Universitat de Lleida

DEGREE CURRICULUM

MECHATRONICS I

Coordination: ESCOLÀ AGUSTÍ, ALEXANDRE

Academic year 2018-19

Subject's general information

<table>
<tr><td>Subject name</td><td>MECHATRONICS I</td></tr>
<tr><td>Code</td><td>102136</td></tr>
<tr><td>Semester</td><td>1st Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
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<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Automation and Industrial Electronic Engineering</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Mechanical Engineering</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><td>PRALAB</td><td>PRAULA</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>1</td><td>2</td><td>3</td></tr>
<tr><th>Number of groups</th><td>3</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>ESCOLÀ AGUSTÍ, ALEXANDRE</td></tr>
<tr><td>Department</td><td>AGRICULTURAL AND FOREST ENGINEERING</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>English</td></tr>
<tr><td>Office and hour of attention</td><td>Flexible. On demand.</td></tr>
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Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ESCOLÀ AGUSTÍ, ALEXANDRE	aescola@eagrof.udl.cat	4,8	
POMAR GOMA, JESUS	pomar@eagrof.udl.cat	4,8	

Subject's extra information

Mechatronics is a recent concept that is born of a synergistic integration of the areas of mechanics, electronics and computer science giving birth to mechatronic systems. The optional block on Mechatronics (Mechatronics I, II and III) provides knowledge about the technology and required tools to address the need to automate both machines and industrial manufacturing processes in order to design and implement equipment and production processes, agile, efficient and reliable that respond to modern industry. Specifically, **Mechatronics I** deals with the key elements for the design and implementation of automatic control with an applied focus, contemplating:

1. physical components: sensors and transducers;
2. computer hardware and electronic components;
3. logical components related to the design and programming of systems to process information, and
4. the integration of all of them for the implementation of real systems.

Learning is done through the resolution of case studies, simulation and experimentation with real systems.

Learning objectives

1. To provide with the technological basis that supports the automation and control equipment and industrial processes based on ICT.
2. Introduce the basic elements that constitute a system of automatic control of the mechatronic field.
3. Introduce and apply sensors and transducers as devices for automatic data acquisition.
4. Introduce and apply the methodology of designing and implementing computer-supported automatic control systems and industrial automation.
5. Introduce and apply techniques prototyping, simulation and virtual instrumentation to facilitate the implementation of real systems.
6. Applying the knowledge gained in the implementation of real projects automatic control and automation.

Competences

Basic Competences

GEEIA28. Applied knowledge of industrial computing and communications.

GEEIA29. Capacity to design systems of industrial automation control.

Specific competences

GEEIA-EPS31. Applied knowledge to measurement systems and industrial actuators.

GEEIA-EPS32. Capacity to design and implement control and automation of mechanical systems.

Subject contents

Module 0. Mechatronics and Mechatronic Systems.

Basic definitions. Key elements. Present and future. Development and educational organization of the optional block on Mechatronics.

Module 1. Technological basis of automation and equipment control and industrial processes.

1.1. Introductory concepts. Automatisms and automation. Concept of process and control actions based on ICT. Bases of automatic control: (1) measuring physical variables; (2) data processing and (3) generating control signals. Application of digital systems to the implementation of automatic control. Automatic control systems with intelligent behaviour. Examples.

1.2. Sensors and Transducers: devices to measure physical phenomena. Concepts. Classification. Signals types. A/D and D/A converters. Signal conditioning. Precision and Accuracy. Origin and types of errors. Calibration. Sensors frequent use in industrial automation.

Workshop 1. Experimenting with sensors

1.3. Electronic process control. Concept of process control and industrial processes. Types of control systems. Open and closed loop systems. Bases of automation and automatic process control. Automatic control actions. PID control: proportional, integral and derivative actions.

1.4. Automatic control systems. Main hardware components: sensors, actuators and digital controllers. Major hardware systems: (1) PC-based systems, (2) PLC-based system (programmable logic controllers, (3) Programmable automation controllers PAC), and (4) Microcontrollers. Distributed systems. Networks, communication buses and data transmission. Applications.

Module 2. Design and Implementation of automatic control systems

2.1 Control by digital logic. Logic functions: deduction and reduction. Combinational and sequential circuits. Automation with integrated circuits. Prototyping with integrated circuits.

Workshop 2. Control of processes using digital logic and integrated circuits

2.2. Control by computerized electronic systems
Bases of computer programming control systems and automation. Progress and next-generation programming languages. Software: concepts, data and variables and structures to support computerized process. Visual programming and graphical programming. Virtual instrumentation. "G" programming language. Programming methodologies for control systems. Storage and data recovery: creating reusable code. Code libraries. Debugging techniques and tools. Resolution of case studies of monitoring and control.

Workshop 3A. Characterization and control of a thermoelectric heat pump and Workshop 3B. Automatic control of a micro-greenhouse.

2.3. Control by Programable Logic Controllers. Control using PLC. Types of PLC. Programming languages. Features. Solving a case study.

Workshop 4. Automation and control of a water supply system using PLC

2.4. Techniques for the design and implementation of control systems. Analysis of applications. Structuring, modularization and other techniques. The concept of fundamental programming structures. Implementation of formulas and equations. Applying the methodology of incremental development. Development of a first project.

2.5. Development of control systems. Requirements analysis and incremental prototyping. Learning by developing real applications. Integration of hardware and software components. Buses and communications between devices. Project development.

Workshop 5. Speed control of a motorized system

Module 3. Integration of technologies: project realization.

Solving a problem and proposal of an automation project. Project development phases: requirements analysis; system design; implementation.

Methodology

The subject has an eminently practical vocation and is taught through master classes that are interspersed with practical sessions either on different days or during the same session. It is for this reason that the sessions are developed in a computer lab and the workshops in the Mechatronics Lab (CREA building, 1.19).

During the development of practical sessions in the Mechatronics lab, the following information must be taken into account:

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Blue laboratory gown from UdL (unisex)
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos
Centre the Cultures i Cooperació Transfronterera

http://www.publicacions.udl.cat/

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...

- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: http://www.sprl.udl.cat/alumnes/index.html

Evaluation

Activity type	Procedure	Weight (%)
Resolution of problems and cases based on contents given during the lectures and workshops.	Delivery of solved cases	**20**
Experimental workshops at the laboratory	Delivery of reports on the workshop	**35**
Automation project	Delivery of a complete report, the process control software and oral presentation of the project	**45**
Technical visits		
Total		**100**

Bibliography

Basic references

Introducción a la mecatrónica y los sistemas de medición. David G. Alciatore, Michael B. Histand. McGraw-Hill. 2008. 3ª ed.

Mechatronics: a foundation course. Clarence W. de Silva. CRC. 2010.

Introduction to mechatronics and measurement systems. Michael B. Histand and David G. Alciatore. WCB/McGraw-Hill. 1999.