

ME344/ECE382: Control Systems
12:00-1:15pm, Tuesdays and Thursdays, Virtual Class
Spring 2021

Michael M. Zavlanos
Department of Mechanical Engineering and Materials Science
Duke University
E-mail: michael.zavlanos@duke.edu

Course Description:

This undergraduate course focuses on analysis and synthesis of feedback control systems that have specified stability and performance criteria. Topics that will be covered include:

- Introduction: Scope of course, motivation, and applications
- Review: Laplace transform
- Dynamic Models: Modeling of physical systems via differential equations and transfer functions; block diagrams and block diagram manipulation
- Transient and Steady-State Response: Response in terms of the location of the closed-loop poles, and the overshoot, rise, peak and settling times; stability; steady-state error analysis; system type; PID control
- Frequency Response: Bode plots; Nyquist stability criterion; stability margins
- Design of basic controllers using MATLAB

Prerequisites:

Basic understanding of differential equations and familiarity with MATLAB.

References:

- Katsuhiko Ogata, *Modern Control Engineering*, 5th Edition, Prentice Hall, 2009.
- Gene Franklin, David Powell, and Abbas Emami-Naeini, *Feedback Control of Dynamic Systems*, 6th Edition, Prentice Hall, 2009.
- Richard Dorf and Robert Bishop, *Modern Control Systems*, 12th Edition, Prentice Hall, 2010.
- Gilbert Strang, *Linear Algebra and its Applications*, 4th Edition, Cengage Learning, 2005.

Office Hours:

- Michael M. Zavlanos, 188 Hudson Hall, Tuesdays 2:45-3:15pm or by appointment
- Teaching Assistants: Luca Di Muro (gianluca.dimuro@duke.edu) and Yi Shen (yi.shen478@duke.edu)

Grading Policy:

3 Midterm Exams: 30%
Final Exam: 35%
Homeworks: 10%
Laboratory: 25%

Class Policy:

1. Students are responsible for any material posted on the Duke Sakai web site (login at: <https://sakai.duke.edu/>).
2. Prior to every class, you are expected to visit the Sakai site and to print any relevant information, such as **class slides**, **handouts**, and **homework assignments**, in order to properly follow the lecture. The posted material will not be handed out in class during the semester.
3. Laboratory attendance is required.
4. Homeworks will be assigned on a weekly basis and will be due in class one week after the day they are assigned. Late homeworks are **not** accepted under any circumstances.
5. Homeworks will not be graded. They serve as practice problems. Turning in all homeworks in class and making effort to solve the problems corresponds to 10% of the final course grade. Solutions will be provided after every homework is due so you can check your answers.
6. Exams and experiments **cannot** be made up, unless agreed upon by the instructor **prior** to the allotted time. The policy for make up exams is **that the exam that follows next** (either a midterm or a final) will count towards the grade of the exam that was missed. Therefore, if a student has missed Midterm 1, then Midterm 2 will count towards both midterms 1 and 2.
7. **Communications:** You are **encouraged** to see the instructor during office hours or by appointment. You are encouraged to use e-mail in order to set up appointments or ask brief questions. Similarly, you are encouraged to check your Duke's e-mail frequently, for reminders as well as urgent class information will be distributed by e-mail, as well as posted on the Sakai site.