

Course Syllabus – CHEM 630

Course Information

Course Number: CHEM 630 WI26

Course Name: Recent Advances in Stereoselective Chemistry

Term: WI 2026

Start Date: 01/06/2026

End Date: 03/27/2026

Credits: 3.0

Meeting Days / Times

Tuesdays, Thursdays, and Fridays, 11:45am-12:45pm PT / 2:45-3:45pm ET
(See Calendar in Canvas for the most up-to-date schedule.)

Locations

CA: Graduate Office Dining Room (Hazen Theory Building)
FL: C304

Course Managers

Role	Last Name	First Name	Email Address
Course Director	Seath	Ciaran	cseath@scripps.edu
Course Director	Wasa	Masayuki	masawasa@scripps.edu

Course Description

This course provides an in-depth exploration of the principles and methodologies underpinning enantio- and diastereo-selective synthesis. We will begin with a concise review of the fundamental concepts in stereoselective synthesis and physical organic chemistry, focusing on mechanistic models essential for understanding and predicting stereochemical outcomes, as well as the thermodynamic and kinetic factors that influence reaction pathways. Emphasis will be placed on the role of chemical catalysis in achieving high levels of selectivity. Throughout the course, students will examine a series of seminal examples, including chiral auxiliary chemistry and enantioselective processes facilitated by stoichiometric Lewis acids and bases. However, the primary focus will be on transformations enabled by enantiopure catalysts. The course will also critically evaluate the current state-of-the-art methods in stereoselective synthesis, addressing the fundamental limitations and remaining challenges in the field. Through lectures, case studies, and problem-solving sessions, students will gain a comprehensive understanding of both the theoretical and practical aspects of stereoselective synthesis, preparing them for advanced research and applications in modern organic chemistry.

Program Learning Outcomes

By the end of the program, students will have accomplished these objectives:

PLO1: Original Research – graduate students are expected to develop the skills critical for generating high-quality research output. This would include absorbing, recalling, and contextualizing scientific knowledge, evaluating scientific information and data, creating testable hypotheses and investigating hypotheses, mastering scientific tools and techniques, displaying ethical behavior, and receiving and giving feedback.

PLO2: Communication – graduate students are expected to demonstrate the oral, written, and media skills to effectively communicate the impact of a study or a body of work to the greater scientific community and to the public at large using a number of methods.

PLO3: Critical Thinking – graduate students are expected to develop a self-directed process to analyze information, form opinions or judgments, and use this process to improve the quality of their scientific thoughts, navigate problems, and make informed decisions.

PLO4: Intellectual Curiosity – graduate students are expected to acquire the capacity to build their intellectual curiosity and demonstrate problem solving approaches that serve their professional growth and ability to impact a field.

PLO5: Career and Professional Development – graduate students are expected to develop a variety of transferable skillsets throughout their graduate experience, including management and leadership, inclusiveness, resilience, scientific rigor, collaboration, accountability, time management, teamwork, networking, and career planning.

For a detailed description of each outcome and specific success indicators, please refer to this web page: <https://education.scripps.edu/graduate/doctoral-program/Links to an external site.>

Course Learning Outcomes

Upon completion of this course students will be able to:

CLO1: Understand the basic concepts and reaction mechanisms of stereoselective organic synthesis and chemical catalysis.

CLO2: Understand the strengths and limitations of various diastereo- and enantio-selective transformations developed and employed in academic and industrial settings.

CLO3: Develop the ability to propose concise stereoselective synthesis of complex natural products and other industrially relevant compounds

Background Preparation (Prerequisites)

Graduate-level courses on Physical Organic Chemistry, Organometallic Chemistry and Organic Synthesis are recommended but not required.

Course Materials

Useful to Consult: Errick M. Carreira and Lisbet Kvaerno (2009). *Classics in Stereoselective Synthesis* (1st edition). ISBN: 978-3527299669

Useful to Consult: Elias J. Corey and László Kürti (2013). *Enantioselective Chemical Synthesis: Methods, Logic, and Practice* (1st Edition). ISBN: 978-0615395159

Useful to Consult: William R. Roush. *Recent Advances in Organic Synthesis Methodology: Stereocontrolled Synthesis of Acyclic Organic Compounds*.

Class Format

The course will feature three 60-minute lectures each week. In addition to the lectures, weekly office hours will be held via Zoom, offering students dedicated time to ask questions, clarify concepts, and receive personalized guidance on course content. To further support learning, optional biweekly recitation sessions led by teaching assistants will be available. These sessions will focus on reviewing lecture topics, working through homework assignments, and addressing any exam-related questions.

Expectations and Logistics

It is essential that you maintain a steady pace with the material—do not fall behind. You are expected to review the relevant material (book chapters mentioned above and relevant reviews and papers to be provided) before each lecture. To reinforce your understanding, please complete the homework assignments and practice with exam questions from previous years. Active participation in discussion sections is crucial, so be sure to attend and engage with the content and your peers. Additionally, whenever appropriate, utilize your model set to visualize and grasp three-dimensional structures effectively. Should you ever feel that you are falling behind or struggling to understand a topic, do not hesitate to ask for help.

Attendance Statement

Students are expected to attend all classes. Students who are unable to attend class must seek permission for an excused absence from the course director or teaching assistant. Unapproved absences or late attendance for three or more classes may result in a lower grade or an "incomplete" for the course. If a student has to miss a class, they should arrange to get notes from a fellow student and are strongly encouraged to meet with the teaching assistant to obtain the missed material.

Scientific and Professional Ethics

The work you do in this course must be your own. Feel free to build on, react to, criticize, and analyze the ideas of others but, when you do, make it known whose ideas you are working with. You must explicitly acknowledge when your work builds on someone else's ideas, including ideas of classmates, professors, and authors you read. If you ever have questions about drawing the line between others' work and your own, ask the course professor who will give you clear guidance. Exams must be completed independently. Any collaboration on answers to exams, unless expressly permitted, may result in an automatic failing grade and possible expulsion from the Graduate Program.

Technology Requirements and Support

For issues related to Canvas, please contact the Graduate Office by email at: gradprgm@scripps.edu or by phone at: 858-784-8469.

Course Grading

Grading is in accordance with the academic policies of the Skaggs Graduate School. The breakdown of grading is as follows:

- Homework: not graded but can be submitted for extra credit.
- Midterm Exam: 60% (2 exams will be given)
- Final Exam: 40%

Letter Grade	Percent	GPA	Description
A	93-100	4.00	Outstanding achievement. Student performance demonstrates full command of the course subject matter and evinces a high level of originality and/or creativity that far surpasses course expectations.
A-	90-92	3.67	Excellent achievement. Student performance demonstrates thorough knowledge of the course subject matter and exceeds course expectations by completing all requirements in a superior manner.
B+	87-89	3.33	Very good work. Student performance demonstrates above-average comprehension of the course subject matter and exceeds course expectations on all tasks as defined in the course syllabus. There is notable insight and originality.
B	83-86	3.00	Satisfactory work. Student performance meets designated course expectations and demonstrates understanding of the course subject matter at an acceptable level.
B-	80-82	2.67	Marginal work. Student performance demonstrates incomplete understanding of course subject matter. There is limited perception and originality.
C+	77-79	2.33	Unsatisfactory work. Student performance demonstrates incomplete and inadequate understanding of course subject matter. There is severely limited or no perception or originality. Course will not count toward degree.
C	73-76	2.00	Unsatisfactory work. Student performance demonstrates incomplete and inadequate understanding of course subject matter. There is severely limited or no perception or originality. Course will not count toward degree.
P	73-100	0.00	Satisfactory work. Student performance demonstrated complete and adequate understanding of course subject matter. Course will count toward degree.
F	0-72	0.00	Unacceptable work/Failure. Student performance is unacceptably low level of knowledge and understanding of course subject matter. Course will not count toward degree. Student may continue in program only with permission of the Dean.

I	0.00	Incomplete is assigned when work is of passing quality but is incomplete for a pre-approved reason. Once an incomplete grade is assigned, it remains on student's permanent record until a grade is awarded.
W	0.00	Withdrew from the course with Dean's permission beyond the second week of the term.

- All courses will be recorded and maintained in the student's permanent academic record; only courses that apply towards the degree will appear on the academic transcript. Non-credit or audited courses will not appear on the transcript.
- 4 core courses taken for a letter grade (pass = B- or higher for a core course)
- 2 elective courses taken pass/fail (pass = A, B, C for an elective)

Because students are encouraged to take electives outside their area of expertise, a "C" letter grade is passing.

Course Summary

Date	Details
Tue Jan 6, 2026	Kinetics and Thermodynamics (Lecturer: Wasa joined by Seath)
Thu Jan 8, 2026	Models for Predicting Stereoselective Outcomes (Lecturer: Seath)
Fri Jan 9, 2026	Nucleophilic Addition to Carbonyl Compounds (Lecturer: Wasa)
Tue Jan 13, 2026	Diastereoselective Processes involving Chiral Auxiliaries (Lecturer: Seath)
Thu Jan 15, 2026	Stereoselective Processes involving Chiral Boron-Based Reagents (Lecturer: Wasa)
Fri Jan 16, 2026	Emergence of Various Enantiopure Catalysts (Lecturer: Wasa)
Mon Jan 19, 2026	No Class (Martin Luther King Jr. Day)
Tue Jan 20, 2026	Midterm Exam #1
Thu Jan 22, 2026	Catalytic Enantioselective Oxidation (Lecturer: Wasa)
Fri Jan 23, 2026	Catalytic Enantioselective Reduction (Lecturer: Seath)
Tue Jan 27, 2026	Catalytic Enantioselective Hydrogenation (Lecturer: Seath)
Thu Jan 29, 2026	Enantioselective Organocatalysis: Enamine Catalysis (Lecturer: Seath)
Fri Jan 30, 2026	Enantioselective Organocatalysis: Iminium and SOMO Catalysis (Lecturer: Seath)
Tue Feb 3, 2026	Enantioselective H-Bonding Catalysis (Lecturer: Wasa)
Thu Feb 5, 2026	Midterm Exam #2
Fri Feb 6, 2026	Enantioselective Anion Binding Catalysis (Lecturer: Wasa)
Tue Feb 10, 2026	Enantioselective Processes Promoted by Engineered Enzymes (Lecturer: Seath)
Thu Feb 12, 2026	Enantioselective C-H Bond Functionalization (Lecturer: Wasa)
Fri Feb 13, 2026	Enantioselective Radical-Mediated Processes (Lecturer: Seath)
Mon Feb 16, 2026	No Class (Presidents' Day)
Tue Feb 17, 2026	Applications in Total Synthesis of Complex Natural Products (Lecturer: Wasa)
Thu Feb 19, 2026	Retrosynthetic Analysis of Enantiopure Small Molecule Drugs (Lecturer: Seath)
Fri Feb 20, 2026	Final Exam