PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL ENGINEERING
ABET COURSE SYLLABI

IEE2613 AUTOMATIC CONTROL

Credits and contact hours: 10 UC credits/10 hours (3 Lecture hours per week ; 1.5 Assistantship hours per week and 5.5 hours of Independent learning experience per week)

Instructor's name: Andrés Guesalaga

Course coordinator's name: Miguel Torres

Textbook:
- R.Dorf, R.Bishop. Modern Control Systems, Prentice Hall, 2004.
- G.K.Franklin, J.D.Powell, A.Emami-Naemi. Feedback Control of Dynamic Systems, Prentice Hall, 2006

Course Catalog Description: The objective of the course is to provide the students with theoretical and practical tools to design control systems that guarantee that the processes achieve the static and dynamic specifications in terms of output quality, performance, operational costs and safety. The course is based on the basic methods of mathematical modeling for continuous and discrete systems. The main tools taught are: i) modeling based on transfer functions and block diagrams, ii) state-space modeling, iii) temporal analysis, iv) frequency analysis, v) root locus techniques, vi) design of controllers using time and frequency methods, vii) introduction to linear optimal control LQR y optimal observers (Kalman filters).
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Prerequisite Courses: IEE2103 Signals and Systems

Co-requisite Courses: To be defined

Status in the Curriculum: Fundamental course

Course Learning Outcomes:

1. Introduce the students to various theoretical automatic control concepts, and their relation to applications in industrial processes or social systems. Some examples are chemical processes, aeronautics, robotics, power systems, among others.
2. The students will be able to describe dynamical systems via equations that allow them to analyze processes in terms of stability, controllability and observability.
3. The student will learn the necessary tools to design controllers that can modify the closed loop behavior of dynamical systems, ensuring their stability.
4. The student will acquire the computational and numerical tools to design controllers and analyze the dynamics of closed loop systems.

Relation of Course to ABET Criteria:

b. Design and conduct experiments: analyze and interpret data
c. Design a system, component, or process
e. Identify, formulate, and solve engineering problems
f. Professional and ethical responsibility
g. Effective communication
j. Knowledge of contemporary issues
k. Techniques, skills, and modern tools for engineering practice.

Topics covered:

1. **Introduction**: History of automatic control and application examples
2. **Mathematical models:** Continuous time models (differential equations); Discrete time models (difference equations); Transfer functions. Transmittance functions; State-space representation of dynamical systems; Linearization; Block diagrams; Discretization of continuous time systems.
3. **Characteristics of closed-loop systems**: Open loop and closed loop systems; Disturbances and manipulated variables; Transient response; Steady-state response; Stability in the time domain.
4. **Analysis of linear feedback processes**: Performance specifications in the time domain; The Laplace s-plane and the transient response; Steady-state error; Figures of merit (performance indices).
5. **Stability of linear feedback systems:** Stability; Routh-Hurwitz criteria; Root-locus.
6. **The root-locus method**: Concept of the root locus technique; Design of controllers using the root locus technique.
7. **Frequency response methods**: Plots in frequency analysis: Bode, Nyquist and Nichols; Performance requirements in the frequency domain.
8. **Stability in the frequency domain**: The Nyquist criteria. Relative stability; Close-loop response in the frequency domain; Stability in systems with delays.
9. **Design of controllers in closed-loop systems**: Analysis via Bode plots; Analysis in the s-plane; The PID controller and the proportional, integral and derivative modes; Computer-based design of controllers: the discrete PID controller; Design of control systems in the time-domain; Feedback in the state-space.
10. **Modern control**: Multivariable control; Kalman filter and the optimal LQR controller.
11. **Applications**: Aero-dynamical systems; Industrial processes.
12. **Software tools for the design of controllers**: MATLAB/Simulink.