ME 407 Computer Aided Design and Manufacture

Part 1

Cole/Bethune

Meeting Times: Tuesday/Thursday at 4:00 – PHO 206

Text: Class handouts

Grades: Homework – 440 pts, Project – 150 pts, Quiz, 200 pts

Late Policy: All assignments are due as assigned. No credit for late work.

> **Copied assignments will receive no credit and 5 points will be subtracted from the final grade for each copied assignment. If you let someone copy your work, you will be fined equally with the copier.**

Lab/Home Assignments: Hand in copies of your assignment in the CAD lab, Room 302 at 110 Cummington Street. A box label ME407 is Available in the TA area for your assignments.
Inportant: Sign each assignment in Ink.

Lecture Topics and Assignments

1/18 Introduction, 2D Construction, Sketching.
Assignments 1,2, 3 Due: 1/25

1/20 3D Construction, Sketching
Assignments 4,5,6 Due: 1/27

1/25 Orthographic Views
Assignments 7,8,9,10 Due: 2/1

1/27 Assembly Drawings, BOMs
Assignments 11,12 Due: 2/3

2/1 Threads, Fasteners
Assignments 13,14,15 Due: 2/8

2/3 Dimensions
Assignments 16, 17, 18, 19 Due:2/10

2/8 Dimensions
Assignments 20,21,22,23,24 Due: 2/15

2/10 Tolerances
Assignments 25, 26, 27 Due: 2/17

2/15 Gears, Bearing, Fit Tolerances
Assignment 28 Due: 2/24
Assignment 29 Due: 3/1

2/17 Quiz Review

2/22 – Monday's class schedule

2/24 QUIZ – Closed book, closed notes

3/1 Project Handout - 3 per team Max.

3/3 No lecture – work on Project

3/8 No lecture – work on Project

3/10 Project Due

Syllabus for 2nd half of ME407, Spring 2011

This first half of the course, ME407, will be taught in the Spring of 2011 by Prof. Bethune. He will largely cover CAD and tolerancing, using SolidWorks as the key tool. Please see a separate document/syllabus on the material that will be covered there.

The second half of this course, which is what the present document is about, will be taught by Prof. Dan Cole in the Spring of 2011. The material that will be covered here will involve the use of CAD from the first half of the semester, but will mostly concentrate on applying finite element analysis (FEA) to solve various problems on structures designed by students. One really good simulation program for solving such problems is COMSOL. We will make fair use of that tool. The other FEA tool readily available to us is within SolidWorks, called SolidWorks Simulation. What FEA enables one to do is to solve complicated partial differential equations, in particular ones that can't be solved by analytic means, which, actually means most realistic problems engineers come up against.

So what problems are tackled here with FEA? There will be three main topics: stress and strain, probably at the heart of mechanical engineering; thermal problems, such as the cooling "pipe design" for a refrigerator or air conditioner, or the heating and temperature distribution of an incandescent lamp, plus fluid flow properties. The latter includes how to optimize the wing design of an airplane for lift, etc.

Thus, the first part of the course, on CAD, teaches how to design and specify tolerances so the parts can be made. The second part then applies FEA to analyze how well these parts perform. Can the wing one designs actually provide the lift needed? Is the wing attached to the main part of the plane sufficiently strongly that it will not tear off? How much will the wing bend under load? (So far I have brought fluid flow and stress and strain into the picture. My next part is a stretch, but I can't resist, so just be warned.) And what if an alien ship hurls a fire ball at the plane? Will it melt, or be able to resist the heat? (There, I brought thermodynamics into the problem. However, we will most likely stick with refrigerators, stoves, engines, etc., for thermal problems.)

Now, some good news and bad. There is no text. You will save money, but, you may wish to have something by which to refer. Class lectures and notes should be self contained. However, I will give you some other references on line that you may find helpful. Most books on FEA only cover the math. Most are several inches thick, and really do not get into the applications so much. We are concentrating on the application, with some general background on material that I will provide, such as general comments on the mesh, the boundary conditions, the material properties, and solvers.

There will be at least two homework sets, and possibly three. These will be carried out in the computer lab, using SolidWorks and COMSOL, and submitted as a report. There will be a "final exam" for the 2nd half, based nearly entirely on what I go over in class (i.e., so not on on material in the 1st half). Finally, appropriately, there will be a final project. The breakout will be:

40% homework, 25% exam, 35% final project

For the final project, we will do that in teams of probably four. You will pick a project that solves some problem of interest, use CAD to design it, and use FEA to analyze aspects of it. I will want to approve the general topic and idea before you proceed. We will try to pick teams early in the second half, so that you know who you will be working with.

I will provide office hours as we get closer to the 2nd half, but it most likely will be Wed. 10:30-12 and Thurs. 9:30-11:30am. My office is in Room 135, at 15 Saint Mary's, very close to the ECL lab, where Matlab used to be taught. My email is dccole@bu.edu, and my phone is 617-353-0432.