Guía docente
230368 - MACA - Programación de Aplicaciones de Control en Arduino con Matlab

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Unidad responsable: Escuela Técnica Superior de Ingeniería de Telecomunicación de Barcelona
Unidad que imparte: 739 - TSC - Departamento de Teoría de la Señal y Comunicaciones.

Titulación: MÁSTER UNIVERSITARIO EN INGENIERÍA DE TELECOMUNICACIÓN (Plan 2013). (Asignatura optativa).
MÁSTER UNIVERSITARIO EN INGENIERÍA ELECTRÓNICA (Plan 2013). (Asignatura optativa).

Curso: 2019 **Créditos ECTS:** 2.5 **Idiomas:** Inglés

PROFESORADO

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

Otros: Jose A. Lázaro / Rosa M. Fernández

METODOLOGÍAS DOCENTES

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

OBJETIVOS DE APRENDIZAJE DE LA ASIGNATURA

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.

HORAS TOTALES DE DEDICACIÓN DEL ESTUDIANTADO

Tipo	Horas	Porcentaje
Horas aprendizaje autónomo	42,5	68.00
Horas grupo pequeño	10,0	16.00
Horas grupo grande	10,0	16.00

Dedicación total: 62.5 h

CONTENIDOS

Unit 1. Fundamentals of Control Theory

Descripción:
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

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

Actividades vinculadas:
Case Study 1. Antenna heading

Dedicación: 12 h
Grupo grande/Teoría: 4h
Aprendizaje autónomo: 8h 30m

Unit 2. PID, Digital and Optimal Controllers

Descripción:
2.1 PID regulators: P, I, D actions. Zieglerâ□□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

Objetivos específicos:
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

Actividades vinculadas:
Case study 2: Temperature regulation of an industrial oven

Dedicación: 10 h
Grupo grande/Teoría: 2h 20m
Aprendizaje autónomo: 8h 30m

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

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

Objetivos específicos:
Introduce the sisotool to design control systems in the complex plane

Actividades vinculadas:
Case study 3: Magnetic levitator

Dedicación: 12 h
Grupo grande/Teoría: 4h
Aprendizaje autónomo: 8h 30m

Unit 4. PRACTICE on MATLAB programed ARDUINO for Control Applications

Descripción:
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

Objetivos específicos:
Gain practical handsâ□□on experience in building highâ□□level examples by oneself
Design, simulate and test custom algorithms in Simulink
Implement these algorithms on lowâ□□cost embedded hardware such as Arduino

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

Dedicación: 25 h
Grupo grande/Teoría: 17h
Aprendizaje autónomo: 8h

SISTEMA DE CALIFICACIÓN

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%

BIBLIOGRAFÍA

Básica:
- 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.
- Ogata, K. Discrete-time control systems. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall, 1995. ISBN 0133286428.
- 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 línea]. New York: Springer, 2006 [Consulta: 11/05/2020]. Disponible a: http://dx.doi.org/10.1007/978-1-84628-056-6. ISBN 1846280559.