



**Department of Mechanical Engineering**  
**ME EN 4010 – Engineering Design II – Fall 2021**

**Syllabus**

- Instructor:** Prof. B. Raeymaekers, MEK 2676, bart.raeymaekers@utah.edu  
**Office Hours:** Mo 100-130p, Th 1200-1230p, and by appointment.  
**Units:** 3  
**Instruction method:** In-person  
**Meeting Times:** Tu, Th: 7:30 am - 8:50 am, MEK 3550  
**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:** John Unterhalter  
**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.
- 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 27 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 30 November. *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 <i>xyz</i> 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 Thu 21 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 9 November at 5 pm on Canvas.**
- **Project poster (5 pts): Due on Th 18 November at 5 pm on Canvas.**

**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.

**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 (follows the same format as DR 1 and 3). The design review presentation is worth 10% of your grade.
- Along with this prototype you will turn in a detailed design analysis report that 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 day (20%) (one submission per team)**

The final design project demonstration will take place on Design Day on 30 November 2021. Each team will have a 15-minute time slot during which the instructor will ask questions about the team's project. We will use the Design Day rubric to evaluate each team's live Q&A.

**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. The final report is submitted to Canvas by 11:59 pm on 30 November 2021.

**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**

Week	Tue (7:30 - 8:50 AM)		Thu (7:30 - 8:50 AM)	
1	24 August Course introduction		26 August No lecture	
2	31 August DR1 Teams 1, 2, 4, 6		2 September DR1 Teams 7, 8, 9, 10	
3	7 September DR1 Teams 11, 12, 14, 16		9 September No lecture	
4	14 September No lecture		16 September No lecture	
5	21 September No lecture		23 September No lecture	
6	28 September Midterm DR Teams 1, 2, 4, 6		30 September Midterm DR Teams 7, 8, 9, 10	
7	5 October Midterm DR Teams 11, 12, 14, 16		ABET visit	
8	12 October Fall break		14 October Fall break	
9	19 October Poster overview/instructions		21 October No lecture	Design day info form/images due
10	26 October No lecture		28 October No lecture	
11	2 November DR3 Teams 1, 2, 4, 6		4 November DR3 Teams 7, 8, 9, 10	
12	9 November DR3 Teams 11, 12, 14, 16	Poster pre- submission due	11 November No lecture	
13	16 November No lecture		18 November No lecture	Final poster submission due
14	23 November No lecture		25 November No lecture/Thanksgiving	
15	<b>Design Day Tue 30 November 2021</b>			
	Final report and peer evaluations are due Thu 9 December by 11:59 PM. Turn it in to Canvas and to advisor.			

**Team 1:** Smart pressure insole (Advisor: Dr. Merryweather)

**Team 2:** Large deformation patterns of 2D mechanical metamaterials (Advisor: Dr. Wang)

**Team 4:** Mechanical inerter for vibration mitigation in seismic events (Advisor: Dr. Wang)

**Team 6:** Compliant EMI cover (Advisor: Dr. d'Entremont)

**Team 7:** Vibration isolation with thermal conductivity (Advisor: Dr. d'Entremont)

**Team 8:** Wave motion visualization teaching aids (Advisor: Dr. Kingstedt)

**Team 9:** Robotic test stand arm (Advisors: Dr. Hochhalter)

**Team 10:** A 3D-printed nerve conduit (Advisor: Dr. Gale)

**Team 11:** Robot hand with supercoiled polymer muscles (Advisor: Dr. Mascaro)

**Team 12:** MEK wind turbine (Advisors: Dr. Metzger and Dr. Stanfield)

**Team 14:** Robotics room exhibits (Advisor: Dr. Mascaro)

**Team 16:** IV pole redesign (Advisor: Dr. Merryweather)

**Course policies**

1. Given the nature of this course, attendance is required and adjustments cannot be granted to allow non-attendance. However, if you need to seek an ADA accommodation to request an exception to this attendance policy due to a disability, please contact the Center for Disability and Access (CDA). CDA will work with us to determine what, if any, ADA accommodations are reasonable and appropriate.
2. 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.
3. Each team (all team members) that presents their Design Review during at a scheduled date must be present at the start of that lecture (7:30a) to minimize disruptions.
4. 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.
5. 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/](http://www.hr.utah.edu/oeo/ada/guide/faculty/))

**COVID-19**

1. University leadership has urged all faculty, students, and staff to model the vaccination, testing, and masking behaviors we want to see in our campus community. These include:
  - Vaccination
  - Masking indoors
  - If unvaccinated, getting weekly asymptomatic coronavirus testing

**Vaccination:**

- Get a COVID-19 vaccination if you have not already done so. Vaccination is proving highly effective in preventing severe COVID-19 symptoms, hospitalization and death from coronavirus. Vaccination is the single best way to stop this COVID resurgence in its tracks.
- Many in the campus community already have gotten vaccinated:
- More than 80% of U. employees
- Over 70% of U. students
- Visit <http://mychart.med.utah.edu/>, <http://alert.utah.edu/covid/vaccine>, or <http://vaccines.gov/> to schedule your vaccination.

**Masking:**

- While masks are no longer required outside of Health Sciences facilities, UTA buses and campus shuttles, CDC guidelines now call for everyone to wear face masks indoors.
  - Check the CDC website periodically for masking updates—<https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinatedguidance.html>
  - Treat masks like seasonal clothing (i.e. during community surges in COVID transmission, masks are strongly encouraged indoors and in close groups outside).

**Testing:**

- If you are not yet vaccinated, get weekly asymptomatic coronavirus tests. This is a helpful way to protect yourself and those around you because asymptomatic individuals can unknowingly spread the coronavirus to others.
  - Asymptomatic testing centers are open and convenient: Online scheduling Saliva test (no nasal swabs) Free to all students returning to campus (required for students in University housing) Results often within 24 hours Visit [alert.utah.edu/covid/testing](http://alert.utah.edu/covid/testing)
- Remember: Students must self-report if they test positive for COVID-19 via this website: <https://coronavirus.utah.edu/>.

**2. Student Mental Health Resources:**

- Rates of burnout, anxiety, depression, isolation, and loneliness have noticeably increased during the pandemic. If you need help, reach out for campus mental health resources, including counseling, trainings and other support.
- Consider participating in a Mental Health First Aid or other wellness-themed training provided by our Center for Student Wellness and sharing these opportunities with your peers, teaching assistants and department colleagues.