DEGREE CURRICULUM

MECHATRONICS III

Coordination: NOGUES AYMAMI, MIQUEL

Academic year 2023-24

MECHATRONICS III 2023-24

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>
</table>
</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><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>
</table>
</td></tr>
<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>40% exercises in class/lab
40% preparation prior class
20% project development</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>
</table>

MECHATRONICS III 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
NOGUES AYMAMI, MIQUEL	miquel.nogues@udl.cat	3,6	Office 0.07 in CREA building Monday and Tuesday from 19:00 to 20:30
SOLE CUTRONA, CRISTIAN	cristian.sole@udl.cat	3,6	

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 information of the *Servei de Prevenció de Riscos Laborals de la UdL*:

- http://www.prevencio.udl.cat/ca/integracio-a-la-docencia/
- http://www.sprl.udl.cat/ca/capsules-formatives/

Learning objectives

The aim of this course is to bring the practical knowledge acquired in the subjects Mechatronics I and Mechatronics II. It is therefore a hands on subject, involging microcontrollers (Arduinos), PLC (Siemens) and the robots which are available in the laboratory. Moreover, digital and analogic signals are used and also different type of communications are implemented for controlling the 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**. Capacity for unidisciplinary and multidisciplinaryteamwork.

Specific competences

- **GEM28/GEEIA 31**. Applied knowledge to measuring systems and industrial actuators.
- **GEM29/GEEIA 32**. Capacity to design and implement control systems and automation of mechanical systems.
- **GEM30/GEEIA 33**. Applied knowledge to multibody mechanisms and robotics.

Subject contents

Unit 1. PLC programming

1.1 Introduction

1.2 Grafcet diagrams

1.3 Siemens PLCs & Hardware

1.4 Programing languages available

1.5 Digital variables

1.6 Analogic variables

Unit 2. Industrial communications

2.1 Introduction

2.2 ASI communication

2.3 Profibus communication

2.4 Profinet communication

Unit 3. Robots and manipulators

3.1 Introduction

3.2 Robot space configuration

3.3 Forward kinematics

3.4 Inverse kinematics

3.5 Robot dynamics

3.6 Robot programing

Unit 4. IoT & Industry 4.0

4.1 Introduction

4.2 Node-Red

4.3 MQTT

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

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	Tutoring			2
10	Lectures Practice	Unit 3: Theory Practice 6: Profinet/Profibus	2 2	2 2
11	Lectures Problems	Unit 4: Theory Unit 4: Robot kinematics	2 2	3 3
12	Lectures Practice	Unit 4: Theory Practice 6: Cartesian robot (I)	2 2	4 4
13	Lectures Practice	Unit 4: Theory Practice 7: Cartesian robot (I)	2 2	4 4
14	Lectures Practice	Unit 4: Theory Practice 8: FESTO workstation (I)	2 2	4 4
15	Lectures Practice	Unit 4: Theory Practice 9: Kuka Robot programing	2 2	4 4
16-17	Tutoring	Tutoring		2
18	Tutoring	Tutoring		2
19	Evaluation		2	

Evaluation

The weighting factor are:

Activity	Weight
The total quizzes prior class	25%
Lab exercise 1	10%
Lab exercise 2	10%
Lab exercise 3	10%
Lab exercise 4	10%
Lab exercise 5	10%
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 development of an automatization project (25%).

Bibliography

- "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

- "Programming Siemens Step 7 (TIA Portal), a practical and understandable approach", Stenerson J and Deeg D. Editorial CreateSpace Independent Publishing Platform ISBN : 9781515036579