MN 507 Process Modelling and Control
Spring 2010

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 develops the knowledge base needed to improve and develop unique manufacturing capabilities as well as for new 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.

The course provides and integrated study of physical system dynamics, control concepts, and process design. The goal is to deepen students 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 in a manufacturing enterprise.

Requirements and Grading

Homework (10%) . Typically due on Thursday. Solutions will be handed out, so late home works will not be accepted.

Two quizzes (25% each) and take-home at the end of term (30 %)

Project (10 %)

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.

Process Presentation: Each student will give a 5-10 minute oral presentation, before midterm describing their process/product and outlining the critical issues that they will address in their project.

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 use the classroom kit that we will supply for your PC (otherwise you need to discuss with me other options). 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.

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