Universitat de Lleida

DEGREE CURRICULUM

CAE STUDIES OF MACHINERY

Coordination: ROCA ENRICH, JOAN

Academic year 2019-20

Subject's general information

Subject name	CAE STUDIES OF MACHINERY
Code	14541
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	<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>2</td><td>OPTIONAL</td><td>Attendance-based</td></tr></table>
Course number of credits (ECTS)	6
Type of activity, credits, and groups	<table><tr><th>Activity type</th><th>PRAULA</th><th>TEORIA</th></tr><tr><th>Number of credits</th><td>3</td><td>3</td></tr><tr><th>Number of groups</th><td>1</td><td>1</td></tr></table>
Coordination	ROCA ENRICH, JOAN
Department	COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING
Teaching load distribution between lectures and independent student work	Attendance work: 40 % Autonomous work: 60 %
Important information on data processing	Consult this link for more information.
Language	English

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ROCA ENRICH, JOAN	joan.rocaenrich@udl.cat	6	

Subject's extra information

Main previous knowledge that is convenient for the proper development of the subject:

- Basic mathematics for engineering

- Sketching and graphical representation of multibody systems

- Fundamentals of 3D-CAD design and modelling

- Kinematic and dynamic analysis of mechanisms with plane motion or with spatial motion

- Fundamentals of materials science

- Fundamentals of elasticity and strength of materials

Regarding 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.

- Laboratory gown from UdL (unisex) (blue or white colour)
- 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 laboratory 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 lenses 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

During the realization of visits to companies, the use of personal protective equipment (PPE) set by the centre is mandatory.

Learning objectives

General objective:

To give students the basic knowledge for the use of computer systems to simulate and to enhance machine and product designs, and also to introduce some techniques, tools, skills and abilities to develop and simulate machine designs using a commercial CAD/CAE software (CREO by PTC).

Specific objectives:

- Understand the top-down design methodology using a CAD/CAE software

- Know how to prepare, to execute and to analyse the results of a mechanism motion simulation

- Know how to prepare, to execute and to analyse the results of a structural FEM analysis

- Learn how to perform sensitivity and optimization studies depending on design parameters

Competences

General competences

CG3. Capacity to convey information, ideas, problems and solutions both to a specialised and no specialised public.

CG4. Capacity to conceive, design and implement projects and/or provide new solutions, using the tools that the engineering offers.

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-disciplinary competences

CT1. Appropriate skills in oral and written language.

CT2. Command of a foreign language.

Subject contents

1. CAE IN THE MACHINE DESIGN PROCESS

1.1 The top-down design methodology

1.2 CAD/CAE interaction

2. MECHANISM SIMULATION

2.1 Definition of mechanism bodies and connections

2.2 Kinematic analyses

2.3 Dynamic analyses

3. MODEL ANALYSES DEPENDING ON DESIGN PARAMETERS

3.1 Sensitivity studies

3.2 Optimization studies

4. STRUCTURAL FEM ANALYSES

4.1 Introduction to the FEM in structural analyses

4.2 Model preparation

4.3 Definition of loads and constraints

4.4 Running an analysis

4.5 Results evaluation

4.5 Analyses of assemblies

4.6 Idealizations to enhance model definition

Methodology

Lectures: In the lectures, the contents of the subject is exposed orally by a teacher without the active participation of students.

Problems: In the activities of problems solving, the professors present a complex issue that students must solve, whether working individually or in teams.

Seminars: Group dynamics technique consisting of working sessions of a rather small group investigating an issue through dialogue and discussion, under the guidance of a teacher or an expert. They can be used to deepen a monographic issue, from the information previously provided by the teacher.

Project development: Active teaching methodology that promotes the learning through the realization of a project: idea, design, planning, development and evaluation of the project.

Development plan

Week	Methodology	Unit	Attendance hours	Autonomous work hours
1	Lectures Problems	Unit 1	2 2	3 3
2	Lectures Seminar	Unit 1	2 2	3 3
3	Lectures Problems	Unit 2	2 2	3 3
4	Lectures Seminar	Unit 2	2 2	3 3
5	Lectures Project	Unit 2	2 2	3 3
6	Seminar Project	Unit 2	2 2	3 3
7	Lectures Problems	Unit 3	2 2	3 3
8	Lectures Project	Unit 3	2 2	3 3
9	Evaluation	Exam 1		
10	Lectures Problems	Unit 4	2 2	3 3
11	Lectures Problems	Unit 4	2 2	3 3
12	Lectures Seminar	Unit 4	2 2	3 3
13	Lectures Problems	Unit 4	2 2	3 3

14	Seminar Project	Unit 4	2 2	3 3
15	Project	Unit 4	4	6
16-17	Evaluation	Exam 2		
18	Tutoring	Tutoring		
19	Evaluation	Recovery of the projects		

Evaluation

Objectives	Evaluation activities	Criteria	%	Dates	M/V (1)	I/G (2)	Observations
Chapter 1-3	1st written exam		10	Week 9	M	I	The content to be evaluated is the one exposed and worked in class up to the date of this exam
Practical application of chapters 1, 2 and 3	Project 1	(3)	40	Delivery: Week 9	M	I	Project about the simulation and optimization of a mechanism
Chapter 4-5	2nd written exam		10	Week 16-17	M	I	The content to be evaluated is mainly the one exposed and worked in class between written exam 1 and written exam 2
Practical application of chapters 1, 3 and 4	Project 2	(3)	40	Delivery: Week 16	M	I	Project about the FEM structural study of some mechanical components
Recovery of Projects	Project 1 / 2	(4)		Week 19	V	I	

(1) Mandatory / Voluntary

(2) Individual / in Groups

(3) In order to pass the subject, it is necessary that the mark of each project is equal or higher than 4

(4) If the minimum mark of 4 is not reached on any of the projects, the subject mark will be the minimum between the result of the percentages of the table above and 4

Bibliography

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.

RIBA, C. (1995) Disseny de Màquines I. Mecanismes. Edicions UPC. Barcelona.

AGULLÓ, J. (1995) Mecànica de la partícula i del sòlid rígid". Ed. Publicacions OK punt

BEER, F.P. et al. (2012) Mechanics of materials. Ed. McGrawHill

LIU G.R., QUEK S.S. (2003) The finit element method. A practical course. Ed. Elsevier

OÑATE, E. (2009) Structural Analysis with the Finite Element Method. Ed. Springer

CREO Tutorials. PTC Corporation, USA

Adaptations to the methodology due to COVID-19

The attendance classes are replaced by online classes by videoconference at the same scheduled times and with the same objective, whether they are master classes or problem classes. These classes are recorded so that students can review them whenever it suits them.

Adaptations to the evaluation due to COVID-19

Objectives	Evaluation activities	Criteria	%	Dates	M/V (1)	I/G (2)	Observations
Practical application of chapters 1, 2 and 3	Project 1	(3)	40	Delivery: Week 11	M	I	Project about the simulation and optimization of a mechanism
Chapter 1-4	Written exam	(5)	20	Week 16-17	M	I	The content to be evaluated is the one exposed and worked in class during the whole course
Practical application of chapters 1, 3 and 4	Project 2	(3)	40	Delivery: Week 16	M	I	Project about the FEM structural study of some mechanical components
Recovery of Projects	Project 1 / 2	(4)		Week 19	V	I	

(1) Mandatory / Voluntary

(2) Individual / in Groups

(3) In order to pass the subject, it is necessary that the mark of each project is equal or higher than 4

(4) If the minimum mark of 4 is not reached on any of the projects, the subject mark will be the minimum between the result of the percentages of the table above and 4

(5) All individual exams will be conducted online