Universitat de Lleida

DEGREE CURRICULUM

MACHINE DESIGN AND TESTING I

Coordination: COMELLAS ANDRES, MARTI

Academic year 2023-24

MACHINE DESIGN AND TESTING I 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>MACHINE DESIGN AND TESTING I</td></tr>
<tr><td>Code</td><td>14522</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION / UNDEFINED</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Master's Degree in Industrial Engineering</td><td>1</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><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>3</td><td>3</td></tr>
<tr><td>Number of groups</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>COMELLAS ANDRES, MARTI</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>40% lectures in class
60% independent student work</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 English.</td></tr>
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MACHINE DESIGN AND TESTING I 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
COMELLAS ANDRES, MARTI	marti.comellas@udl.cat	3	Wednesday 17-19h CREA building, office 0.19
COMELLAS ANDRES, MARTI	marti.comellas@udl.cat	3	Wednesday 17-19h CREA building, office 0.19
NOGUES AYMAMI, MIQUEL	miquel.nogues@udl.cat	0	
NOGUES AYMAMI, MIQUEL	miquel.nogues@udl.cat	0	

Subject's extra information

The main background needed to take advantatge of this subject are:

- Knowledge of Elasticity and Strength of Materials
- Knowledge of Theory of Mechanisms

Software used: **CREO Parametric** 3D CAD.

In relation to the safety rules established in laboratories, it is required to state

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 information at the *UdL Servei de Prevenció de Riscos Laborals* web pages:

- http://www.prevencio.udl.cat/ca/integracio-a-la-docencia/
- http://www.sprl.udl.cat/ca/capsules-formatives/

Learning objectives

Provide students with the basic knowledge and techniques, tools, skills and abilities to effectively develop professionals activities involved in conducting machine designs. For this reason, the topics considered to be developed are both kinematics and dynamics in three dimensions, in order to carry out a proper assessment of stress of any machine part. In addition, the bases of balancing rotors and multicylindrics machines are exposed.

The achivement of the above objectives can be specified in:

- Improve both vision and skills on the spatial movement
- Learning to use CAD for kinematic and dynamic analysis
- Achieve basic knowledge in balancing devices
- Improve skills in mechanical design

Competences

Basic competences

- **CB2** To be able to applytheknowledgegainedand to solve problems in new environments in wider contexts (or multidisciplinary) relatedwiththearea of study.

General competences

- **CG4** Capacity to conceive, design and implement projects and/or provide new solutions, using the tools that the engineering offers.
- **CG6** To have suitable knowledge of the scientific and technologic alissues of: mathematical, analytical and numerical methods in engineering, electrical engineering, energetic engineering, chemical engineering, mechanical engineering, mechanics of continuous means, industrial electronics, automation, manufacture, material, quantitative methods of management, industrial computing, urbanism, infrastructures, etc.
- **CG7** To project, calculate and design products, processes, installations and plants.
- **CG9** To do research, development and innovation in products, processes and methods.

Specific competences

- **CE3** Capacity for the design and testing of Machines.

Cross-disciplinarycompetences

- **CT3** Mastering ICT's.

Subject contents

Unit 1. 3D Rigid Body Kinematics

1.1 Vector time derivative in a mobile coordinate system

1.2 Common coordinate systems in mechanical analysis.

1.3 Three-dimensional position analysis

1.4 Three-dimensional velocity analysis

1.5 Instant rotation centers and centrodes

1.5 Three-dimensional acceleration analysis

1.6 Kinetic energy

Unit 2. 3D Rigid Body Dynamics

2.1 Linear and angular momentum

2.2 Inertia tensor and its properties

2.3 Free-body diagrams

2.4 Newton-Euler equation of motion

2.5 Gyroscopic effects

2.6 Virtual work

Unit 3. Balancing rotors and engine cylinder

3.1 Balancing rotors introduction

3.2 Static balancing

3.3 Dynamic balancing

3.4 Balancing multicilindrical systems.

Methodology

Lectures: Theoretical contents and proposal and/or resolution of some practical examples.

Problems: Presentation and discussion of problems that will eventually solve by the students in a individual way or in groups.

Practices: 4 laboratory sessions.

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Development plan

Week	Methodology	Unit	Attendance hours	Autonomous work hours
1	Lectures	Unit1: Theory Unit 1: Problems	2 0	0 0
2	Lectures Problems	Unit1: Theory Unit 1: Problems	2 2	3 3
3	Lectures Problems	Unit1: Theory Unit 1: Problems	2 2	3 3
4	Lectures Problems	Unit1: Theory Unit 1: Problems	2 2	3 3
5	Lectures Practice	Unit1: Theory Practice 1	2 2	3 3
6	Lectures Problems	Unit 1: Theory Unit 1: Problems	2 2	3 3
7	Lectures Problems	Unit 1: Theory Unit 1: Problems	2 2	3 3
8	Lectures Practice	Unit 2: Theory Practice 2	2 1	3 3
9	Evaluation	Exam 1	2	4
10	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	3 3
11	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	3 3
12	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	3 3
13	Lectures Practice	Unit 2: Theory Practice 3	2 2	3 3
14	Lectures Problems	Unit 3: Theory Unit 3: Problems	2 2	3 3
15	Lectures Practice	Unit 3: Theory Practice 4	2 2	3 3
16-17	Evaluation	Exam 2	2	4
18	Tutoring	Tutoring	1	2
19	Evaluation	Recovery exam	2	2

Evaluation

Several evaluation activities will be carried out:

BLOCK 1: Kinematics

- 1st individual written exam focused on theory/practical/problems work developed along of the midterm.

The exam will be done on the date scheduled in the academic calendar (approx. week 9th), where it will be evaluated the content exposed until the day of the exam.

BLOCK 2: Dynamics and Rotor balancing

• 2nd individual written exam which will be focused on the theory/practical/problems work developed in the second quarter. The exam will be done on the scheduled date in the academic calendar (approx. week 17th or 18th).

BLOCK 3: Practice

• The student will have to do the corresponding laboratory reports, which must be delivered in the period scheduled for evaluation. The student could only get in the laboratory if he/she is wearing the corresponding PPE indicated in the laboratory guide.

• Recovery exam/s (week 20th). The student will be able to take one or the two exames. If a student attends to this exam/s, the grade achieved replaces the previous grade.

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

Activity	**Weight**
Exam 1	40
Exam 2	50
Practice	10
Recovery exam/s	40+50=90

Note: The Practice grade is not recoverable. A minimum grade of 3,5 is required in Exams 1 and 2.

Alternative evaluation:
• Individual exam, will take place on the recovery exam day. It will consist of two parts corresponding to each of the two individual exams carried out throughout the course. It will have a weight of 90% (40+50).
• The student will have to do the corresponding laboratory reports, which must be delivered in the period scheduled for evaluation. The student could only get in the laboratory if he/she is wearing the corresponding PPE indicated in the laboratory guide. It will have a weight of 10%.

Bibliography

"Diseño de maquinaria", Robert L. Norton, Edicions Mc Graw Hill

"MECÀNICA de la partícula i del sòlid rígid", Joaquim Agulló i Batlle, Publicacions OK punt

"Disseny de màquines I. Mecanismes", Carles Riba Romeva, Edicions UPC.

"Mecanismes i màquines III. Dinàmica de màquines", Carles Riba Romeva, Edicions UPC.

"Teoria de màquines" Salvador Cardona Foix i Daniel Clos Costa, Edicions UPC

"Mechanical design", Peter R.N. Childs, Arnold Publishers