Universidad Zaragoza

Academic Year/course: 2022/23

28817 - Fundamentals of Automation

Syllabus Information

Academic Year: 2022/23
Subject: 28817 - Fundamentals of Automation
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 424 - Bachelor's Degree in Mechatronic Engineering
ECTS: 6.0
Year: 2
Semester: Second semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The expected result of the subject response to the following goals

The Automatic Foundation is the very first subject that introduces the foundations of the control techniques in the degree. Therefore, the student can acquire, understand and apply the scientific and technological issues of the principles in systems automation, modelling, simulation, and control.

This subject forms part of the topic Automatic Control and it requires other competencies in subjects of previous courses. The student must rule the calculus in the complex variable, Laplace transform, differential equations, algebra, physic and mechanic.

In the next course, the students find new subjects in the field of regulation and control in which they can apply most of the concepts lectured on this subject, they will study issues like discrete systems control, robotics, and other advanced techniques.

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

The Automatic Foundation is a subject that forms part of the Mechatronics Engineering Degree which is instructed in EUPLA, the subjects are englobed inside the Control module. This compulsory subject of six ECTS credits is lectured in the second four-month period of the second year.

This subject has extraordinaire importance in the acquisition of the competencies of the degree. Moreover, it gives additional useful skills for the Mechatronics Engineering work in industrial control.

It?s important that students have strong knowledge of math, physic, mechanic and circuit theory. This subject is the fundament for regulation and automatic control, automatization and industrial informatics, robotics, advanced automatization and control engineering, those subjects are essentials in the Mechatronics Engineering Degree.

1.3. Recommendations to take this course

In order to be successful in this subject, the student must pass the following subjects: Math I, II & III, Mechanical engineering, Electrical engineering, and its recommended to have Physics I, Physics II and Informatics.

2. Learning goals

2.1. Competences

The student must be able to?

General competencies:

GI03: Have the knowledge of basic 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 of abstract and logical thinking
GC04: Have the capability to learn continuously, be self-directed and be autonomous.
GC05: Be capable of evaluating the alternatives.
GC06: Have the ability to adapt to the fast evolution of technology.
GC07: Be capable of leading a team and being a committed member.
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 putting 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 knowledge about the fundaments of automatic and control methodology.
EE10: Have the knowledge and the capability to 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. Student needs to understand the automation fundaments and industrial control.
2. Student needs to have a good command of modelling tools, analysis and design of control systems and automation.

2.3. Importance of learning goals

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

In addition, this subject gives the fundament in developing future subjects in the field of control.

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 workshops 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. In written tests (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 on each test.

The student may choose between continuous evaluation or global evaluation. The continuous evaluation consists of two written tests 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 fails any part of the continuous evaluation can pass it in the global test.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

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 are 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, and 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 by giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

The approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

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 a 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 understand 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, and preparation of summaries and reports.

? Preparation of the written tests for continuous assessment and final exam

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 moderate level of experimentation considered for the said subject.

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 learning tasks:

The theoretical program.

1. Introduction to the control systems.
2. Math modelling of the systems
3. Math model in status variables
4. Features of the loop closed control systems
5. The behaviour of the loop closed control systems
6. The stability in the linear loop closed systems
7. The root locus methodology
8. The frequency response of the systems

Laboratory workshop

1. Introduction to Octave/Matlab and math modelling
2. Open and closed-loop systems
3. The stability in closed-loop systems
4. PID controllers and the root locus method
5. Identify systems by their response to frequency.

Materials

Material	**Soporte**
Topic theory notes / Topic problems	Paper
Topic presentations / Topic problems / Related links	Digital/Moodle

4.4. Course planning and calendar

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

The dates of the final exams will be those that are officially published at http://www.eupla.es/secretaria/academica/examenes.html.

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

- **Test 1**: Topic 1, 2, 3 y 4.
- **Test 2**: Topic 5, 6, 7 & 8.

At the end of every topic, the student can find some reinforcing 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.

On the www.eupla.unizar.es you can check the exam dates.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28817