOOKS

1. Organic Chemistry Volume 2, 6th edition, I L Finar, Pearson – New Delhi, 2015.
2. Chemistry of natural products – a unified approach, 2nd edition, N R Krishnaswamy, Universities Press, Hyderabad, 2010.
3. Natural products: Their chemistry and biological significance, J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorpe & J. B. Harborne, Longman, UK, 1994.
4. Terpenes, J. Verghese, Tata McGraw-Hill, New Delhi, 1982.
5. Chemistry of terpenes and terpenoids, A. Newman, Academic Press, London, 1975.
6. Handbook of naturally occurring compounds Vol. II: Terpenes, T. K. Davon, A. I. Scott, Academic Press, NY, 1972.
7. Natural products chemistry Vol. I & II, K. Nakanishi, T. Goso, S. Ito, S. Natori & S. Nozoe, Academic Press, NY, 1974.
8. Total synthesis of natural products Vol. I & VI, Apsimon, John Wiley, NY, 1973-1981.
9. Chemistry of natural products Vol. I & II, O. P. Aggarwal, Goel Publishing House, 6th Edn. 1982.
10. Total synthesis of natural products: The chiral approach Vol. III, S. Hanessian Pergamon Press, 1983.
11. Total synthesis of steroids, Akhaun & Titov, Jerusalem, 1969.
12. Medicinal natural products: A biosynthetic approach, P. M. Dewick. John Wiley, Chichester, 1997.
13. The colours of life: An introduction to the chemistry of porphyrins and related compounds, L. R. Milgrom, Wiley Chichester, 1995.
14. Interpretation of the UV spectra of natural products, A.I. Scott, Pergamon Press, Oxford, 1964.
15. Spectral data of natural products Vol. I- K. Yamaguchi, Elsevier Publishing Co, London, 1970.
16. Chemistry of natural products: A unified approach, N. R. Krishnaswamy, University Press, India, 1999.

C-403 OC: INDUSTRIAL ORGANIC CHEMISTRY

52 Hours

UNIT-I

13h

Dyes

Introduction. Modern theories of colour and chemical constitution. Methods of applying dyes to fabrics. A general study of the following: Mordant dyes, vat dyes, disperse dyes, fibre reactive dyes, sulphur dyes, cyanine dyes, solvent dyes and pigment dyes with examples. Direct azo dyes (Congo red), acid azo dyes, (Ponceau 2R, Naphthol blue black 6B), basic azo dyes (Chrysoidin G, Bismarck brown), developed dyes (indigo).

Fluorescent brightening agents (Tinopal).

Cyanine dyes: Quinoline blue and sensitol red. Chemistry of colour developers, and instant colour processes.

Synthesis and applications of malachite green, rhodamine-B, phenolphthalein and methyl orange. Triphenylmethane dyes: crystal violet, *p*-rosaniline, acid chrome Violet-K.

Application of dyes in photography, visual displays, biological studies and electronics.

UNIT-II

13h

Heterocyclic Chemistry

Small ring heterocycles: Properties and reactions of 3- and 4- membered heterocycles: oxiranes, thiranes, aziridines, azetidines, oxetanes and thietanes.

Benzo-fused heterocycles: Synthesis and reactions of benzofurans, benzothiophenes, benzoxazoles, benzothiazoles and benzimidazoles.

Six-membered heterocycles with two or more heteroatoms: Synthesis of Diazines, triazines, tetrazines and thiazines.

Seven and large membered heterocycles: Synthesis and reactions of azepanes, oxepines, thiepinines, diazepines, thiazepines, azocines, diazocines, dioxocines and dithiocines.

Heterocycles containing P, As, Sb and Bi: Synthesis of 5- and 6- membered heterocycles with P, As, Sb and Bi.

Mesoionic compounds: General classification, chemistry of some important meso-ionic heterocycles of type-A and type-B and their applications.

UNIT-III

13h

Organometallic Chemistry

Organosilicons: Preparation and reactions of trialkylsilyl halides with ethers, epoxides, esters, carbamates and acetals. Peterson olefination.

Organotins: Preparation and reactions of tri-*n*-butyltin hydride, Barton decarboxylation and Barton- McCombie reaction.

Organomercurials: Preparation, electrophilic substitution reactions, Solvomercuration-demercuration reaction. Cyclopropanation of alkenes.

Organozincs: Preparation, reaction with compounds containing acidic protons, reaction with C-C multiple bonds, trans-metallation, addition reactions of zinc reagents with carbonyl compounds. Simmons Smith and Reformatsky reaction.

Organolithiums: Preparation, deprotonation reaction, nucleophilic addition reactions, reactions with imines, nitriles and isonitriles.

Organocopper reagents: (Gilman reagents-lithium dialkyl cuprates): Preparation, reactions with alkyl, allyl, vinyl, benzyl and aryl halides, aldehydes, ketones (including α,β - unsaturated carbonyl compounds) and epoxides.

Organoseleniums: Preparation, synthesis of alkenes from alkyl halides and α,β - unsaturated carbonyl compounds from carbonyl compounds.

Organoaluminiums: Preparation, hydroalumination and carboalumination of alkenes, nucleophilic addition reactions with carbonyl compounds and Hydrocyanation. Preparation of alkenyldialkylalanes and their reactions.

UNIT-IV

13h

Polymers

Preparation, properties, classification (natural and synthetic), nomenclature and importance of polymers. Properties of polymers (molecular weight, glass transition temperature – T_g, solubility, viscoelasticity etc). Basic concepts and techniques in polymer chemistry. Monomers, repeat units, degree of polymerization. Homo-, co-, ter-, addition and condensation polymers with examples. General structures of polymers. Tacticity. Techniques of polymerization (bulk, emulsion, copolymerization). Stereochemistry – configuration. Thermoplastics, thermosets and elastomers. Polymer processing techniques, additives for improvement of polymer properties, spinning of industrial polymers, wet and dry. Melt spinning. Application of polymers in fibres, composites, adhesives etc. Polymer degradation – thermal and oxidative-reductive processes.

Natural polymers: Polyisoprenes, and chitosan. Synthesis and applications of vinyl polymers: (polyethylene, poly styrene, polypropylene, PVC, chlorinated PVC, teflon and polymethacrylate). Polyesters: (Polyethylene terephthalate). Polyamides: Kevlar and Nomex, Bakelite. Polyureas, polyurethanes, polyimides and polysulfones.

SUGGESTED BOOKS

1. Modern methods of organic synthesis, W. Carruthers and I Coldham, 4th edition, Cambridge Univ. Press, Cambridge, 2014.
2. Advanced organic chemistry – organic synthesis heterocycles and biomolecules, N Tewari, Books and Allied Publishers, Kolkata – 2013.
3. Heterocyclic Chemistry, J. A. Joule, K. Mills and G. F. Smith, 5th edition, Blackwell, Chichester, 2010.
4. Synthetic Dyes, G R Chatwal, Himalaya, New Delhi – 2009.
5. Advanced Organic Chemistry, J. March, 4th edition, John Wiley, 2008.
6. Technology of synthetic dyes, pigments and intermediates, EIRI, New Delhi – 2005.
7. Polymer science, V R Gowarikar, N V Vishwanathan, J Sreedhar, New Age International, New Delhi – 2005.
8. Industrial organic chemistry, 4th edition, K. Weissmehl, H,-J Arpe, translated by C R Lindley, S Hawkins, Wiley-VCH, Weinheim, 2003.
9. Handbook of heterocyclic chemistry, 2nd edition, A R Katritzky, Pergamon, Oxford, 2000.
10. The chemistry of colour application R M Christie, R R Mather and R H Wardman, Blackwell, Oxford, 2000.
11. Stereochemistry of Organic Compounds, D Nasipuri, New-Age International, 1999.
12. Heterocyclic Chemistry, Vols. 1-3, R. R. Gupta, M. Kumar and V. Gupta, Springer Verlag, 1998.
13. Comprehensive Heterocyclic Chemistry, A. R. Katritzky and C. W. Rees, Eds. Pergamon Press, 1996.
14. The Chemistry of Heterocycles, T. Eicher and S Hauptmann, Thieme, 1995.

15. Introduction to synthetic polymers, I M Campbell, Oxford, 1994
16. Heterocyclic Chemistry, T. L. Gilchrist, Longman, 1992.
17. Textbook of polymer science, 3rd edition, F W Billmeyer, Wiley, 1984.
18. Contemporary Heterocyclic Chemistry, G. R. Newkome, and W. W. Paudler, Wiley-Inter Science, 1982.
19. An introduction to Heterocyclic Compounds, 3rd edition, R. M. Acheson, John Wiley, 1976.
20. The chemistry of synthetic dyes, K Venkataraman Ed., Vols 1-7, Wiley, New York, 1971.
21. Synthetic dyes in biology, medicine and chemistry, E Gurr, Academic, NY, 1971.

C-404 OC: MEDICINAL ORGANIC CHEMISTRY

52 Hours

UNIT-I

13h

Basic Concepts of Medicinal Chemistry

Basic terms defined: Drug, medicine, pharmacy, pharmaceuticals, toxicology, pharmacodynamics agents, pharmacophore, pharmacodynamics, metabolites and anti-metabolites, chemotherapy. LD₅₀, ED₅₀, IC₅₀ and ID₅₀.

Classification of drugs on the basis of therapeutic action. Drug Discovery. Identification of Lead. Lead Modification. SAR. Identification of pharmacophore. Structure-activity relationship structure modification to increase potency and the therapeutic index by homologation; chain branching; ring-chain transformation. Bioisosterism. Concept of prodrugs and soft drugs. Properties of soft drugs.

Basics of drug receptor interactions. Theories of drug activity. Hansch equation. QSAR. Computer-aided drug design and molecular modeling.

UNIT-II

13h

Steroids

Occurrence. Nomenclature, basic skeleton, Diels hydrocarbon and stereochemistry. Isolation, structure and structural elucidation of sterols and bile acids (determination of ring size, nature of side chain, position of angular methyl and stereochemistry of ring junctions). Sex hormones and corticosteroids. Synthesis of cholesterol, estrone, progesterone, androsterone, testosterone. Photo products of ergosterol- vitamins D. Barton reaction for the synthesis of aldosterone.

Marker degradation. Brief discussion of homosteroids, norsteroids and oral contraceptives. Synthesis of (*dl*)-norgestrel and ethinyl oestradiol.

UNIT-III

13 h

Synthesis and mechanism of drug action and of the following classes of drugs

Introduction and general mode of action of:

Antibiotics: Discovery/synthesis of penicillins, cephalosporin-C, streptomycin, chloromycetin and tetracyclins (terramycin and aureomycin).

Antipyretics, analgesics and non steroidal anti-inflammatory drugs: Aspirin, paracetamol, phenacetin, novalgin, phenylbutazone and ibuprofen.

Antidiabetics: Sequence of A- & B- chains of insulin, glibenclamide, metformin, ciglitazone.

Antihistamines: Methapyrilene, chlorpheniramine.

Antivirals: Acyclovir, amantidine, rimantidine and zidovudine.

Antineoplastic agents: alkylating agents and antimetabolites in treatment of cancer. Synthesis of mechlorethamine, cyclophosphamide, melaphan, uracil mustard and 6- mercaptopurine.

Cardiovascular drugs: Synthesis of amyl nitrite, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol, oxyprenol.

UNIT-IV

13h

Local anti-infective agents

Introduction synthesis and general mode of action. Sulfa drugs: sulphanilamide, dapsone.

Antiparasitic chemotherapy: furazolidone, nalidixic acid, ciprofloxacin, chloroquin and primaquin, DOTS treatment using p-aminosalicylic acid, isoniazide, ethionamide, ethambutal.

Antifungals: griseofulvin, fluconazole, econazole.

Psychoactive drugs- chemotherapy of the mind: Synthesis of utility of the following: pethidine, methadone, benzodiazepines: diazepam, oxazepam, chlorazepam, alprazolam, chlorpromazine, butyrophenones, buspirone, barbiturates: phenobarbital, phenytoin, ethosuximide, trimethadione, , thiopental sodium, glutethimide. SAR with opioid alkaloids.

SUGGESTED BOOKS

1. An Introduction to Medicinal Chemistry, 6th edition, P Graham, Oxford, 2017.
2. The Organic Chemistry of Drug Design and Drug Action, R B Silverman, and M W Holladay, 3rd edition, Academic Press, Amsterdam, 2014.
3. Organic chemistry Vol.II, I. L. Finar, 6th Edn. Pearson – New Delhi, 2012.
4. Foye's Principles of Medicinal Chemistry, 6th Edn., T L Lemke and D A Williams Eds., Lippincott, Williams and Wilkins, 2008
5. Medicinal Chemistry, T Nogrady and D F Weaver, 3rd edition, Oxford, 2006
6. Goodman and Gilman's Pharmacological Basis of Therapeutics, 11th Edn., Tata McGraw-Hill, 2005.
7. Burger's Medicinal Chemistry and Drug Discovery, Vols. 1-6 Ed. D.J. Abraham, John Wiley, 2003
8. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical chemistry, J H Block and J M Beale, Jr., Eds., Lippincott, Williams and Wilkins, 2003.
9. Medicinal Chemistry – G R Chatwal, Himalaya, New Delhi, 2002.
10. Instant Notes Medicinal Chemistry, P Graham, Viva, New Delhi, 2002
11. Medicinal Chemistry, A Kar, Wiley, 2000.
12. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock, New Age International, 1999.
13. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley, 1998.
14. Medicinal natural products: A biosynthetic approach, P. M. Dewick. John Wiley, Chichester, 1997.
15. Synthetic drugs, G. R. Chatwal, Himalaya, New Delhi, 1995.
16. Natural Products Chemistry Vol 1 and 2, G R Chatwal, Himalaya, New Delhi, 1990
17. Comprehensive Organic Chemistry, Vol. 5 (Antibiotics), D. H. R. Barton, W. D. Ollis, Pergamon Press, NY, 1979.
18. Total synthesis of natural products: The chiral approach Vol.III, S. Hanessian Pergamon Press, 1983.
19. Total synthesis of steroids, Akhaun & Titov, Jerusalem, 1969.
20. Natural products: Their chemistry and biological significance-J. Mann, R S Davidson, J. B. Hobbs, D. V. Banthorpe & J. B. Harborne, Longman, UK, 1994.
21. Natural products chemistry Vol. I & II, K. Nakanishi, T. Goso, S. Ito, R. Natori & S. Nozoe, Academic Press, NY, 1974.
22. Chemistry of natural products Vol. I & II, O. P. Aggarwal, Krishna Prakashan,

2015.

23. Total synthesis of natural products: The chiron approach, S Hanessian Pergamon Press, 1983.

PRACTICALS

(4 days a week, 4 hours a day)

C-405 OC: PREPARATION OF INDUSTRIAL IMPORTANCE

1. Preparation of NBS from succinic acid and its application in allylic/benzylic brominations
2. Photochemical preparation of benzpinacolone from benzophenone.
3. Preparation of tetracyclone. Generation of benzyne and its trapping with tetracyclone.
4. Synthesis of 2-phenylindole from phenylhydrazone
5. Oxidation of anthracene to anthraquinone and conversion to anthrone.
6. Reduction of benzoin to stilbene.
7. Esterification of 4-nitrobenzoic acid and conversion to benzocaine.
8. Preparation of tetraphenyldihydrophthalic anhydride from N-phenylglycine.
9. Preparation of 2,4,5-triphenyloxazole from benzoin.
10. Biosynthesis of ethanol from sucrose.
11. Preparation of methyl red/methyl orange from aniline.
12. Synthesis of benzimidazole from urea.
13. Conversion of 2-naphthol to 1-bromo-2-naphthol.
14. Synthesis of hippuric acid.
15. Synthesis of 1,2,3,4-Tetrahydrocarbazole.
16. Diels-Alder cycloaddition of anthracene with maleic anhydride.
17. Synthesis of 2,3-diphenylquinoxaline.
18. Green synthesis of acetanilide from aniline.
19. Photo-dimerisation of *trans*-cinnamic acid to β -truxinic acid.
20. Preparation of caprolactam from cyclohexanone. Conversion to Nylon-6.
21. Synthesis of Nylon-6,6.
22. Synthesis of tetraphenylporphyrin.
23. Preparation of indigo from anthranilic acid.
24. Synthesis of fluorescein and eosin from resorcinol.
25. Preparation of urea-formaldehyde resin (bakelite).

C-406 OC: EXTRACTIONS & SEPERATIONS

1. Extraction of piperine from pepper.
2. Extraction of caffeine from tea leaves.
3. Extraction of hesperidine from citrus fruits rinds'.
4. Extraction of azelaic acid from castor oil.
5. Extraction of DNA from onion peels.
6. Extraction of lycopene from tomatoes.
7. Isolation of essential oils from cumin.
8. Isolation of essential oils from rose petals.
9. Isolation of curcuminoids from turmeric powder.
10. Isolation and separation of lactose and casein from milk.
11. Isolation and separation of pigments chlorophyll and β -carotene from spinach.

12. Separation of caffeine from tannins by sublimation.
13. Natural product isolation using steam distillation and liquid phase extraction of thymol, camphor, and citral, monoterpenes sharing a unified biosynthetic precursor
14. Isolation of enzymes: Lipase and Sucrase.
15. Extraction of groundnut/coconut/eucalyptus oils
16. Separation of p-rosaniline and methyl red by column chromatography.
17. Separation of amino acids by paper chromatography.
18. Separation of carbohydrates by thin layer chromatography.
19. Separation of *o*- and *p*-nitroanilines by thin layer chromatography.
20. Separation of anthracene from anthracene picrate.
21. TLC of analgesic drugs: acetaminophen, aspirin, caffeine, ibuprofen and salicylamide.

C-407 OC: INSTRUMENTAL METHODS AND QUANTITATIVE ANALYSIS

Instrumental methods in organic analysis

1. Recording/predicting/downloading the UV, IR, NMR and GC-MS spectra from web sites of the compounds prepared in third semester.
2. Structural elucidation of organic compounds with the help of spectra provided by the instructors/examiners.

Quantitative analysis

Estimations:

1. Estimation of Nitro group by reduction using SnCl_2 .
2. Estimation of Nitrogen by Kjeldahl's method.
3. Estimation of an acid in presence of an amide.
4. Estimation of an ester in the presence of an acid.

C-408 OC: QUALITATIVE ANALYSIS OF BINARY MIXTURES

Separation of binary mixture of organic compounds by organic solvents/aqueous techniques. Identification of the separated component/s by systematic qualitative organic analysis.

SUGGESTED BOOKS

1. Organic Synthesis Collective Volumes 1 to 11, 1956-2019. (Freely available on the web)
2. Advanced practical organic chemistry, 3rd edition, J Leonard, B Lygo and G Proctor, Routledge, CRC Press, London, 2013.
3. Practical Organic Chemistry, 5th edition, Furniss B S, Hannaford, A J, Smith, P W G and Tachell, A R, Pearson, New Delhi – 2012.
4. Practical organic chemistry F.G. Mann and B. C. Saunders, Pearson, 2009.
5. Laboratory Techniques in Organic Chemistry, V K Ahluwalia, Pooja Bhagat and Renu Aggarwal, I K International Publishing House, New Delhi, 2005.
6. Intermediates for Organic Synthesis, V K Ahluwalia, Pooja Bhagat, Ramesh Chandra and Renu Aggarwal, I K International Publishing House, New Delhi, 2005.
7. Text book of practical organic chemistry, A. I. Vogel, Pearson, 5th Edition, Delhi, 2004.
8. The systematic identification of organic compounds, 8th edition, R L Shriner, C K F Hermann, T C Morrill, D Y Curtin and R C Fuson, Wiley, 2004
9. Organic structures from spectra, 3rd edition, L D Field, S Sternhall, J R Kalman, Wiley, Sydney, 2002.
10. Laboratory Experiments for Organic and Biochemistry, IV edition, F. A. Bettelheim and J. M