CHBE442 Chemical and Biomolecular Systems Analysis, Fall 2019

Credit: 3

Prerequisite: CHBE302, CHBE424, CHBE426

Requirements: Working knowledge and problem solving skills of calculus (differentiation and integration) and differential equations (ODEs), dynamic (non-steady state) mass and energy balances (ChBE440 materials)

Catalogue description: Dynamic response applied to process systems. Goals and modes of control, Laplace transform, analysis and synthesis of simple control systems, closed loop response, dynamic testing.

Course objectives:

1. Learn the *role of process control* in process operation.
2. Learn the *mathematics* needed to understand process control principles.
3. Learn how to obtain mathematical models of processes by writing *unsteady-state mass and energy balances*.
4. Learn *how to analyze dynamical systems* using *matrix algebra and Laplace transforms*.
5. Learn *how to construct block diagrams* for feedback control systems.
6. Learn the basic *hardware and instrumentation* needed to implement process control.
7. Learn various simple *empirical models* that are used for designing controllers.
8. Learn basic *feedback control principles*.
9. Learn how to *analyze stability and performance of feedback loops* using Laplace and frequency domain techniques.
10. Learn basic *control strategies*.
11. Introduce the main ideas behind *advanced multivariable control*.

Textbook:

Seborg, Edgar, Mellichamp, Doyle III, "Process Dynamics and Control," 4th edition, Wiley.

Other references:

Coughanowr and LeBlance, Process Systems Analysis and Control, 3rd edition, McGraw Hill, 2009. ISBB: 978-0-07-339789-4

Class time and location:

Lecture: MWF 12:00pm – 12:50 pm (CHE2108)
Discussion: W 4:00 pm-4:50 pm (CHE2108)

Exam Date:

Exam 1: October 14 (Monday) (2108/2136)
Exam 2: November 13 (Wed) (2108/2136)
Final Exam: TBA (12/11-12/17)

Labor Day: Sept. 2 (Mon)
Thanksgiving Recess: Nov. 27-29
UMD-Penn State Football Night: Sept 27 (Fri)- Class is cancelled
Last Day of Class: Dec. 10 (Monday)

Instructor:

Prof. K. Y. Choi
Email: choi@umd.edu
Office: Room 1208B, Bldg 090, Office Hour: Tu 10 am -12 pm

Graduate Teaching Assistants:

Gaurav Iyer gauraviyer96@gmail.com Office Hr: Mon/Th 10-11 am
Faraz Burni farazahmedburni@gmail.com Office Hr: Tu 1-2 pm, Wed. 3-4 pm

Grading:

Exams (90%)
Midterm (2): 25%/25%
Final: 40%
Homework: 10%

Grading Criteria (Exam+HW):

A: 75-100%
B: 60-74.9%
C: 45-59.9%
D: 35-44.9%
F: 0-34.9%

Common Sense Policy for Classroom Environment:

- No talking or eating
- Cell phones must be turned off.
- Homework and some supplementary course materials will be posted on the CANVAS course web site. Students should visit the course site often, download and study the posted materials.
- In case you use your notebook PC, please make sure that you will not disturb other students sitting close to you.
- Videotaping or voice recording of the lectures is prohibited without instructor permission.
- Emails: Emails will be received from Monday to Friday (8 am to 6 pm). Emails received after 5 pm on Friday through Sunday will be responded in the following week. When emailing, please begin the subject line with ChBE442 with your name. (Please do not ask in the email whether your hw solutions are correct or wrong before the due date.)
- No make-up exams will be given. Exception: Hospitalization due to life-threatening medical conditions. Request to re-grade an exam or part of an exam must be submitted within 24 hours after you receive the graded exam. The submitted exam paper for re-consideration MUST be in its original form.
- If a student is absent on days when tests are scheduled or papers are due, he or she is required to notify the instructor in advance (but NOT ON THE EXAM DAY), and upon returning to class, bring documentation of the illness, signed by a health care professional. "Simply I do not feel well" is **not** accepted.

Inclement weather: In case of inclement weather, we will abide by University's policy on closures and delays, which will be posted at www.umd.edu. If the University closes on a class day due to inclement weather, any HW due will become due on the next day the class meets, and any exams scheduled will be postponed, with the new date notified on ELMS (https://umd.instructure.com).

Homework:

- Please turn in your homework on time. Deadline for turning in homework will be rigidly enforced. 24 hr after the due date, no late HW will be accepted.
- Only one or two randomly selected HW problems per assignment will be graded; At least one exam problem will be taken from HW problems (probably with some minor modifications).
- All homework turned in must be your own work. You may discuss technical concepts relating to the HW with your classmates, but must work the problems by yourself. Copying another person's homework is a serious violation of the University of Maryland Academic Integrity Policy. No warnings will be issued to the violators of this policy. If authenticity is questioned, the HW papers will be forwarded to the University of Maryland Honor Council for review.
- Normally, homework solutions will not be posted. They will be discussed in the regularly scheduled recitation class. Students are strongly encouraged to attend the recitation classes. Instructor will not provide HW solutions or lecture notes to individual students.

Exams:

- Two midterm exams will be given in addition to the final exam. All exams will be closed book and closed notes. Please do not expect that the exam problems will be very similar to hw problems but if you were able to solve hw problems, you should have no troubles with exam problems. Some hw problems need Simulink simulator to enhance the understanding of open loop and closed loop dynamics of linear systems.

- After each mid-term exam, interim grade will be given.

Major topics to be discussed:

- Introduction to Process Dynamics and Control (Chapter 1)
- Modeling of Chemical Processes (Chapter 2)
- Laplace Transform (Chapter 3)
- Transfer Function Models (Chapter 4)
- Dynamic Behavior of First-Order and Second-Order Processes (Chapter 5)
- Dynamic Response Characteristics of More Complicated Processes (Chapter 6)
- Development of Empirical Models (Chapter 7)
- Feedback Controllers (Chapter 8)
- Control System Instrumentation (Chapter 9)
- Dynamic Behavior and Stability of Closed-Loop Control Systems (Chapter 11)
- PID Controller Design, Tuning and Troubleshooting (Chapter 12)
- Control Strategies at the Process Unit Level (Chapter 13)*
- Enhanced SIngle-Loop Control Strategies (Chapter 16)*
- Multiloop and Multivariable Control (Chapter 18)*

* Time permitting, selected topics will be discussed

Course Related UMD Policies: http://www.ugst.umd.edu/courserelatedpolicies.html