

Course title: Organic Chemistry and Inorganic Chemistry (Core Course)

Lectures: Twenty eight lectures, one and half hour each

Evaluation: 10 Assignments, and 2 Written Exams

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**

Course Overview

This course aims at providing a comprehensive insight into advanced organic and inorganic chemistry starting with a brief overview of basic concepts and then delving into details of reactions and principles. In the organic chemistry section emphasis will be on designing reaction schemes based on retrosynthetic analysis, the chemistry of protecting groups, asymmetric synthesis and catalysis, use of chiral auxiliaries, and bio-conjugation chemistry. Taking cue from asymmetric catalysis, topics in inorganic coordination chemistry and organometallic chemistry will be covered. One-third of the course material will be devoted to recent advances in the development of catalysts, supra-molecular chemistry, metal-organic frameworks, photochemistry, combinatorial chemistry, solid-phase synthesis, and biological applications. The detailed course syllabus is given below.

Course Syllabus

Section 1: Functional Group Interconversion (KM -5 lectures)

- 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 (AJ)

- 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 (KM - 2 lectures)

- 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 (KM - 2 lectures)

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

Section 5: Basics of Organometallic chemistry (AJ)

- 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, Negeshi coupling, Stille coupling, Buchwald-Hartwig Coupling, Heck reaction, Click Reactions.

Section 6: Asymmetric Synthesis (AJ)

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 (KM -2 lectures)

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) (AJ)

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 (AJ)

9.1 Organo-lanthanide reagents

9.2 Applications in fluorescence imaging

Section 10: Special Topics (KM -2 lectures, AJ)

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. (AJ)

10.2 Supramolecular constructs and metal-organic frameworks (AJ)

10.3 Combinatorial approaches to synthesis (KM)

10.4 Light induced reactions (KM)

10.5 Synthesis in engineered micro-organisms (KM)

**Time Table: Organic and Inorganic Chemistry (1st half)
(Instructor: AJ)**

1.	8th Aug 2017, Tue	
2.	10th Aug 2017, Wed	Assignment 1 (25 marks)
3.	15th Aug 2017, Tue	holiday
4.	17th Aug 2017, Wed	
5.	22nd Aug 2017, Tue	Assignment 2 (25 marks)
6.	24th Aug 2017, Wed	
7.	29th Aug 2017, Tue	
8.	31st Aug 2017, Wed	Examination-1 (100 marks)
9.	5th Sept 2017, Tue	
10.	7th Sept 2017, Wed	Assignment 3 (25 marks)
11.	12th Sept 2017, Tue	
12.	14th Sept 2017, Wed	
13.	19th Sept 2017, Tue	Assignment 4 (25 marks)
14.	21st Sept 2017, Wed	
15.	26th Sept 2017, Tue	no class
16.	28th Sept 2017, Wed	Examination-2 (100 marks)

Evaluation Method (Weightage for Internal Assessment, Mid Term / Term End exams, Presentations etc.) by AJ:

33.33 % weightage from four assignments, 33.33 % weightage from examination-1 and 33.33 % weightage from examination-2.

**Time Table: Organic and Inorganic Chemistry (2nd half)
(Instructor: KM)**

1.	5th Oct 2017, Thu	
2.	10th Oct 2017, Tue	no class
3.	12th Oct 2017, Thu	
4.	17th Oct 2017, Tue	
5.	19th Oct 2017, Thu	holiday
6.	24th Oct 2017, Tue	
7.	26th Oct 2017, Thu	Quiz 1
8.	31st Oct 2017, Tue	
9.	2nd Nov 2017, Thu	Quiz 2
10.	7th Nov 2017, Tue	
11.	9th Nov 2017, Thu	Quiz 3
12.	14th Nov 2017, Tue	
13.	16th Nov 2017, Thu	Quiz 4
14.	21st Nov 2017, Tue	
15.	23rd Nov 2017, Thu	
16.	28th Nov 2017, Tue	Final Exam

Evaluation Method (Weightage for Internal Assessment, Mid Term / Term End exams, Presentations etc.) by KM:

5% Marks for attendance and participation in class discussions, 25 % marks for four short take-home quizzes, 70 % marks for on-site written final examination.