Universitat de Lleida

DEGREE CURRICULUM

MECHATRONICS I

Coordination: NOGUES AYMAMI, MIQUEL

Academic year 2023-24

MECHATRONICS I 2023-24

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>
<table>
<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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</td></tr>
<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><th>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Number of groups</td><td>1</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>NOGUES AYMAMI, MIQUEL</td></tr>
<tr><td>Department</td><td>INDUSTRIAL AND BUILDING ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>Each ECTS credit is assigned 25 hours of student work. 10 hours per ECTS are devoted for in-person student work attending the different academic activities and 15 hours per ECTS are devoted to independent student work and preparing the next session class</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>Distribution of credits</td><td>The distribution of credits is approximately as follows:
- 40% lab exercises
- 40% preparing class prior attendance
- 20% project development

The distribution may slightly vary from year to year.</td></tr>
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MECHATRONICS I 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
NOGUES AYMAMI, MIQUEL	miquel.nogues@udl.cat	7,2	Office 0.07 CREA building Monday and Tuesday from 19:00 to 20:30

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.

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 a mark of 0 points.

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

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

Specific competences

GEEIA 31 - GEM 28. Applied knowledge to measurement systems and industrial actuators.

GEEIA 32 - GEM 29 . Capacity to design and implement control and automation of mechanical systems.

Subject contents

Unit 1. Arduino programing

1.1 Introduction

1.2 Digital input /output pinout

1.3 Analogic input /output pinout

1.4 Communications types available in Arduino boards

Unit 2. Basic electronic devices

2.1 Bipolar transistors

2.2 Field effect transistors

2.3 Thyristor

2.4 Insulated gate bipolar transistor

2.5 Triac

2.6 Digital Optocouplers

2.7 Operational amplifiers

Unit 3. Sensors and transducers

3.1 Resistive sensors

3.2 Capacitive sensors

3.3 Inductive & electromagnetic sensors

3.4 Generator sensors

3.5 Digitals sensors

3.6 Ultrasounds sensors

3.7 Transducers

Unit 4. Actuators and its control

4.1 Electrical valves

4.2 DC motors

4.3 AC motors

4.4 Hydraulic & Pneumatic actuators

Unit 5. Control strategies

5.1 Open loop

5.2 Closed loop

Methodology

The methodology for this subject is a combination of flipped class learning and a project based learning.

The flipped classroom is a type of blended learning where students are introduced to content at home and practice working through it at school. In this scenario, students learn new contents or refresh it watching pre-recorded videos at home, then they have to answer a quiz prior come to class in order to achieve background knowledge required to carry out the project o lab exercise.

At the beginning of the class, the teacher will solve any doubts, and after the students in groups of to carry out the lab exercise or the project proposed guided by the teacher.

What Do Students could Do At Home In A Flipped Classroom?

- Watch an online lecture
- Review online course material
- Read physical or digital texts
- Perform research

What Do Students could Do At School In A Flipped Classroom?

- Skill practice

- In-person, face-to-face discussion with peers
- Debate
- Presentations
- Lab experiments
- Project development
- Peer assessment and review

Development plan

A detailed planning of the subject will be loaded in the Resources section of the Virtual Campus at the beginning of the course. The planning will contain the distribution of the credits in the different activities and the dates, and class.

Evaluation

The weighting factor are:

Activity	Weight
The total quizzes prior class	25%
Lab exercise 1	5%
Lab exercise 2	5%
Lab exercise 3	5%
Lab exercise 4	5%
Lab exercise 5	5%
Lab exercise 6	5%
Lab exercise 7	5%
Lab exercise 8	5%
Lab exercise 9	5%
Lab exercise 10	5%
Automatization Project development	25%

In case of **alternative grading**, there will be a single theoretical exam that will include all the syllabus developed in the subject (25%), the completion of all laboratory exercises (50%) and the completion of an automatization project (25%).

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.