Universitat de Lleida

DEGREE CURRICULUM

THEORY OF MACHINES

Coordination: PIJUAN CASES, JORDI

Academic year 2023-24

THEORY OF MACHINES 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>THEORY OF MACHINES</td></tr>
<tr><td>Code</td><td>102303</td></tr>
<tr><td>Semester</td><td>1st Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Mechanical Engineering</td><td>3</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Double bachelor's degree: Degree in Mechanical Engineering and Degree in Energy and Sustainability Engineering</td><td>4</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><td>PRALAB</td><td>PRAULA</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>0.4</td><td>2.6</td><td>3</td></tr>
<tr><th>Number of groups</th><td>4</td><td>2</td><td>1</td></tr>
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<tr><td>Coordination</td><td>PIJUAN CASES, JORDI</td></tr>
<tr><td>Department</td><td>INDUSTRIAL AND BUILDING ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>Presencial: 40 %
Treball autònom: 60 %</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Catalan.
Part of the course materials can be in Spanish and English.</td></tr>
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THEORY OF MACHINES 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
PIJUAN CASES, JORDI	jordi.pijuancases@udl.cat	9,8	

Subject's extra information

The main background needed for the correct follow-up of the course are:
Operations with vectors, trigonometry, derivatives and integrals of one variable, esquematics and graphical representation of solid systems, kinematics and dynamics of rigid body motion in the plane, kinematic and dynamic analysis of mechanisms in movement in the plane.

It is considered essential to have studied previously, and it is advisable to have overcome the following subjects:
- Linear algebra
- Calculation
- Physics I
- Graphic Expression I
- Theory of Mechanisms

SECURITY INFORMATIOM:

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Blue laboratory gown from UdL (unisex)
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos
Centre the Cultures i Cooperació Transfronterera

http://www.publicacions.udl.cat/

The use of other elements of protection (for example caps, masks, gloves of chemical orelectricalrisk, etc.) wil ldepend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or shorts kirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or widesleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.

- Wash your hands when ever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*:http://www.sprl.udl.cat/alumnes/index.html

Learning objectives

- Kinematic design of a mechanism, from the specifications of positions of one of its members
- Kinematic analysis of cam-follower mechanisms
- Kinematic and the dynamic analysis gear transmissions
- Study transmission systems in machines, its driving system and the regularity of operation
- Vibratory analysis of systems with one degree of freedom.

Competences

Cross-disciplinary competences

EPS1. Capacity to solve problems and prepare and defence arguments inside the area of studies.

EPS6. Capacity of analysis and synthesis.

Specific competences

GEM20. Knowledge and capacity for the calculation, design and testing of machines.

Subject contents

1. Graphic synthesis of mechanisms
2. Cam-follower mechanisms
3. Gear transmissions
4. Dynamics of machines with one degree of freedom
5. Vibrations of one degree of freedom

Methodology

- **Lectures:** They will take place during the Full Group sessions. Explanation of theoretical content and proposal and/or resolution of some practical examples. In the 2021-22 academic year, these sessions will be held online using the "Videoconferencia" tool of theVirtual Campus.
- **Problems:** They will take place during the Half Group sessions. Approach and discussion of some problems that the students will solve individually or in groups.
- **Practices:** They will take place during the Half Group sessions. A practice about graphical synthesis of mechanisms using CAD and a practice at the mechanics laboratory of analysis of cams and gears.
- **Work in group:** Development of a work about the synthesis and dynamic analysis of a cyclic machine that must be done during the course.

Development plan

Week	Methodology	Unit	Attendance hours	Autonomous work hours
1	Lectures	Unit 0: Introduction	2	0

2	Lectures Problems	Unit 1: Theory Unit 1: Problems	2 2	4
3	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	4
4	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	4
5	Lectures Practice	Unit 2: Theory Practice 1	2 1	6
6	Lectures Problems	Unit 3: Theory Unit 3: Problems	2 2	4
7	Lectures Problems	Unit 3: Theory Unit 3: Problems	2 2	4
8	Lectures Practice	Unit 3: Theory Practice 2	2 1	6
9	Evaluation	Exam 1	2	5
10	Lectures Problems	Unit 4: Theory Unit 4: Problems	2 2	6
11	Lectures Problems	Unit 4: Theory Unit 4: Problems	2 2	6
12	Lectures Work in group	Unit 4: Theory Work in group treatment	2 2	8
13	Lectures Problems	Unit 5: Theory Unit 5: Problems	2 2	6
14	Lectures Problems	Unit 5: Theory Unit 5: Problems	2 2	6
15	Lectures Problems	Unit 5: Theory Unit 5: Problems	2 2	6
16-17	Evaluation	Exam 2	2	7
18	Tutoring	Tutoring	2	4
19	Evaluation	Recovery exam	2	4

Evaluation

Several evaluation activities will be carried out:

- 1st written test in the middle of the semester (week 9). The syllabus presented in class and worked on in practice will be evaluated until the date of the 1st test. The test will consist of a part of test-type questions and a part of problems to be developed.
- 2nd written test at the end of the semester (week 17 or 18). The syllabus presented in class and worked on in practices corresponding to the topics presented between the dates of the 1st test and the 2nd test will be evaluated. The test will consist of a part of test-type questions and a part of problems to be developed.
- 2 practice sessions, from which the corresponding report made in a group will be evaluated.
- 1 work of synthesis and analysis of a machine, done in groups of 4 or 5 students.
- Recovery test (week 20). The syllabus presented in class and worked on throughout the subject will be evaluated. The test will consist of a part of test-type questions and a part of problems to be developed. If the student takes this test, the grade obtained replaces the weighted grade of the two previous written tests, whether it is higher or lower.
- Practice and group work notes are not recoverable.

The weight assigned to each evaluation activity, out of a total of 100, is as follows:

Activity	Weight
1st written exam	35
2nd written exam	45
Work in group	10
Practices	10
Recovery exam	80

For those who request it, the alternative evaluation will be carried out in a single exam at the end of the semester that will be 100% of the grade for the subject.

Bibliography

Course notes: “Teoria de Màquines”.

Myszka, D. H. (2005). *Machines and mechanisms: applied kinematic analysis*. Prentice Hall.

Norton, R.L (1995). *Diseño de maquinaria: una introducción a la síntesis y al análisis de mecanismos y máquinas*. McGraw-Hill.

Mabie, H. H., Reinholtz, C. F. (1998). *Mecanismos y dinámica de maquinaria*. Limusa.

Cardona, S., Clos, D. (2000). *Teoria de màquines*. Edicions UPC.

Riba, C. (1999). *Mecanismes i màquines II. Transmissions d'engranatges*. Edicions UPC.

Thomson, W.T., Dahleh, M. D. (1998). *Theory of vibration with applications*. Prentice Hall.

Beer, F.P., Johnson, E.R., Clausen, W.E. (2007). *Mecánica vectorial para ingenieros. Dinámica*. McGraw-Hill.