30112 - Mechanics

Información del Plan Docente

Academic Year	2016/17
Academic center	175 - Escuela Universitaria Politécnica de La Almunia 179 - Centro Universitario de la Defensa - Zaragoza
Degree	425 - Bachelor's Degree in Industrial Organisational Engineering 563 - Bachelor's Degree in Industrial Organisational Engineering 457 - Bachelor's Degree in Industrial Organisational Engineering
ECTS	6.0
Course	2
Period	First semester
Subject Type	Compulsory
Module	---

1.Basic info

1.1.Recommendations to take this course

1.2.Activities and key dates for the course

2.Initiation

2.1.Learning outcomes that define the subject

2.2.Introduction

3.Context and competences

3.1.Goals

3.2.Context and meaning of the subject in the degree

3.3.Competences

3.4.Importance of learning outcomes

4.Evaluation

Defence profile

Assessment methodology

The evaluation methodology is based on written examinations and on practical sessions of simulation of mechanical systems:

- **Written examinations** . Exams comprised by exercises and questions. A mid-semester exam on the Statics and Kinematics blocks will be carried out. If a student obtains a minimum mark of 4.0 in this examination can choose not to re-take the first part of the final examination and complete only the second part (Geometry of mass, Dynamics and Machines Theory).

- **Practical sessions** . Three computer lab sessions about simulation of mechanical systems are scheduled. In the course of the practical sessions the students will complete a written questionnaire which, along with the simulation files, will be used for evaluating this block.

Assessment criteria

In order to compute the final mark and evaluate if the student has passed the subject the following criteria have been established:

- The minimum marks to be obtained in the practical session's assessment (PM) and in the final examinations assessment (EM) are 5.0.

- Moreover, it is needed to obtain a minimum mark of 4.0 in each of the two blocks in which the subject is divided for examinations (Statics and Kinematics for the first part and Geometry of mass, Dynamics and Machines Theory for the second part). This means that both the mark of the first part (EM1) and of the second part (EM2) must be greater or equal to 4.0. This will be required in all the assessment periods (February and August).

- The overall mark of the examinations will be worked out as follows:

$$EM = 0.5*EM1 + 0.5*EM2$$

if EM1 and EM2 are both greater or equal to 4.0.

- The final mark (FM) of the subject will obtained by means of a weighed average as follows:

$$FM = 0.8*EM + 0.2*PM$$

5.Activities and resources

5.1.General methodological presentation

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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:

— **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** : Practical activities will be conducted in the computer room 1.1 software simulation mechanisms (GIM16.0) 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

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The teaching will be structured following as follows:

A) There will be in-class (54 hours) and non in-class (90 hours) activities.

B) In addition, there will be 6 hours for assessment activities (two hours of the mid-semester examination and four hours for the final examination).

C) The in-class activities can be:

- Master classes: Theoretical and exercises sessions (48 hours).

- Practical sessions (6 hours).

D) The non in-class activities will consist basically in autonomous work of the student (90 hours).

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5.2.Learning activities

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The programme offered to the student to help them achieve their target results is made up of the following 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.

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

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1. Theoretical and exercises master sessions. In these sessions the teacher will detail the theoretical basis of the subject. Moreover, these will be complemented with exercises sessions in which the teacher will highlight the applications of the basic concepts and will provide the students with general guidelines for solving exercises. These which will be extracted from the collections proposed for each block.

2. Practical sessions. These are compulsory in-class activities which the student has to complete to pass the subject. The practical sessions will consist on simulation of mechanical systems. Groups for performing the computer lab sessions will be made up of two (exceptionally of three) students. Before beginning the sessions the students will be provided with guidelines where the theoretical principles and the motivation of the practical can be consulted. In addition, each group will complete during the session a written questioner which will be handed in at the end of the class.

3. Tutorials. These will be used for orienting and guiding the learning process of the students adequately.

5.3.Program

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Chapter 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

Chapter 2: Kinematic Analysis of Mechanisms Plans

* Statement of the problem Kinematic

* Relative Movement Plano

* Relative Instant Center

* Determination of the instantaneous centers mechanism

* Theorem Aronhold -kennedy

* Calculation of speed of a mechanism analytically

* Calculation of speed of a mechanism graphically

Chapter 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

Chapter 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

Chapter 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

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0. INTRODUCTION (2 hours)

0.1. Presentation. Review of vector calculus.

0.3. Equivalent force-momentum systems.

1. STATICS (12 hours)

1.1. Equilibrium conditions. Free body diagram. Reaction forces.

1.2. Distributed forces. Centre of gravity.

1.3. Static friction. Case studies: overturns, friction bands and wedges.

1.4. Practical session of simulation: Dimension of a clutch.

2. KINEMATICS (13 hours)

2.1. Types of motion. Motion around a fixed axis.

2.2. General plain motion. Instant Rotation Centre. Degrees of freedom.

2.3. Relative motion. Absolute and relative velocity. Absolute, relative and Coriolis acceleration.

2.4. Tri-dimensional motion: about a fixed point and general case.

2.5. Motion on Earth's surface.

2.6. Practical session of simulation: Kinematic study of a crank-rod-piston mechanism.

MID-TERM EXAMINATION (2 hours)

3. GEOMETRY OF MASS (7 hours)

3.1. Moments of inertia and products of inertia. Inertia tensor.

3.2. Theorem of Steiner. Composed bodies.

4. DINAMICS (17 hours)

4.1. Dynamic variables. Linear momentum. Angular momentum. Kinetic energy.

4.2. Fundamental equations. D'Alembert principle and inertia forces. Theorems of linear and angular momentums.

4.3. Theorem of energy and work.

4.5. Tri-dimensional motion. Balancing of rotors.

4.6. Practical session of simulation: Dimension of the traction system of a spy robot.

5. MACHINES THEORY (3 hours)

5.1. Design of mechanical mechanisms.

5.2. Transmission of motion.

5.3. Degrees of freedom. The Grübler criterion.

FINAL EXAMINATION (4 hours)

5.4.Planning and scheduling

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weeks	WEEKLY PLANNING SEMESTER
1ª	Exercise No. 1 Continuous

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2ª	Topic 1	Assessment
3ª		Exercise No. 2 Continuous Assessment
4ª		1st Practice with software GIM (Topic 1 and 2)
5ª	Topic 2	
6ª		1st Written Test (Topic 1 and 2)
7ª		Exercise No. 3 Continuous Assessment
8ª	Topic 3	2nd Practice with software GIM (Topic 3)
9ª		2nd Written Test (Topic 3)
10ª		Exercise No. 4 Continuous Assessment
11ª		
12ª	Topic 4	
		3rd Written Test (Topic 4)

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13ª		Exercise No. 5 Continuous Assessment
14ª	Topic 5	4th Written Test (Topic 5)
15ª		

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See section 5.3

5.5.Bibliography and recomended resources

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- Khamashta Shahin, Munir. Problemas de cinemática y dinámica de máquinas. Vol.1, Problemas resueltos de cinemática de mecanismos planos / Munir Khamashta, Lorenzo Alvarez, Ramón Capdevila Barcelona : Edicions de la Universitat Politècnica de Catalunya, 1986
- Petuya, V.; Macho, E.; Altuzarra, O.; Pinto, C. and Hernández, A. "Educational Software Tools for the Kinematic Analysis of Mechanisms". Comp. Appl. Eng. Education. First published online: February 24, 2011. DOI: 10.1002 cae.20532. ISSN: 1061-3773.

Recursos

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Material	Format
Topic theory notes	Paper/repository
Topic problems	
Topic theory notes	Digital/Moodle
Topic presentations	E-Mail
Topic problems	
Related links	
Educational software GIM 16	Web page: http://www.ehu.eus/compmech/software/

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- Mecánica vectorial para ingenieros: Dinámica ed. 10. 2013. Beer, Johnston, Mazurek. Ed. Mc Graw Hill.

- Ingeniería mecánica: Estática. 2005. Riley, Sturges. Ed. Reverté.

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- Teoría de Máquinas. 2014. Avelló. Ed. Tecnun.

Resources

- Moodle online course, http://moodle.unizar.es. There the student will find the subject program, materials, recommended references and different suggestions.

- Information about calendar and schedules can also be consulted at the Centro Universitario de la Defensa web site, http://cud.unizar.es