

MECH 140

Introduction to Engineering Design

Fall 2007

"Introduction to Machine Design"

Instructor: Nick Repanich

Class times: Section 01/02 MW 8-10 ; Section 03/04 TTh 8-10

Final Exam Date & Time: Section 01/02 M 10-12 ; Section 03/04 T 10-12

Office Hours: M 10:30-11:30 ; W 12:30-1:30 (OCNL 426)

Classroom: OCNL 431

Units: 3

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Textbook and other supplies:

Moaveni, *Engineering Fundamentals*, Thomson, 3rd Ed., 2008, ISBN 0-495-08253-8

Your high school Physics book will also be a useful reference.

You will also need a USB memory drive to store many of the assignments and exercises.

Course Description:

Through the process of designing and building a machine, you will learn a process for designing and essential project management skills. You will learn the basic systems used in most every machine such as sensors, pneumatics, hydraulics, bearings, bushings, gears, belts and pulleys, clutches and brakes, and framing materials. You will also get introduced to ac and dc motor control, simple electrical circuits, machine controllers, programming, testing and analysis of results. The class has an economic overlay in that the project(s) will include budgeting and feature justification. Labs are *not* recipe-type activities. They demand the student simulate the actions an engineer might take in considering automation of a machine or process, and then complete a proof-of-concept system to verify those decisions. Many of the project skills introduced here will be used in other projects in and out of classes, and especially in your capstone senior design project.

Prerequisites:

None, though working of concepts taught in High School Physics will be essential.

Course Fee:

\$5 for materials for projects

Grading:

Homework	10%
Project Model & Presentation	15%
Project - Amount Completed	40%
Project Knowledge	10%
Individual Contribution & Teamwork	15%
Final Presentation & Lab Notes	10%

Attendance:

Required at all class meetings including during the scheduled final exam period. Your course grade will be lowered 0.2 grade points for each unexcused absence from class.

Exams:

None planned.

Homework:

Homework should be typed (except sketches) and proofread. It will be graded on effort, content, spelling and grammar. Since this is a more project/lab-oriented course there will be plenty of out-of-class work you will need to do with your lab partner(s) to accomplish each project. Generally, an average student during an average week should spend four hours per unit on a class. This includes time in class and time spent out of class doing homework and studying. Since this is a 3-unit class which meets four hours per week, on average you should devote 8 hours outside of class each week to this course.

Lab Notebooks:

Spiral bound, 5x5quad-ruled, 80-page lab notebooks should be kept to document all work on the applications, and will be collected for review after each major section. Before starting your notes, put your name on the front cover, pre-number all the pages in the notebook, and include a Table of Contents. Date the start of each session's entry and be neat. Draw a line after each session, and initial your work. Use the right hand pages for lab notes, and you may use the left hand pages for lecture notes. Paste/Gluestik/tape in any other useful items such as pictures of your setup, printed programs, Excel files etc. Please do homework separately so that my collection of your lab notebook does not hinder your project work.

Submitted Work:

All pages ***must be stapled*** together. Only the first page and any additional pages which are stapled to the first page will be graded. Assignments due at the beginning of a class should be stapled and ready to submit ***when the class starts***. I will not have a stapler in class. For written work, please use engineering paper, no tear off paper, and only the front of the page. For computer work, please print out your work, and bring a backup of your work on a USB memory drive to class for in class modifications.

All work must have an appropriate heading including:

1. Assignment title
2. Your name
3. Date submitted

Safety:

You will be working with tools which have the potential of causing injury. The Department's Lab Safety Policies and Procedures are available to read on the department web site. There is also a form to print and sign. You will be required to bring this signed form to class prior to participating in any lab activities. Safety glasses are available in the Department office.

Everyone in OCNL 432 must wear eye protection at all times. Anyone failing to comply with all lab safety rules will be told to leave the lab immediately and not be allowed to return to the lab that day. Repeated offenses will result in failing the course.

(Note that when OCNL432 and 436 are not being used for another scheduled class you may use them, but you may NEVER work alone.)

Courtesy:

To keep the facilities a pleasant place for you and students who follow you to work, please:

1. Always ***cover your table*** in OCNL 436 or 431 with a sheet of masonite when working with ***any*** tools.
2. When finished working, ***clean up*** your table, any power tool you used and any other area in which you worked. Return tools to the tool cabinet and sweep up if necessary.

COURSE OUTLINE:

Week # (approximate)

1-2 Introduction to the design process

All projects will adhere to the following procedure:

1. Ask questions of the "customer" (instructor)
2. Present an economic justification and payback period for the machine
3. Project the resources and costs needed to finish the application
4. Design
5. Build
6. Program
7. Test
8. Analyze results and give a "proof-of-concept" presentation

Each group will meet with a 'customer' to gather the technical details of a simple project. As you ask questions, constraints arise that lead to a simple system. Upon acceptance of your design, you receive the materials needed to build a proof-of-concept. Your and your partner(s) must build it and demonstrate the project.

3-5 Design Project Mockup

6-7 Computer Control of Machines

8-15 Final Design Project

Lectures:

Lectures have been developed to address specific technical and economic issues. Interaction between the instructor and students is encouraged and expected. Lectures are scattered throughout the semester, as they become needed. The lectures are, in no particular order:

- Framing Material Choices
- Electrical Safety
- Machine Control Topologies
- Power Supplies
- I/O Circuits and Devices (Sensors)
- AC and dc Motors
- Gearing
- Belts and Pulleys
- Solenoids
- Bearings and Bushings
- Energy Sources
- Clutches and Brakes
- Couplers
- Motor Control (VFD's, Vector Drives)
- Asking Project Questions
- Pneumatics and Hydraulics in Machines
- Machine Controllers
- plus more