

28817 - Automation: the Basics

Información del Plan Docente

Academic Year	2016/17
Academic center	175 - Escuela Universitaria Politécnica de La Almunia
Degree	424 - Bachelor's Degree in Mechatronics Engineering
ECTS	6.0
Course	2
Period	Second semester
Subject Type	Compulsory
Module	---

1. Basic info

1.1. 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.

1.2. Activities and key dates for the course

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 you can check the exams dates.

2. Initiation

2.1. Learning outcomes that define the subject

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. He needs to have a good command of modeling tools, analysis and design of control systems and automation.

2.2. Introduction

Brief introduction to the subject

The Automatic Foundation is a compulsory subject with six ECTS credits that is lectured in the second four-month period in the second year of the Mechatronics degree and forms part of the topic Automatic Control. This subject develops the basis of the systems and control theory, studying the concepts of modelling of systems, representing of systems, system dynamics, and analysis and design of feedback systems.

Every lesson of this subject shows the theoretical background that is supplemented with practical exercises and simulation studies. Therefore, students work in the class and have some homework in order to get the main role of their learning process.

28817 - Automation: the Basics

3.Context and competences

3.1.Goals

The expected result of the subject responds 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 basis in systems automation, modelling, simulation, and control.

This subject forms part of the topic Automatic Control and it requires from others competencies in subjects of the 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 student finds new subjects in the field of regulation and control in which he can apply most of the concepts lectured on this subject, he will study issues like discrete systems control, robotics, and other advanced techniques.

3.2.Context and meaning of the subject in the degree

The Automatic Foundation 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 compulsory subject of six ECTS credits is lectured in the second four-month of the second year.

This subject has an extraordinaire importance in the acquisition of the competences 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 in 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.

3.3.Competences

The student must be able to...

General competencies:

1. Have the knowledge in basics subjects and technologies that make the students capable learning new methods and theories and give their necessary versatility in order to adopt new sceneries.
2. 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
3. Have the ability to handle specifications, regulations, and compulsory norms.
4. Interpret experimental dates, contrast them with theoretical foundations and extract conclusions.
5. Have the capability in abstract and logical thinking
6. Have the capability to learn in a continuous way, self-directed and autonomous.
7. Be capable evaluating the alternatives.
8. Have the ability in adaptation to the fast evolution of technology.
9. Be capable leading a team and be a committed member of the team.
10. Have the ability to find technical information, understand it and value it.

28817 - Automation: the Basics

11. Have a positive attitude to technological innovation.
12. Have the ability to write technical documentation and represent it with informatics tools.
13. Be capable communicating their thinking and designs in an easy way to specialized and nonspecialized audiences.
14. Have the ability to understand the operation and develop maintenance of devices in mechanical, electrical and electronics installations.
15. Be capable analyzing and put on simplified models to the devices and technological applications that allow making provisions about their behavior.
16. Have the ability to configure, simulate, build and test the prototypes of electronics and mechanical systems.
17. Be capable in the right interpretation of plans and technical documentation.

Specific competencies:

1. Have the knowledge about the fundamentals of automatic and control methodology.
2. Have the knowledge and the capability to the model and simulation of electronic systems.
3. Have the applied knowledge of industrial informatics and communications.
4. Have the ability to design control systems and industrial automation systems.

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

3.4.Importance of learning outcomes

This subject has a strong engineering character. It offers an important quantity of contents that are very useful to the market labor 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 fundamentals in developing of future subjects in the field of control.

4.Evaluation

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 in two write test plus written essays in laboratory workshop. The global evaluation consists in a written test at the end of the course and the written essays in laboratory workshop.

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

5.Activities and resources

5.1.General methodological presentation

There are a strong interaction between teacher and student. This interaction is brought into being through a division of

28817 - Automation: the Basics

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:

- **Theory Classes** : Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the subject are displayed, highlighting the fundamental, structuring them in topics and or sections, interrelating them.
- **Practical Classes** : 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.

5.2.Learning activities

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** :

• **Theory Classes** : The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.

• **Practical Classes** : 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.

28817 - Automation: the Basics

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 into 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.

5.3.Program

The theoretical program .

1. Introduction to the control systems.	-Historic introduction to the automatic control
---	---

28817 - Automation: the Basics

	<ul style="list-style-type: none"> -Open loop systems. -Close loop systems. -Modern control systems -Examples of design
1. Math modeling of the systems	<ul style="list-style-type: none"> -The solution to the modeling problems -Modeling with differential equations -Linearizing the systems -Modeling with Laplace's transform -Transfer function of a linear system -Modeling with blocks -Examples of design -Simulating systems using Octave/Matlab
1. Features of the loop closed control systems	<ul style="list-style-type: none"> -Open and close loop systems -Sensitivity in systems with parameter changes -Transitory response in the control systems -Noise in the loop closed control systems -Error in permanent state
1. The behavior of the loop closed control systems	<ul style="list-style-type: none"> -Permanent and transient states -Signal of test used in control systems -Behavior of the first order systems

28817 - Automation: the Basics

	<ul style="list-style-type: none"> -Behavior of the second order systems -The behavior of the second-order systems with pole o zero. -Choosing the parameters -Dominant pole -Permanent error in permanent state in loop closed systems -Permanent response in loop closed systems
1. The stability in the linear loop closed systems	<ul style="list-style-type: none"> -The stability of the systems -Stability criteria of Routh-Hurwitz -Relative stability of the closed loop systems -Testing the stability with Matlab/Octave
1. The root locus methodology	<ul style="list-style-type: none"> -The root locus method -PID controllers -Design of PID controllers
1. Frequency response of the systems	<ul style="list-style-type: none"> -Frequency response of the loop closed systems -Bode diagram analysis and design -Stability of the systems in Bode diagrams

Laboratory workshop

1. Introduction to Octave/Matlab and math modeling
2. Open and close loop systems

28817 - Automation: the Basics

Topic 5									2	3					5	
Topic 6											3	3			6	
Topic 7													3	3	2	8
Laboratory 1	1	1														2
Laboratory 2			1	1	1	1										4
Laboratory 3								1		1						2
Laboratory 4											1	1				2
Laboratory 5													1	1		2
Test 1									2							2
Test 2															2	2
Teamwork ³	3	3	3	3	3	3	3	3	0	3	3	3	3	3	1	40
Personal ³ study	3	3	3	3	3	3	3	3	6	3	3	3	3	3	5	50
Total	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	150

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:

28817 - Automation: the Basics

— **Test 1** : Topic 1, 2, 3 y 4.

— **Test 2** : Topic 5, 6 y 7.

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

5.5. Bibliography and recommended resources

Dorf, R. C. (1991). *Modern Control Systems* (6th ed.). Boston, MA, USA: Addison-Wesley Longman Publishing Co., Inc.

Kuo, B. C. (1996). *Sistemas de control automáticos de control*. Pearson Educación.

Ogata, K. (1997). *Modern control systems*. Prentice Hall.

Raven, F. H. (1978). *Automatic control engineering*. McGraw-Hill, Inc. Retrieved from <http://dl.acm.org/citation.cfm?id=542874>

Salgado, M. E., Yuz, J. I., & Rojas, R. A. (2005). *Análisis de sistemas lineales*. Prentice Hall.

Skogestad, S., & Postlethwaite, I. (2007). *Multivariable feedback control: analysis and design* (Vol. 2). Wiley New York. Retrieved from <http://alexandria.tue.nl/openaccess/Metis208895.pdf>

Truxal, J. G. (1955). *Automatic feedback control system synthesis*. McGraw-Hill.