Course guides
295902 - ISCA - Implementation of Automatic Control System

Last modified: 14/06/2021

Unit in charge: Barcelona East School of Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2021 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Blesa Izquierdo, Joaquim

Others: Blesa Izquierdo, Joaquim

PRIOR SKILLS

It is convenient to have passed the subjects of the previous levels.

TEACHING METHODOLOGY

ISCA is based on practical learning, through the development of a project that will be designed during the course.

This course studies Automatic Control and mechatronics at a practical level; theory is presented wherever necessary but is not emphasized. More emphasis is placed on physical understanding rather than on mathematical formalism. Several practical examples are discussed throughout the course; one of them forms the basis for a final project.

LEARNING OBJECTIVES OF THE SUBJECT

Mechatronics is an engineering discipline to study the synergistic combination of mechanical engineering, electronics engineering, control engineering, and computer engineering.

This course covers the fundamental areas of science and technology on which a mechatronics design is based. This includes mathematical modeling of complex dynamical systems, analysis of mathematical models using computer simulations, measurement systems (sensors and signal conditioners), actuators, continuous-time controller design and its real-time digital implementation, and networked control systems. The focus is on the role of each of these areas in the overall design process and how these key areas are integrated to form a successful mechatronics system design.

The instructional objectives are:
- To enable students understanding the modern mechatronics components.
- To present the underlying principles and alternatives for mechatronics systems design.
- To provide students with hands-on experience of mechatronics technology for diverse applications.
- To develop the student?s ability to evaluate appropriate technology and devise realistic industrial systems.

STUDY LOAD

Type	Hours	Percentage
Guided activities	90,0	60.00
Hours small group	15,0	10.00
Hours large group	45,0	30.00

Total learning time: 150 h

CONTENTS

1. Course Presentation

Description:
1.1 Course contents and syllabus.
1.2 Involved projects - Description.
1.3 Rules and timetable.

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

2. Introduction to Mechatronics Systems Design.

Description:
2.1 Components of mechatronics systems.
2.2 Motion control systems.
2.3 Servomotors, Stepper Motors, and Actuators for Motion Control.
2.4 Stationary and Mobile robots.
2.5 Linkages: Drives and Mechanisms.
2.6 System integration.

Full-or-part-time: 20h
Theory classes: 4h
Laboratory classes: 4h
Self study : 12h

3. Dynamic systems Modelling.

Description:
3.1 Example of Models.
3.2 Principles of Physical modelling.
3.2 Parameters identification.
3.3 Model simulation.

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

4. Control System Design.

Description:
4.1 Controllers types.
4.2 Design in Time Domain.
4.3 Design in frequency.

Full-or-part-time: 40h
Theory classes: 8h
Laboratory classes: 8h
Self study : 24h

5. ARM-based Microcontrollers.

Description:
5.1 ARM Cortex-M0+ Processors.
5.2 Interrupts and Low Power Features.
5.3 CMSIS and peripherals.

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

6. From the System to the microcontroller.

Description:
6.1 Code generation for embedded applications.
6.2 Code generation from MATLAB/SIMULINK to C/C++.
6.3 Workflow for code generation.
6.4 Optimization Strategies
6.5 Controlling C Code Style.
6.6 Deploy and Test Executable Program.

Full-or-part-time: 20h
Theory classes: 4h
Laboratory classes: 4h
Self study : 12h

GRADING SYSTEM

The final course mark is based on four evaluations:

1. Description and scope of the work (20%).
2. Development and evolution of the work during the course (25%).
3. Project Presentation (25%).
4. Technical report (30%).

According to the specific EEBE academic regulations, sections 2.2.b and 2.2.c, this subject is considered as continuous assessment methodology and, therefore, is not subject to reevaluation.

BIBLIOGRAPHY

Basic:

- Nise, Norman S. Control systems engineering. 6th ed., international student version. Hoboken: John Wiley & Sons, cop. 2011. ISBN 9780470646120.
- Ljung, Lennart; Glad, Torkel. Modeling of dynamic systems. Englewood Cliffs: PTR Prentice Hall, 1994. ISBN 9780135970973.
- MATLAB Embedded Coder. User's guide [on line]. Natick: The MathWorks, 2007 [Consultation: 27/08/2018]. Available on: https://rophoenixmakerevolution.files.wordpress.com/2015/09/eml_ug.pdf.
- SimScape. User's guide [on line]. Natick: The MathWorks, 2007 [Consultation: 29/05/2020]. Available on: https://es.scribd.com/document/203875789/MATLAB-SIMSCAPE-manual#.
- MATLAB Coder. User's guide [on line]. Natick: The MathWorks, Inc, 2011 [Consultation: 29/05/2020]. Available on: https://www.mathworks.com/help/pdf_doc/coder/coder_ug.pdf.