



Department of Mechanical Engineering
ME EN 4010 – Engineering Design II – Fall 2020

Syllabus

- Instructor:** Prof. B. Raeymaekers, MEK 2676, bart.raeymaekers@utah.edu
Office Hours: Mo 100-130p, Th 1230-100p, ZOOM: <https://utah.zoom.us/j/7149075329>
Units: 3
Instruction method: IVC
Meeting Times: Tu, Th: 7:30 am - 8:50 am, ZOOM (see detailed schedule underneath)
Engineering Lab: CADE Lab and Engman Lab
Course Website: Hosted on CANVAS
Pre-requisites: **ME EN 3000, 4000, and Upper Division ME Status**
Course TA: Karl Niendorf (karl.niendorf@utah.edu)
Course summary: ME EN 4010 is the final course in the Senior Design Sequence - ME EN 3000, 4000, 4010. The course is a team project-based course, in which teams of engineering students complete an engineering design project from start to finish.
- Course objectives:** At the end of this course the student will be able to apply design methodology to define, design, analyze, manufacture, evaluate, and document an engineered product. To do this the student will:
1. Solve a complex design problem using a standard design process.
 2. Formulate design objectives, constraints, functions, and metrics.
 3. Create and evaluate design concept alternatives.
 4. Create, analyze, and document a design.
 5. Prepare detailed design drawings according to ASME standards.
 6. Construct and test critical function prototype(s).
 7. Present design process and prototype testing.
 8. Create and present a final product that meets design specifications.
 9. Manage a design project scope, schedule, and budget.
 10. Write a detailed report summarizing the final design.
- Grading:** >90% = A, 80-90% = B, 70-80% = C, 60-70% = D, and <60% = E.
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| • Team homework | 5% |
| • Design review 1 | 10% |
| • Midterm prototype and detailed analysis report | 20% |
| • Design review 3 | 10% |
| • Design day demonstration and poster | 20% |
| • Design project / Final report | 30% |
| • Peer evaluation | 5% |
- Each item must be completed to pass the course.

Deliverables:**Team homework (5%) (one submission per team)**

There will be four team homework assignments:

- **Project milestones document (5 pts): Due on Fri 28 August at 5 pm on Canvas.**

Your first assignment of the semester will be to produce a document outlining your project plan. This document should clearly list all milestones that need to be reached, with dates, to accomplish a successful project by Design Day on 1 December. *Each milestone must be quantifiable (not yes or no)*, and you need to define a quantitative “metric of success” and the corresponding measurement you will perform, for each milestone.

Example milestone overview:

Date	Milestone	Metric of success	Measurement	Pass?
09/02	Electrical motor control circuit design	Motor must accelerate to 1,500 RPM under full load in less than 3 seconds.	Time and RPM measurement	
10/02	Mechanical frame design	Frame must withstand 5,000 N static load in location xyz without plastic deformation of steel with $\sigma_y = 300$ MPa	Maximum stress from FEM simulation	

At each of both design reviews you will report on the status of meeting these milestones. You will be expected to have met milestones that have passed at the time of the design review and have clear plans to reach the upcoming milestones.

- **Design day information form and images (5 pts): Due on Tu 15 October at 5 pm on Canvas.**
You will need to fill out the online Design Day information form and upload project images to be used for promotional material.
- **Project poster pre-submission (5 pts): Due on Tu 10 November at 5 pm on Canvas.**
- **Project poster (5 pts): Due on Th 19 November at 5 pm on Canvas.**

Midterm prototype and detailed analysis report (20%) (one submission per team).

You will prototype your full design, approximately mid-way through the semester. This prototype is intended to (a) validate your design analysis (i.e., the product will perform as engineered), and (b) uncover practical implementation issues early. You will present the results of the prototype and its evaluation to the course instructor, TA, and possibly team advisor during the Midterm Design Review. The design review presentation is worth 10% of your grade.

Along with this prototype you will turn in a detailed design analysis report which will include detailed part drawings (2D), following the relevant ASME standards, and relevant analysis to demonstrate how you engineered or optimized your design to meet specifications. This report will be worth 10% of your grade and will become a major section in your final report.

Design review 1 and 3 (10% each) (one submission per team).

The design review is limited to 12 minutes per team + 3 minutes for questions. The design review needs to provide a succinct update on the status of the project in max. 8 slides. The format of the design review presentation must be according the following format:

Slide 1: Project description

Slide 2: Goals and milestones. Status of the project.

Slide 3, 4, 5, 6: Discussion of status of specific milestones that the team has worked on/problems/solutions. Provide quantitative analysis, and a quantitative comparison between the outcomes of your experiments and analysis, and the metrics of success defined for each milestone.

Slide 7: Plan for next design review

Slide 8: Budget update.

All team members are required to be present and answer questions in a professional and competent manner about all aspects of the project. Each team member is required to present in at least one design review. If problems in the planned design arise, team members are expected to provide approaches to solve the problems in their designs. Students that miss design reviews will receive a failing grade (0/10) for that Design Review.

Submit your design review slides on Canvas by 5 pm on the day of your design review.

Design day (20%) (one submission per team)

The final design project demonstration will take place on Design Day via Zoom. It is anticipated that this presentation will involve a live demonstration of the project or pre-recorded video demonstration, based on COVID-19 conditions at that time.

Final report (30%) (one submission per team)

The final report will include all deliverables developed in ME EN 4000 and 4010. A summary of the requirements for the final report are found in the Introductory Lecture Notes.

Team peer evaluations (one submission per student)

At the end of the semester you will fill out peer evaluation forms. As all assignments are team assignments, your individual grade will be scaled based on your individual contributions, which will be determined by the peer evaluations. Your individual grade can be increased or decreased up to one full letter grade (10 percentage points) based on individual contributions. The instructor can adjust individual grades more under special circumstances.

Schedule

The schedule is **preliminary and subject to change**. Changes to the published schedule will be announced on Canvas and emailed to affected teams.

Week	Tue (7:30 - 8:50 AM) Zoom	Thu (7:30 - 8:50 AM) Zoom	
1	25 August Course introduction	27 August No lecture	
2	1 September DR1 Teams 1, 2, 3	3 September DR1 Teams 4, 5, 6	
3	8 September DR1 Teams 7, 8, 9	10 September No lecture	
4	15 September No lecture	17 September No lecture	
5	22 September No lecture	24 September No lecture	
6	29 September No lecture	1 October No lecture	
7	6 October Midterm DR Teams 1, 2, 3	8 October Midterm DR Teams 4, 5, 6	
8	13 October Midterm DR Teams 7, 8, 9	15 October No lecture	Design day info form/images due
9	20 October Poster overview/instructions	22 October No lecture	
10	27 October No lecture	29 October No lecture	
11	3 November DR3 Teams 1, 2, 3	5 November DR3 Teams 4, 5, 6	
12	10 November DR3 Teams 7, 8, 9	12 November No lecture	Poster pre- submission due
13	17 November No lecture	19 November No lecture	Final poster submission due
14	24 November No lecture	26 November No lecture/Thanksgiving	
15	Design Day Tue December 1, 2020 on ZOOM.		
16	Final report and peer evaluations are due Thu 3 December by 11:59 PM. Turn it in to Canvas and to advisor.		

Team 1: Robotic arm (Advisors: Dr. Hochhalter)

Team 2: Off road recreational walker (Advisor: Dr. Merryweather)

Team 3: Powered accessible dock (Advisor: Dr. Merryweather)

Team 4: Wind tunnel lift/drag balance (Advisor: Dr. Metzger)

Team 5: H-track lift (Advisor: Dr. Merryweather)

Team 6: Aircraft ADSB Camera Pointing (Advisor: Dr. Mascaro)

Team 7: Mechanical inerter for vibration mitigation (Advisors: Dr. Wang)

Team 8: Cogging torque parallel-elastic actuator (Advisor: Dr. Abbott)

Team 9: Aquaponics (Advisor: Dr. Leang)

Course policies

1. Attendance: Failure to attend a Design Review will result in a score of zero for that Design Review. Failure to be present at Design Day (or online equivalent) will result in failing the course.
2. If the Instructor or Project Advisor determines that you have not significantly contributed to your team's project, the Instructor reserves the right to give a failing grade for the course.
3. Based on CDC guidelines, the University requires everyone to wear face coverings in shared public spaces on campus, including our classroom. As a reminder, when I wear a face covering, I am protecting you. When you wear a face covering, you are protecting me and all of your classmates. If you forget your face covering, I will ask you to leave class to retrieve it. If you repeatedly fail to wear a face covering in class, I will refer you to the Dean of Students for a possible violation of the Student Code. Note that some students may qualify for accommodations through the Americans with Disabilities Act (ADA). If you think you meet these criteria and desire an exception to the face covering policy, contact the Center for Disability and Access (CDA). 2 Accommodations should be obtained prior to the first day of class so that I am notified by CDA of any students who are not required to wear a face covering.
4. Academic dishonesty policy: ME EN 4010 will strictly follow the standard academic policy outlined by the University and the College of Engineering.

Faculty and student responsibilities:

1. No laptops, cellular/smart phones are allowed during class meeting times. These can be disruptive and distracting to your class mates.
2. All students are expected to maintain professional behavior in the classroom setting and during interactions with each other and the instructor, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.
3. "Faculty...must strive in the classroom to maintain a climate conducive to thinking and learning." PPM 8-12.3, B.
4. "Students have a right to support and assistance from the University in maintaining a climate conducive to thinking and learning." PPM 8-10, II. A.
5. ADA statement: "The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations." (www.hr.utah.edu/oeo/ada/guide/faculty/)