DEGREE CURRICULUM

THEORY OF MECHANISMS

Coordination: SOLE CUTRONA, CRISTIAN

Academic year 2023-24

THEORY OF MECHANISMS 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>THEORY OF MECHANISMS</td></tr>
<tr><td>Code</td><td>102110</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 Automation and Industrial Electronic Engineering</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Energy and Sustainability Engineering</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Mechanical Engineering</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Common branch in industrial engineering programs - Lleida</td><td>2</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>2</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>0.6</td><td>2.4</td><td>3</td></tr>
<tr><th>Number of groups</th><td>10</td><td>4</td><td>3</td></tr>
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<tr><td>Coordination</td><td>SOLE CUTRONA, CRISTIAN</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>Attendance work: 40 %
Autonomous work: 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. Also some material in spanish or in english</td></tr>
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THEORY OF MECHANISMS 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
SOLE CUTRONA, CRISTIAN	cristian.sole@udl.cat	10,2	
TERRIBAS SALA, XAVIER	xavier.terribas@udl.cat	14,4	

Subject's extra information

The main background needed to take advantatge of the subject are: operations with vectors, trigonometry, derivatives and integrals of one variable, graphical representation of multi-body systems, dynamics of a mass particle

It is essential to have studied previously, and it is advisable to have passed, the following subjects:

- Linear Algebra

- Calculus

- Physics I

- Graphics Expression I

Regardind the safety rules that apply to the laboratory practices:

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 or electrical risk, etc.) will depend 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 short skirts 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 wide sleeves 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 whenever 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

- Get a deeper knowledge about rigid body mechanics
- Analyze the typology and the constituent elements of a mechanism
- Study the possibilities of movement of a given mechanism
- Analyze the kinematics of a mechanism, corcerning positions, speeds and accelerations
- Analyze the dynamics of a mechanism at a given instant
- Analyze the dynamics of a mechanism considering the evolution between two specific situations

Competences

Cross-disciplinary competences (GEM)

- **EPS1**. Capacity to solve problems and prepare and defence arguments inside the area of studies.
- **EPS2**. Capacity to gather and interpret relevant data, within the area of study, to judge and think about relevant subjects of social, scientific and ethical nature.
- **EPS7**. Capacity to work in situations with a lack of information and/or under pressure.

Specific competences (GEM/GEEIA)

- **GEM13**. Knowledge of the principles of theory of machines and mechanisms.
- **GEEIA13.** Knowledge of the principles of theory of machines and mechanisms.

Basic competences (GEES)

- **CB2.** That students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.
- **CB3.** That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant issues of a social, scientific or ethical nature.

General competences (GEES)

- **CG13**. Have knowledge of the principles of machine and mechanism theory.

Subject contents

1. Rigid body kinematics
2. Rigid body dynamics: momentum and angular momentum
3. Introduction and Mobility of mechanisms
4. Mechanism kinematics
5. Mechanism dynamics: vectorial theorems
6. Energy theorem apllied to mechanism dynamics

Methodology

Lectures: They will take place during the Full Group sessions. Explanation of theoretical content together with videos of the lesson and proposal and/or resolution of some practical examples.

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. 2 Practices at the Mechanics laboratory, analysing and measuring variables of mechanical systems, 1 practice about graphical kinematics using CAD.

Work in group: Development of 2 works about kinematic and dynamic analysis of different systems.

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 1: Theory Unit 1: 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 4: Theory Unit 4: Problems	2 2	4
8	Lectures Practice	Unit 4: Theory Practice 2	2 1	6
9	Evaluation	Exam 1	2	5
10	Lectures Problems	Unit 5: Theory Unit 5: Problems	2 2	6

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

Evaluation

Evaluation System
Monitoring and evaluation will be conducted according to a system of continuous assessment, where the final grade will consist of the sum of the percentages of different evaluation blocks.

Recovery:
During the 19th week the grade of the subject can be recovered/improved, following the guidelines of the Academic Degrees Framework of EPS, through a recovery test.

Alternative evaluation
During the 19th week the grade of the subject can be recovered/improved, following the guidelines of the Academic Degrees Framework of EPS, through a recovery test.

There will be several evaluation activities inside the different evaluation blocks:

- Block 1. Mid-term exam 1
  - 1st individual written exam (week 9). Multiple choice exam, the content to be evaluated is the one exposed and worked in class up to the date of this exam.
  - 2n individual written exam (week 9). The content to be evaluated is the problems, the works in group and the practice sessions realised up to the date of this exam.
- Block 2. Final exam 2
  - 3rd individual written exam (week 16 or 17). Multiple choice exam, the content to be evaluated is the one exposed and worked in class from the 1st and 2n exams date on.
  - 4th individual written exam (week 16 or 17). The content to be evaluated is the problems, the works in group and the practice sessions realised from the 1st and 2n exams date on.
- Block 3. Group work

- Recovery exam of the individual ones (week 19). The topics covered in class and worked on throughout the course will be assessed. The test will consist of a theoretical part and a practical problem. If the student takes this test, the mark obtained will replace the marks obtained in the previous written tests, whether it is higher or lower.

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

Evaluation Blocks	Weigth
Block 1: Theory 1	10
Block 1: Problem 1	20
Block 2: Theory 2	20
Block 2: Problems 2	30
Block 3: Group Work	20
Recovery	80

Bibliography

Lecture notes about the subject

BEDFORD, A. & FOWLER, W. (1996) *Mecánica para Ingeniería. Dinámica*. Addison-Wesley Iberoamericana.E.U.A.

BEER, F.P. & JOHNSTON, E.R. (1998) *Mecánica Vectorial para ingenieros. Dinámica*. McGraw Hill.

HIBBELER, R.C.(2016) *Ingeniería Mecánica Dinámica (14 ed)*. Pearson.

HIBBELER, R.C.(2016) *Ingeniería Mecánica Estática (14 ed)*. Pearson.

MERIAM, J.L. & KRAIGE, L.G.(1998) *Engineering Mechanics. Dynamics*.John Wiley & Sons. USA.

MYSZKA,D. (1998) *Machines and Mechanisms. Applied Kinematic Analysis*. Prentice Hall. New Jersey.

CARDONA, S. et al. (1998) *Teoria de Màquines*. Ed. CPDA-ETSEIB.Barcelona.

MABIE, H & REINHOLTZ, C. (1998) *Mecanismos y Dinámica de Maquinaria*. Limusa.México.

RIBA, C. (1995) *Dissenyde Màquines I. Mecanismes*. Edicions UPC. Barcelona.

NORTON, R.L. (1995) *Diseño de Maquinaria*. McGraw Hill. México.

SHIGLEY & MISCHKE.*Diseño en Ingeniería Mecánica*. McGraw Hill.