Sabancı University Faculty of Engineering and Science

ENS 206: System Modelling and Control

Spring 2021 - 2022 Weekly Schedule: T 8:40-9:30, R 8:40-10:30

Instructor: Melih Turkseven melih.turkseven@sabanciuniv.edu

Office Hours: TBD

Description: This course will enable students to build mathematical models from first principles that represent behaviors of various physical systems (such as mechanical, electrical, and electromechanical systems). In addition to system modeling, the course also introduces basic concepts of control engineering.

Textbook: System Dynamics, Katsuhiko Ogata, Pearson Prentice Hall Learning

Outcomes: • Develop system response to various inputs • Utilize basic engineering approximations to simplify the models • Learn analytical methods, such as Laplace's transformation and state space approach for modeling dynamic systems • Learn Matlab/Simulink for dynamic system simulation and control • Use time-domain and frequency-domain analysis of dynamic systems to predict system performance • Introduce basic concepts in control systems Important

Notes:

- Quizzes will be conducted through SUcourse and students will be expected to participate on Zoom. Students are required to turn on pc cameras, and mics. The assessment sessions can be recorded.
- Students may be called for oral assessments in the following days of exams.
- To qualify for make-ups the average score of both homework assignments, and quizzes should be at least 20 out of 100.
- Any possible make-up exam will be scheduled at the end of the semester. In fairness to those who take the original exam, the make-up will include all the topics covered at the time of the exam. All the excuses and medical reports must be submitted before the exam.
- The lowest score among the quizzes will be dropped.
- Recitation sessions will be held online
- MATLAB software will be extensively used. Students are expected to have a running version on their personal computers. We will provide tutorials and examples suitable for those who have not used MATLAB before.

Course Plan:

Week 1	Introduction_ What does 'dynamic' mean?
Week 2 Recitation	Mathematical preliminaries, Differential equations & Concept of stability Getting started with MATLAB
Week 3-4 Recitation Quiz 1	Laplace's transformation Transfer function approach to modeling dynamic systems Example questions more on MATLAB Math Basics (Contents of Week 2)
Week 5 Recitation Quiz 2	Analyzing the time domain response of dynamic systems & Case of mechanical systems Simulation with MATLAB & Example mechanical systems Laplace and Transfer functions (Contents of Week 3-4)
Week 6 Recitation Quiz 3	Case of electrical and electromechanical systems Case of DC motor more examples Transfer functions and their I/O (Contents of Week 5)
Week 7 Recitation Quiz 4	Linearization (Case of hydraulic systems) & More on Stability Simulation examples on the difference between linear/nonlinear, stable/unstable Electro-mechanical systems (Contents of Week 6)
Week 8	Review and Midterm Exam Recitation Q&A
Week 9-10 Recitation Quiz 5	Modeling in State-Space Modeling in State-Space Stability and Linearization (Contents of Week 7)
Week 11 Recitation Quiz 6	Frequency domain analysis of dynamic systems Analyzing dynamic systems in frequency domain Modeling in State-Space (Contents of Week 9-10)
Week 12-13 Recitation Quiz 7	Introduction to control systems PID control Formulating closed-loop control Frequency domain analysis (Contents of Week 11)
Week 14 Recitation Quiz 8	Implementing basic closed-loop control Implementation examples Modeling and Control

Assessments:

- Final Exam: 35%
- Midterm Exam: 25%
- Assignments: 20%
- Quizzes: 10%
- Project: 10%