<u>ME 57500 SYLLABUS</u>

# THEORY AND DESIGN OF CONTROL SYSTEMS

Fall Semester 2020

**INSTRUCTORS:**   George T.-C. Chiu, ME 3061C, (765) 494-2688
E-mail: gchiu@purdue.edu

**TA:**   TBD, E-mail: TBD
Office Hour:  TBD

**COURSE TEXT:**   *Feedback Systems*: *An Introduction for Scientists and Engineers*, Karl J. Åström and Richard M. Murray, 2nd Ed. (available on-line)

Lecture handouts will be posted to the course website.

**RECOMMENDED REFERENCE**:
*Multivariable Feedback Control*: *Analysis and Design*, Sigurd Skogestad and Ian Postlethwaite, Wiley, 2nd Ed., 2005. (paperback version)

**PREREQUISITE:**   ME475 or the consent of the instructor.

**OBJECTIVES:**   This course is to review and introduce analysis and synthesis tools for continuous-time linear time-invariant (LTI) control systems:
- Analysis - state space and input/output representations, time and frequency domain, stability, robustness and sensitivity
- Synthesis - input/output or frequency domain, state feedback control, state observer, observer-based compensator

**GRADING POLICY:**

| | |
|---|---|
| Homework | 35% |
| Midterm Exam (Take home) | 25% |
| Final Exam (Take home) | 40% |

**HOMEWORK POLICY:**

We will be using Gradescope (http://www.gradescope.com) to handle homework submission and grading. Homework is to be uploaded by the designated deadline. *No late homework will be accepted*.  There will be, on average, one homework set every two weeks.  Since assigned homeworks are an integral part of the course content, they are to be an individual effort.  However, discussion is strongly encouraged. *Each homework problem must begin on a new page*. **You must receive a passing homework grade (60%) to pass the course**.  The lowest homework grade will be dropped when computing the overall homework average.

**MIDTERM EXAM:** There will be one midterm exam during the semester. It will be a take home exam. There will be no makeup examination.

**FINAL EXAM**:   The final take home exam will be comprehensive.  Time, date, and duration will be announced.

**COMPUTER USAGE:**

Course communication is going through the Purdue Brightspace web site at https://purdue.brightspace.com/.  When login with your Purdue Career account you should be able to access the ME57500 site.  Course announcements, lecture notes, homework are posted there.  You should check the web site at least once a day.

You will be expected to use MATLAB/SIMULINK for some of the homework assignments and the course project. There is a self-paced MATLAB tutorial on the Web. The tutorial can be accessed through http://ctms.engin.umich.edu/CTMS/.

ON-LINE ACCESS: The course will be offered on-line in a semi-asynchronous manner within a given week to accommodate for different time-zones and individual situations. Homework and exam will still have a fixed due date/time. Lecture videos (in multiple segments) will be posted to the course website. We will schedule on-line office hours through the new Purdue LMS system, Brightspace. Since this is our first experience with Brightspace, several backup options such as Zoom and/or Slack for on-line communication will also be considered. We will give them a try during the first week of class.

## TENTATIVE COURSE OUTLINE (AS OF JULY 2020)

| Week | Date | Tentative topic | Homework |
|---|---|---|---|
| Week 1 | 08/25/20 | Introduction | |
| | 08/27/20 | Feedback control | HW0 due |
| Week 2 | 09/01/20 | Modeling | |
| | 09/03/20 | Modeling | |
| Week 3 | 09/08/20 | Dynamic response | |
| | 09/10/20 | Dynamic response | HW1 due |
| Week 4 | 09/15/20 | Transfer function | |
| | 09/17/20 | Transfer function | |
| Week 5 | 09/22/20 | Frequency analysis | |
| | 09/24/20 | Frequency analysis | HW2 due |
| Week 6 | 09/29/20 | Frequency analysis | |
| | 10/01/20 | Pole placement | |
| Week 7 | 10/06/20 | PID control | |
| | 10/08/20 | Frequency domain design | HW3 due |
| Week 8 | 10/13/20 | Frequency domain design | |
| | 10/15/20 | Miterm exam break | |
| Week 9 | 10/20/20 | Robust performance | |
| | 10/22/20 | Robust performance | HW4 due |
| Week 10 | 10/27/20 | Robust performance | |
| | 10/29/20 | Stabiilty | |
| Week 11 | 11/03/20 | Linear systems | |
| | 11/05/20 | Linear systems | HW5 due |
| Week 12 | 11/10/20 | State feedback | |
| | 11/12/20 | State feedback | |
| Week 13 | 11/17/20 | Output feedback | |
| | 11/19/10 | Output feedback/LQR | HW6 due |
| Week 14 | 11/24/20 | LQR/LQG | |
| | 11/28/20 | Thanksgiven break | |
| Week 15 | 12/01/20 | DOB | |
| | 12/04/20 | Review | HW7 due |