Engineering 10
Engineering Design and Analysis

Spring, 2009

Faculty
Alice Agogino, Mechanical Engineering, Lecture Section 1, 2
Ray Seed, Civil and Environmental Engineering, Lecture Section 3
Xin Guo, Industrial Engineering and Operations Research, Lecture Section 4

Lectures	10 – 11 AM	Monday, Wednesday and Friday (Sibley Auditorium, Jan. 21-Feb. 6)
Lab	2 – 5 PM	Tuesday, Wednesday or Thursday, starting week of Feb. 9

Course Description
Engineering 10, *Engineering Design and Analysis*, is an introduction to the profession of engineering and its different disciplines through a variety of modular design and analysis projects. Hands-on creativity, teamwork, and effective communication are emphasized.

Common lecture sessions address the essence of engineering design, the practice of engineering analysis, the societal context for engineering projects and the ethics of the engineering profession. Students develop design and analysis skills, and practice applying these skills to illustrative problems drawn from various engineering majors.

Textbook:
Dym, Clive, and Patrick Little with Elizabeth Orwin and R. Erik Spjut. *Engineering Design: A Project-Based Introduction.* Third Edition. John Wiley & Sons, Inc., Hoboken, NJ: 2008. Annotated textbook outline at: http://www.k-grayengineeringeducation.com/textbooks/?p=409

Course Website
All reading and homework assignments for the first three weeks will be posted on the course website at ***bspace.berkeley.edu***. All homework during the first three weeks of class should be submitted via bspace, unless otherwise specified.

Course Objectives
Engineering Design and Analysis is a course that provides first year students a broad introduction to the profession of engineering and its different disciplines, through a variety of small group design and analysis projects. At the core of the course are projects and case studies, through which the main concepts of the course are developed. The objectives of the course are to:

- enhance critical thinking and design skills;
- introduce students to a broad view of engineering analysis and design;
- reinforce the importance of mathematics and science in engineering design and analysis;
- emphasize communication skills, both written and oral;
- develop teamwork skills;
- offer experience in hands-on, creative engineering projects;
- provide an introduction to different fields of engineering; and

- introduce students to professional ethics and the societal context of engineering practice.

Educational Outcomes

Through active participation in this course, students will:

- begin to recognize the role of mathematics and science in engineering;
- understand the design of systems, components, and processes to meet desired needs within realistic constraints;
- gain experience in working in multi-disciplinary teams;
- develop early abilities in identifying, formulating, and solving engineering problems;
- appreciate the importance of professional and ethical responsibility in engineering;
- obtain experience in effective communication;
- begin to understand the impact of engineering solutions in a global, economic, environmental, and societal context; and
- begin to use the techniques, skills, and engineering tools necessary for contemporary and future engineering practice.

Course Structure

All students meet for a common lecture series during the first three weeks of the semester and submit weekly homework assignments during this portion of the course.

Students then participate in two successive six-week modules for the rest of the semester. Each module of 60 students is administered by one faculty member, with the support of up to three Graduate Student Instructors, for three hours of lecture and three hours of lab each week. The small-group lab sections, with a maximum of 20 students, allow student teams to address the module topic in depth. Students are assigned homework during the modules, and write a report or make a presentation (or both) at the end of each module. All students then take a final examination to evaluate the student's integration of the course material (lectures and modules) during the semester.

Lectures

During the first three weeks, all students convene in the Sibley Auditorium of the Bechtel Engineering Center for common lectures. Starting in the fourth week, each module will run the lectures scheduled for 10 – 11 in the room assigned to the module, not in Sibley Auditorium.

Modules

Each student will take two of the four modules offered this semester. A brief description of each module is provided on the next several pages. Each module will last for six weeks, and will consist of lectures and lab or discussion sections, depending upon the module. The lab/discussion periods are intended for students to be able to work in small groups on problems posed in their module. Students will rank order their preference for module assignments, with a guarantee that each student will get at least one of her or his first two choices.

Grading

Homework	20%
First Module	35%
Second Module	35%
Final	10%

Module Descriptions

Mechanical Engineering Module
Human-Centered Design for Sustainability
Instructor: Prof. Alice Agogino
Lecture Section: 1,2

How do engineers design successful, sustainable products? Students in this module will follow a human-centered design process to investigate the needs of stakeholders (users, customers, decision makers, etc.) to develop sustainable design solutions. This sustainable product development process includes customer needs analyses, conceptual design, prototyping, testing and life cycle analyses. Various prototyping tools will be available, including our new rapid prototyping equipment. Students can expect to finish this module with an understanding of what sustainability means, how designers draw from sustainability concepts, and the process used to generate and evaluate sustainable solutions. Areas of focus this semester will be sustainable products for residence halls and energy-production/reduction/conversion products. We will also explore extensions to underserved communities and developing countries. Funding will be available for design development and prototyping, including prototyping with our new rapid prototyping facility in 2117 Etcheverry Hall (using fused deposition manufacturing – FMD).

Civil and Environmental Engineering Module
Seismic Levee Improvements for Sacramento and Natomas
Instructor: Prof. Ray Seed
Lecture Section: 3

In the wake of the catastrophic flooding of New Orleans during Hurricane Katrina, the nation's flood defenses are now being re-evaluated and re-engineered. California, with approximately 9,000 miles of critical levees, leads the nation in flood risk; ahead of even Louisiana, Florida and Texas. The city that is currently rated as the most dangerous in the Nation in this regard is our State's capitol: Sacramento. Two major populated levee-protected basins (the South Sacramento "Pocket" area, and the Natomas basin) are known to have significant problems with regard to the potential for "regular" levee failures due to overtopping and/or under-seepage, and efforts are currently underway to resolve these vulnerabilities (at an estimated cost of ~$1.5 billion). A second set of even more challenging (and more costly) problems are those associated with seismic vulnerability of these same levees. These are not yet being addressed, as current estimates of cost to mitigate this risk are stunningly high. A major program to attempt to develop less costly solutions to this seismic risk has just been put "on hold" this past month due to the State's budget impasse. Accordingly, the students of this class will step in and fill this void. In this module, the students will form mini-consulting firms, and will work to perform seismic analyses and evaluations, and to develop seismic mitigation designs and estimates of the associated costs for selected levee sections.

Industrial Engineering and Operations Research Module

Real Life IEOR

Instructor: Prof. Xin Guo

Lecture Section: 4

Have you ever wondered how Toyota manages to have automobiles roll off its assembly line every minute? Or how Starbucks decides where to open its next store and how much coffee beans to stock? Or how Disney determines how many ticket booths and turnstiles to open on 4th of July? Do you know what's happening behind the scenes at these companies? These are just a few real life applications of industrial engineering and operations research (IEOR). The list goes on and on. In this module we will cover the basics of IEOR. The topics we will examine include, but are not limited to, mathematical programming, simulation modeling, and supply chain management. The principles you learn in this module will enable you to have a better understanding of the answers to the questions above.

Semester Schedule

Weeks 1-3	All students in all modules (maximum of 240 students) meet together for the first three weeks of the semester MWF 10 – 11 a.m. Sibley Auditorium, Bechtel Engineering Center
Weeks 4-9	First Module Rotation (Participate in 1 of 3 modules) Lecture MWF 10 – 11 a.m. Lab: T, W, or Th 2-5:00 p.m. Location varies with module
Weeks 10-15	Second Module Rotation (Participate in another 1 of 3 modules) Lecture MWF 10 – 11 a.m. Lab: T, W, or Th 2-5:00 p.m. Location varies with module
Final	Final exam and poster session Saturday, May 16, 2009 8 – 11 a.m.