ME 451: Control Systems
Spring 2010

Course Description: Mathematical Modeling of Dynamic Systems. Standard Feedback Control Formulation. Transient and Sinusoidal Steady State Analysis. Time and Frequency Domain Controller Synthesis.

Required Prerequisites: (ME391), MSM 306, EE345 or written instructor approval.

Required Text: *Feedback Control Systems*, 4th Edition by C. L. Phillips and R. D. Harbor

Strongly Recommended Software: *The Student Edition of MatLab* (Includes Software)*

Instructors:	Dr. Jongeun Choi	Dr. Clark J. Radcliffe
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Dr. Choi's Class Website: http://www.egr.msu.edu/classes/me451/jchoi/2010/

-All the class notes, hws, the solutions and announcements will be posted in the class web.

Course Learning Objectives

1. Math Review:
Students can use matrices to solve algebraic equations and Laplace transforms to find system transfer functions.

2. Physical System Modeling:
Students can model coupled electromechanical systems and linearize nonlinear input/output models about a non-zero operating point.

3. System Time Response:
Students can solve for 1st and 2nd order system time responses and analyze for time response specifications, settling time, overshoot, rise time, etc.

4. Control System Characteristics:
From transfer functions, students can analyze system characteristics including stability via root locus and Routh-Hurwitz, sensitivity to parameter variation, disturbance rejection, and steady-state accuracy; and they can also design PID controllers to meet desired system characteristics.

5. Frequency Response Analysis & Design:
From transfer functions, students can solve for system frequency responses, sketch Bode diagrams of open loop frequency response, determine gain and phase margin from a Bode diagram, design PID controllers based upon an open loop frequency response, and design lead and lag controllers from an open loop frequency response.

Schedule; (Approximate)

Weeks 1 & 2:	Introduction and math review, Math quiz (Chapter 1 and Appendices A, B, and C)
Weeks 3 & 4:	Physical system modeling (Chapter 2)
Weeks 5 & 6:	System responses (Chapter 4)
Feb.17 (Wed)	Exam I (Chapters 1 & 2, Appendices)
Weeks 7 & 8:	Control system characteristics & its stability analysis (Chapters 5 & 6)
Week 9:	Spring break
Weeks 10 & 11:	Root Locus (Chapter 7)
Weeks 12 & 13:	Frequency domain analysis (Chapter 8)
April 7 (Wed)	Exam II (Chapters 4, 5, 6, and 7)
Weeks 14 & 15:	Frequency domain synthesis (Chapter 9)
Week 16:	Frequency domain synthesis and class review

GRADING

	Weekly Lab	25%
(1)	Math Quiz	5%
(2)	Midterms @ 17.5% each	35%
	Weekly Homework	10%
(1)	Final Exam	25%
	Total	100%

Note: Lab attendance and a minimum of 70% Lab grade is required to pass the course!
Homework assigned each Wednesday and due by next Wednesday. Each assignment graded

* The MatLab software package will be used during the term to solve many of the homework problems. This software package provides a high level means for performing linear system analysis and design on the PC's. The PC's in the Case Center already have MatLab installed. The texts recommended above include a copy of the student version of MatLab for students using their PC at home. Matlab will be used in ME461 next term as well as other courses

Lab Report Writing Tutorial Sessions for Spring 2010 (by Craig Gunn)

Lab on Monday	7:00 p.m.
Lab on Tuesday	8:00 a.m.
Lab on Wednesday	3:00 p.m.
Lab on Wednesday	7:00 p.m.

In the first week of classes- January 11th-15th

On Tuesday and Thursday, if your lab does not have one, please go to one of the other sessions for this tutorial.