Universidad Zaragoza

Academic Year/course: 2022/23

39633 - Mechatronic Systems: Design and Maintenance

Syllabus Information

Academic Year: 2022/23
Subject: 39633 - Mechatronic Systems: Design and Maintenance
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 608 -
ECTS: 6.0
Year: 4
Semester: First semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The subject and its expected results respond to the following approaches and objectives:
- Show the fundamentals and main components of mechatronic systems, as well as their context within the current technological development.
- To make known the methodology of the development of mechatronic systems, together with the phases to be applied in the mechatronic design from the initial conception, through the development of prototypes, until the final concretion of said system.
- Design mechatronic systems of general application integrating the knowledge of electronic design, mechanics, programming, electrical machines and control.
- Study the types of maintenance applicable to mechatronic systems, as well as the development of a maintenance plan according to each type or particular characteristics of the mechatronic system in question.
- Indicate the phases that must be taken in a number when carrying out a safety study in mechatronic systems.
- Analysis of how security in a mechatronic system affects maintenance and how both, in turn, affect the design process.
- Introduce the existing regulations on design, maintenance and safety of mechatronic systems.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDG) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the results of Subject learning provides training and competence to contribute to some extent to its achievement:

- Goal 9: Build resilient infrastructure, promote sustainable industrialization and encourage innovation.

And, specifically, with the target:

- Target 9.b: Support domestic technology development, research and innovation in developing countries, including by ensuring a policy environment conducive to industrial diversification and value addition to commodities, among other things.

1.2. Context and importance of this course in the degree

The subject of Design and Maintenance of Mechatronic Systems is part of the Degree in Mechatronic Engineering taught by EUPLA, framed within the group of subjects that make up the module called Mechanics and within this to the subject of Design and Calculation. It is a subject of the fourth course located in the seventh semester and compulsory, with a teaching load of 6 ECTS credits.

This subject implies a very important impact in the acquisition of the skills of the degree, in addition to providing a useful and specific training in the performance of the functions of the Mechatronic Engineer.

1.3. Recommendations to take this course

The development of the subject of Design and Maintenance of Mechatronic Systems brings into play knowledge and strategies coming from subjects related to the areas of ELECTRONICS, MECHANICS, CONTROL and COMPUTERS.

In relation to the above, in the first, second and third year of the degree and in advance subjects related to these subjects are studied, providing the basic knowledge to be able to follow without any type of restriction the evolution of the subject in question.

This subject does not possess any normative prerequisite nor does it require specific complementary knowledge. Therefore, the above is understood from a formal point of view, although it is necessary to be clear that an adequate training base is needed in the disciplines previously indicated.

2. Learning goals

2.1. Competences

Upon passing the subject, the student will be more competent to ...

- GI03: Knowledge of basic and technological subjects, which enables them to learn new methods and theories, and equips them with versatility to adapt to new situations.

- GI04: Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of Industrial Engineering and in particular in the field of industrial electronics.

- GI06: Ability to manage specifications, regulations and mandatory standards.

- GI10: Ability to work in a multilingual and multidisciplinary environment.

- GC01: Ability to integrate and apply mechanical, electronic and control knowledge in the design, development and maintenance of products, equipment or industrial facilities.

- GC02: Interpret experimental data, contrast them with the theoretical ones and draw conclusions.

- GC03: Capacity for abstraction and logical reasoning.

- GC04: Ability to learn continuously, self-directed and autonomously.

- GC05: Ability to evaluate alternatives.

- GC06: Ability to adapt to the rapid evolution of technologies.

- GC07: Ability to lead a team as well as to be a committed member of it.

- GC08: Ability to locate technical information, as well as its understanding and evaluation.

- GC09: Positive attitude towards technological innovations.

- GC10: Ability to write technical documentation and present it with the help of appropriate computer tools.

- GC11: Ability to communicate their reasoning and designs clearly to specialized and non-specialized audiences.

- GC14: Ability to understand the operation and develop the maintenance of mechanical, electrical and electronic equipment and installations.

- GC15: Ability to analyze and apply simplified models to technological equipment and applications that make it possible to forecast their behavior.

- GC16: Ability to configure, simulate, build and test prototypes of electronic and mechanical systems.

- GC17: Capacity for the correct interpretation of plans and technical documentation.

- EM05: Knowledge and capabilities for the design and maintenance of mechatronic systems.

2.2. Learning goals

The student, to pass this subject, must demonstrate the following results ...

- Know how to explain the fundamentals and main components of mechatronic systems, as well as the importance of the philosophy of mechatronic systems in current technological development.

- Acquire knowledge of a methodology in the development of mechatronic systems, knowing how to apply the mechatronic design phases from the initial conception, through the development of prototypes, until reaching the final concretion of said system. As well as knowing how to choose the appropriate components to the problems raised by said system.

- Design mechatronic systems of general application integrating knowledge of electronic, mechanical, programming, electrical machines and control design.

- Know how to differentiate the types of maintenance applicable to mechatronic systems, as well as develop a maintenance plan according to each typology or particular characteristics of the mechatronic system under study.

- Analyze how the maintenance of a mechatronic system affects the design of said system.

- Distinguish the different phases that must be taken into account when carrying out a safety study on mechatronic systems.

- Analyze how security in a mechatronics system affects both its maintenance and its design process.

- Know how to apply current regulations regarding the design, maintenance and safety of mechatronic systems.

2.3. Importance of learning goals

This subject has a marked engineering character, that is, it offers training with application content and immediate development in the labor and professional market. Through the achievement of the relevant learning results, the necessary capacity is obtained to understand the development and operation of mechatronic systems, based on their design, maintenance and safety, essential aspects for the Mechatronic Engineer.

3. Assessment (1st and 2nd call)

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

The student must demonstrate that they have achieved the expected learning outcomes through the following assessment activities

Continuos assessment system.

Following the spirit of Bologna, regarding the degree of involvement and continued work of the student throughout the course, the evaluation of the subject contemplates the continuous evaluation system, as the most consistent to be in line with the guidelines set by the new EEES framework.

The continuous assessment system will have the following group of qualifying activities:

- **Individual activities in class**: Active participation in the entire teaching-learning process, the public presentation of works and the resolution of theoretical and practical exercises in class will contribute 10 % to the final grade for the subject.

- **Laboratory sessions**: Practices corresponding to each of the subjects susceptible of it will be carried out, which will serve to assimilate and apply the concepts seen in the theory and acquire the relevant skills. These practices will be carried out in groups of students, taking into account that in addition to verifying its correct operation, a memory must be prepared, the format of which will be provided by the teacher and which must be submitted for correction in the next class. The memories of the practices, if they are delivered correctly, completely and within the required time period, will contribute 15 % to the final grade for the subject. The realization of these practices and their learning are compulsory for all, therefore they will be part of the global assessment test. If any student is unable to attend the practical classes, they will subsequently have to do them during the extraordinary hours determined for this purpose.

- **Exercises, theoretical questions and proposed works**: The teacher will propose exercises, problems, practical cases, theoretical questions, works, etc. to be solved individually or in a group of maximum students. Said activity will contribute 25 % to the final grade for the subject. To take this grade into account, the works must be delivered on the dates set.

- **Written examinations**: They will be carried out in order to regulate learning, stimulate the distribution of effort over time and have a more individualized evaluation tool of the educational process. These tests will collect theoretical and / or practical questions, of the different subjects to evaluate, their total number will be two distributed throughout the whole semester. This activity will contribute 50 % to the final grade for the subject.

As a summary of the above, the following weighting table of the grading process of the different activities has been designed, in which the continuous evaluation system of the subject has been structured.

Continuous assessment system activity	Weighing
Individual activities in class	10 %
Laboratory sessions	15 %
Exercises, theoretical questions and proposed works	25 %
Written examinations	50 %

Prior to the first call, the teacher of the subject will notify each student whether or not they have passed the subject based on the use of the continuous assessment system, based on the sum of the scores obtained in the different activities carried out throughout thereof, each contributing a minimum of 50 %. In case of not passing in this way, the student will have two additional calls to do so (global assessment system), on the other hand, the student who has passed the course through this dynamic, may also choose the global assessment system, in first call, to upload note but never to download.

The evaluation criteria to be followed for the activities of the continuous assessement system are:

- **Individual activities in class**: The active participation of the student will be taken into account, answering the questions promptly posed by the teacher in the daily course of the class, their fluency and oral expression when presenting the works in public and the qualification of the theoretical-practical exercises proposed and collected on site. All the activities will contribute in the same proportion to the total mark of said block, being valued from 0 to 10 points. *At least 80 % of said activities must be carried out to qualify for the continuous assessement system.*

- **Laboratory sessions**: In each one of the practices the dynamics followed for its correct execution and operation will be valued, as well as the problems raised in its development, the specific weight of this section being 40 % of the total mark of the practice. The remaining 60 % will be dedicated to the qualification of the report presented, that is, if the required data is correct and the questions asked have been answered correctly. The score of each practice will be from 0 to 10 points and never less than 5, since if it is not considered suspended and will have to be repeated, correcting what is not correct. The final grade for all the practices will be the arithmetic mean of all of them.

- **Exercises, theoretical questions and proposed works**: Their approach and correct development, the writing and coherence of what is discussed, as well as the achievement of results and the final conclusions obtained, will be scored from 0 to 10 points.

? **Work 1**: Based on the theme related to the design process of mechatronic systems.

? **Work 2**: Based on the theme related to the maintenance and safety of mechatronic systems.

- **Written examinations**: They will consist of the typical written exam scored from 0 to 10 points. The final grade of said activity will be given by the arithmetic mean of said tests, as long as there is no unit grade of less than 3 points, in this case the activity will be suspended. The approach and the correct resolution will be valued, as well as the justification of the methodology used when solving the exercises. Particularizing, for each of the tests will have the following:

? **Examination 1**: It will consist of several theoretical and / or practical exercises, related to the subject of maintenance of mechatronic systems. The theoretical part will be composed of questions to be developed or test type contributing to the total mark of the test with 30 %, with 70 % being reserved for the practical part.

? **Examination 2**: It will consist of several theoretical and / or practical exercises, related to the topic of mechatronic system security. The theoretical part will be composed of questions to be developed or test type contributing to the total mark of the test with 30 %, with 70 % being reserved for the practical part.

Global assessment system.

The student must opt for this modality when, due to their personal situation, they cannot adapt to the rhythm of work required in the continuous assessment system, have suspended or want to increase their grade having participated in said evaluation methodology.

As in the previous assessment methodology, the global assessment system must be aimed at verifying whether the learning results have been achieved, as well as contributing to the acquisition of the various competences, and should be carried out through more objective activities if possible.

The global assessment systemt will have the following group of qualifying activities:

- **Laboratory sessions**: They will have to be carried out integrated within the schedule of continuous evaluation. If this is not possible, they can be carried out during special laboratory hours to be specified during the semester. Likewise, they will contribute 15 % to the final grade of the evaluation.

- **Exercises, theoretical questions and proposed works**: The teacher will propose exercises, problems, practical cases, theoretical questions, works, etc. to be solved individually, being delivered on the date set for this purpose. This activity will contribute 25 % to the final grade for the course.

- **Written exam**: Consists of solving exercises of theoretical and / or practical application with similar characteristics to those solved during the conventional development of the subject. This exam will be unique with representative exercises of the topics, contributing 60 % to the final grade for the subject.

As a summary of the above, the following weighting table of the grading process of the different activities has been designed in which the global assessment system of the subject has been structured.

Global assessment system activity	Weighing
Laboratory sessions	15 %
Exercises, theoretical questions and proposed works	25 %
Written exam	60 %

The subject will have been passed based on the sum of the scores obtained in the different activities carried out, each contributing a minimum of 50 %.

For those students who have suspended the continuous assessment system, but some of their activities, with the exception of the written examinations, have been carried out may promote them to the global assessment system, and it may be the case that they only have to take the written exam.

All the activities included in the global assessment system, with the exception of the written exam, may be promoted to the next official call, within the same academic year.

The evaluation criteria to be followed for the activities of the global evaluation system will be the same as those defined for the continuous evaluation system, taking into account that the written exam will consist of theoretical and / or practical exercises, the theoretical part will be composed for questions to develop or test type contributing to the total mark of the test with 30 %, with 70 % being reserved for the practical part.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process designed for this subject is based on the following:

In a strong teacher/student interaction. This interaction is materialized through the distribution of work and responsibilities between students and teachers. However, it will have to be taken into account that to a certain extent students can mark their learning pace according to their needs and availability, following the guidelines set by the teacher. The present subject of Electrical Engineering is conceived as a unique set of contents but worked under three fundamental and complementary forms as they are: the theoretical concepts of each didactic unit, the resolution of problems or questions and the laboratory practices, supported in turn For another series of activities. The organization of the teaching will be carried out following the following guidelines:

- **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 sessions**: The lecture group is divided up into various groups, according to the number of registered students, in order to make up smaller sized groups.

- **Group tutorials**: Programmed activities of learning follow-up in which the teacher meets with a group of students to guide their work of autonomous learning and supervision of works directed or requiring a very high degree of advice by the teacher.

- **Individual tutorials**: Those carried out 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

he course includes the following learning tasks:

? **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.

? 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 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.

- Tutored autonomous activities.
Although they will have more of a face character that has been taken into account in part for their idiosyncrasies, they will be primarily focused on seminars and tutorials under the supervision of the teacher.

- **Reinforcement activities.**

Non-contact marking character, through a virtual learning portal (Moodle) various activities that reinforce the basic contents of the subject be addressed. These activities can be customized or not, controlling their realization through it.

4.3. Syllabus

The subject program is structured around two components of complementary content:

- Theory.
- Practice.

THEORETICAL CONTENTS.

The theoretical contents are articulated based on a series of didactic units, attached relationship, indivisible blocks of treatment, given the configuration of the subject that is programmed. These topics cover the contents necessary for the acquisition of predetermined learning outcomes.

- TOPIC 1: Design of mechatronic systems.

- TOPIC 2: Maintenance of mechatronic systems.

- TOPIC 3: Security of mechatronic systems.

PRACTICAL CONTENTS.

Its aim is none other than to be covered learning outcomes of the course through a program of laboratory practices, encompassing aspects related to the following issues:
- Work With the tools, techniques and methods necessary involved in the design process of mechatronic systems from initial design to manufacturing planning.
- Apply The most common when planning a typology of maintenance methodologies, based on situations and analysis of results.
- Basic Notions of implementing security features in mechatronic systems.

The laboratory workshop practices to be developed by the student will be conducted in sessions of two hours.

4.4. Course planning and calendar

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 high.

Activity	**Weekly school hours**
Lectures	2
Laboratory	2
Others activities	6

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

? 28 hours of lectures, with 50% theoretical demonstration and 50% solving type problems.

? 28 hours of laboratory workshop, in 1 or 2-hour sessions.

? 4 hours of written assessment tests, one or two hours per test.

? 90 hours of personal study, divided up over the 15 weeks of the semester.

Written continuous assessment tests are related to the following topics:

? **Written assessment examination 1**: Topics 2.

? **Written assessment examination 2**: Topics 3.

The most significant dates of the continuous evaluation system will be published in Moodle during the development of the course.

The dates of the global evaluation test will be those published officially on the School website.

The weekly schedule of the subject will be published officially on the School website.

4.5. Bibliography and recommended resources

Resources and materials used in the development of the subject are reflected in the following table:

Material	**Format**
Topic theory notes Topic problems	Paper/repository
Topic theory notes Topic presentationso Topic problems Related links	Digital/Moodle E-Mail
Software	Pc?s laboratorio
Technical manuals	Paper/repository Digital/Moodle
Labware	

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28833