ChE 489: Process Dynamics and Control

Fall 2024

Instructor: Dr. Nellone Reid, Senior University Lecturer
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Zoom Link: Nellone Reid's Personal Room
TA:
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Class Hours: Monday/Wednesday: 10:00 AM – 12:05 PM; Kupfrian Hall 209
Office Hours: Tuesday/Thursday: 2:30 PM – 3:30 PM

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability –and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. [I will not tolerate disrespectful language or behavior.]
To Report ANY Incidents In or Outside the Classroom, Please Contact:
https://www.njit.edu/dos/reporting

Course Description and Requirements

This course is an introduction to chemical process dynamics and control. Topics include analysis of the dynamics of open-loop systems, the design of control systems, and the dynamics of closed-loop systems. Control techniques and methodologies used by practicing chemical engineers are emphasized.

Pre-Requisites: ChE 349; ChE 365

Course Objectives

- Define process control objectives, classify processes, and identify process control variables
- Develop mathematical models for chemical processes by applying conservation laws and making reasonable assumptions
- Derive dynamic solutions of process models by applying Laplace transformations
- Develop transfer function models in deviation variables to find open-loop solutions to process models
- Identify nonlinear models in chemical processes and linearize them to find an approximate solution
    - Classify characteristic inputs and compute responses of first and second-order models
- Simplify higher-order models using Taylor's and Skogestad's methods.
- Define and classify different controllers and their characteristics
- Design controller and find appropriate controller settings for processes
- Write a professional technical report based upon a process control scenario, incorporating numerical calculations and recommendations for reducing the risk of instability in the process control system.
- Deliver a professional oral presentation in a team.
- Participate in collaborative teamwork and learn to establish goals and meet deadlines while recognizing the importance of diversity and ineffective teamwork.
- Model dynamic processes using MATLAB and SIMULINK.

Learning Materials

Textbook: D. E. Seborg, T. F. Edgar, D. A. Mellichamp and F. J. Doyle, "Process Dynamics and Control," 4th Edition, 2012, Wiley, Hoboken, NJ. The textbook is

Calculator: A high-end calculator (TI-83, TI-84, or TI-84SE) is required for solving numerical problems.

Tentative Course Outline

Number	Topic (preliminary, subject to minor changes)
1	**Ch. 0 – Important Heat and Mass Transfer Models**
2	**Ch. 1 – Introduction to Process Control**
3	**Exam 1 – Ch. 0 Important Heat and Mass Transfer Models**
4	**Ch. 2 – Dynamic Models of Chemical Processes**
5	**Ch. 3 – Laplace Transforms**
6	**Exam 2 Review**
7	**Exam 2**
8	**Ch. 4 – Transfer Function Models**
9	**Ch. 5 – Dynamic Response of First Order Systems**
10	**Ch. 5 – Dynamic Response of Second Order Systems**
11	**Ch. 6 – Dynamics of Higher Order Systems**
12	**Exam 3 Review**
13	**Exam 3**
14	**Ch. 9 – Control Instrumentation; Ch. 15.3 – Feedforward Control**
15	**Ch. 8 – Intro to Feedback Control; Ch. 11.1-2 – Servo/Regulator Problem**
16	**Ch. 11.3 – Dynamics of Feedback Loops, Project Time**
17	**Ch. 11.4 – Stability of Closed Loop Systems, Project Time**
18	**Project Presentations**
19	**Final Exam Review**

Note: The professor reserves the right to change the syllabus as needed. Where necessary, the reading from the book will be supplemented by class notes, reading assignments, and other literature.

Assessment and Grading

Homework/Quizzes	20%
Exams	45%
Term Project	10%
Final Exam	25%
	100%

A = > 90; B+ = 89.99 – 85; B = 84.99 – 75; C = 74.99 – 65; D = 64.99 – 60; F = < 59.99

Policies

NJIT Honor Code: The NJIT Honor Code will be upheld and any violations will be brought to the immediate attention of the Dean of Students.

Special Accommodations: If you need accommodations due to a disability please contact:

Marsha Williams-Nicholas (marsha.williamsnicholas@njit.edu; 973-596-5417), Associate Director, Office of Accessibility Resources and Services or **Lily Hershkowitz** (lily.hershkowitz@njit.edu; 973-596-2994), Accessibility Resources and Services Manager, Office of Accessibility Resources and Services

Lectures

- Attendance is strongly recommended. Attendance sheet has to be signed at the beginning of each class. The examples discussed in the class are not necessarily from the main textbook and therefore missing a class will have consequences for preparation to quizzes and exams.
- The classes start at the designated time above, and the students must be in class by that time. Being late to class may have consequences for the grade, since many of the classes will start from quizzes.
- Electronic devices other than calculators (laptops, tablets, cell-phones etc.) are not permitted during the classes. No audio or video recording is allowed.
- Cellphones should be turned off during both lectures and exams and not allowed under any circumstances.
- Laptops will be permitted only if necessary for class activities.

Course materials, office hours and correspondence

- The course Canvas page is the main platform for delivering information about the course. All relevant course materials and assignments will be posted on Canvas, so a student should check it regularly.
- The students should upload a professional-looking head shot for their Canvas profile.
- The students are strongly encouraged to attend Office Hours held bi-weekly. Long questions, which require derivations will be discussed only during the Office Hours and will not be answered by email.
- Questions regarding grades can be discussed only during the Office Hours.
- E-mail and Canvas correspondence is intended only for quick questions. Questions which require a detailed discussion should be discussed in person during the Office Hours.
- To assure quick response to your emails, please add “ChE489” in the subject of your emails.

Exams and Grades

- A letter grade is based on the final score, calculated using an Excel spreadsheet in accordance with the Tables given in this syllabus. The assigned letter grade is final and cannot be negotiated.
- A student can dispute the exam scores within a week after the announcement of the score. Exam scores can be disputed during the official Office Hours, not during class time or via email.
- The graded exams must be returned within a week to be saved for the department course assessment initiative.
- Students will get 0 for not showing to quizzes, exams, or any other course activity. If students miss an exam due to extreme circumstances (such as a medical problem), they need to notify the instructor via email before the beginning of the exam, and bring proof of the circumstance to the Dean of Student's office. Only in this case of official approval from the Dean of Student's office, may a makeup be given at the discretion of the instructor.
- A student must show as many details when solving a problem during an exam or a quiz. Not showing the work will cause losing points even if the final answer is correct.
- Partial credits can be given for solving the exams problems.
- No partial credit will be given if there is not enough details to follow.
- The final answer should be always evaluated with respect to its reasonability. No partial credit will be given if the final answer is wrong and unreasonable, and it is not stated.
- There will be no partial credits for the questions/problems quizzes.
- Student handwriting must be legible in order to receive points.
- A student coming to dispute a grade has to bring completed homework sheets. No discussion of grades will be held without completed homework.