M.Phil/Ph.D Organic Chemistry

CHM-751 Modern Trends in Organic Synthesis 3(3-0)

Introduction to retero synthesis and disconnection approach, synthesis of aromatic compounds. One and two group C-X disconnections. Donor and acceptor synthesis and concepts of Umpulung. C-C disconnections and disfunctionalized compounds compounds. Devising synthetic schemes for unknown molecules and some natural products.

Books Recommended:

1. R. O. C. Norman "Principles of Organic Synthesis", 3rd Ed, Blackie Academic & Professional, Glasgow, UK (1993).
2. G. M. Loudon, "Organic Chemistry", 3rd Ed. Addison Wesley, London Company, UK (1995).
3. S. H. Pine, "Organic Chemistry", 5th Ed., McGraw Hill, New York, USA (1987).
4. G. M. Loudon, "Organic Chemistry", 2nd Ed., Addison Wesley, London, UK (1998).

CHM-752 ADVANCED STEREOCHEMISTRY 3(3-0)

Prostereoisomerism, Concept of Re and Si face, Homotopic, Enantiotopic and Diastereotopic ligands and faces, Stereoselectivity and Stereospecificity, Configuration and conformation of cyclic molecules, Stereochemistry and conformational analysis of cyclohexane system, six-membered sp^2-hybridized cyclic systems and six membered saturated heterocycles. Stereochemistry and conformational effects in small, common and medium rings. Bicyclic and polycylic fused rings systems. Bridged rings and stereochemical restrictions. Chiroptical properties, Optical Rotatory Dispersion and Circular Dichroism.

Books Recommended:

1. K. Mislow "Stereochemistry", 2nd Ed., W. A. Benjamin Inc., New York, USA (1965).
2. E. L. Eleil, S.H. Wilen, L.N. Mander, "Stereochemistry of Organic Compounds", 4th Ed, John Wiley & Sons, USA (1994).
3. E. L. Eliel, S. H. Wilen, M. P. Doyle "Basic Organic Stereochemistry", John Wiley & Sons, USA (2001).

CHM-753 Physico-Organic Chemistry and Reaction Mechanism 3(3-0)

Chemical reactions and energy changed; qualitative aspects of collision. Transition state theories, rates and equilibria; tracer techniques, trapping of intermediates. Interpretation of kinetic data. Correlation of structure with reactivity,; Linear free energy relationship, stereochemical and spectroscopic evidences. Study of reaction mechanism of some recent reactions.

Books Recommended:

1. S. H. Pine, "Organic Chemistry", 5th Ed., McGraw Hill, New York, USA (1987).
2. G. M. Loudon, "Organic Chemistry", 2nd Ed., Addison Wesley, London, UK (1998).
3. J. Clayden, N. Greeve, S. Warren, P. Wothers, "Organic Chemistry", Oxford University Press, Oxford, UK (2001).
4. P. Sykes, "A Guide Book in Modern Organic Chemistry", 6th Ed., Longman, London,UK (1986).
5. H. O. House "Modern Synthetic Reactions", Benjamin, California, USA (1972).
6. K. I. Rinehart, "General Oxidation Reaction of Orgainc Compounds", Prentice Hall, New Jersey, USA (1973).

CHM-754 Advanced Heterocycles I 3(3-0)

Three membered heterocycles:

Nomenuclature, Physical properties, Synthesis, Chemical reactions and medicinal importance of Aziridine, Oxirane, Thiirane, Diazirine, Oxaziridine, Dioxirane.

Four membered heterocycles:

Nomenuclature, Physical properties, Chemical reactions and medicinal importance of Azetidine, Oxetan, Thietane, Diazetidine, Dioxetane, Dithietane

Seven membered heterocycles

Nomenuclature, Physical properties, Chemical reactions and medicinal importance of Azepane, Oxepane, Thiepane, Thiazepene

Recommended Books:

1) J. Clayden, N. Greeves, S. Warren, "Organic Chemistry", 2nd Ed., Oxford University Press Inc., New York (2012).
2) J. S. Clark "Heterocyclic Chemistry", by J. Stephen Clark.

3) J. A. Joule, K. Mills, G. F. Smith, "Heterocyclic Chemistry", 3rd Ed.,Chapman & Hall, UK (1995).
4) T. L. Gilchrist, "Heterocyclic Chemistry", 3rd Ed., Oxford Primer Series,(1997)
5) A. R. Katritzky, "Handbook of Heterocyclic Chemistry", Pergamon press, New York (1985).

CHM-755 Chemistry of Glycosides 3(3-0)

Glycosides of flavonoids, coumarins and saponinsIsolatins, detection and chromatographic separation; acid, alkaline and enzymatic hydrolysis to aglycones; identification of sugar residue. Spectroscopic determination of aglycone and glycoside structures. Derivatization, structural elucidation and biological importance of glycosides.

Books Recommended:

1. B. A. A. Borm, "Introduction to Flavonoids", Harwood Academic publishers Canada (1998).
2. J. B. Harborn, "The Flavonodids-Advance in Research" Chapman & Hall. London, UK (1994).
3. K. Nakanishi, "Natural Products Chemistry", Vol. I., Academic press, New York, USA (1974).

CHM-756 Biosynthesis of Natural Products 3(3-0)

Introduction to biosynthesis. Biosynthesis of fatty acids, polyketides, isopernoids, amino acids and alkaloids, Metabolites from shikimic acid (ArC1 ARC2 and ARC3 metabolites) and of mixed biosynthetic origin (metabolites derived from acetate and mevalonate,)

Books Recommended:

1. Mann, "Secondary Metabolism", 2nd Ed, Oxford Science Publication, UK (1987).
2. J. D. Bu Lock, "The Biosynthesis of Natural Products", McGraw-Hill, London, UK (1965).
3. D. Ranganathan, S. Ranganathan, "Art in Biosynthesis", Academic Press, New York, USA (1976).
4. I. I. Finar "Organic Chemistry", Vol. II, 5th Ed. Longman, London, UK (1975).

CHM-757 ADVANCED NUCLEAR MAGNETIC RESONANCE 3(3-0)

Theoretical principles. Chemical shift and spin coupling in ^{1}H and ^{13}C nuclei, factors affecting chemical shift and spin coupling in different spin systems. DEPT, INEPT, SINEPT, Homonuclear 2D NMR techniques COSY, NOESY, INADEQUATE, TOCSY, ROESY, 2D J-resolved spectroscopy, Heteronuclear 2D techniques HMQC, HMBC, DOSY, Structure

elucidation by using NMR techniques.

Books Recommended:

1. H. Friebolin "Basic one and two dimensional NMR Spectroscopy", 2nd Enlarged Edition, VCH, Germany (1988).
2. G. E. Martin, A. S. Zektzer "Two Dimensional NMR Methods for Establishing Molecular Connectivity", VCH, Germany (1988).
3. W. Voelter, "Carbon-13 NMR Spectroscopy", 3rd Ed., VCH, Germany (1990).
4. Atta-ur-Rahman "Nuclear Magnetic Resonsance Spectroscopy", UGC press, Islamabad, Pakistan (1989).

CHM 761 Protective Groups in Organic Synthesis 3(3-0)

Introduction

(i) Protection of Carboxylic Acid Group

By ester formation, By diazotization, By salt formation, by reaction with $SOCl_2$ by hydroxamic acid etc.

(ii) Protection of Hydroxyl Group

Both for alcoholic and phenolic by ether formation, by ester formation by acetal and ketal formation

(iii) Protection of Carbonyl Group

By Acylation

By phthaloyl group and their related deprotecting Groups.

(iv) Protection of Amine Group

By acetal and ketal formation.

By hydrazone formation.

Books Recommended:

1. S. H. Pine, "Organic Chemistry", 5th Ed., McGraw Hill, New York, USA (1987).
2. G. M. Loudon, "Organic Chemistry", 2nd Ed., Addison Wesley, London, UK (1998).
3. F. A. Carey, R. J. Sunderg. "Advanced Organic Chemistry". Part A & B, 3rd Ed., Pleman Press, New York, USA (1990).
4. F.W. Greene, "Protective Groups in Organic Synthesis". 3rd Ed., Wiley and Sons New York, USA (1999).
5. G. March "Advanced Organic Chemistry" 4th Edition, John Wiley and Sons, New York, USA (1999).

CHM-762 Advanced Heterocycles II 3(3-0)

Five membered heterocycles:

Nomenuclature, Physical properties, Synthesis, Chemical reactions and medicinal importance of Pyrrole, Thiophene, Furan, Indole, Benzo[b]Thiophene, Benzo[b]furan, Isoindole, Benzo[c]Thiophene, Isobenzofuran, 1,3-azoles, (Imidazole, Thiazole, Oxazole), 1,2-azoles (pyrazole, Isothiazole & Isoxazole) and their Derivatives

Six membered heterocycles:

Nomenuclature, Physical properties, Synthesis, Chemical reactions and medicinal importance of Pyridine, Quinoline, Isoquinoline, Pyryliums, 2- and 4-Pyrones, Benzopyryliums, Benzopyrans, Diazines (Pyridazine, Pyrimidine & Pyrazine) and their derivatives

Recommended Books:

1) J. Clayden, N. Greeves, S. Warren, "Organic Chemistry", 2nd Ed., Oxford University Press Inc., New York (2012).
2) J. S. Clark "Heterocyclic Chemistry", by J. Stephen Clark.
3) J. A. Joule, K. Mills, G. F. Smith, "Heterocyclic Chemistry", 3rd Ed., Chapman & Hall, UK (1995).
4) T. L. Gilchrist, "Heterocyclic Chemistry", 3rd Ed., Oxford Primer Series, (1997)
5) A. R. Katritzky, "Handbook of Heterocyclic Chemistry", Pergamon press, New York (1985).

CHM-763 Advanced Molecular Rearrangements 3(3-0)

Amadori Rearrangement, Aza-Claisen Rearrangement, Aza-cope Rearrangement, Aza-[2,3]-Wittig Rearrangement, Baker Venkataraman Rearrangement, Brook Rearrangement, Carroll Rearrangement, Claisen-Ireland Rearrangement, Cope Rearrangement, Cornforth Rearrangement, Demjanov Rearrangement, Dienone-Phenol Rearrangement, Dimroth Rearrangement, Eschenmoser-Tanabe Rearrangement, Favorski and Homo Favorski Rearrangement, Ferrier Rearrangement, Johnson-Claisen Rearrangement, Meisenheimer Rearrangement, Meyer-Schuster and Rupe Rearrangement, Mislow-Evans Rearrangement, Neber Rearrangement, Overman Rearrangement, Oxy-Cope Rearrangement, Payne Rearrangement, Semipinacol Rearrangement, Prins-Pinacol Rearrangement, Pummerer Rearrangement, Smiles Rearrangement, Stevensen Rearrangement

Books Recommended:

1. J. Clayden, N. Greeve, S. Warren, P. Wothers, "Orgaic Chemistry", Oxford University Press, Oxford, UK (2001).

2. F.A Carey, R .J Sunderg. “Advanced Organic Chemistry”. Part A & B, Pleman Press, New York, USA (1990).
3. G, March “Reaction Mechanism” Printice Hall, Englewood Glin. New York, USA (1999).

CHM-764 Chemistry of Nitrogenous Compounds 3(3-0)

Chemistry of heterocyclic compounds containing oxygen, nitrogen and sulphur with emphasis on their synthesis, reaction, sterochemsitry and spectroscopy; fused ring systems involving furan, pyrrole and thiophene, heterocyclic analogues of quinoline, heterocyclic compounds with more than one heteroatom, heterocyclic compounds with a seven member ring.

Books Recommended:

1. E. Block “Heteroatom Chemistry”,Verlag Gesellchaft, Germany (1989).
2. D.T. Davies “Atomic Heterocyclic Chemistry”, Oxford Science Publications, UK (1991).
3. G. M. London, “Organic Chemistry”, Addison Wesley, London, UK (1998).

CHM-765 Advanced Mass Spectrometry 3(3-0)

The mass spectrometer, ionization and ion source, mass analyzers, metastable ion, ion detection and recording. Electron impact and chemical ionization, field ionization, field desorption, fast atom bombardment, plasma desorption, thermospray, electrospray mass spectra. Fragmentation pattern of common functional groups. Structure elucidation using mass spectrometry in conjunction with other spectroscopic techniques.

Books Recommended:

1. H. E Duckworth, R.C Barber, V. S Barber, V.S Venkatasubramanian “Mass Spectroscopy”, Cambridge University Press, London, UK (1996).
2. E. D. Hoffmann, J. Charette, V. Stroobant “Mass Spectrometry, Principes & Applications”, John Wiley & Sons, New York, USA (1996).
3. A. Frigerio “Essential Aspects of Mass Spectrometry”, Spectrum Publication, Ine New York, USA (1974).

CHM-766 Supramolecular Chemistry 3(3-0)

Definition and Development of Supramolecular Chemistry, Nature of Supramolecular Interactions, Classification of Supramolecular Host–Guest Compounds, Biological Inspiration for Supramolecular Chemistry, Porphyrins and Tetrapyrrole Macrocycles, Supramolecular Features of Plant Photosynthesis, DNA, Cation binding Host, The Crown Ethers, Calixarenes, Cyclodextrins, Urea and Thiourea Clathrates, Haem Analogues, Supramolecular Polymers, Gels and Fibres, introduction to Nanochemistry, Nanoparticles, Nanotechnology.

Books Recommended:

1. J. W. Steed , J. L. Atwood, "Supramolecular Chemistry" Wiley Publishers, USA(2009)
2. D. T. Davies "Atomic Heterocyclic Chemistry",Oxford Science Publications, UK (1991).
3. G. M. London, "Organic Chemistry", Addison Wesley, London, UK (1998).

CHM-767 Chemistry of Drugs 3(3-0)

Introduction to drugs, Pharmacokinetics, Pharmacodynamics, $IC_{50,}$ LD_{50} values, Pharmacophore, Agonist, Antagonist, Naming Drugs, Lead Compounds, Local Anaesthetics, Random Screening, Non-random Screening, Serendipity in Drug development, Receptors, Drugs as enzyme Inhibitors, Drug-Receptor Theories, Designing A suicide substrate, Quantitative Structure activity Relationships (QSARS), Molecular modeling, Combinatorial organic Synthesis, Antiviral drugs, Economics of drugs.

Books Recommended:

1. F. A Carey, R. J Sunberg, "Advanced Organic Chemistry", Part A & B, Plenum Press, New York, USA (1990).
2. R. T. Morrison, R. N. Boyd, "Organic Chemistry" Prentice-Hall, Inc; 6th Ed, USA (1992).
3. I. I. Finar "Organic Chemistry", Vol. II, I.I, 5th Ed, Longman, London, UK (1975).

CHM-768 Chelated Enolates in Organic Synthesis 3(3-0)

Introduction to reactivity of carbonyl compounds. Preparation of chelated enolates of amino acids and dipeptides. Reactions/synthetic utility of chelated enolates in stereoselective alkylation reactions, transition metal catalyzed allylic alkylations, stereoselective epoxide ring opening reactions, aldol reaction, Michael reaction, addition to nitro group. Synthesis of target molecules using chelated enolates.

Books Recommended:

1. László Kürti and Barbara Czakó Strategic applications of named reactions in organic synthesis: background and detailed mechanisms. Amsterdam; Boston: Elsevier Academic Press, c2005.
2. Francis A. Carey, Richard A. Sundberg Paperback Advanced Organic Chemistry, 1199 Pages 5th Edition, 2007.
3. Michael B. Smith, Jerry March March's Advanced Organic Chemistry. Reactions, Mechanisms, and Structure Hardcover, 2384 Pages 6th Edition, 2007.

4. Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro Name Reactions and Reagents in Organic Synthesis , 886 Pages 2nd Edition, March 2005).

CHM-769 Cross Coupling Reactions 3(3-0)

Introduction to cross coupling reactions. Mechanism, Background and synthetic applications of Suzuki reaction, Stille reaction, Heck reaction, Hiyama reaction, Kumada reaction, Negishi synthesis, Chan-Lam reaction etc and their modifications.

Books Recommended:

1. László Kürti and Barbara Czakó Strategic applications of named reactions in organic synthesis: background and detailed mechanisms. Amsterdam; Boston: Elsevier Academic Press, c2005.
2. Francis A. Carey, Richard A. Sundberg Paperback Advanced Organic Chemistry, 1199 Pages 5th Edition, 2007.
3. Michael B. Smith, Jerry March March's Advanced Organic Chemistry. Reactions, Mechanisms, and Structure Hardcover, 2384 Pages 6th Edition, 2007.
4. Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro Name Reactions and Reagents in Organic Synthesis , 886 Pages 2nd Edition, March 2005).

CHM-770 Multicomponent Reactions 3(3-0)

Introduction to Multicomponent reactions. Mechanism, Background and synthetic applications of Passerini reaction, Ugi reaction, Biginelli reaction, Mannich reaction, Gewald reaction, Hantzsch dihydropyridine synthesis, Strecker reaction etc

Books Recommended:

1. László Kürti and Barbara Czakó Strategic applications of named reactions in organic synthesis: background and detailed mechanisms. Amsterdam; Boston: Elsevier Academic Press, c2005.
2. Francis A. Carey, Richard A. Sundberg Paperback Advanced Organic Chemistry, 1199 Pages 5th Edition, 2007.
3. Michael B. Smith, Jerry March March's Advanced Organic Chemistry. Reactions, Mechanisms, and Structure Hardcover, 2384 Pages 6th Edition, 2007.
4. Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro Name Reactions and Reagents in Organic Synthesis , 886 Pages 2nd Edition, March 2005).

CHM-771 Green Synthesis 3(3-0)

Introduction to Green Chemistry, The 12 Principles of Green Chemistry, Toxicology and Green Chemistry, Environmental Issues, Climate and Green Chemistry, CC and CN bond formations in water, Alkene synthesis, Alcohol synthesis, Transition metal-catalyzed reactions in environmental benign conditions, Pericyclic reactions in green conditions.

Books Recommended:

1. Ahluwalia, V. K. Green Chemistry: Environmentally Benign Reactions; CRC Press: Boca Raton, FL, 2008.
2. Ahluwalia, V. K.; Kidwai, M. New Trends in Green Chemistry; Kluwer Academic: Dordrecht, The Netherlands, 2004.
3. Francis A. Carey, Richard A. Sundberg Paperback Advanced Organic Chemistry, 1199 Pages 5th Edition, 2007.
4. Michael B. Smith, Jerry March March's Advanced Organic Chemistry. Reactions, Mechanisms, and Structure Hardcover, 2384 Pages 6th Edition, 2007.
5. Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro Name Reactions and Reagents in Organic Synthesis , 886 Pages 2nd Edition, March 2005).

CHM-772 Symmetry Controlled Reactions 3(3-0)

Huckel moleculars orbital-and perturbation orbital theories; Frontier orbitals (HOMO-LUMO) concept; orbital symmetry; alternate and non-alternate hydrocarbons, Huckel and Mobious systems, Classes of peicyclic reations: electrocyclic, cycloaddition, sigmatropic and chelotropic reactions and their interpretation through (a) orbital symmetry conservation (b) frontier orbital treatment and (c) Huckel-Mobious approach Applications to organic synthesis.

Books Recommended:

1. E. A. Halevi "Orbital Symmetry and Reaction Mechanism", 1st Ed., Springer Verlag, Germany (1992).
2. G. M. Loudon, "Organic Chemistry", 3rd Ed. Addison Wesley London Company, UK (1995).
3. P. Sykes, "A Guide Book in Modern Organic Chemistry", 6th Ed., Longman, London, UK (1986).
4. H. O. House, "Modern Synthetic Reactions", 2nd Ed., Benjamin, California, USA (1972).

CHM-773 Classics in Total Synthesis 3(3-0)

Basic Concepts, Retro synthesis, Multistep total Synthesis of natural products, Pencillins, Prostaglandins, Estrone, Menthol, Quinine, Ajmaline.

Books Recommended:

1. R. T. Morrison, R. N. Boyd, "Organic Chemistry," Prentice-Hall,. 6th Ed., New Jersey, USA (1992).
2. F. A. Carey, R. J. Sunberg, "Advanced Organic Chemistry". Part A & B, 3rd Ed., Plenum Press, New York, USA (1990).
3. G. March "Advanced Organic Chemistry" 4th Edition, John Wiley and Sons, New York, USA (1999).
4. S.V. Bhat, B. A. Nagasampagi, M. Sivakumar, "Chemistry of Natural Product" Narosa Publishing House, New Dehli, India (2005).

CHM- 774 **3(3-0)**

ADVANCED TECHNIQUES FOR POLYMERS AND POLYMERIC MATERIALS

Learning Objectives/ Motives:

It is an advanced research oriented course dealing with polymers properties and their characterization via IR, FTIR, XRD techniques to cover the theoretical as well as practical aspects of this important topic. Students will be able to determine the polymer morphology based on information generated from their structure.

Course Contents:

Introduction and Properties of Macromolecules, Structural Analysis Techniques such as Fourier Transform Infrared (FTIR) spectroscopy,. the interpretation of polymer spectra. Thermal analysis techniques (TGA, DSC, DMTA etc.) the interpretation of thermal transitions curves**.** Surface morphological techniques (Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM). Interpretation of surface morphology. Characterization of polymeric materials by X-ray Diffraction (XRD), and applications.

Recommended Books:

1. M. E. Brown, "Introduction to Thermal analysis, Techniques and Applications, Chapman and Hall, New York, USA (1988).
2. P. Gabbot, "Principles and Applications of Thermal Analysis, Blackwell publishing Ltd. USA (2008).
3. W. Hemminger, S. M. Sarge, "Hand Book of Thermal Analysis and Calorinery, Vol. 1, (Ed. M. E. Brown), Elsevier, Amsterdam, Netherland (1998).
4. J. O. Hill (Ed.) For "Better Thermal Analysis and Calorimetry, 3rd Ed, CPC Reprographics, Portsmouth, UK (1991).
5. B. Wunderlich, "Thermal Analysis" Academic Press, Boston, USA (1990).

6. R. E. Hester, R.M. Harrison,“Nanotechnology: Consequences for Human Health and the Environment” The Royal Society of Chemistry, UK (2007).
7. A Beginners' Guide to Scanning Electron Microscopy Book by Anwar Ul-Hamid, Originally published: October 26, 2018
8. A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) by Christian M. Ringle, Marko Sarstedt, Hai er, G. Tomas M. Hult, Originally published: April 3, 2013
9. Electrical Atomic Force Microscopy for Nanoelectronics by Umberto Celano, Originally published: August 2019