

ME 507 Process Modelling and Control

Spring 2013

Prof Gevelber, Mechanical Engineering

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Office Hours: by appointment. Please take advantage to ask questions, that's what I'm here for.

Course Goal: This course provides an integrated study of physical system dynamics, control concepts, and process design. The goal is to deepen student's physical intuition as well as learning how to determine the appropriate roles for changing the system design and adding closed loop control. Case studies are used to examine the opportunities for developing new process capabilities and products. Examples are drawn from a variety of applications including welding, MEMS, CD manufacturing, thermal processing, film deposition for electronics, optics, and energy applications, robotics, biomedical applications and high speed machining.

Requirements and Grading

Homework (20%) . Typically due on Thursday. Solutions will be handed out, so late home works will not be accepted [unless medical or other excuse]. Please bring questions to class on Tuesdays!

Two quizzes (20% each) and take-home at the end of term (35%)

Project (5 %)

Project: I'm looking for you to analyze a process you choose from the perspective of the course. (Teams of two are acceptable.) Ideally, it will be a process that can yield a significant competitive advantage if developed and/or improved. However, working on something that you are familiar with is acceptable. I will be glad to discuss options.

Your project should include a description of the processing objectives/performance benchmarks, important process physics/dynamics, control objectives, design options, and possible control strategies. Detailed analysis of the system is not required (i.e. this should be descriptive and not quantitative). A one paragraph outline of your project is due the 4th session. You will present your project the last class of the term. This is a chance to reinforce the relevance of the course to your own work.

You must provide an extended outline, including sources by the 14th class.

Matlab will be used to assist in dynamic simulations, controls analysis, processing, linear algebra, and graphics (it also has other great tools/applications). DL students will need a ACS account and be able to logon to the campus computers via VPN. On campus student will use Matlab on ACS.

Texts:

Introduction to Physical System Dynamics, R. Rosenberg and D. Karnopp, McGraw Hill, 1983. (RK)

Control System Design and Simulation, J. Golten and A. Verwer.

Notes from N. Hogan and M. Athans.

Recommended References:

Linear Algebra and Its Applications, G. Strang, Academic Press, 1980. Readable text on linear algebra

Modern Control Engineering, K. Ogata, Prentice-Hall: The bible, has worked problems.

Feedback Control of Dynamic Systems, G.F. Franklin, et.al., Addison-Wesley: Nice treatment of mechanical systems for both classical and some modern approach

Feedback Control Systems, Phillips & Harbor, Prentice Hall.

Automatic Control Systems, B. C. Kuo, Prentice Hall. Verbose, but has it all.

<u>Class</u>	<u>Date</u>	<u>Topic</u>	<u>Reading</u>	<u>Notes</u>
1	17-Jan	Intro/Overview		
2	22-Jan	Bond Graph Intro	HP discuss	
3	24-Jan	Mech-Elec Syst	Minds Eye discuss	Hmk 1 due
4	29-Jan		Pilkington Case	
5	31-Jan	Equation Derivation	project outline due	Hmk 2 due
6	5-Feb			
7	7-Feb	Fluid-Thermal syst		Hmk 3 due
8	12-Feb			
9	14-Feb	Case Study		Hmk 4 due
10	19-Feb	Intro Dynamics		
11	21-Feb	1 st /2 nd order resp		Hmk 5 due
12	26-Feb	SS to TF		
13	28- Feb	Quiz 1: modeling		
14	5-Mar	Zero's		
15	7-Mar	Dynamics of Phys Syst		Hmk 6 due
----	3/10-18	Spring Break	-----	-----
16	19-Mar			
17	21-Mar	Frequency Domain		Hmk 7 due
18	26-Mar	JHT/accel ex		
19	28-Mar	Rel. freq. To time.		Hmk 8 due
20	2-Apr	Control Intro		
21	4-Apr	Root Locus		Hmk 9 due
22	9-Apr			
23	11-Apr	Quiz 2: dynamics & control		
24	16-Apr	CL freq anal/design		Hmk 10 due
---	18-Apr	No class (mond sched)	-----	-----
25	23-Apr	Actuator selection		
26	25-Apr		Take-home out (due 5/9)	Hmk 11 due
27	30-Apr	Project Presentations		
28	2-May	Wrap-up		

Finals (5/10-5/14)

Take-home due 5/9