

## DEA-GITI-321 Control Systems

**SEMESTER:** Spring

**CREDITS:** 6 ECTS (4 hrs. per week: 2.7h Theory + 1.3h Lab, on average)

**LANGUAGE:** Spanish

**DEGREES:** GITI

### Course overview

This course is an introduction to Control Systems. Given a dynamic system, by using negative feedback, the output of the system is controlled so as it tracks a given setpoint and rejects disturbances. The main characteristics of a control system are analyzed: stability, accuracy, speed and damping. PID (Proportional-Integral-Derivative) controllers are designed using both time-response and frequency-response techniques.

### Prerequisites

Basic knowledge of Dynamic Systems. Laplace Transform, Transfer Function, 1<sup>st</sup>- and 2<sup>nd</sup>-order systems time and frequency response.

### Course contents

#### Theory:

1. Introduction to Control Systems. Concept of control system. Objectives of a control system. Structure and components of control systems. Specifications and control methods.
2. Second-Order Control Systems Design. Damping, speed and accuracy. Additional poles and zeros.
3. Steady-State Accuracy. Setpoint tracking. Disturbance rejection. Typical configurations for accuracy analysis. Feed-forward.
4. Stability. Nyquist and Black diagrams. Nyquist stability criterion. Reverse stability criterion. Routh-Hurwitz stability criterion.
5. Control Design based on Frequency Response. Relation between time and frequency responses. Stability margins. P control. PI control. PD control. PID control.
6. Introduction to Computer-Controlled Systems. Automatic systems. Effect of the sampling time. Control algorithms.
7. Complementary Issues. Integral saturation. Setpoint weighting. Root locus.

## Laboratory:

There will be ten 2-hour sessions to develop two projects, including the lab exam.

- P1.** Design and analysis of a speed control for a car in a closed circuit
- P2.** Design and analysis of PID-type controls for a closed-loop-controlled Cartesian plotter.

## Textbook

- N. S. Nise. Control Systems Engineering, 6th Edition. John Wiley and Sons. 2011.
- L. Pagola. Regulación Automática. Universidad Pontificia Comillas. 2006. (English version available).

## Grading

- Exams account for 60% of the final grade (45% corresponding to the final exam and 15% to the mid-term exam. Anyway, a minimum grade of 5 is required on the final exam to pass the course.
- Continuous evaluation quizzes account for 5%.
- Lab accounts for 35% of the grade. A minimum grade of 5 is required to pass the course.