Universidad Zaragoza

Academic Year/course: 2022/23

39611 - Mechanical Engineering

Syllabus Information

Academic Year: 2022/23
Subject: 39611 - Mechanical Engineering
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 608 -
ECTS: 6.0
Year: 2
Semester: First semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The main goal of the subject is to build graduate engineers with the particular ability to carry out the analysis of machines, mechanisms and mechanical systems. Accordingly, learners will be able to understand a wide range of physical phenomena, develop creative abilities for technological design and analytical procedures for problems resolution, with the aim of application of the acquired knowledge.
The combination of the competence achieved leads the graduated engineers on Industrial Organisational Engineering to obtain a versatile education, being able to access a wide field of professional positions.
The main goal of the subject guarantee graduate engineers to acquire competence that will be included in the following sections.

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 4: Quality Education.

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

1.2. Context and importance of this course in the degree

This subject belongs to the common training module to face, in addition to the generic competence of the Industrial Organization Engineer, knowledge about the principles of machine theory and mechanisms.

Brief presentation of the subject

Mechanical engineering is a huge part field of engineering that involves the use of the principles of physics for the analysis, design and manufacture of mechanical systems. Traditionally, it has been the branch of engineering that using the application of physical principles has allowed the creation of useful devices, such as tools and machines.

Mechanical Engineering is the branch of the machines, equipment and facilities always keeping in mind ecological and economic aspects for the benefit of society. To fulfil its task, mechanical engineering analyzes the needs, develops and solves technical problems through interdisciplinary work, and supported on scientific developments, transforming them into elements, machines, equipment and facilities that provide a suitable service, through rational and efficient use of the available resources.

1.3. Recommendations to take this course

Students enrolled in this subject are recommended to have pursued the subject Fisica I, where the fundamental concepts required and employed in the present subject are explained.

2. Learning goals

2.1. Competences

GI03.- Knowledge in basic and technological matters, which enables them to learn new methods and theories, and provides them with versatility to adapt to new situations.
GI04.- Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and convey knowledge, skills and abilities in the field of Industrial Engineering.
GI06.- Capacity to deal with specifications, regulations and mandatory rules. GC03.- Capacity for abstraction and logical thinking.
GC04.- Ability to learn in a continuous, self-directed and autonomous way.
GC05.- Capacity to evaluate options.
GC06.- Ability to adapt to the rapid evolution of technologies.
GC07.- Ability to lead a team as well as being a committed member of it.
GC08.- Ability to locate technical information, as well as its understanding and assessment.
GC09.- Positive attitude towards technological innovations.
GC10.- Ability to write technical documentation and to present it with the help of appropriate computer tools.
GC11.- Ability to convey their ideas and designs clearly to specialized and non-specialized audiences.
GC14.- Ability to understand the operation and deal with the maintenance of mechanical, electrical and electronic equipment and installations.
GC15.- Ability to analyze and apply simplified models to equipment and applications.
GC16: Ability to set up, simulate, build and test prototypes of electronic and mechanical systems.
GC17.- Capacity for correct interpretation of plans and technical documentation.
IE07: Knowledge of the principles of machine and mechanism theory

2.2. Learning goals

The student, to overcome this subject, must demonstrate the following results:
To obtain knowledge from the combination of movements.
To define and identify the parameters involved in the movement of a mechanical system as well as its degrees of freedom.
To know the application of forces that emerge in the interaction between solids in mechanical systems.
To know the application to mechanical systems of the concepts of mass center.
To know the application of theorems of vector calculus to mechanical systems and interpret the results obtained.
To obtain knowledge and employ software of modelling of mechanical systems

2.3. Importance of learning goals

This subject has a strong engineer character supporting the learning with content of immediate applicability in the present professional market. The learner will acquire through the learning goals the ability required to understand the operation of machines and mechanisms, which will be essential to design and setup any mechanical application within the field of Mechatronic Engineering.

3. Assessment (1st and 2nd call)

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

The assessment must be understood as a continuous and individualized process throughout the entire teaching-learning period, prioritizing the capacities and abilities of each student, as well as their performance.

At the beginning of the course, the student will choose one of the following two assessment methodologies:

A) A continuous assessment system, which is carried out throughout the entire learning period. Characterized by the obligation to take and pass the practical tests, partial exams and academic tasks proposed in the subject, within the deadlines established for this purpose. In this case, the student does not have to take a final exam.

B) A global assessment test, showing the achievement of learning results, at the end of the teaching period. Characterized by not taking or not passing the practical tests, partial exams or academic work proposed in the subject. In this case, the student must compulsorily take the final exam.

Breakdown and content of each assessment system:

The continuous assessment system consists of three blocks that are explained below. The first condition is that the student must attend at least 80% of the classroom activities.

1st Block: Continuous assessment exercises: The student will carry out a total of 5 continuous assessment exercises (one per chapter) on a compulsory basis in the continuous assessment system, which will be distributed throughout the course. Each exercise will be delivered to the student once the corresponding theory topics and exercises have been completed. The student will have a week to do it and deliver it to the teacher, since this activity is continuous and should not be delayed in time. The continuous assessment exercise will be very similar to the exercises carried out in class. In addition, the student will have tutorials to answer any questions about it. This activity will globally account for 30% of the final grade for the course. To take this grade into account the student must meet two requeriments:

- 1st They will have to deliver all the exercises within the period given by the teacher. Otherwise, this activity will be considered as a fail (except for properly justified major cause).
- 2nd They will have to obtain a minimum of 3.0 in each exercise. And you must obtain a minimum grade of 4.0 with all the exercises included. If not, this activity will be considered as a fail.

2nd Block: Written tests for continuous assessment. The student will take a total of four compulsory written tests in the continuous assessment system, which will be distributed throughout the course. These tests will include theoretical questions and exercises on the corresponding topics. The duration of the test will be a minimum of two hours of classes and a maximum of three, depending on the case. This activity will globally account for 50% of the final grade of the course, to take this mark into account, the student must fulfill two requirements:

- 1st They will have to turn up in all the tests in the date given by the professor. Otherwise, this activity will be considered as a fail (except for properly justified major cause).
- 2nd They will have to obtain a minimum of 3.0 in each test. And they must obtain, including all the tests, a minimum grade of 4.0. If not, this activity will be considered as a fail.

3rd Block: Computer-Assisted Practices. The student will carry out two compulsory practice sessions in the continuous assessment system, which will be distributed throughout the course, according to the planning chart. This activity will globally account for 20% of the final grade for the course, to take this grade into account the student must meet two requirements:

- 1st They will have to attend all practice sessions on the date given by the teacher. Otherwise, this activity will be considered as a fail (except for properly justified major cause).
- 2nd They will have to obtain a minimum of 3.0 in each practice. And they must obtain a minimum grade of 4.0 including all the practices. If not, this activity will be considered as a fail.

Prior to the first call, the teacher will notify each student whether or not they have passed the subject depending on the use of the continuous assessment system, based on the sum of the scores obtained in the different activities carried out throughout it. according to the formulation:

Final mark of the subject in THE first call = 50% A + 30% B + 20% C

A = Average grade of written tests
B = Average grade of exercises
C = Average mark of practice task

Thus, they must obtain a minimum grade of 5.0 to pass the course, fulfilling all the above mentioned and explained requirements. The students who have passed the subject in this way, will be allowed to increase their grade on the first call (never to lower it).

Global Test: In case of not passing with the previous system, the student will have two additional calls (June and September) with a global assessment test. This test will be unique with theory and exercises representative of the entire syllabus of the subject contributing 100% to the final grade of the course.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

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

Strong interaction between the teacher/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 (Mechanical Engineering) 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 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:** Practical activities will be conducted in the computer room 1.1 software mechanism (GIM 16.0) with the presence and teacher mentoring**.**

? **Individual Tutorials**: Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

4.2. Learning tasks

Programmed learning activities	The program offered to the student to help them achieve their target results is made up of th activities... Involves the active participation of the student, in a way that the results achieved in the learning p developed, not taking away from those already set out, the activities are the following: ? **Face-to-face generic activities**: ? **Theory sessions**: The theoretical concepts of the subject are explained and illustrative ex developed as a support to the theory when necessary. ?**Practice Sessions**: Problems and practical cases are carried out, complementary to the concepts studied. ? **Laboratory Workshop**: This work is tutored by a teacher, in groups of no more than 20 studen ? **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 clas ? 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 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 ob the subject file in the Accreditation Report of the degree, taking into account the level of expe considered for the said subject is moderate.

Activity	Weekly school hours
Lectures	3
Laboratory Workshop	1
Other Activities	6

4.3. Syllabus

The course will address the following topics:

Topic 1: Structural Analysis of Mechanisms Plans

Introduction: Historical development of the theory of mechanisms and machines

? Terminology mechanisms

? Classifications of elements and kinematic pairs of a mechanism

? Mobility and Degrees of Freedom: Criteria Grübler

? Act Grashoff Theorem and Graphical Analysis

? Obtaining a mechanism kinematic scheme

Topic 2: Kinematic Analysis of Mechanisms Plans

? Statement of the problem Kinematic

? Relative Movement Plano

? Relative Instant Center

? Determination of the instantaneous centres' mechanism

? Theorem Aronhold -Kennedy

? Calculation of speed of a mechanism analytically

? Calculation of speed of a mechanism graphically

Topic 3: Dynamic Analysis of Mechanisms Plans

? Dynamic Approach problem

? Calculation of acceleration of a mechanism analytically

? Calculation of acceleration of a mechanism graphically

? Forces of inertia mechanisms

? Balance mechanisms

Topic 4: Kinematic Analysis of Gear and Gear Trains

? Gears: Gear Fundamental Law

? Classification of Gears

? Gear Trains

? Classification Gear Trains

? Applications: Differential of a vehicle

Topic 5: Theory of Mechanical Vibrations

? Fundamental concepts in vibration

? Systems degree of freedom

? Free Vibrations in systems of one degree of freedom

? Vibrations systems forced a degree of freedom

? Resonance Phenomenon

4.4. Course planning and calendar

Weeks	WEEKLY PLANNING SEMESTER	
1ª 2ª	Topic 1	Exercise No. 1 Continuous Assessment
3ª 4ª 5ª 6ª	Topic 2	Exercise No. 2 Continuous Assessment 1st Practice with software GIM (Topic 1 and 2) 1st Written Test (Topic 1 and 2)
7ª 8ª 9ª	Topic 3	Exercise No. 3 Continuous Assessment 2nd Practice with software GIM (Topic 3) 2nd Written Test (Topic 3)

The weekly schedule of the subject will be published at http://www.eupla.unizar.es/asuntos-academicos/calendario-y-horarios

The dates of the global evaluation test (**official calls**) will be published at http://www.eupla.unizar.es/asuntos-academicos/examenes

10ª 11ª 12ª	Topic 4	Exercise No. 4 Continuous Assessment 3rd Written Test (Topic 4)
13ª 14ª 15ª	Topic 5	Exercise No. 5 Continuous Assessment 4th Written Test (Topic 5)

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=39611

recommended resources:

Material	Format
Topic theory notes Topic problems	Paper/repository
Topic theory notes Topic presentations Topic problems Related links	Digital/Moodle E-Mail
Educational software GIM	1. In the bibliography cite: Petuya, V.; Macho, E.; Altuzarra, O.; Pinto, C. and Hernández, A. "Edu the Kinematic Analysis of Mechanisms". Comp. Appl. Eng. Education. February 24, 2011. DOI: 10.1002 cae.20532. ISSN: 1061-3773. 2. In the acknowledgements cite: The authors wish to acknowledge Alfonso Hernández, CompMech, De Engineering, UPVEHU for the permission to use the GIM® software. (v