CHE-345
Chemical Process Control, Modeling and Simulation
Spring 2017

Instructor: Prof. Simon Podkolzin
Office hours: Thursday 4:50 – 6:50 pm
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Textbook "Process Dynamics and Control" by Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, and Francis J. Doyle III, Publisher: Wiley; 3rd edition, ISBN-10: 0470128674, ISBN-13: 978-0470128671

E-book through CourseSmart
"Process Dynamics and Control", 3rd Edition
by Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Francis J. Doyle, III
ISBN 978-0-470-57404-1
E-book: Wiley Desktop Edition

Class schedule
Tuesday 4:00 pm – 5:40 pm in Babbio Center 122
Thursday 4:00 pm – 4:50 pm in Babbio Center 122

Website in addition to Canvas:

http://Podkolzin.com/Courses/345_Control_and_Modeling.htm

or

http://goo.gl/iCvVR (case sensitive)

Website updates will be posted on Twitter to make it easier to track them: @Stevens_ChE345

Grading, %

Homework	25
Class participation	5
Test 1	12
Test 2	16
Team project	20
Final exam	22

Letter grades will be assigned based on the absolute scale:

A	91-100
A-	86-90
B+	81-85
B	75-80
B-	70-74
C+	65-69
C	60-64
C-	55-59
D+	50-54
F	below 50

Grade = *Homework Average* (out of 100 total) * 0.25 + *Class participation* (out of 100 total) *0.05 + *Test 1 Score* (out of 100 total) * 0.12 + *Test 2 Score* (out of 100 total) * 0.16 + *Team Project Grade* (out of 100 total) * 0.2 + *Final Exam Score* (out of 100 total)* 0.22

Class tests and the final exam will be open book, open notes. You do not have to memorize lengthy formulas or definitions. You do, however, need to understand the material and know how to apply it to solving problems. If you do not know the material, *you will run out of time* on the tests.

Homework is due in class on Tuesday. No late homework will be accepted *for any reason*. Each student may miss 1 homework assignment and still receive full credit for it. For students who complete all assignments, the homework with the lowest grade will be adjusted to 100%.

If you are unable to attend teaching assistant's office hours, you may send your questions to the TA by E-mail. If you send a question to the TA before 12 noon on Monday, you will receive a response by 5 pm on Monday. If you send the TA a question after 12 noon on Monday, you will receive a response only after the lecture on Tuesday.

The course establishes the fundamentals of model development, parameter estimation, analysis of process dynamics and process control in chemical engineering:

- Methods for developing mathematical models of chemical processes.
- Characteristics of different control modes: feedback, feedforward and mixed.
- Degrees of freedom analysis.
- Application of Laplace transforms for solving linear ordinary differential equations.
- Obtaining and applying transfer function between input and output process parameters and construction of block diagrams.
- Analysis of first, second and higher order processes using standard process inputs (step, ramp, pulse, and sinusoidal).
- Analysis of dynamic response characteristics based on poles and zeros of the system.
- Basic components of process control systems.
- Development of dynamic models for multiple input and multiple output systems.
- Process control systems and safety features
- Model parameter estimation with linear and non-linear regression.
- Setup of control algorithms. Proportional-integral-derivative (PID) controllers.
- Methods of tuning PID controllers.
- Dynamic behavior and stability of closed-loop control systems.

CHE-345
Process Control, Modeling and Simulation

Course Outline

1. Introduction: The Control of Chemical Processes, Incentives, Design Aspects and Hardware for a Process Control System.

2. Modeling the dynamic behavior of chemical processes: development of a mathematical model, modeling for control purposes.

3. Analysis of dynamic behavior of chemical processes: computer simulation and linearization of the nonlinear systems.

4. Laplace transforms: solution of linear differential equations using Laplace transforms.

5. Transfer functions and input-output models: transfer function matrix, poles and zeros, qualitative response.

6. Dynamic behavior of first order systems: processes with first-order system description, pure capacitive systems, first-order lag systems, variable time constant and gain.

7. Dynamic behavior of higher order systems: second-order system, multi-capacity processes, presence of controllers, N capacities in series, dynamic systems with dead time, inverse response.

8. Analysis and design of feedback control systems: dynamic behavior of feedback-controlled processes, stability analysis, performance criteria and design.

9. Frequency response analysis: Sinusoidal input, frequency response characteristics of linear processes, design of feedback control systems using frequency response techniques, Nyquist stability criteria.