

Design and Manufacturing I

ME250 - Fall 2011

Department of Mechanical Engineering, University of Michigan

Course description

ME250 teaches the creative design process, principles of engineering materials and mechanical elements (including linkages, gears, bearings, and DC motors), and prototype-scale manufacturing using machine shop tools. These topics and skills are addressed using theory and examples in lectures, and are funneled through a semester-long team project involving the design, engineering, and manufacture of a remote controlled machine. The project culminates in the “North Campus” contest held at the College of Engineering Design Expo. Laboratory sections teach CAD modeling (Solidworks), machine shop fabrication (including drilling, milling, turning, laser/waterjet cutting), and provide ample time for ad-hoc design reviews (“Design Workshops” and individual discussions) with the instructors.

Students learn to identify a problem, and to create, develop, and select the strategies, concepts, and modules for their machine at increasing levels of detail throughout the first half of the term. Students justify their decisions according to fundamental design principles, quantitative analysis (e.g., force, power, speed), and cost/manufacturability. A midterm design review presentation is the gateway for the students to begin final engineering of their machine, which is then the gateway to manufacturing. The budget for the project is a kit of materials and components given to each team.

Professional responsibilities are emphasized throughout the course. Use of milestones, scheduling, and risk management are emphasized to keep the project on time and to guide the teams through the design, engineering, and manufacturing activities.

Course goals

1. Learn a design process, based on the scientific method, which combines creative thinking with engineering.
2. Learn how to visualize (in 2D and 3D) parts and assemblies, and how to communicate these (i.e., using a CAD model and engineering drawings) along with appropriate dimensions, tolerances, and specifications.
3. Learn fundamental design principles, become familiar with basic materials and mechanical elements, and learn the practice and limitations of basic prototyping and manufacturing tools.
4. Learn to assess and manage risks in a project, and to complete a project step-by-step using milestones and a schedule.
5. Be professional, use safe shop practices, and maintain high ethical standards.
6. **Combine all of the above in a challenging and fun open-ended design-build-test project.**

Lecture

- Tu/Th, 8.40-10.00a, 220 Chrysler (Chesbrough Auditorium), North Campus

Lab (attendance will be taken!)

- M/W, 9.40-5.30 (sections begin every hour at .40; choose one)
- CAD sessions in **224 EPB**
- DW (Design Workshop)/FAB/project sessions in **1185 GGB**

Machine shop, 1103 GGB (for training and project work)

- M-F 8a-5p. Extended hours will be announced during the project period.
- You will be permitted to work on your ME250 projects starting Monday, November 7.
- You may not work in the shop until you have completed training (see below).

ME250 Staff

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Course materials

- Notes and readings via <http://ctools.umich.edu>, MECHENG 250 001 F11
- There is no textbook or coursepack. Online references will be recommended with each lecture.

Schedule and list of assignments (including point values and due dates)	http://bit.ly/pHXEof
Kit contents	http://bit.ly/pjJmAh
Rules of the game	http://bit.ly/nfbjSC
Control system documentation	http://bit.ly/p7stMz
Suggested suppliers for extra components	http://bit.ly/92baHI
Course blog (project highlights)	TBA
Team rosters and numbers	http://bit.ly/ricm1X
Grades	see ctools
Staff office hours	http://bit.ly/mRumRK

Important Dates

September 19	Project Teams are formed
September 23	Deadline to finish machine shop training
September 28	Project kits are distributed to teams
October 19 or 21	Project Design Review
November 7	Begin Building Your Machine in the ME Shop
November 17	Exam (Individual)
December 7	Shipping Day (Machines inspected and locked until Expo)
December 8	Balltower Contest at Design Expo

Note: The ME250 schedule and list of assignments (google spreadsheet) is the official reference for due dates. Any changes to due dates will be reflected there, because a new syllabus will not be distributed.

Grading

HW assignments (4)	20%	50 points each
Exam (1)	15%	150 points
Project	65%	650 points total
- Milestones 1-4, design process	10%	25 points each
- Milestone 5, design review	10%	100 points
- Milestones 6-8, engineering + manufacturing	10%	100 points (50, 25, 25)
- Machine (milestones 9-10)	20%	200 points (25, 175)
- Team blog, incl. machine summary and video	5%	50 points
- Individual reflection (on team blog)	2.5%	25 points
- Lab attendance	2.5%	25 points
- Peer evaluation (see below)	5%	50 points
Total	100%	1000 points

Notes

Assignments listed on the schedule without point values are pass/fail; pass = 0 points, fail = -N points.

Confidential peer evaluations will be completed after the design expo, and can contribute from 0% to 10% to your individual course grade. If you contribute \approx equally, you will get 50 points; thus, in this nominal case the peer evaluation will not affect your grade. Your peer evaluation score will be assigned based on your % contribution to the project, which will be calculated as the average of the scores reported individually by your team members (including yourself). If there is a significant disparity in effort on your team, please make the staff aware of the issue as early as possible. For a 4-person team, the points will be assigned as follows:

% contribution	points
<15%	0
15-16.5	10
16.5-18	20
18-20	30
20-23	40
23-27	50
27-30	60
30-32	70
32-33.5	80
33.5-35	90
>35	100

Teams of 3 students will be evaluated by the staff on a case-by-case basis, recognizing that the load is greater than a 4-person team. *We cannot predict the grade distribution; however, based on past semesters it is likely that a 5% difference in your total course grade will make a difference of one or two letter grade steps.*

ADMINISTRATIVE POLICIES

General guidelines

- You are expected to attend lecture, and arrive **on time**.
- You are expected to be **respectful** to your instructors and peers during lecture, e.g., no use of mobile phones or text messaging, no laptops unless you're taking notes, eat quietly and neatly, don't clip your nails (seriously, someone did that during lecture)...

Assignment and grading

- Late assignments will **NOT** be accepted unless you have made **prior** arrangements.
- Questions on assignment scores must be brought to the attention of staff within one week after the assignment is returned.
- Lecture homework assignments must be completed on your own, meaning:
 - You may discuss the subject matter with your classmates (this is encouraged!) but you must independently formulate your solution.
 - You may not compare your solution with your classmates.
 - You must submit the solution individually.
 - Violation of this policy is grounds for the staff to initiate an action that would be filed with the Dean's office and would come before the College of Engineering's Honor Council (<http://www.engin.umich.edu/students/honorcode/>). If you have any questions about this policy, please contact the staff.
- Collaboration and discussion of solutions to the design milestones (MS) is encouraged, although you (or your team) must individually prepare and submit your work. It will be quite obvious to the staff if your submission does not reflect your independent thought and analysis!

Lab safety

- Safe use of the ME 250 lab facilities and equipment is a primary concern and responsibility of ALL users. Everyone must follow the safety and equipment procedures without fail. Please carefully read the shop rules on the following pages.
- Everyone without exception must take four training sessions (cutting/drilling, milling, turning, measurement). This requires online registration as described during the first lecture. **You must provide documentation of your training before the design review or you will automatically receive a grade of zero for the project.**