ChBE 4400 Spring 2012 Syllabus

Process Dynamics and Control

Course objectives:

1. Develop a basic understanding of the hardware and approaches used to implement process control schemes industrially.
2. Master the ability to develop process models for non-steady state systems.
3. Learn to use Laplace transform methods to solve systems of linear ordinary differential equations.
4. Develop knowledge of the open loop dynamics of first, second, and higher order systems.
5. Use transfer function analysis to model the dynamic behavior of first, second, and higher order systems.
6. Learn how to characterize the stability and frequency response of dynamic systems.
7. Learn how to implement simple feedback control using PID controllers and learn how to tune such controllers.
8. Develop knowledge of advanced control strategies including feedforward and model predictive control.
9. Learn how to analyze the interactions in multivariable systems and develop methods to decouple such interactions.
10. Develop a basic understanding of the methods of and applications for statistical process control.
11. Develop the ability to synthesize all of the knowledge concerning individual chemical engineering subjects in order to analyze, model, and control a variety of chemical processes.

Office hours

	Time	*Location*
Instructor: Prof. Martha Grover martha.grover@chbe.gatech.edu	Monday 3-4 pm Thursday 2-4 pm	1228 ES&T (404) 894-2878
Co-instructor: Dr. Yuzhen Xue yuzhen.xue@chbe.gatech.edu		1326 ES&T
Lecture/Project TA: Dan Griffin daniel.griffin@chbe.gatech.edu	Tuesday 2-3 pm Wednesday 12-1 pm	2306 ES&T
Lecture/Project TA: Xun Tang xun.tang@chbe.gatech.edu	Wednesday 11am-12 pm Friday 11 am-12 pm	1328 ES&T
Project TA: Ming-Chien Jackey Hsieh mhsieh34@gatech.edu	Tuesday 11 am-12 pm Thursday 11 am-12 pm	1326 ES&T

Lecture time: 1:05-1:55 pm, MWF, L1255 ES&T

Lab sections: 3-6 pm, L1160 ES&T (M-Th)

Textbook: Seborg, Edgar, Mellichamp, and Doyle, *Process Dynamics and Control*, 3rd edition, Wiley, 2010.

Quizzes: We will have at least 6 quizzes throughout the semester, and the dates will be unannounced. Your lowest 2 scores will be dropped, so if you need to miss class for any reason, please plan to use one of these 2 "free-passes".

Exams: Exams will be closed book and closed notes. You may have a note sheet (one-side only). They are evening exams from 6:30-8:30 pm, on 2/15 and 3/14. (You may also bring your old note sheets to subsequent exams.)

Design project: The design project will be due in multiple phases throughout the semester. You will work with Professor Grover and the Lecture TA's on this aspect of the course.

Homework: Suggested homework problems will be assigned periodically and solutions will be posted on the class website. Homework will not be collected and graded. It is for your use in studying for the class and preparing for the exams.

Honor Code: Students are expected to follow the policies outlined in the Georgia Institute of Technology Academic Honor Code (on-line guide at *www.honor.gatech.edu*). Students are also expected to report honor violations as detailed in the code. Calculators will be permitted during exams, but programming and use of formulas or other information via such calculators during exams is prohibited. For open-book or take-home exams and assignments (such as lab report writing), it is expected that students will limit the use of resources and materials to those specified and adhere to the given time limits. Using copies of old pre-laboratory quizzes, laboratory reports, and other test materials not supplied by the instructor to the entire class is prohibited. Students having knowledge of the use of such improper materials should report the infraction to the instructor.

Grade breakdown for course

Laboratory reports	20%
Design project	15%
Exam 1	15%
Exam 2	15%
Final exam	25%
Quizzes	10%

Lecture schedule

	Date	Topic	Reading
1	1/9	Intro to process control	1, 9
2	1/11	Building models of process dynamics	
3	1/13	Solving models of process dynamics	2
	1/16	MLK Day: no class	
4	1/18	State space modeling	4
5	1/20	More examples of process models	
6	1/23	Laplace transforms	3
7	1/25	Partial fraction expansion	
8	1/27	Simulink for transfer functions	
9	1/30	Linearization of nonlinear models	4
10	2/1	Comparison between state space and transfer functions	
11	2/3		
12	2/6	First order and second order processes	5
13	2/8	Higher order processes	6
14	2/10		
15	2/13	Overview of Chapters 1-6, 9	
16	2/15	Exam 1: 6:30-8:30 pm	
17	2/17	Modeling from data	7
18	2/20		
19	2/22	Introduction to feedback control	8
20	2/24	Overview of control system design	10
21	2/27	Background for Labs 3-5	
22	2/29	Stability of closed loop systems	11
23	3/2		
24	3/5	PID control	12
25	3/7		
26	3/9	Frequency response analysis	13
27	3/12		
28	3/14	Exam 2: 6:30-8:30 pm	
29	3/16		
Spring Break: 3/19-3/23			
30	3/26	Control system design based on frequency analysis	14
31	3/28		
32	3/30		
33	4/2	Feedforward and ratio control	15
34	4/4	Cascade control	16
35	4/6		
36	4/9	Multivariable control	18
37	4/11		
38	4/13		
39	4/16	Model predictive control	20
40	4/18		
41	4/20		
42	4/23	Statistical process control	21
43	4/25		
44	4/27	Design project contest	

Final exam: Monday April 30, 2:50-5:40 pm

On the days of the two evening exams, we will have an in-class review session. Attendance is not mandatory, but I will not be holding another out of class review session.

Amendments and additions to this syllabus will be posted on T-Square.