ME 470 (A01) - Mechanical Engineering Design I (Sr. Design, or SrD)
2010-1 (Fall 2009), 4 Credit Hours, Call #: 04545

Meetings: M,W 1:10-2 PM, F 12:10-2 PM, Stocker 103

Instructor: Dr. Greg Kremer , Stocker 253, 593-1561, kremer@ohiou.edu
Team taught with Dr. Urieli, Dr. Cotton, & Lab Coordinator Randy Mulford, with assistance from the ME Advisory Board.

Office Hours: Open door policy, email or call if you prefer an appointment

Course catalog description:
This course is the first of a three course sequence that will provide a comprehensive, capstone, senior design experience for mechanical engineering majors. Course includes studies in the analytical techniques of design, as well as the design, construction, and evaluation of the performance of an actual engineering system.

Prerequisite courses: ME 303, ME328. ME 304 and ME351 are also helpful.

Schedule and course details: Provided via online course calendar and course website

Planned Activities
Design Project activities (Documented in reports, presentations, discussions,...)
> FOCUS – capturing the voice of the customer through dialogue, observations, surveys, ...)
> Defining the problem and translating customer needs into specifications
> Conducting background and benchmarking research using good research procedures
> Conceptual Design Generation and Selection, including sufficient proof of feasibility and effectiveness **[Note: the Conceptual Design Feasibility Review is a pass/fail activity, and those teams that fail will be given an incomplete grade in the course and required to demonstrate feasibility by the first week of winter quarter.]**
> Scheduling / Planning / Project Management
> Time Permitting: Design Concept Refinement, and Initial Application of Design Methods
Interactions with ME freshmen (ME101)
> Mentoring / Teaching / Collaborating in the context of shared activities and case studies in Engineering Ethics.
Professionalism:
> Team formation and Team effectiveness (team operating procedures, agendas, action items, etc.)
> Showing initiative and an ability to get things done with minimal oversight
> Participation in industry-style performance reviews and peer reviews
> Planning and completing professional development (skill improvement) activities
> Project documentation, including a design notebook
> Process and teamwork reflections, demonstrating a thoughtful and effective approach
> Participation in collaborative development of and adherence to SrD operating procedures.

SrD Course Sequence outcomes:
This capstone experience is designed to help students achieve the following **outcomes**.
Successful achievement of **mastery level outcomes** is required to receive a passing grade in the course.
Where mastery is not achieved, feedback will be given and the work must be redone and resubmitted.

1) Ability to model, analyze, design, and realize a mechanical system that meets a particular need
2) Demonstrate Professional Skills, including
    a) Awareness of the expectations of the engineering profession concerning the behaviors or characteristics of a 'good engineer'
    b) Appreciation for the importance of continual lifelong learning and an awareness that continuous improvement is part of an engineer's personal responsibility
    c) Ability for self evaluation, leading to improvement
    d) Ability to find, evaluate and use resources to learn independently
    e) Appreciation for the importance of diversity of learning styles, abilities, perspectives, and roles within a team or organization.
    f) Ability to apply project management tools such as Gantt charts, Pareto charts, critical path analysis, and action items for planning, prioritizing, and scheduling tasks in a design project
    g) Ability to work effectively on project teams in both member and leader roles, with team members who may have different backgrounds and technical skill levels. This may include the ability to: work cooperatively with others, analyze ideas objectively, encourage active participation of others, build consensus, deal productively with conflict, take leadership roles as the need arises to accomplish the group's objective
    h) [Mastery Outcome] Appreciation for and an ability to promote safety and health in all aspects of the engineering profession, including safety during manufacturing and assembly, and product safety through Design For Safety or similar approaches
    i) Ability to evaluate ethical issues that may occur in professional practice
    j) Ability to interact in a professional manner with professionals from industry, including members of the Mechanical Engineering Industrial Advisory Board
3) Demonstrate Technical Skills, including:
    a) Ability to start with an open ended need statement or problem statement and through research, interviews and observations capture the 'voice of the customer' and translate the needs into requirements and design specifications
    b) Ability to generate numerous creative and feasible alternative solutions to a design problem, using precedent, brainstorming, and other methods for creativity and synthesis
    c) A working knowledge of estimation techniques and engineering heuristics (rules of thumb)
    d) Ability to evaluate the importance of an engineering decision, select an appropriate decision making process, and implement that process to make a defensible engineering decision
    e) Ability to apply failure modes and effects analysis (FMEA) to organize and prioritize analysis and testing and to improve the safety and reliability of a design
    f) Ability to apply useful tools for design refinement such as value engineering and design for manufacturing and assembly (DFMA)
    g) Awareness of the influence of engineering standards and constraints in engineering design, such as: manufacturability, sustainability, health and safety, environmental, ethical, social, political, and economic
    h) Ability to work with vendors / part suppliers to select and purchase machine elements (such as bearings, gears, or fasteners) to satisfy specific functional requirements
    i) Ability to use basic manufacturing skills to build and assemble prototypes of a product design
    j) Ability to select appropriate materials for a design, considering manufacturability, availability, cost, performance, suitability for the conditions, potential failure modes, environmental impact, and other considerations
    k) Ability to evaluate and use mock ups and prototype tests for design improvement and validation
    l) Awareness of the importance of patents and intellectual property rights

Technical Communication Activities

- **[Mastery Outcome] Ability to write and edit technical reports that are clear and concise, that use visuals and figures effectively, that make clear claims and support them with evidence, and that include proper citations**

- **[Mastery] An ability to synthesize a large design report in an informative abstract or executive summary**
- **[Mastery] An ability to prepare and present clear and effective design presentations that include "professional quality" visual aids**
- The ability to participate in technical discussions
- An ability to document project work properly in a design notebook
- Completion of a Users Manual that is delivered along with the prototype
- Completion of an entire drawing package and manufacturing plan that describes the production of the designed product prototype

Notes on expectations, Course Format, etc.:

This is a professional-level course, so students (and instructors) are expected to demonstrate

- professional attitude, professional behavior, professional-quality work, ...

Instructional Methods:

- Learning in this class is based on the "guided discovery" model, not lecture.
- The intent is to learn by doing (and by making some mistakes) with appropriate assistance and feedback given as needed.
- Please take a positive attitude and work on developing the skills for independent, lifelong learning.

Process / Product / Professionalism:

The focus in this class is not solely on product (making something that works) but more broadly on
> **process** (proper procedures that lead to good designs) and
> **professionalism** (what it means to be a "good" engineer).

- What directly transfers from this capstone experience is process and professionalism. You are not supposed to be learning to be a designer of a particular product, you are supposed to be learning what it means (in the big picture) to be a mechanical engineer and how to design any product or complete any project and work with any type of person as effectively as possible.
- The emphasis on process and professionalism is our response to directives from industry employers and the engineering profession (ABET, ASME, NAE, etc.)

Class Format:

- Part of the "learning experience" in this capstone design experience is role playing. You are expected to act professionally (i.e. act like an engineer) to help prepare you for interviewing and starting your professional career.
- Class meetings and individual or group meetings with faculty are normally treated like working meetings in industry - instructors acting as supervisors and classmates as fellow employees.
- You are expected to be active contributors in classes and meetings, not passive listeners. You are also expected to help shape the class by requesting help in areas that are important to the success of your project and your team.

Administrative Details

Textbook: None required – Most materials will be distributed in class or posted on the web, accessible via the course websites. Important reference texts for the SrD sequence include

- R.L.Norton, Machine Design: An Integrated Approach.
- Visualization, Modeling and Graphics for Engineering Design, Lieu and Sorby.

Attendance policy: In accord with the professional nature of this capstone experience it is expected that you will behave in a manner similar to that expected of a professional in industry. It is understood that there will be times where you must miss a class session or a team meeting due to job search or for other good reasons (including University approved absences), but in all cases it is expected that you inform the instructor or meeting leader in advance of the absence and work with members of your team to make up for anything that

you missed during the class session or meeting. If you do not know of the absence in advance, please inform the instructor or meeting leader as soon as possible after the absence. The way that you handle class absences will be considered in your performance review.

Academic dishonesty policy:
The Ohio University Student Code of Conduct prohibits all forms of academic dishonesty. These include cheating; plagiarism; forgery; furnishing false information to the University; and alteration or misuse of University documents, records, or identification.

- The foundation of professionalism is integrity. Any course-related academic dishonesty will be viewed as an integrity violation and will be considered in your performance review – serious violations will lead to a failing grade in the course (and may have further repercussions in accordance with the OU student manual).
- Please be particularly careful about plagiarism, and make sure you fully understand proper citations and cite your reference sources in all reports and projects. If in doubt, make sure to ask.
- Team participation is also an integrity issue – it is not professional to take credit for work that you did not adequately contribute to. If you are unable (or unwilling) to fully contribute to the work done by your team, you are expected to discuss your situation with the instructor and your team in order to ensure an equitable grade distribution.

Grading guidelines: (Details to be discussed in class)
- This is a "professional practices" course, and the method of 'grading' follows an industry-style performance review process. You will be evaluated on an individual and team level, with significant emphasis placed on demonstrations of 'expected characteristics' of good engineers.
- Process, product and professionalism are all evaluated and contribute to your course grade. For example, the way you reach your design decisions and the way you present your decisions is given the same weight as the results of your decisions.
- Our purpose is to help you develop into competent, professional engineers. You will be given prompt feedback on each activity and will be required to redo unacceptable work, just as in industry.
- Please remember: CRITICISM OF YOUR WORK IS NOT CRITICISM OF YOU!
- **Assigning letter grades:** (Details to be discussed during the course)
    - Although most major deliverables in this course are team deliverables (reports, presentations, designs, prototypes,...) individual grades will be determined as much as possible on demonstrated individual contributions to teamwork and the project and on demonstrated personal development, rather than on the model of "everyone on the team gets the same grade, with some redistribution based on peer ratings".
    - Final grading in this class is based on an industry-style performance review model. Because of the nature of teamwork (different roles) and the diverse work required for a complex project (different tasks), not all students will be doing the same type and amount of work, and therefore there will not be a single way to compute grades for all students. The Instructor will review the level of challenge of your roles and tasks, the quality of all of your individual work and team-based work, and the peer ratings and comments from your teammates, and will use personal observations and discussions (as needed) to assign a grade based on your overall performance relative to the expectations for a student preparing to enter the profession.
    - To emphasize the importance of taking initiative, work that goes above and beyond being a good student (i.e. not just doing what you are told but rather actively figuring out what needs to be done and doing it) is necessary to achieve a grade of "B" or higher in this class.
    - "A" and "A-" grades are reserved for students who demonstrate initiative and professionalism, take on a coaching role in mentoring teammates or other classmates, and show a high level of performance in all aspects of the capstone experience (including teamwork, practical skills, and analytical skills).