

MECH 7710: Optimal Estimation and Control
Spring 2023
MW 11:00-12:15 Lowder 111

Instructor: Dr. Scott Martin

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Office Hours: MW 10:00 – 10:30 AM, MW 3:00 – 4:00 PM, Friday 10:00 – 11:30 AM, or by appointment

Website: Canvas

Textbook: *Optimal Control and Estimation* Robert Stengel (not required)

Other References:

Introduction to Random Signals and Applied Kalman Filtering by: Brown, R. G. and Hwang

Applied Optimal Control by: R.F. Stengel

Applied Optimal Estimation by: Gelb

Optimal Estimation of Dynamic Systems by: Crassidis and Junkins

Digital Control of Dynamic System by: Franklin Powell and Workman

Pre-Requisites:

ELEC7500 or MECH5970: Basic understanding of classical and state-space systems/analysis and synthesis tools

Matlab: A good working knowledge of MATLAB is essential to this course and is assumed

Working knowledge of Discrete Systems, z-transforms, difference equations

Grading Policy:

1. 1 Exam	20
2. Homework	60
3. Project	20

Scale:

90-100 - A	70-79 - C
80-89 - B	60-69 - D
below 60 - F	

Goals:

Overall: Develop skills for the design of real world, modern, digital controllers accounting for: Measurement noise, model uncertainty, and process noise. Introduce the Kalman filter

Specific:

- Understand Random Processes
- Introduction to Plant Identification
- Combine Optimal Estimation and Control Techniques
- Explore performance and robustness issues of new design techniques with examples

General Policies:

Class attendance is expected but not *formally* recorded. Late submission of assigned work or make-up examinations will be allowed if and only if accompanied by an approved University excuse. You are encouraged to discuss homework and problem sets but submitted work should be your own.

Accessibility:

It is the policy of Auburn University to provide accessibility to its programs and activities, and reasonable accommodations for persons defined as having a disability under Section 504 of the rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act of 1990. Students who need special accommodations should make an appointment to see the instructor as soon as possible or contact The Student with Disabilities Program office at (334) 844-5943 (Voice/TT)

Tentative Lecture Topics (Subject to Change):

Number of Weeks	Topics	Reading
3	Linear Systems and Probability Theory	Stengel Chapters 1 and 2
3	Least Squares Estimation	Stengel Chapter 4
3	Linear Discrete and Continuous Kalman Filtering	Stengel Chapter 4
3	Nonlinear Estimation	Stengel Chapters 4
1	System Identification	Ljung: System Identification: Theory for the User
1	Optimal Control with Noise	Stengel Chapters 5 and 6
1	Model Predictive Control	TBD

Online Instruction

All lectures for 7710 will be made available on Canvas. The lectures are taken from a previous semester so they may not line up exactly with classroom lecture, but by the end of the semester the same topic will have been covered.