# COURSE OUTLINE

# ChE 489: Process Dynamics and Control

# Fall 2018

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| **Instructor:** | Dr. Ezinwa Elele |
| **Office:** | Tiernan 387 |
| **Phone:** | (973) 596-5729 |
| **E-mail address:** | [eoe4@njit.edu](mailto:eoe4@njit.edu) |
| **Time & Place of Class:** | Friday, 09:15 AM - 11:20 AM, KUPF 106  Tuesday, 10:00 AM - 12:05 PM, KUPF 209 |
| **Office hours:** | Tuesday, 1:00 p.m.– 2:00 p.m. or individual appointment, Tier 387 |
| **Course Prerequisites:** | ChE 349; ChE 365 |
| **Course Description:** | 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. |
| **Textbook:** | Process Dynamics and Control (4th Edition) by Seborg, Edgar, Mellichamp and Doyle, John Wiley & Sons, Inc.  ISBN: 978-1-119-28591-5 |

**Course Objectives:**

* Students will be able to model chemical engineering processes and analyze/predict their dynamics both for open- (without control) and closed-loop (with control) cases.
* Students will be able to develop control strategies and select the most appropriate input to manipulate, and to tune controllers to meet/achieve specified process objectives.
* Students will be able to work effectively in problem-solving teams and assess the performance of their teammates and themselves on the group efforts.

**Grading schemes:**

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| **Category** | **Score** |
| In-class group activities | 8% |
| Homework and Quizzes | 12% |
| Project | 15% |
| Exam 1 | 20% |
| Exam 2 | 20% |
| Final Exam | 25% |

**Grade:**

A final course grade will be assigned on the following basis:

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| **Weighted final score (%)** | **Letter Grade** |
| 90-100 | A |
| 85-89.9 | B+ |
| 80-84.9 | B |
| 75-79.9 | C+ |
| 70-74.9 | C |
| 60-69.9 | D |
| <60 | F |

**In-class group activities:**

You will be assigned to work in teams and complete many in-class activities with your team. The performance of your team is part of your course grade.

**Homework and Quizzes:**

* Homework assignments will be uploaded on Moodle. Typically, it will mirror and extend the problems treated in the classroom to test understanding of concepts
* Please write legibly and organize your homework so that it will be easy to understand and grade. You can also type your work.
* A late homework will not be accepted and no extension will be granted unless there is a legitimate excuse. A homework is considered late if received later after the deadline.
* Quizzes will be given in class throughout the semester. Students who do their assigned homework assigned and actively participate in in-class activities will have no problems passing the quizzes.

**Exam:**

Exams will test materials treated in class and questions will range in difficulty from easy to challenging. The exams will be cumulative and will be taken during a class period. There will be no make-up exam for students who miss an exam unless there is a legitimate excuse.

**Project:**

Project will be posted in Moodle and will be discussed in class. Part of the project will require knowledge of an engineering software such as MATLAB.

**Courtesy Reminders:**

* Attendance is important. There is a high correlation between failure and poor class attendance
* There will be no eating, drinking, use of cell phone, cameras or laptops in the class unless you are permitted by the instructor.
* All class assignments are expected to be submitted timely.
* In this course, each voice in the classroom has something of value to contribute. You are expected to behave professionally and show respect to fellow students and the instructor. Exhibit a conduct that is attributable to a professional engineer.

**Academic Integrity:**

The NJIT Honor Code and standards of *academic integrity* will be enforced in this course. Any violation will be brought to the immediate attention of the Dean of Students. All students are encouraged to look over the [University Code on Academic Integrity](http://studentsenate.njit.edu/images/stories/SenatePresident/University_Code_on_Academic_Integrity.doc) and understand this document. Students are expected to uphold the integrity of this institution by reporting any violation of academic integrity to the [Office of the Dean of Students](http://www.njit.edu/doss/).

**Student with disabilities:**

NJIT is committed to providing students with documented disabilities equal access to programs and activities. If you have, or believe that you may have, a physical, medical, psychological, or learning disability that may require accommodations, please contact Student Disability Services. Information on the self-identification, documentation and accommodation process can be found on the webpage at: <http://www.njit.edu/counseling/services/disabilities.php.>

**Schedule**

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| **Week** | **Date** | **Topics** | **Chapter/Section** |
| Week 1 | Tues: 09/04  Fri: 09/07 | Introduction to process dynamics and control | 1.1, 1.2 , 1.3, 1.4, 1.5 and 1.6 |
| Week 2 | Tues: 09/11  Fri: 09/14 | Theoretical models of chemical processes | 2.1, 2.2, 2.3, 2.4 and 2.5 |
| Week 3 | Tues: 09/18  Fri: 09/21 | Laplace transforms | 3.1, 3.2, 3.3, 3.4 and 3.5 |
| Week 4 | Tues: 09/25  Fri: 09/28 | Transfer function models | 4.1, 4.2 and 4.3 |
| Week 5 | Tues: 10/02  Fri: 10/05 | Transfer function models (cont.)  **Exam 1** | 4.1, 4.2 and 4.3 |
| Week 6 | Tues: 10/09  Fri: 10/12 | Dynamic behaviors of first order processes | 5.1, 5.2 and 5.3 |
| Week 7 | Tues: 10/16  Fri: 10/19 | Dynamic behaviors of second order processes | 5.4 |
| Week 8 | Tues: 10/23  Fri: 10/26 | Dynamic response characteristics of more complicated processes | 6.1, 6.2, 6.3, 6.4, 6.5 and 6.6 |
| Week 9 | Tues: 10/30  Fri: 11/02 | Feedback controllers and control system instrumentation  **Exam 2** | 8 and 9 |
| Week 10 | Tues: 11/06  Fri: 11/09 | Feedback controllers and control system instrumentation  Dynamic behavior of closed-loop systems  ***(Project assigned)*** | 8 and 9  11.1, 11.2, 11.3 |
| Week 11 | Tues: 11/13  Fri: 11/16 | Dynamic behavior of closed-loop systems | 11.1, 11.2, 11.3 |
| Week 12 | Tues: 11/20  Fri: 11/23 | Stability of closed-loop control  ***Thanksgiving Recess*** | 11.4, 11.5 |
| Week 13 | Tues: 11/27  Fri: 11/30 | Stability of closed-loop control  PID controller design and tuning  ***(Project due)*** | 11.4, 11.5  12.1, 12.2, 12.3 |
| Week 14 | Mon: 12/04  Wed: 12/07 | PID controller design and tuning | 12.1, 12.2, 12.3 |
| Week 15 | Mon: 12/11 | Feedforward and ratio control | 15 |
|  |  | **Final Exam: TBA** |  |