# SE 320: Control Systems

**TR 10:00AM - 11:20AM**
**Location: 163 Noyes Laboratory**

**Instructor:** Prof. Yingying Li, (*yl101@illinois.edu*)
Office Hours: Thursdays, 5:30pm - 6:30pm
Location: Coordinated Science Lab: Room 347

**TA**: Haonan Xu (*haonan9@illinois.edu*)
Office Hours: TBD
Location: TBD

**Required Text:** *Feedback Control Systems:* Fifth Edition,
by Charles L. Phillips and John M. Parr, Prentice-Hall publ.

**Specific Course Information:**

- **Course Description:** Fundamental control systems and control systems technology. Sensors, actuators, modeling of physical systems, design and implementation of feedback controllers; operational techniques used in describing, analyzing and designing linear continuous systems; Laplace transforms; response via transfer functions; stability; performance specifications; controller design via transfer functions; frequency response; simple nonlinearities.
- **Prerequisites:** CS101, MATH 285, & TAM212, Credit or Concurrent registration in ECE211.
- **Labs:** Labs will not start until February. The date of the first lab session will be announced soon. Prof. Daniel Block will be your instructor for the lab sessions.

**Assignments:**

- There will be **6 homeworks** posted approximately every other week. Homeworks and their solutions will be posted in Canvas.illinois.edu. The students should return their answers by the specified deadline by scanning or taking a photo of their answers and uploading them on Canvas. You will need Matlab to solve some questions.
- **No late homeworks** will be accepted. It is important to write your solution clearly as it may affect your grades. No collaboration or other solution sources are allowed on the homeworks or exams. Otherwise, UIUC student code § 1-402 on academic dishonestly will be followed.

**Matlab:**

- You will need Matlab to solve some homework questions, starting from homework 1. Please try to **set up Matlab** before Sep 3 2024. You can find useful instructions at https://webstore.illinois.edu/shop/product.aspx?zpid=4105. If you encounter any technical issues, you can reach out to the TAs and/or the IT help desk and/or the instructor.

- **Recitation session:** There will be three recitation sessions on a basic introduction to Matlab. Time and location are posted on Canvas Announcements.
- **Useful resources:** Mathworks Help Center, Mathworks Matlab Answers, online courses, e.g. https://www.mathworks.com/learn/training/matlab-fundamentals.html?s_tid=hp_training_matlab https://ocw.mit.edu/courses/6-057-introduction-to-matlab-january-iap-2019/pages/assignments/ https://guides.library.illinois.edu/sets/matlab, etc.
- **Homework submission related to Matlab:** You should take a screenshot of your codes and their outputs, and attach them to your submitted answers.

**Exams:**

- There will be **two in-class midterm exams** during the semester. The midterms will be in-class, closed-book, and 80 minutes. TENTATIVE DATES: March 3rd and April 21st.
- There will be **six in-class quizzes** held roughly every-other week; these will be announced the lecture prior to the quiz date. Quizzes are open-book and open-notes.
- **Final Exam**: 8:30-11:00 a.m. (150 minutes), Thursday, May 14. (The time for the final exam is according to https://registrar.illinois.edu/final-exam-scheduling-guidelines/). Location: TBD.
- For both the midterms and the final exam,
  - The exams are closed book, closed notes, closed homeworks. One cheat sheet is allowed for each midterm and final exam. The cheat sheet should be A4 paper, double sided.
  - You are expected to submit the cheat sheet at the end of each exam.
  - You may use your calculator provided it has no wi-fi capabilities.
  - No cellphones allowed during the test.

**Course Grade Composition:**

| Item | % of grade |
|---|---|
| Participation | 5% |
| Homework | 18% |
| Quizzes | 12% |
| Midterm 1 | 15% |
| Midterm 2 | 15% |
| Final Exam | 20% |
| Lab Report | 15% |

- Total Score $\geq$ 95: A+, Total Score $\geq$ 90: A, Total Score $\geq$ 85: A-
- Total Score $\geq$ 80: B+, Total Score $\geq$ 76: B, Total Score $\geq$ 73: B-
- Total Score $\geq$ 70: C+, Total Score $\geq$ 66: C, Total Score $\geq$ 62: C-
- Total Score $\geq$ 56: D, Total Score $<$ 56: F.

**TENTATIVE COURSE OUTLINE:**

| Reading | Topics | Lectures |
|---|---|---|
| **Chapter 1:** | Introduction to Control Systems | Week 1 |
| **Appendix B:** | Laplace Transforms<br>definition of Laplace transform and inverse Laplace transform; examples of common transforms; properties and theorems | Weeks 1-2 |
| **Chapter 2:**<br>**Sec. 1-3; 5-12** | Mathematical models for physical systems<br>circuits, mechanical systems, electromechanical systems<br>transformers and gears, more examples | Weeks 2-4 |
| **Chapter 4:** | System Responses to Inputs<br>responses in time-domain and frequency domain; design specifications | Weeks 4-5 |
| **Chapter 5:** | Closed-loop Systems<br>stability; transient response and steady state response; sensitivity | Weeks 5-7 |
| **Chapter 6:** | Stability Analysis<br>history and notions of stability; Routh-Hurwitz criterion; roots of the characteristic equation | Weeks 8-9 |
| **Chapter 8:** | Frequency Response Analysis<br>Frequency responses; Bode diagrams; Nyquist Criterion | Weeks 10-12 |
| **Chapter 9:** | Frequency Response Design<br>gain compensation; lag and lead compensation; lag-lead compensation<br>PID design and implementation | Weeks 13-14 |