

Guia docent

230368 - MACA - Programació D'Aplicacions de Control en Arduino amb Matlab

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Unitat responsable: Escola Tècnica Superior d'Enginyeria de Telecomunicació de Barcelona
Unitat que imparteix: 739 - TSC - Departament de Teoria del Senyal i Comunicacions.

Titulació: Curs: 2019 **Crèdits ECTS:** 2.5
Idiomes: Anglès

PROFESSORAT

Professorat responsable: Rosa M. Fernández / Jose A. Lázaro

Altres: Jose A. Lázaro / Rosa M. Fernández

METODOLOGIES DOCENTS

Application examples solved in class via Matlab/Simulink and Arduino
Laboratory Practices
Final work and oral exposition of the solution obtained to the proposed problem

OBJECTIUS D'APRENTATGE DE L'ASSIGNATURA

The aim of this course is to train students in methods for the design and analysis of digital controllers by means of the computer. The course includes a brief introduction to control theory for the students not familiar with this field and it is mainly developed on the basis of several application examples and case studies. The students will work with the Matlab/Simulink software. Finally, several laboratory experiments with ARDUINO will be performed.

Learning results of the subject:

- Ability to formulate the control problem specifications taking into account theoretical and practical constraints.
- Ability to design digital controllers by several software-based techniques: empirical methods, root locus, direct synthesis, and optimization.
- Ability to select, analyze and implement digital controllers by means of Arduino and Simulink.

HORES TOTS DE DEDICACIÓ DE L'ESTUDIANTAT

Tipus	Hores	Percentatge
Hores grup petit	10,0	16.00
Hores aprenentatge autònom	42,5	68.00
Hores grup gran	10,0	16.00

Dedicació total: 62.5 h

CONTINGUTS

Unit 1. Fundamentals of Control Theory

Descripció:

- 1.1 Fundamentals of Control Theory.
- 1.2 Laplace modeling of dynamic systems. Linearization
- 1.3 System Response (time and frequency)
- 1.4 Feedback. Specifications
- 1.5 Matlab/Simulink tools for control systems analysis, design and implementation

Objectius específics:

Give minimum Control Theory concepts necessary to follow the course
Introduce Matlab/Simulink software for control systems analysis

Activitats vinculades:

Case Study 1. Antenna heading

Dedicació: 12h 30m

Grup gran/Teoria: 4h

Aprenentatge autònom: 8h 30m

Unit 2. PID, Digital and Optimal Controllers

Descripció:

- 2.1 PID regulators: P, I, D actions. Ziegler-Nichols tuning
- 2.2 Optimal tuning of PIDs
- 2.3 Design of optimal ITAE controllers by direct synthesis
- 2.4 Signal processing for digital control systems. Z Transform
- 2.5 Discretization of analog controllers
- 2.6 Deadbeat and Dahlin controllers

Objectius específics:

Learn different approaches and techniques to design linear controllers (empirical methods, optimization)
Learn how to discretize analog controllers and how to select a proper sampling time
Learn to design pure digital controllers by direct synthesis

Activitats vinculades:

Case study 2: Temperature regulation of an industrial oven

Dedicació: 10h 50m

Grup gran/Teoria: 2h 20m

Aprenentatge autònom: 8h 30m

Unit 3. Software-based controller design in the complex plane

Descripció:

- 3.1 Analysis of Control Systems: Root locus
- 3.2 Stability analysis: Routh-Hurwitz, Nyquist, margins
- 3.3 Performance analysis: Steady State Error Constants
- 3.4 Sisotool: Design of P, I, and PI controllers

Objectius específics:

Introduce the sisotool to design control systems in the complex plane

Activitats vinculades:

Case study 3: Magnetic levitator

Dedicació:

12h 30m
Grup gran/Teoria: 4h
Aprenentatge autònom: 8h 30m

Unit 4. PRACTICE on MATLAB programed ARDUINO for Control Applications

Descripció:

- 4.1 Basics on ARDUINO
- 4.2 Programming ARDUINO with MATLAB/Simulink
- 4.3 Actuating and Monitoring Hardware using ARDUINO & MATLAB
- 4.4 Developing a Controller in ARDUINO with MATLAB

Objectius específics:

Gain practical hands-on experience in building high-level examples by oneself
Design, simulate and test custom algorithms in Simulink
Implement these algorithms on low-cost embedded hardware such as Arduino

Activitats vinculades:

Case study 4: Controlling a Tunable Laser or Electronic Circuit with ARDUINO & MATLAB.

Dedicació:

25h
Grup gran/Teoria: 17h
Aprenentatge autònom: 8h

SISTEMA DE QUALIFICACIÓ

Final examination: from 20% to 50%

Partial examinations and controls: from 0% to 50%

Exercises: from 0% to 20%

Laboratory assessments: from 0% to 50%

BIBLIOGRAFIA

Bàsica:

- Ogata, K. Discrete-time control systems. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall, 1995. ISBN 0133286428.
- Friedland, B. Control system design: an introduction to State-Space methods. New York: Dover, 1986. ISBN 0486442780.
- Kuo, B.C. Digital control systems. 2nd ed. Ft. Worth: Saunders College, 1992. ISBN 0030128846.
- Kailath, T. Linear systems. Englewood Cliffs, NJ: Prentice-Hall, 1980. ISBN 0135369614.
- Landau, I.D.; Zito, G. Digital control systems: design, identification and implementation [en línia]. New York: Springer, 2006 [Consulta: 11/05/2020]. Disponible a: <http://dx.doi.org/10.1007/978-1-84628-056-6>. ISBN 1846280559.