

ChE 496 Special Topics Section 001
Introduction to Experimental and Computational Research in
Chemical Engineering
(Winter 2019, 2 credit hours)

Core Staff

Name	Role	Office Hours	Email
Prof. Henry Wang	Course Coordinator	W 1-2 pm; F 9:30-10:30 am: 3024 DOW	hywang@umich.edu
Steven Chavez	Graduate Student Instructor	Th 4-5 pm: DOW 3rd floor UG Study Room	stchavez@umich.edu
Salwan Butrus	Instructional Aide	M 6:00 pm to 7 pm: UGLi basement	salwan@umich.edu
Irina Kopyeva	Instructional Aide	F 1-2 pm: DOW 3rd floor UG Study Room	ikopyeva@umich.edu
*Kevin Greenman	Instructional Aide	M 1-2 pm: DOW 3rd floor UG Study Room	kpgreenm@umich.edu

If possible, please include all five of us in emails to ensure the timeliest response. We are happy to schedule appointments outside of our office hour times.

*Kevin's office hours will begin after spring break.

Lecture

Friday, 2:00-3:00 pm in 1012 EECS

Lab

Tuesday, 12:30-2:30 pm

- DOW 3001 (Jan. 15th - Feb. 26th)
- DOW 3216 (Mar. 19th - Apr. 16th)

Course Description

This course will give students an introduction to research in the ChE department and an exposure to the key skills necessary for success in research. The course is split into two phases. Phase 1 focuses on experimental work and Phase 2 will familiarize students with key computational tools used in ChE research. Each phase will consist of weekly 1-hour lecture and 2-hour lab sessions. Different faculty members will deliver the weekly lectures on a range of topics including technical and non-technical aspects of research, while students will gain practical experience with hands-on research techniques and projects in the lab sessions.

At the completion of this course, students will be:

- Exposed to the research happening in the ChE department
- Prepared with introductory research skills so they can contribute more rapidly and effectively in future research endeavors
- Introduced to practical applications of a ChE education earlier in the curriculum
- Trained on skills that will be beneficial for research and non-research track careers

In addition, we hope that this course will spark students' interest in pursuing research as undergraduates and beyond.

Pre-Requisites:

Open to first-year engineering and sophomore ChE students. Class permission required.

<https://tinyurl.com/ChE-496-001-Permission-Request>

Course Structure

The course will consist of 12 one-hour seminar-style lectures and 12 two-hour labs, divided into two major phases - experimental Phase 1 and computational Phase 2, each consisting of a science research communication element.

Key topics covered in this course will include:

- Biochemical engineering, nanomaterials, microfabricated systems, sustainable energy, mathematical modeling of biological systems, machine learning, molecule dynamics, Monte Carlo, density functional theory
- Literature review and research communication

Lecture assignments will focus on introduction to research literature review. Pre-lab and post-lab assignments will focus on experimental design and analysis of results, respectively. As this is a pilot run of such a course in our department, students will be asked to provide frequent feedback on several elements of the course and they will be given extra credit in return.

Course Outline:

Week	Date	Description	Instructor	Lecture Assignment
PHASE 1: EXPERIMENTAL				
1	Jan 11	LEC: Introduction to Research	Profs. Henry Wang, Sharon Glotzer	Analyze an Accomplishment in ChE Research
	Jan 15	LAB: Introduction to Basic Skills Part I	Steven Chavez	
2	Jan 18	LEC: Fundamental and Application of Plasmonic Nanomaterials	Steven Chavez	N/A
	Jan 22	LAB: Introduction to Basic Skills Part II	Steven Chavez	
3	Jan 25	LEC: Reading Research Papers	Dr. Andrew Tadd	Analyze Intro and Abstract

	Jan 29	LAB: Electrostatic Interactions between Macromolecules	Steven Chavez	
4	Feb 1	LEC: Introduction to Nanomaterials	Prof. Nick Kotov	Analyze Methods and Materials
	Feb 5	LAB: Nanoparticle Synthesis and Characterization I	Steven Chavez	
5	Feb 8	LEC: Microfabricated Systems	Prof. Mark Burns	Analyze Results, Discussion, and Conclusion
	Feb 12	LAB: Nanoparticle Synthesis and Characterization II	Steven Chavez	
6	Feb 15	LEC: Biotechnology and Biomolecular Engineering	Prof. Fei Wen	Group Journal Club (consolidating the parts)
	Feb 19	LAB: Antimicrobial effect of AgNPs	Steven Chavez	
7	Feb 22	LEC: Experimental and Computational Aspects of Solar Energy Conversion	Prof. Andrej Lenert	Introduction to Review Papers
	Feb 26	LAB: Electron Transport in Nanomaterials	Steven Chavez	
7.5	Mar 1	LEC: Undergraduate Talks and Panel	UG Students	
Mar 2nd - Mar 8th SPRING BREAK				
PHASE 2: COMPUTATIONAL				
7.5	Mar 12	LAB: Crash Course in Python	Kevin Greenman	-
8	Mar 15	Mathematical Modeling of Biological Systems	Prof. Jennifer Linderman	Linderman Paper
	Mar 19		Patrick Kinnunen	
9	Mar 22	Machine Learning	Prof. Bryan Goldsmith	Goldsmith Paper
	Mar 26		Jacques Esterhuizen, Samuel Young	
10	Mar 29	Molecular Dynamics	Prof. Heather Mayes	Mayes Paper
	Apr 2		Tucker Burgin	
11	Apr 5	Monte Carlo	Prof. Robert Ziff	Ziff Paper
	Apr 9		Dr. Wenlin Zhang	
12	Apr 12	Density Functional Theory	Prof. Emmanouil Kioupakis (MSE)	Kioupakis Paper

	Apr 16		Kevin Greenman	
13	Apr 19	Project Guidelines Lecture	Instructors	-
	Apr 29	Final Project Due		
	Apr 30	Post-course survey due		

Lab Session Structure

Organization

You will be working in teams of two or three, and will have a different partner for each lab session. Every student is individually responsible for all assignments in this course. Pre-lab assignments will prepare you for each session and post-lab assignments will allow you to reflect on your work and results. The evaluation forms you complete after every lab will shape the adjustments we make to maximize your learning experience. With regards to content, you will build from elementary lab skills to specific experiments that reflect several areas of research within the department.

Laboratory Notebooks

Each student will use a provided lab notebook to organize experiments and detail observations and analyses. It is advised that you use the pre-lab assignment to plan experiments in your lab notebook before coming into lab each week. Doing so will ensure that you are prepared for the session and will maximize your time in the lab.

Wet-Lab Guidelines

Please review the document posted on Canvas that details proper safety guidelines to follow when in lab. We will also devote time during the first lab session to lab safety and etiquette in this course and research in general.

Computer Lab Guidelines

Lab sessions will consist of a lecture-like learning session from an instructor and hands-on practice with each week's topic on your computer. More details will be provided as we approach Phase 2

Canvas Course Site:

All resources, assignments, and lecture slides will be posted on Canvas unless otherwise specified. You will submit pre-lab assignments on Canvas and you will complete and submit post-lab assignments on your lab notebook. Lecture assignments will be submitted to Canvas and lab/lecture evaluation surveys in person. Due dates for all assignments can be found on Canvas.

Please let us know if you find any typos and errors in any of the documents we provide. We appreciate your feedback and are happy to correct mistakes.

Deliverables and Grading

We encourage you to attend office hours or email us if you have any questions when doing the assignments.

Assignment	Due	Percentage of total grade
Guest lecture short quiz	Midnight Saturday after lecture. On Canvas.	10
Lecture feedback form	End of each lecture.	5
Pre and post course surveys	Beginning and end of course	5
Literature review	A week after date assigned. On Canvas	20
Pre-lab assignment	Midnight Sunday before each lab. On Canvas	20
Post-lab assignment	A week after each lab. On Canvas	20
Lab feedback form	24 hours after every lab. On Canvas	10
Final Project	On Canvas.	10

Notes: Credit for feedback forms will only be received by those who attend the lectures. Week 1's literature review assignment will be due two weeks after the assigned date. For post-lab assignments, you will turn in a portion of your lab notebook. Guidance on completion of this assignment will be posted on Canvas. The final project involves preparing an application to join a research lab. The goal of this project is to help students transition into a research lab and make use of the techniques and skills acquired in this course. More details will be provided as the end of the course nears.

Late Assignments

Any late assignments will be accepted for 50% of the credit 24 hours after the due date only. Anything submitted after 24 hours will not receive credit.

Absences

Any absence that affects your ability to complete any of the course's assignments (e.g. post-lab assignment, post-lecture quiz, lab feedback form, lecture feedback form) will be excused if it belongs in any of the following categories:

- Personal/family/friend emergency (e.g. medical)

- Religious holiday
- An activity in which you represent the university (e.g. athletic, sponsored student organization)
- Job interview travel

Please notify us and we will ensure that you can make up any missed assignments.

Grading

We will use a straight percentage grading scale. We guarantee that the grading will be no tougher than the scale shown below.

A/A- 93%

A-/B+ 89%

B+/B 86%

B/B- 82%

B-/C+ 80%

We reserve the right to be more generous when assigning letter grades. We also reserve the right to take into account class and lab participation of the students when final grades are determined. Any inquiries about your overall grade in this course should be directed to Prof. Wang.

Engineering Honor Code

All assignments will be administered under the College of Engineering Honor Code. Any suspected violations of these policies will be reported to the College of Engineering Honor Council and, if guilt is established, penalties may be imposed by the Honor Council and Faculty Committee on Discipline. Such penalties can include, but are not limited to, letter grade deductions or expulsion from the University for repeat offenses. For more information about the Honor Code, refer to <http://honorcode.engin.umich.edu>. If you have any questions about this course policy, please consult the teaching team.