Sabanci University
Faculty of Engineering and Science

ENS 206: System Modelling and Control

Spring 2020 - 2021

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Office Hours: TBD

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Weekly Schedule: **T** 8:40-9:30, **R** 8:40-10:30

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:

Exams 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 homework assignments and quizzes will be dropped.
- Recitation sessions will be held online and will not be recorded.
- MATLAB software will be extensively used. Students are expected to have a running version on their personal computers.

Course Plan:

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

Assessment:

Final Exam: 35%
Midterm Exam: 25%
Assignments: 20%
Quizzes: 10%
Projects: 10%