

Chemistry 504: Recent Advances in Organic Chemistry – Careers in Review
Fall 2015, Rutgers University, Newark
Syllabus
Lecture: Thursday, 6:00-8:50 PM, Smith Hall, 240

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Office hours: By appointment.

Course Synopsis:

Recent advances and advanced topics in synthetic organic chemistry are covered through careers of leading contemporary organic chemists. Trends in the last 10-15 years are covered in detail with emphasis on recent advances in methodology development, synthesis of molecules of biological interest and of industrial relevance. Special attention is given to catalysis, organometallic chemistry, radical chemistry, organocatalysis, natural product synthesis, metal-free synthesis. This advanced course is aimed to enhance understanding of fundamental problems in organic chemistry, improve writing and presentation skills by graduate students and advanced undergraduates involved in research in organic synthesis.

Required Text:

- *Strategic Applications of Named Reactions in Organic Synthesis*. Kurti, L.; Czako, B.

Recommended Texts/Articles:

General organic chemistry textbooks/references

- *Advanced Organic Chemistry, Part B: Reactions and Synthesis*. Carey, F. A.; Sundberg, R. J.
- *Organotransition Metal Chemistry: From Bonding to Catalysis*. Hartwig, J.
- Yoon, T. P.; Jacobsen, E. N. Privileged Chiral Catalysts. *Science* **2003**, 299, 1691.
- MacMillan, D. W. C. The Advent and Development of Organocatalysis. *Nature* **2008**, 455, 304.
- Hartwig, J. F. Carbon-Heteroatom Bond Formation Catalysed by Organometallic Complexes. *Nature* **2008**, 455, 314.
- Seebach, D. Organic Synthesis – Where Now? *Angew. Chem. Int. Ed.* **1990**, 29, 1320.
- Trost, B. M. The Atom Economy: A Search for Synthetic Efficiency. *Science* **1991**, 254, 1471.
- Whitesides, G. M. Reinventing Chemistry. *Angew. Chem. Int. Ed.* **2015**, 54, 3196.
- Wu, X. F.; Anbarasan, P.; Neumann, H.; Beller, M. From Nobel Metal to Nobel Prize: Palladium-Catalyzed Coupling Reactions as Key Methods in Organic Synthesis. *Angew. Chem. Int. Ed.* **2010**, 49, 9047.
- Johansson-Seechurn, C. C. C.; Kitching, M. O.; Colacot, T. J.; Snieckus, V. Palladium-Catalyzed Cross-Coupling: A Historical Contextual Perspective to the 2010 Nobel Prize. *Angew. Chem. Int. Ed.* **2012**, 51, 5062.
- Hickman, A. J.; Sanford, M. S. High-Valent Organometallic Copper and Palladium in Catalysis. *Nature* **2012**, 484, 177.

Grading:

Breakdown:

Seminar presentations (2): 30%**Written projects (2): 30%****Final Exam: 40%****Approximate Class Outline:**

Week	Date	Lecture	Topic
1	Sep 3	Lecture 1	C-C activation: Murakami, Cramer, Dong
2	Sep 10	Lecture 2	C-H activation: Sanford, Yu, Gaunt
3	Sep 17	Lecture 3	Natural product synthesis: Baran, Movassaghi, Snyder
4	Sep 24	Lecture 4	Organocatalysis: MacMillan, List, Jorgensen
5	Oct 1	Lecture 5	Photoredox catalysis: Yoon, Stephenson, Nicewicz
6	Oct 8	Lecture 6	Decarboxylative couplings: Goossen, Lei Liu, Liebeskind
7	Oct 15	Lecture 7	Other TM advances: Ritter, Sigman, Rajanbabu
8	Oct 22	Lecture 8	Nickel catalysis: Montgomery, Jamison, Jarvo Midterm Project Due
9	Oct 29	Lecture 9	Insertions into X-X bonds: Suginome, Morken, Oestreich
10	Nov 5	Lecture 10	Conjugate additions: Hayashi, Hoveyda, Sawamura
11	Nov 12	Lecture 11	Inert bond activation: Garg, Martin, Itami
12	Nov 19	Lecture 12	Ligand design: Fu, Buchwald, Stradiotto
13	Nov 26		Thanksgiving Break
14	Dec 3	Lecture 13	TM-free synthesis: Kurti, Maulide, Charette
15	Dec 10	Lecture 14	Gold catalysis: Toste, Zhang, Echavarren
Finals	Dec 17		Final Exam, Final Project Due

Exam:

Exam will be closed book, closed note. Exam will cover lecture material, seminar presentations, assigned reading and literature discussed in class.

Seminar Presentation:

Each student will be asked to present two short seminars (20-25 min) based on a research line of leading organic chemist. The selection of chemists/papers will be given early in the semester. The presentation should cover the most important aspects and references from the assigned topic (3-5 original papers). Each presentation should include the following: (i) person's background, current institution; (ii) the most important aspects of research; (iii) novelty of the contribution; (iv) applications and extensions. Typically, you will start your preparation by consulting a personal faculty webpage. Applications and extensions may include work from the same research group or by others. **Your goal is to provide a comprehensive, critical and balanced overview of a chemist's research area to the class.** The presentations will be graded as 30% of the final grade. Grading will include content, presentation and clarity.

Written Project:

Each student will be asked to review a transformation based on an original research paper by leading organic chemist in *Synlett Spotlight* article format. The review article should include 5-7 insets. The review should cover: (i) the most important aspects (mechanism, scope); (ii) cited references; (iii) follow-up work from the assigned topic, *and be formatted in a format ready for journal submission* (<https://www.thieme.de/de/synlett/author-tools-58894.htm>). **The review should be a critical summary of the assigned topic, and not simply a description of the lead paper.** The selection of papers will be given early in the semester (1st assignment) and after the first round of presentations (2nd assignment). The review article should be formatted using *Synlett* template (ChemDraw drawings, ACS settings). The review should be submitted in an electronic format (as .pdf file). Assignment 1 is due on Oct 22nd. Assignment 2 is due at the time of the final exam. The reviews will be compiled and distributed to the class. The projects will be graded as 30% of the final grade. Grading will include content, presentation and clarity.

Learning Objectives:After completion of this course students should:

- be familiar with state-of-the-art work by leading organic chemists published in the last 10-15 years with focus on methodology development, the importance for the synthesis of biologically-active molecules and industrial applications
- be familiar with major 'hot topics' in synthetic organic chemistry, advantages, limitations, future prospects
- be able to predict reactivity of different classes of substrates and functional groups
- be familiar with novel synthetic routes to commonly used motifs in organic synthesis
- be able to plan synthetic routes to complex organic molecules incorporating recent developments
- be familiar with the major advances and the current state-of-the-art methods in organic synthesis
- be familiar with major journals and publications in synthetic organic chemistry
- be familiar with general synthetic approaches used by organic chemists in academia and industry
- be able to critically evaluate current chemical literature, present seminars and short reviews in organic chemistry

Attendance Policy:

Please, review Rutgers University attendance policy, which can be found at <http://policies.rutgers.edu/view-policies/academic-%E2%80%93-section-10#2>

Academic Integrity Policy:

Please, review Rutgers University Academic Integrity Policy, which can be found at <http://academicintegrity.rutgers.edu/academic-integrity-policy>. This policy applies to all Schools and Colleges of Rutgers, the State University of New Jersey, including the Ernest Mario School of Pharmacy and the Rutgers College of Nursing.