Universitat de Lleida

DEGREE CURRICULUM

MECHATRONICS III

Coordination: NOGUES AYMAMI, MIQUEL

Academic year 2018-19

Subject's general information

<table>
<tr><td>Subject name</td><td>MECHATRONICS III</td></tr>
<tr><td>Code</td><td>102138</td></tr>
<tr><td>Semester</td><td>2nd 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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<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>PRAULA</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>3</td><td>3</td></tr>
<tr><th>Number of groups</th><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>COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>40% lectures
60% independent student work</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Catalan.
Also some material will be in Spanish or in English</td></tr>
<tr><td>Office and hour of attention</td><td>Monday, from 19:00 to 20:30, and Thursday from 10:00 to 11:30 at 0.07 office (CREA building).</td></tr>
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Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
NOGUES AYMAMI, MIQUEL	mnogues@diei.udl.cat	7,2	

Subject's extra information

This subject wants to integrate the knowledge acquired in both Mechatronics I and Mechatronics II, and therefore considered necessary to enroll in both subjects.

In relation to the safety rules established in laboratories, it is required to state

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

Learning objectives

The aim of this course is to bring practical knowledge acquired in the subjects Mechatronics I and Mechatronics II. It is therefore a hand on subject, and microcontrollers (Arduinos) and PLC (Siemens) are used. Digital and analogic signals and also communications are implemented for controlling workstations that are available in the laboratory.

Competences

Strategic Competences of the UdL

- **UdL2** Command of a foreign language.

Cross-disciplinary competences

- **EPS4**. To have the skills required to undertake new studies or improve the training with self-direction.
- **EPS9**. Capacityforunidisciplinary and multidisciplinaryteamwork.

Specific competences

- **GEM28**. Applied knowledge to measuring systems and industrial actuators.
- **GEM29**. Capacity to design and implement control systems and automation of mechanical systems.
- **GEM30**. Applied knowledge to multibody mechanisms and robotics.

Subject contents

Unit 1. Introduction to mechatronic systems

Unit 2. Introduction to robotic systems

Unit 3. Industrial communications and distributed control

Unit 4. Modelling dynamic systems and setting open control loops

Methodology

The course has a practical orientation, and therefore it is essential to attend all practice classes in the laboratory. Because the course is 6 ECTS, it will be a two-hour session per week of theory where the basic concepts of different subjects wiill be introduced, and two hours per week which will take the practical part of the course, involving programming tasks and and control setting up.

Lectures: theoretical contents and proposal and/or resolution of some practical examples.

Problems: Presentation and discussion of problems that will eventually solve by the students in an individual way or in groups.

Group work: Development of a study in groups on a set of different parts to be manufactured.

Practices: 7 laboratory sessions: digital signal processing with Arduino, DC motors and step-by-step **s**peed control with Arduino, SPI Communication with Arduino, remote control of a variable frequency driver (Arduino / PLC), sorting station with a Cartesian manipulator (Arduino / PLC) and loading-buffer-shorting pneumatic workstation (Arduino / PLC)

Development plan

Week	Methodology	Unit	Attendance hours	Autonomous work hours
1	Lectures Problems	Unit 1: Theory Unit 1: Problems	2 2	0 0
2	Lectures Problems	Unit 1: Theory Unit 1: Problems	2 2	3 3
3	Lectures Practice	Unit 1: Theory Practice 1: Digital processing	2 2	3 3
4	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	3 3
5	Lectures Practice	Unit 2: Theory Practice 2: DC motor speed control	2 2	3 3
6	Lectures Practice	Unit 2: Theory Practice 3: Step motor speed control	2 2	3 3
7	Lectures Practice	Unit 3: Theory Practice 4: SPI comunication	2 2	4 4
8	Lectures Practice	Unit 3: Theory Practice 5: Remote control fo a AC motor driver	2 2	4 4
9	Evaluation			
10	Lectures Practice	Unit 3: Theory Practice 6: Cartesian robot (I)	2 2	3 3
11	Lectures Practice	Unit 4: Theory Practice 6: Cartesian robot (II)	2 2	3 3
12	Lectures Practice	Unit 4: Theory Practice 6: Cartesian robot (III)	2 2	4 4
13	Lectures Practice	Unit 4: Theory Practice 7: FESTO workstation (I)	2 2	4 4
14	Lectures Practice	Unit 4: Theory Practice 7: FESTO workstation (II)	2 2	4 4
15	Lectures Problemes	Unit 4: Theory Unit 4: Problems	2 2	4 4
16-17	Evaluation	Exam 2	2	
18	Tutoring	Tutoring		
19	Evaluation	Recovery exam	2	2

Evaluation

As the subject is focused in the practice work, it is not planned to hold examinations, and the grading is based on the delivery work that are developed in the laboratory, which includes theoretical and practical topics.

The weighting factors of each lab exercises for the final mark are:

- Digital Signal Processing (1 point)
- DC motors and step-by-step speed control (2 points)
- Communications (1 point)
- Speed control of an asynchronous motor (2 points)
- Sorting station with a robot (2 points)
- Loading-buffer-shorting pneumatic workstation (2 points)

Bibliography

- "Sistemas modernos de control. Teoría i pràctica", Ricard c. Dorf. Editorial Addison-Wesley Iberoamericana. ISBN 0-201-64417-7

- "Ingeniería de control moderna", Katsuhiko Ogata. Editorial Prentice Hall. ISBN 0-13-589128-0

- "Mechatronics. A Foundation course", Clarence W. de Silva. Editorial CRC Press. ISBN 978-1-4200-8211-1

- "Modeling and analysis of Dynamic Systems", Ramin S. Esfandiari, Editorial CRC Press. ISBN 978-1-4398-0845-0

- "Fundamental of Robotics. Analysis & Control", Robert J.Schilling, Editorial Prentice Hall. ISBN 0-13-344433-3

- "Modeling and control of engineering Systems", Clarence W. de Silva. Editorial CRC Press. ISBN 978-1-4200-7686-8