ENG ME 404: Dynamics and Control of Mechanical Systems, Fall 2011

INSTRUCTOR

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TEACHING FELLOW

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MEETING TIME AND PLACE

Monday and Wednesday from 12-2 in tbd.

INTRODUCTION AND COURSE GOALS

Systems and control theory plays a vital role across most aspects of modern life. Control systems are found in your car, in your appliances, in your cell phone, in your computer, and just about anywhere you look. The goal of this course is to introduce you to the fundamental concepts in feedback control and provide you a set of tools to analyze and design controllers. Elements of both state-space (modern) and frequency (classical) control will be discussed. Topics will include modeling, feedback, transfer functions, frequency domain analysis and design, and PID control.

COURSE PREREQUISITES

All students should have taken ME 302: Engineering Mechanics II as well as the standard math sequence. In addition, Matlab (including the Control toolbox) will be used.

COURSE EXPECTATIONS AND GRADING

It is my firm belief that learning is an *active* experience. You will of course be expected to participate through the normal means, including homeworks, labs, quizzes, and exams. In addition, lectures will often include time spent working together in small groups to solve examples, discuss concepts; active participation is important. You will also be working in small groups throughout the semester on a project.

Homeworks will be assigned regularly. As usual, you are welcome to discuss the problems but each student must perform and submit their own work. Submitted work should be neat, organized, and legible and is to be turned by the start of class on the due date. For problems requiring Matlab, your m-file should also be submitted electronically (likely by just e-mailing it to me).

Quizzes will be random and will be one of two types. The first is your standard quiz; answer the questions, turn it in, move on with your life. The second is a two-part quiz. The first part is a normal quiz. After this part is submitted, you will discuss it in small groups, helping each other to understand the material better. After the discussion period has ended you will take the second part (again a normal quiz).

There will be only one exam– a final that will cover all the material in the course. The exam will be given in the regular final exam time slot.

The project will center on a particular technology that centers on control and will culminate with a controller design and a detailed simulation of the technology that achieves a specification. Each group will do three presentations. The first, early in the semester, will be an overview of the technology and a discussion of the system model to be used. The second presentation will go into the details of control for the system and demonstrate basic simulation of the system (likely without control). The final one will present the controller design and the results. Groups will also submit a written progress report (about midway through the semester) and a final report (at the end of the semester). Further details will be provided in a separate document.

There will be one lab in the course in which you will design and test a proportional-integral-derivative (PID) controller on a flying wing we have in the basement.

Course participation will be evaluated based on participation in lecture, both in response to my questions and during group discussions. While somewhat hard to judge, feedback on this component will be provided periodically and will always be available upon request.

The final course grade will be assigned according to the following weighting.

Homework (15%), Quizzes (20%), Final exam (25%), Lab (10%), Project (25%), Participation (5%)

COURSE WEBSITE

A website will be setup on blackboard.bu.edu. All course materials will be disseminated there.

DROP AND WITHDRAWAL DATES

The last day to **drop** the class (without a W appearing on your transcript) is 10.11.2011.

The last day to **withdraw** from the class (with a W appearing on your transcript) is 11.11.2011.

TEXTBOOK AND REFERENCES

K. J. Åström and R. M. Murray, *Feedback Systems: An Introduction for Scientists and Engineers*, Princeton University Press, 2008. [Available also online at http://www.cds.caltech.edu/ murray/amwiki/index.php/Main_Page]

This will be my first time trying this textbook and so your comments on its suitability, accessibility, etc. will be greatly appreciated. It has several good things going for it: it is relatively cheap in hardcopy (about $50 on Amazon), it is available free in electronic version through the website noted above, it has an excellent support website, and it takes a more modern approach than just about any other undergraduate textbook that I have seen.

Note that in the bookstore, this text should be marked as 'suggested'. I did this so that you would not rush out and buy it before the start of class, giving you the chance to see the different options for getting it. Nevertheless, **this book is required.**

For linear and nonlinear control systems:

1. G. F. Franklin, J. D. Powell, and A. Emami-Naeini, *Feedback Control of Dynamic Systems*, 6th Edition, Prentice Hall, 2009.
2. K. Ogata, *Modern Control Engineering*, 5th Edition, Prentice Hall, 2009.
3. N. Nise, *Control Systems Engineering*, 6th Edtion, Wiley, 2010.
4. R.W. Brockett, *Finite Dimensional Linear Systems*, Wiley (1970) [Out of print]
5. H.K. Khalil, *Nonlinear Systems*, Prentice-Hall, Third Edition, 2002.