Carleton UNIVERSITY | Department of Systems and Computer Engineering

SYSC 4505
Automatic Control Systems I

Calendar description

Review of Laplace transform techniques. Effects of feedback: frequency response, pole-zero positions. Compensation: root locus, Bode plots. State variables: formulation, solution of linear systems, examples of simple second-order non-linear systems. Discrete time systems: z-transforms. Signal reconstruction.

Includes: Experiential Learning Activity.

Lectures three hours a week, laboratory three hours alternate weeks.

http://calendar.carleton.ca/undergrad/courses/SYSC/

Prerequisites

MATH 2004 and (SYSC 3500 or SYSC 3600 or SYSC 3610).

Precludes additional credit for MAAE 3500, MAAE 4500 (no longer offered).

Prior knowledge

Students should:

- Have prior exposure to elementary transforms and differential equations.

Course objectives

The objective of the course is to teach the student the fundamental concepts of control system design and analysis. The course reviews linear systems theory and presents how linear systems theory is used to both specify performance requirements and how to design the control system. A number of electromechanical examples are used to illustrate control system analysis and design. The course focuses on the engineering design process to achieve required specifications.

List of topics

- Review of Laplace transforms, transfer functions, dynamics of linear systems and frequency response.
- Review of modeling of dynamic systems.
- Review of block diagram reduction and Op-Amp circuits.
- Steady state errors, system types, stability and Routh-Hurwitz criteria.
- The effect of feedback on system dynamics. Construction of root loci.
- Real axis segments, asymptotic angles, centroids of asymptotes.

- Root locus design examples.
- Time domain controller design. The PD and PID controllers.
- Frequency response analysis.
- Nyquist polar plots, the Nichols chart, gain margin and phase margin.
- Compensation design.
- Phase lead compensation in time domain and frequency domain.
- Phase lag compensator design in the time and frequency domain.
- Design of lead-lag compensation.
- State space techniques, matrix formulation.

Learning outcomes

By the end of this course, students should be able to:

- Understand control system diagrams, feedback loops and identify the processing of signals through block processors (such as amplifiers, integrators, differentiators etc.).
- Model control systems and create simulation experiments for analyzing their performance.
- Propose alternate designs and/or fine tune system parameters to achieve design goals.
- Design suitable control blocks (compensators) to be used in feedback loops and/or feedforward configurations to achieve required performance characteristics.
- Compare and asses the performance of control systems and propose design procedures for optimizing their response.
- Be trained to use various simulation software (MATLAB, simuling, Analog Devices PLL modelling and analysis software etc.) to assess and design practical control systems (e.g. Phase Locked Loops).

Graduate Attributes (GAs)

The Canadian Engineering Accreditation Board requires graduates of engineering programs to possess 12 attributes at the time of graduation. There are no GA's related to this course. For more information, please visit: https://engineerscanada.ca/.

Instructor and TA contact

Specific to course offering (tbd)

Textbook (or other resources)

Specific to course offering (tbd)

Evaluation and grading scheme

Specific to course offering (tbd)

Breakdown of course requirements

Specific to course offering (tbd)

Tentative week-by-week breakdown

Specific to course offering (tbd)

General regulations

Specific to course offering (tbd)