EEP 547 Linear Systems Theory

Class Time: 6:30pm - 9:50 pm Thursdays

Classroom: ECE 037

Instructor: Professor Linda Bushnell, LB2@uw.edu Office hours: email

TA: Xingjian Yang, yxj1995@uw.edu. Office hours: email; Saturday 9:00am - 10:00am Zoom link

Introduction:

We will have lectures and lab on Thursdays (lecture first by Professor, then a break, then hands-on lab work with TA). The lecture will cover topics in linear systems theory; the laboratory will work with these concepts in Matlab and Simulink and on a MinSeg robot. All students will get a MinSeg robot kit to take home and work with.

Textbooks & Software & Hardware:

- Joao Hespanha, "Linear Systems Theory," 2nd Ed., Princeton University Press, 2018 or any other Linear Systems Theory book (recommended)
- Matlab, Simulink, Control Systems Toolbox, Symbolic Math Toolbox (see UW-IT for software)
- Minseg robot based on Arduino (each student receives one robot kit for the quarter)

Other Reference Books (many to choose from):

1. P. J. Antsaklis and A. N. Michel, Linear Systems, McGraw Hill, 1997.
2. W. J. Rugh, Linear System Theory, Prentice Hall, 1993.
3. T. Kailath, Linear Systems, Prentice Hall, 1980.
4. C.T. Chen, Linear System Theory and Design, 3rd Ed, Oxford, 1999.
5. Uy-Loi Ly pdf textbook (posted in Modules)

Grading:

Homework 50% (8 assignments; drop lowest grade)

Project 50% (MinSeg robot project; report and presentation) project document will be posted in Week 5

No midterm; no final exam

Schedule:

See posted schedule under Files. We will have 10 classes. There is no midterm or final exam. The last week will be project presentations (on Thursday, December 4th).

Prerequisites:

- **Linear Algebra**

Topics Covered:

- System Representation: modeling, transfer function, state space, linearization, causality, time invariance, linearization
- System Response: LTV and LTI systems, impulse response, step response, frequency response, Bode Plots
- Stability: Lyapunov, Input-Output
- Controllability: concept of controllability, controllable subspaces, decompositions
- Observability: concept of observability, output feedback, minimal realizations
- State-variable Feedback from state space model
- State Observers from state space model
- PID control via transfer function model
- LQR controllers from state space model
- Use of Matlab and Simulink to explore concepts covered above.
- Implementation of above concepts on a MinSeg robot