ME 3015 System Dynamics and Control

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Office Hours: TTh 10:00am-11:00am

Pre-requisites: MATH 2403 (or MATH 2413 or MATH 24x3) and ME2202 and ECE3741

Catalog Descriptions: Dynamic modeling and response of systems with mechanical, fluid, thermal, and/or electrical elements. Linear feedback control systems design and analysis in time and frequency domains.

Textbook: K. Ogata, *System Dynamics*, Fourth Edition, Prentice Hall, 2004.

Grading Policy:

Homework assignments (not graded)
Bi-weekly short quizzes 15%
Two mid-terms 40% (20% each)
Final Exam 40%
Simulation 5%

Mid-term and Final Tentative dates

Mid-term #1: October 2, 2003 (Thursday)
Mid-term #2: November 13, 2003 (Thursday)
Final Exam: December 12, 2003 (Friday); 11:30am-2:20pm

Homework: Homework sets will be assigned bi-weekly and solutions to the homework assignments will be posted on the website http://www.me.gatech.edu/me3015. The homework sets will not be graded. For your benefit, you are expected to work on them on your own as problems in the quizzes, mid-terms and final exam will be designed on the same bases to these homework problems.

Quizzes: There will be seven 15-minute quizzes. There will be NO make-up but your 5 highest quiz scores will be averaged. In other words, you will have a score of zero if you are not present for the quiz.

Computer Assignment: Approximately three weeks before the end of the semester, you will be given a computer assignment that requires you to apply the following techniques to design a feedback system:

(1) model a physical system that consists of components of different disciplines;

(2) analyze the system performance using computer simulation, and determine whether the dynamic response of the system meets a set of design specification; and

(3) improve the dynamics of the system using feedback control theory.

This assignment is also a good place for review before the final exam which will be cumulative.

Course Syllabus and reading assignments:

Introduction (Chapter 1)

Mathematical Background (Chapter 2)

Modeling	**Disciplines**	**General concepts used in a unified approach**	
	Mechanical Systems	Ideal elements and their constitutive equations	Chapter 3
		Work, energy, & power	
		Power conversion	
		Transfer function approach	Chapter 4
	Electrical Systems	Transfer function	Chapter 6
		Complex impedances	
		Operational amplifiers	
		Electromechanical conversion	
	Thermal Fluid Systems	Equilibrium operating point	Chapter 7
		Linearization of non-linear system	
Analysis	Time domain: transient response analysis		Chapter 8
	Frequency domain: steady-state response to sinusoidal input		9.1-9.2
	Vibration analysis		9.3-9.5

Feedback System design (Chapter 10)

- Block diagram reduction (4.1-4.2, 10.1-10.2)
- PID Controller and lead-lag compensators (10.3)
- Time domain analysis and design specification (10.4-10.6)
- Performance improvement and effect of poles and zero on transient responses (10.5)
- Stability: Routh-Hurwitz Criterion (10.7)
- Review of FVT and steady-state error analysis
- Root locus sketching and analysis (10.8-10.9)
- Compensation design

Frequency domain design (Chapter 11)

- Sketching of Bode diagrams
- System identification
- Relative stability (Nyquist plot, phase and gain margins)

Computer-aided design and simulation (Matlab)

- Simulation of dynamic systems using Matlab commands
- Computer-aided-design using root locus techniques and time simulation