

Department of Chemical Sciences

Graduate Course on

Organic and Inorganic Chemistry

Course Content

Section 1: Functional Group Interconversion

- 1.1 Introduction to Functional group interconversion including protecting group strategy
- 1.2 Conversion of Alcohols to different functional groups
- 1.3 Introduction of different Functional group in selective positions of un-activated carbon centers
- 1.4 Interconversion of carboxylic acid derivatives
- 1.5 Installation and removal of protecting groups
- 1.6 Applications: solid phase peptide synthesis and bio-conjugation reactions

Section 2: Addition and reduction reactions of unsaturated homo- and hetero-nuclear bonds

- 2.1 Metathesis of homo- and hetero-nuclear sigma bond with different substituent's across unsaturated homo- and hetero-nuclear bonds.
- 2.2 Hydroalumination, carboalumination, hydrozirconation reactions
- 2.3 Hydrogen addition reactions and catalytic hydrogenations using transition metal catalyst.
- 2.4 Reductions using DIBAL-H, L-selectride, K-selectride, and Red-Al reagents including selective reduction.

Section 3: Reactive Intermediates

- 3.1 Carbonium ions, carbanions, and radicals: formation and rearrangement
- 3.2 Technique and strategy for isolation and trapping of reaction intermediates
- 3.3 Overview of some the reaction mechanism based on reaction intermediates

Section 4: Methodologies for the construction of 3-7 membered rings

- 4.1 Diels-Alder reactions
- 4.2 Metal catalyzed cyclopropanation reactions (including Simmons Smith reaction)
- 4.3 [2+2] and [2+2+2]-cycloaddition reactions
- 4.4 Nazarov cyclizations
- 4.5 Ring expansion and ring contraction reactions
- 4.6 Aza macrocycle synthesis
- 4.7 Baldwin' rules for ring-closing reactions
- 4.8 Special topic: Coordination Complexes in Inorganic Chemistry

Section 5: Basics of Organometallic chemistry

- 5.1 d^n electron counting

- 5.2 Elimination and Addition Reactions involving transition metal complexes and their consequence on catalytic process
- 5.3 Syntheses and application of organometallic reagents
- 5.4 Coupling reactions: Kumada coupling, Suzuki-Miyaura coupling, Hiyama coupling, Sonogashira coupling, Negishi coupling, Stille coupling, Buchwald-Hartwig Coupling, Heck reaction, Click Reactions.

Section 6: Asymmetric Synthesis

- 6.1 Sharpless epoxidation and dihydroxylation, Jacobsen's epoxidation
- 6.2 Corey's oxazaborolidine catalyzed reduction
- 6.3 Noyori's BINAP reduction
- 6.4 SAMP, RAMP, Evans oxazoline.

Section 7: Principles of retrosynthetic analysis and Multistep synthesis

- 7.1 Linear and convergent synthesis
- 7.2 Synthesis under steric control, Regio- and stereoselective synthesis
- 7.3 Application of chiral auxiliaries

Section 8: Chemistry of Main group Elements (involving their usual oxidation states)

- 8.1 Group 13, 14, and 15 elements: Boranes, Siloxanes, cyclophosphazenes, cyclophosphazanes, poly silanes, and poly phosphazenes.
- 8.2 Group 16 elements: Sulfur and selenium

Section 9: Chemistry and Applications of f-block elements

- 9.1 Organo-lanthanide reagents
- 9.2 Applications in fluorescence imaging

Section 10: Special Topics

- 10.1 Homogeneous catalysis and catalysts: Alkene isomerization. Hydrogenation, Hydroformylation, Monsanto acetic acid process, Alkene polymerization, Cross coupling reactions, Metathesis, C-H activation and functionalization, Oxidation of olefins, Metal Clusters and catalysis.
- 10.2 Supramolecular constructs and metal-organic frameworks
- 10.3 Combinatorial approaches to synthesis
- 10.4 Light induced reactions
- 10.5 Synthesis in engineered micro-organisms

Prescribed Text:

- 1. Advanced Organic Chemistry, Francis A. Carey and Richard J. Sundberg, Part B: Reactions and Synthesis
- 2. Advanced Inorganic Chemistry, F. Albert Cotton, 6th Edition
- 3. The Organometallic Chemistry of the Transition Metals, Robert H. Crabtree, 5th Edition
- 4. Inorganic Chemistry, 5th edition, Shriver and Atkins

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Venue: Lecture room AG-80

Days: Mondays and Thursdays

Time: 11:00 hr to 12:30 hr (Mondays) and 9:30 hr to 11:00 (Thursdays)

The first lecture starts on August 4, 2016.