

ChE 421 -- PROCESS DYNAMICS AND CONTROL

Spring 2006

Text: "Process Dynamics and Control 2nd Edition," by Seborg, Edgar and Mellichamp (2004).

Supplemental Texts: "Principles and Practices of Automatic Process Control 3rd Edition," by Smith and Corripio (2006) and "Process Dynamics, Modeling, and Control" by Ogunnaike and Ray (1994).

Instructor: Derrick K. Rollins, 304F Snedecor (294-8192), **1033 Sweeney Hall (294-5516)** and 292-8773 (home), **drollins@iastate.edu**.

Office Hours: MWF 1:10 to 2:00 p.m. in **1033 Sweeney Hall** or by appointment.

Grader: TBA

Recitation: TBA

The basic objective of this course is to teach you fundamental concepts and principles in the modeling of dynamic chemical processes and in the application of process control. This objective will be accomplished by covering the following topics (in the order given):

1. Introduction to process control (Chapter 1).
2. Theoretical and semi-empirical mathematical modeling of chemical processes (Chapter 2).
3. Process dynamics including Laplace transforms, transfer functions, state space models, block diagrams, first, second and higher order systems and the development of empirical dynamic models (Chapters 3 to 7).
4. Feedback Control; controllers, instrumentation, dynamics, stability, design and tuning (Chapters 8 to 12).
5. Advanced Control techniques; feedforward, cascade, adaptive, MIMO, and supervisory control (Chapters 15 to 16), as time permits.

See the last page for more specific information on course objectives.

Grading System:

1. Homework (HW) and Class work (CW) 15%
2. Exam I (Process Dynamics) 20%
3. Exam II (Process Control) 20%
4. Lab Project 20%
5. Final Computer Project 25%

Grading Scale:

C	96.0 # A+ # 100	91.1 # A < 96.0	88.0 # A- < 91.1
C	84.6 # B+ < 88.0	81.3 # B < 84.6	77.9 # B- < 81.3
C	74.1 # C+ < 77.9	71.2 # C < 74.1	67.6 # C- < 71.2
C	63.3 # D+ < 67.6	60.0 # D < 63.3	57.6 # D- < 60.0
C	0.00 # F < 57.6		

This is not necessarily the final grading scale but represents the minimum cutoffs. For example, every student that has a total percentage $\geq 91.1\%$ will definitely receive an A. However, it may still be possible to receive an A if your total percentage is below 91.1%. Note that the official grade for an A+ is an A.

Bonus: If your HW/CW is above 90% and you are within one percentage point of the next higher grade you will receive the higher grade.

Homework

Homework will be assigned and collected on Thursday. Each assignment will be worth 100 points. I will give unannounced in class group assignments that will be worth from 10 to 20 HW points. I advise you not to miss class. You will only be able to make up these assignments with excused absences. We will have a weekly recitation to go over homework assignments. I strongly encourage you to be at all the recitations. You will find them to be very helpful and will save you a significant amount of time in doing the homework and will help prepare you for the exams. I may give the answers in recitation.

Spring '06 Graduates Only

I will drop your lowest exam. Congratulations! This is my gift to you for a job well done.

Ground Rules:

Homework:

- C You have the choice of choosing a partner (only once) or working by yourself.
- C With acceptable excuses, I will accept late assignments if arranged before they are due.

Projects:

- C The computer and laboratory projects are to be done in teams of four or five that I will assign.
- C For each assignment one report will be accepted per team.
- C Team members are not allowed to consult with classmates except team members within their group. This is really for your benefit. In the past students have misdirected classmates in serious ways that resulted in large wasted effort and poor performance.
- C Your project grades will be adjusted by an evaluation of your effort by your group members.

Class Attendance:

- C I will not take attendance but I strongly encourage you not to miss class. My style is to strongly evaluate performance (i.e., tests and projects) from material covered in class.
- C I will have no grading mercy on people with poor class attendance.
- C If you are going to miss class I suggest that you let me know (I accept good excuses for missing class).

Chemical Engineering 421

Syllabus, Spring 2006

<u>Dates</u>	<u>Chapters</u>	<u>Exam/Project</u>
T 1/10	1	
R 1/12	2	
T 1/17	2	
R 1/19	2	Lab I assigned
T 1/24	3	
R 1/26	3	
T 1/31	3	
R 2/2	3	
T 2/7	4	
R 2/9	4	
T 2/14	5	
R 2/16	5	Lab I due
T 2/21	6	
R 2/23	6	
T 2/28	7	
R 3/2		Exam I, Chapters 1-7
T 3/7	8	
R 3/9	8	
***** Spring Break 3/13 - 3/17 *****		
T 3/21	9	Final Project assigned
R 3/23	11	
T 3/28	11	
R 3/30	11	
T 4/4	11	
R 4/6	12	
T 4/11	12	
R 4/13	15	
T 4/18	15-16	
R 4/20		Exam II, Chapters 8-9, 11-12, 15-16
T 4/25	16	
R 4/27	Other topics, Review	
T 5/2	The Final Project is Due Tuesday, May 2 at 12-2 p.m.	

CHE 421 – Course Objectives

Basic Objective

The basic objective of this course is to teach you fundamental concepts and principles in the modeling of dynamic chemical processes and in the application of process control

Specific Objectives

- C To teach you to dynamically model chemical processes using theoretical principles.
- C To teach you to dynamically model processes using empirical and semi-empirical modeling methods.
- C To teach you to design and implement feedback and other control schemes.
- C To teach you how to assess the stability of self regulating and automatically controlled processes.
- C To familiarize you with basic equipment in controlled processes.
- C To give you an appreciation for the importance of process control in industrial processes.
- C To teach you how to develop transfer functions and block diagrams for linear and non-linear processes.
- C To expose you to other a variety of topics in the process control literature such as PLC's, inferential control, adaptive control, statistical process control, etc.
- C To give you familiarity and understanding of the three modes of control for feedback controllers.
- C To teach you to exploit process modeling in the design and development of process control systems.
- C To give you a perspective on the importance of process control on safety, quality, cost, the environment, productivity, and technical feasibility.