

ENGN 379: Capstone Design

MTuWF 8:30 - 9:30am, Howe 115

Instructor information

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Course overview and objectives

Second term of the year-long capstone design project in which student teams solve open-ended engineering problems by integrating and synthesizing engineering design and analysis learned in previous courses. Project topics vary year-to-year and are driven by student interest. The fall term is dedicated to the design and planning phases. This includes project topic selection; comprehensive study of necessary background material; and identification of design objectives, conceptual models, and materials and equipment needed.

By the end of the course, students should be able to:

- Identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics
- Apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs
- Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- Develop and assess design communication skills with a range of audiences
- Recognize ethical and professional responsibilities in engineering situations and make informed judgments
- Recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately
- Function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty

Course textbook

You will not be required to purchase any books for this course. However, here is a list of books that you might find helpful when planning, implementing, and refining your designs:

- Hoffman, H. F. (2014). *The engineering capstone course: Fundamentals for students and instructors*. Springer. <https://doi.org/10.1007/978-3-319-05897-9>.
- Kerzner, H. (2017). *Project management* (12th edition). John Wiley & Sons, Inc.
- Petroski, H. (2018). *Success through failure: The paradox of design*. Princeton University Press.
- Ulrich, K. T. & Eppinger, S. D. (2012). *Product design and development* (5th edition). McGraw-Hill.

Grading

Grades for each assignment will be posted on Canvas. Your grade will be determined using the following distribution:

Category	Portion of grade
1. Interview report	5%
2. Technical design review presentation	10%
3. Midterm report	10%
4. Peer review reports	5%
5. Project exit plan	5%
6. Final poster presentation	15%
7. Final report	15%
8. Biweekly meeting preparation	5%
9. Progress reports	15%
10. Team website	5%
11. Attendance	10%
$(100\%) \times \text{participation modifier}$	

Your letter grade is determined using the following scheme:

Percentage Grade	Letter Grade	Meaning
90-100%	A	Superior
80-89%	B	Good
70-79%	C	Fair
60-69%	D	Marginal
<60%	F	Failure

Your final grade must be no less than 60% to pass the course. In some circumstances, an incomplete (letter grade I) or conditional failure (letter grade E) may be assigned at the professor's discretion. Please see the Grades section in the university Academic Regulations for more information on conditional failures and incomplete grades.

1. Interview report (5%)

In order to reinforce the course's goal of developing your professional skills, your team will interview a practicing engineer closely related to your project's field. The interview will focus on developing an understanding of how the engineer spends their day, what skills have been most useful to them in their careers, and to glean any advice from their experiences. Your team will develop the interview questions before meeting the engineer (over Zoom or in person). You will submit a short written report describing lessons learned and how they tie into your project.

2. Technical design review presentation (10%)

Roughly halfway through the term, your team will present the progress you have made on your project. The focus of your presentation should be on prototyping and/or testing progress and early results. Critical review will be conducted by the engineering faculty members.

3. Midterm report (10%)

Along with the technical design review presentation, you will be required to present your team's progress in a written report. The report should provide greater detail on your prototyping and/or testing process.

4. Peer review reports (5%)

Critical thinking and skeptical judgment of another engineer's design is a core skill in the effort to design safe and serviceable technology. As such, you will be asked to review a midterm report and poster presentation from your peers. These reports are brief and intended to aid your classmates in improving their work. Reports will be graded based on thoughtfulness and breadth of critical thinking.

5. Project exit plan (5%)

As your team approaches the last few weeks left in your undergraduate careers, you will need to reflect back on the work you have done and set realistic goals for finalizing and presenting your work. This assignment aims to prepare you for the remaining deliverables and for you to find a reasonable conclusion to your project.

6. Final poster presentation (15%)

In the last week of classes, your team will present your final design in a poster session open to members of the community. The purpose of this assignment is to learn how to succinctly describe and market your design using visual and conversational media.

7. Final report (15%)

Along with the final poster presentation, you will be required to present your team's final design in a written report. The report will build on previous reports.

8. Biweekly meeting preparation (5%)

Your team will conduct biweekly meetings with the professor. The purpose of these meetings is to review the team's progress, set goals for the following two weeks, and discuss problems that your team has encountered.

To promote effective meetings, your team will be required to submit a meeting agenda at least twelve hours before the scheduled start of the meeting. The agenda will describe logistical information and discussion topics for the meeting. The agenda will be shared with members of the team and the professor via email. Within forty-eight hours after the meeting, notes on what was actually discussed along with action items should be sent to the team and professor. The notes can be written as bullet points beneath the meeting agenda points.

9. Progress reports (15%)

In lieu of keeping a design notebook, you will write a weekly progress report describing the work you individually performed in the prior week and plans for the following week. These reports should be between 250 and 500 words (one to two double-spaced pages). Your grade will depend on the depth of your reflection and specificity and detail of your plans.

Remember, as a four-credit course, twelve hours per week per student of substantive time and energy investment (i.e., project progress) is the baseline expected contribution. This is an opportunity for you to share the work that you have done that can be difficult to see in the final deliverables.

10. Team website (5%)

Throughout the course, your team will continue to develop a project website that documents important information about your progress. The website will be made available to members of the W&L community along with relevant stakeholders to your project (e.g., clients, community members, governments). The exact content you will be required to curate will be explained as the term progresses, but will closely follow the deliverables for the course. Your grade in this category depends on the organization, ease-of-use, and appearance of your team's website at the end of the semester.

11. Attendance (10%)

With twelve class meetings and six biweekly team-professor meetings, you are expected to attend at least fifteen of those to receive full points in this area. Arriving more than five minutes late to a meeting will count as an absence. This policy is meant to incentivize you to improve your habits and prepare you for the workforce.

Participation modifier

At the end of the semester, you will be asked to assess your participation and the participation of your teammates in the project so far. Using these assessments, along with evidence from your progress reports, your final grade could be scaled up or down in proportion to the amount of effort you put into the project. The purpose of this policy is to incentivize all members of the team to participate equally. Any problems regarding unequal participation should be addressed as soon as they come up through team discussions, first, and possible mediation with the professor if initial resolutions fail.

Late submission policy

Late submissions will not be accepted in this course (see exemptions below). There are several reasons for this policy. The first is that you will be working in teams for the majority of the deliverables, so it will be harder for everyone to forget a deadline. Additionally, you and your team will have ample time to complete each deliverable (a week, at least). Finally, this class is meant to prepare you for the next step in your career, and learning how to manage your time, meet deadlines, and work with your teammates are essential skills you will need.

Exemptions to this policy are as follows. If you or one of your teammates experiences an emergency (e.g., hospitalization, death in the family) that prevents the entire team from submitting a deliverable on time, please email the professor as soon as possible explaining the situation and request for an extension.

Communication policy

Your success in this class (and any other) depends on your ability to communicate with your professor and stakeholders in a timely and professional manner. By setting some ground rules, you can achieve this goal. These rules include:

- Any requests should be made in writing (meeting notes or email or work best) to ensure that there is a record (for requests made in conversations, send a note over email).
- Try to send emails during normal work hours (Monday-Friday, 8am-5pm). Responses to emails sent outside of this period may be delayed.
- Be courteous and professional in your writing (try not to write like you do in a text message).

You are welcome to ask questions about the course, engineering in general, structural engineering, careers, graduate school, etc., and asking questions is a great way to generate rapport with the professor.

Collaboration policy

In this course, you will be required to collaborate with your peers. You will benefit by talking with others within and outside of your team and by using the myriad resources available to you online to overcome obstacles you might face in this course. However, your team must submit original work. Copying (or superficially modifying) code, text, or drawings from your peers or from online resources is plagiarism. Additionally, individual assignments (e.g., the progress reports) should represent your own work, with quotations and ideas cited so that the source can be traced back (e.g., title, author, date, publication). Any person or team found violating these rules will receive a zero on the assignment and will be referred to the Executive Committee for an Honor Violation.

Technology/electronic devices policy

It is not recommended that you use your cell phone or computer in ways irrelevant to the class during meeting times. Doing so will harm your participation modifier, lowering your final grade. Please speak with the professor if there is a pressing issue requiring you to use your phone in class.

Policy on respect and inclusion

The greatest resources engineers have are the knowledge, experience, and wisdom of the members of their team. This course will work to ensure that students from all background and perspectives are treated equitably and have the respect they deserve as engineers and human beings. This includes the chance to share your personal pronouns with the professor and/or the class (if you feel comfortable and safe to do so) or to share your concerns with the professor about other issues in private.

Your responsibility as a student is to uphold the values of diversity, equity, and inclusion by being respectful and welcoming to other students and your instructors. You are encouraged to start brave conversations with your peers and instructors when you see actions or hear statements that harm members of your community.

Remember, if an idea creates a strong emotional response in you, be sure to first ask yourself why that might be before reacting. You will either learn something new about yourself and others or strengthen your own argument against what was said. Practicing this emotional intelligence skill will benefit you professionally and intellectually.

Policy on student mental health and wellbeing

An engineering curriculum, on top of other aspects of life, is stressful. If you feel overwhelmed, please, seek help from friends, family, the professor, or professionals. Washington and Lee University is committed to advancing the mental health and wellbeing of its students. Mental

health services are available to you at no cost. For help, contact the University Counseling Center (website here) or to your class dean. Your dean is Megan Hobbs (mhobbs@wlu.edu). Additionally, feel free to reach out to the professor if you have any questions or concerns about this class or anything else.

Policy for students requiring accommodation

There can be a frustration and fear that comes with seeking accommodation in classes. However, know that accommodations exist to help you meet your potential – they do not give unfair advantages to people with disabilities. It is recommended that you request accommodations through the university (instructions here) to receive documentation of your accommodation needs that you may share with the professor. Know that you have the right to choose whether or not to disclose your accommodation needs to the professor. You are encouraged to meet with the professor to discuss your needs if you believe they will affect your experience in the class.

Land and labor acknowledgment

Engineering is more than just solving math and science problems to develop new technology. In this class, you will develop solutions to other people's problems, and it is essential that you understand the impact that technology and development can have on people adjacent to those problems.

In that vein, acknowledge that Washington and Lee University sits on land historically occupied by members of the Monacan and Yésah-descended nations. Further acknowledge that the land you occupy, like almost all property in the United States, stands on lands obtained, generally in unconscionable ways, from indigenous people. The resources you benefit from as a member of the university were originally gained through exploitation of others. Knowing where you live and work does not change the past, but a thorough understanding of the ongoing consequences of this past can empower you and the community in the work to create a future that supports human flourishing and justice for all individuals. For more information about indigenous land occupation, visit <https://native-land.ca/>.

Also acknowledge that you cannot separate the history of Washington and Lee University and the surrounding community from the history of slavery in the United States. Acknowledge the legacy of slavery in this area and the blood, sweat, and tears of enslaved people that soak the earth beneath your feet in Lexington, Virginia. This legacy persists today as you and the community continue to work towards racial equity and justice.

Course schedule (subject to change)

Wk #	Day	Date	Topic	Due
1	W	01/11	Course updates overview	
2	Tu	01/17	Biweekly meeting: Teams 1 & 2	
	W	01/18	Workshop: Interview questions	
	F	01/20	Biweekly meeting: Teams 3 & 4	
3	W	01/25	One-on-one meetings	
4	M	01/30	Biweekly meeting: Teams 2 & 1	
	W	02/01	One-on-one meetings	
	F	02/03	Biweekly meeting: Teams 4 & 3	
5	W	02/08	Practice: Technical Design Review	Interview report
6	M	02/13	Biweekly meeting: Teams 1 & 2	Midterm reports
	W	02/15	Presentation: Technical Design Review	
	F	02/17	Biweekly meeting: Teams 3 & 4	
Washington break 02/20-24 (no classes)				
7	M	02/27	Biweekly meeting: Teams 2 & 1	Peer review report
	W	03/01	Peer review: Midterm reports	
	F	03/03	Biweekly meeting: Teams 4 & 3	
8	W	03/08	Workshop: Project exit plan	
9	M	03/13	Biweekly meeting: Teams 1 & 2	Project exit plan
	W	03/15	Workshop: Creating a design poster	
	F	03/17	Biweekly meeting: Teams 3 & 4	
10	W	03/22	Workshop: Developing a poster presentation	
11	M	03/27	Biweekly meeting: Teams 2 & 1	Peer review report
	W	03/29	Peer review: Poster and presentation	
	F	03/31	Biweekly meeting: Teams 4 & 3	
12	W	04/05	Course evaluations	Final poster
13	Exam week (no classes)			Final report
<p>Notes: (1) All deliverables due on Fridays at 11:59pm, unless otherwise stated (2) MTuF classes are reserved for either biweekly meetings or project work days (3) Weekly progress reports due each week except for Weeks 1 and 13 (4) For biweekly meetings, first listed team meets at 8:30-9am, second at 9-9:30am</p>				