ME 507 Process Modelling and Control
Spring 2015

Prof Gevelber, Mechanical Engineering

Office: 730 Comm Ave, room 202F. Phone W 617-353-9693, H 617-964-7515,
email: gevelber@bu.edu

Mailing address: Mechanical Engineering, 110 Cummington St., Boston MA 02215.

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)

Notes from N. Hogan and M. Athans (to be supplied in class).

Control Text: you should have a intro control text such as

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

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	20-Jan	Intro/Overview		
2	22-Jan	Bond Graph Intro	**HP discuss**	
3	27-Jan	Mech-Elec Syst	**Minds Eye discuss**	
4	29-Jan		**Pilkington Case**	Hmk 1 due
5	3-Feb	Equation Derivation	**project outline due**	
6	5-Feb			Hmk 2 due
7	10-Feb	Fluid-Thermal syst		
8	12-Feb			Hmk 3 due
	17-Feb	No-class		
9	19-Feb	Case Study		Hmk 4 due

10	24-Feb	Intro Dynamics		
11	26-Feb	$1^{st}/2^{nd}$ order resp		Hmk 5 due
12	3-Mar	SS to TF		
13	5- Mar	**Quiz 1:** modeling		
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14	17-Mar	Dynamics of Phys Syst		
15	19-Mar			Hmk 6 due
16	24-Mar	Frequency Domain		
17	26-Mar	JHT/accel ex		Hmk 7 due
18	31-Mar	Rel. freq. To time.		
19	2-Apr	Control Intro		Hmk 8 due
20	7-Apr	Root Locus		
21	9-Apr	**Quiz 2:** dynamics & control		
22	14-Apr			Hmk 9 due
23	16-Apr	CL freq anal/design		
24	21-Apr	**Actuator selection**		
25	23-Apr		**Take-home out (due 5/7)**	Hmk 10 due
26	28-Apr	Project Presentations		
27	30-Apr	Wrap-up		Hmk 11 due
		Finals (5/5-5/9)	**Take-home due 5/7 (5pm)**	