

## 28832 - Robotics

### Syllabus Information

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**Academic Year:** 2021/22

**Subject:** 28832 - Robotics

**Faculty / School:** 175 - Escuela Universitaria Politécnica de La Almunia

**Degree:** 424 - Bachelor's Degree in Mechatronic Engineering

**ECTS:** 6.0

**Year:** 4

**Semester:** First semester

**Subject Type:** Compulsory

**Module:**

## 1. General information

### 1.1. Aims of the course

#### The expected result of the subject responds to the following goals

Robotics is the third subject in the Mechatronics degree that studies the fundamentals of the control techniques. Therefore, the student may improve its scientific and technological foundations in systems automation, modelling, simulation, and control.

Robotics is an engineering discipline itself, for this reason, students must complete their knowledge of this topic in a future master or with self-study.

The main aim of this subject, if they choose this professional path, is to give students some background of the classic troubles in robotics, give some of the most common solutions and to know nowadays issues without a solution.

#### Aligned with ODS:

These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (<https://www.un.org/sustainabledevelopment/es/>), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree:

- Goal 7: Ensure access to affordable, reliable, sustainable and modern energy.

Specific targets:

- Target 7.3: By 2030, double the global rate of improvement in energy efficiency.

### 1.2. Context and importance of this course in the degree

Robotics is a subject that forms part of the Mechatronics Engineering Degree which is imparted in EUPLA, the subjects are englobed inside the Control module.

This subject has extraordinary importance in the acquisition of the competences of the degree. Moreover, it gives additional useful skills for the Mechatronics Engineering work in industrial robotics area.

### 1.3. Recommendations to take this course

In order to be successful in this subject the student must pass the following subjects: Automatic Foundation, Automatic Regulation and Control, Math I, II & III, Mechanical engineering, Electrical engineering, Calc and design of machines, Power Electronics, Electronics Instrumentation, Programmable electronics systems, Electronics Technology I & II, Physics I, Physics II and Informatics.

## 2. Learning goals

### 2.1. Competences

**The student must be able to?**

**General competencies:**

GI03: Have the knowledge in basics subjects and technologies that make the students capable of learning new methods and

theories and give their necessary versatility in order to adopt new sceneries.

GI04: Have the ability to solve problems with initiative, take decisions, creativity, critical reasoning and communicate and transmit knowledge, abilities, and skills in the field of Industrial Engineering and especially in Industrial Electronic.

GI06: Have the ability to handle specifications, regulations, and compulsory norms.

GC02: Interpret experimental dates, contrast them with theoretical foundations and extract conclusions.

GC03: Have the capability in abstract and logical thinking.

GC04: Have the capability to learn in a continuous way, self-directed and autonomous.

GC05: Be capable of evaluating the alternatives.

GC06: Have the ability in adaptation to the fast evolution of technology.

GC07: Be capable of leading a team and be a committed member of the team.

GC08: Have the ability to find technical information, understand it and value it.

GC09: Have a positive attitude to technological innovation.

GC10: Have the ability to write technical documentation and represent it with informatics tools.

GC11: Be capable of communicating their thinking and designs in an easy way to specialized and nonspecialized audiences.

GC14: Have the ability to understand the operation and develop maintenance of devices in mechanical, electrical and electronics installations.

GC15: Be capable of analyzing and put on simplified models to the devices and technological applications that allow making provisions about their behaviour.

GC16: Have the ability to configure, simulate, build and test the prototypes of electronics and mechanical systems.

GC17: Be capable of the right interpretation of plans and technical documentation.

#### **Specific competencies:**

EI06: Have the knowledge about the fundamentals of automatic and control methodology.

EE09:

Have the knowledge about the fundamentals and implementations of robotics systems.

EE10: Have the knowledge and the capability to the model and simulation of electronic systems.

EE11: Have the applied knowledge of industrial informatics and communications.

EE12: Have the ability to design control systems and industrial automation systems.

EE13: Have the knowledge of automatic regulation and control techniques and their application to industrial automation.

## **2.2. Learning goals**

**The student in order to pass the subjects must demonstrate the following results:**

1. He needs to understand the automation fundamentals and industrial control.
2. Setup robotics systems and make programs for them.
3. He needs to have a good command of modelling tools, analysis, and design of control systems and automation.
4. Get some basis in industrial communications.

## **2.3. Importance of learning goals**

This subject has a strong engineering character. It offers an important quantity of contents that are very useful to the market labour and professional market. When the student reaches the learning outcomes he obtains the necessaire capability to understand the robotics systems, which are essential to the design and setup of each application, working plant, industrial process, etc. included in the Mechatronic Engineering field.

## **3. Assessment (1st and 2nd call)**

### **3.1. Assessment tasks (description of tasks, marking system and assessment criteria)**

**The student must demonstrate that he has reached the expected learning results with the next evaluation activities:**

1. Practical work (30%). These Works included laboratory workshop and problem-solving. In the laboratory workshop, the student must make a previous study that must give before the beginning of the practice. The final mark is based on the quality of the analysis and the obtained results given in a written document. In order to pass the subject, the student must have a mark of at least five points.
2. Written test (70%), the student can find some questions or need to solve an engineering problem like the ones resolved in the theoretical lessons. We value the quality and clarity of the provided solution, the used concepts, the absence of errors in developing and solution, and the right use of the terminology and notation. In order to pass the subject, the student must have a mark of at least five points in each test.

The student may choose between continuous evaluation or global evaluation. The continuous evaluation consists of two write test plus written essays in a laboratory workshop. The global evaluation consists of a written test at the end of the course and the written essays in a laboratory workshop.

The student that suspends any part of the continuous evaluation can pass it in the global test.

## **4. Methodology, learning tasks, syllabus and resources**

## 4.1. Methodological overview

**The learning process is designed following these key ideas:**

There is a strong interaction between teacher and student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current subject Automatic Foundation is conceived as a stand-alone combination of contents, yet organized into three fundamental and complementary forms, which are: the theoretical concepts of each teaching unit, the solving of problems or resolution of questions and laboratory work, at the same time supported by other activities.

The organization of teaching will be carried out using the following steps:

- **Lectures:** Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the subject are displayed, highlighting the fundamentals, structuring them in topics and or sections, interrelating them.
- **Practice Sessions:** The teacher resolves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects.
- **Laboratory Workshop:** The lecture group is divided up into various groups, according to the number of registered students, but never with more than 20 students, in order to make up smaller sized groups.
- **Individual Tutorials:** Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

If classroom teaching were not possible due to health reasons, it would be carried out on-line.

## 4.2. Learning tasks

The course involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out, the activities are the following:

**Face-to-face generic activities:**

- **Lectures:** The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.
- **Practice Sessions:** Problems and practical cases are carried out, complementary to the theoretical concepts studied.
- **Laboratory Workshop:** This work is tutored by a teacher, in groups of no more than 20 students.

**Generic non-class activities:**

- Study and understanding of the theory taught in the lectures.
- Understanding and assimilation of the problems and practical cases solved in the practical classes.
- Preparation of seminars, solutions to proposed problems, etc.
- Preparation of laboratory workshops, preparation of summaries and reports.
- Preparation of the written tests for continuous assessment and final exams.

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class.

A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

| Activity            | Hours per week |
|---------------------|----------------|
| Lectures            | 3              |
| Laboratory workshop | 1              |
| Other activities    | 6              |

Nevertheless, the previous table can be shown in greater detail, taking into account the following overall distribution:

- 44 hours of lectures, with 50% theoretical demonstration and 50% solving type problems.
- 12 hours of laboratory workshop, in 1 or 2-hour sessions.
- 4 hours of written assessment tests, one hour per test.
- 40 hours of teamwork divided up over the 15 weeks of the semester.
- 50 hours of personal study, divided up over the 15 weeks of the semester.

## 4.3. Syllabus

The course will address the following topics:

### The theoretical program

1. Introduction to the robotic
2. Robot morphology
3. Math tools for the spatial location
4. The cinematic problem
5. Dynamics in robots
6. Sensing and driving systems
7. Path control
8. Language programming in robotic

### The lab program

Most of the previous topics come with lab practices. The different lab works will be introduced in the Moodle platform.

The main work in the subject will be a robot design in a BPL teamwork.

1. The Design of path controls systems
2. The Design of a robotic system

### Materials

| Material   | Support        |
|--|----------------|
| Topic theory notes / Topic problems                  | Paper          |
| Topic presentations / Topic problems / Related links | Digital/Moodle |
| Educational software                                 | Web page       |

## 4.4. Course planning and calendar

The class hall sessions & work presentations timetable will be presented in <https://moodle2.unizar.es/add/>

The dates of the final exams will be those that are officially published at <http://www.eupla.unizar.es/asuntos-academicos/examenes>

The written assessment tests will be related to the following topics:

? **Test 1:** Topic 1, 2, 3, 4.

? **Test 2:** Topic 5, 6 & 7.

At the end of every topic, the student can find some reinforce exercises in order to guide him in their personal homework.

The activities of this subject and its temporal schedule depend on the academic organization proposed by the faculty in EUPLA and you can read it in section 5, activities and resources.

In the [www.eupla.unizar.es](http://www.eupla.unizar.es) you can check the exam dates.

## 4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28832>