**MECH 7710: Optimal Estimation and Control**

**Spring 2023**

**MW 11:00-12:15 Lowder 111**

**Instructor:** Dr.Scott Martin

**Office:** Wiggins 2428

**Phone:** 334-844-4928

**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):**

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| 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.