

MEC 440-441: Mechanical Engineering Design I & II

Department of Mechanical Engineering
The State University of New York, Korea
Spring/Fall 2024

Instructor: Prof. Y. Eugene Pak

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Lectures: Tue./Thur. 2:00~3:20 PM

- First few lectures for MEC 440 will be in person in Room A117
- Once the team building is done, each team will meet once a week in person with their respective faculty advisor to discuss progress. This will continue into MEC 441 until the end of the Fall semester.

Laboratory: Doosan Dream Makerspace will be the primary workspace for carrying out the projects. Other labs can also be used depending the advising faculty.

Office Hours: Mon./Wed. 3:30-5:00 PM (or by appointment)

Textbook: No textbook required

Reference book: Stuart Pugh, Total Design—Integrated Methods for Successful Product Design, Addison Wesley, 1991

MEC 440 Prerequisites: MEC 300, MEC 310, MEC 317, MEC 320, MEC 325/125;
MEC major U4 standing

Co-requisite: MEC 410 and MEC 411

MEC 441 Prerequisites: MEC 440

Course sequence description

This two-semester (MEC 440 and 441) capstone design course provides senior mechanical

engineering undergraduate students opportunity to gain significant design experience while applying their engineering fundamentals learned through course work. This course is designed to motivate self-learning and to encourage students to develop teamwork in implementing innovative techniques so that they are better prepared for their future engineering careers. Students are encouraged to take on projects that meet the societal and technological needs as well as to provide service to the betterment of humanity. Students will work in groups designing and implementing their ideas based on the total design methodology. At the end of the second semester, each project group will present and demonstrate the final project prototypes.

The design process consists of the following major steps:

- 1) Teaming and project selection
- 2) Market search and user needs analysis
- 3) Product design specification (PDS) initialization and updating
- 4) Conceptual design
- 5) Detail design with engineering analysis
- 6) Prototyping
- 7) Testing
- 8) Final prototype presentation
- 9) Final project documentation

The design process spans two semesters. The first semester will emphasize design and analysis. Students will go through the major design steps. By the end of the first semester, each team should generate a complete set of design details of the project that is ready for fabrication and prototyping. The second semester will emphasize implementation and testing. Students will fabricate and refine their prototypes based on testing, then finally realize the proposed functions.

To fulfill the course requirement, each design team needs to submit a project proposal after choosing the project, progress report for each of the above-listed design phases, and a final project report. Moreover, at the end of the first semester, each team needs to give an oral presentation of their design steps and results; and at the end of the second semester, each team needs to give an oral presentation of their design and implementation process, and demonstrate their prototype.

Course topics

1. MEC440

- 1) Form design teams
- 2) Develop design proposals
- 3) Project management
- 4) Market and user needs analysis
- 5) Development of Product Design Specifications (PDS)
- 6) Conceptual design
- 7) Preliminary detail design
- 8) Engineering analysis
- 9) Writing technical reports
- 10) Project presentations

2. MEC441

- 1) Detail design
- 2) Design Review
- 3) Prototyping
- 4) Testing
- 5) Writing technical reports
- 6) Project presentations and demonstrations

Course learning objectives

1. MEC 440

- 1) Form a design team and identify a mechanical engineering problem with real-world constraints as a year-long design project.
- 2) Present project research on how engineering solutions can have impact on the society and people's lives.
- 3) Define and delineate individual professional responsibility for each team member.
- 4) Learn contemporary issues related to the project through background search.
- 5) Identify the desired needs and multiple realistic constraints.
- 6) Generate and evaluate conceptual designs according to PDS.
- 7) Search, analyze and document prior art (patents) and existing markets and products
- 8) Conduct detail design and analysis using modern engineering tools such as CAD and FEM as well as incorporating engineering standards and manufacturing constraints.

- 9) Acquire independently information and knowledge specific for the project.
- 10) Prepare design reports and give effective oral presentations.

2. MEC 441

- 1) Conduct detail design and analysis incorporating engineering standards and manufacturing constraints.
- 2) Identify and acquire new knowledge/information that are required for the project beyond the classroom learning.
- 3) Use modern engineering tools to implement the project.
- 4) Conduct experiments and analyze the data based on the requirements of the specific project.
- 5) Gain a better appreciation of how engineering solutions can have impact on the society and people's lives.
- 6) Prepare design reports and give oral presentations with visualized materials.
- 7) Develop an ability to effectively communicate and function as a multidisciplinary team.

Team Rules

- 1) The design project should be a team work. Each design team should consist of 3-4 people based on the need of the chosen project. No single-person team is allowed. Any team who wishes to have 5 members must obtain explicit approval from the instructors.
- 2) Each team must choose an advisor among the faculty, and maintain regular meetings with the advisor based on a schedule discussed between the team and advisor.
- 3) Each team must schedule meetings with the person who can advise on the manufacturing issues in the detail design phase to deal with the manufacturability issues.

Grading

The letter grade will be issued at the end of the second (Fall) semester. The Fall and Spring Semesters will have the same grade. The grade will be based on the following breakdown:

1. Reports (20%)

MEC 440

- 1) Project Proposal
- 2) Progress Report 1 (market/user needs analysis, conceptual design)
- 3) Progress Report 2 (updated market/user needs analysis + updated conceptual design + preliminary detail design)
- 4) Spring Semester Final Presentation/Design Review (date TBD)

MEC 441

- 5) Progress Report 3 (progress since the last Report, updates from Design Review)
- 6) Final Report

2. Execution of the Project (30%)

- Due diligence and teamwork
- Meeting attendance
- Class attendance and team effort (class lectures, presentations and small group meetings)

3. Design Review and Final Presentation (20%)

- Clarity and communication of ideas through presentation
- Aesthetics of the presentation material

4. Working Prototype Delivery (30%)

- Meeting the design specifications and the overall objective
- Working level and completion of the prototype

Grading Guidelines

- In order to get a valid grade, a working prototype must be finished by the end of the Fall Semester. If the prototype is not finished, no grade will be given to the team. If your project is under external funding, you should be responsible to the project requirements.
- Each report will be submitted and graded on a team basis. Late submission of your report will cost 5% of that report per calendar day, and will not be accepted with a delay of 3 or more days.
- The grade for each student will be adjusted on the basis of his/her team score

according to his/her contribution to the project. Team members will have clear delineation of tasks as part of their documentation. Work that is not submitted by assigned deadlines will be reflected in a reduction of the team grade with additional reductions possible for work not completed by an individual team member who was responsible for that phase of the work. If any member misses 1/3 of project team activities as documented by their teammates, no grade will be given to him/her. If this happens in the first semester, he/she cannot continue on with MEC441.

- The semester and final reports will be graded by both of the instructors and the project advisor. These grades will be used to calculate semester grades. It is your responsibility to make sure that you submit these reports to your instructors and your project advisor by the deadline.
- Your attendance of class presentations, small group sessions, and guest lectures is a part of your final grade. If you miss 1/3 or more of them, you will not be credited for class attendance.
- Students are expected to clean up after themselves in the senior design lab and machine shop with regards to all parts and tools that they use and in terms of cleaning up waste material. They must also follow all lab and university policies with regards to avoiding the use of food and beverages in laboratories. Students must return all keys to the lab to the mechanical engineering department staff. Any student in violation of these policies may be subject to discipline including reductions in grades.

Project budget and reimbursement policy

- 1) The budget limit per student is \$165.00
- 2) The project related purchase covers only materials and components.
- 3) All purchases will be made by the student with their own fund first, then at the end of each semester the money will be reimbursed by the Department Coordinator.
- 4) Detailed instructions and policy statements will be sent to the students.

ABET Student Outcomes:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Policies:

- The due dates and details about the reports and the final presentation will be announced in class (and also posted on the Brightspace).
- It is the responsibility of students to make sure that they can access the Brightspace and they have a working email registered with it. The Brightspace should be checked frequently for new materials.

Academic Integrity Statement:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website: http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management Statement:

The State University of New York, Korea expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn.

Attendance Policy of SUNY Korea:

1. All students of SUNY Korea are required to attend every class.
2. Unexcused absences will affect seriously the student's final grade in the course.

3. If a student has over 20% unexcused absence, the student's final course grade will be an 'F'.
4. Students should report the reason of absence to the instructor in advance, or immediately after the absence.
5. When a student excuses his/her absence, the student must provide documentation of the reason for the absence to the instructor.
6. The instructor of the course reserves the right to excuse absences.
7. The course instructor may excuse the absence if the submitted documentation fulfills the conditions below.
 - Extreme emergencies (e.g., death in the family)
 - Severe medical reasons with doctor's note (not a slight illness)
 - Very important events (e.g., national conference, official school event)
8. At the end of semester, the course instructor should submit a copy of the attendance sheet to the Academic Affairs Office.

Disability Support Services (DSS) Statement:

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact One-Stop Service Center, Academic Building A201, (82) 32-626-1117. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

In addition, this statement on emergency evacuation is often included, but not required: Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and One-Stop Service Center.

Subject to Change Notice

All material, assignments, and deadlines are subject to change with prior notice. It is your responsibility to stay in touch with your instructor, review the course site regularly, or communicate with other students, to adjust as needed if assignments or due dates change.

Syllabus Disclaimer

The instructor views the course syllabus as an educational understanding between the instructor and students. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary. The instructor reserves the right to make changes to the syllabus as deemed necessary. Students will be notified in a timely manner of any syllabus changes via email or in the

course site Announcements. Please remember to check your email and the course site Announcements often.