



Universitat de Lleida

# DEGREE CURRICULUM **STRUCTURAL AND MECHANICAL ANALYSIS**

Coordination: ROCA ENRICH, JOAN

Academic year 2019-20

## Subject's general information

Subject name	STRUCTURAL AND MECHANICAL ANALYSIS			
Code	14535			
Semester	1st Q(SEMESTER) CONTINUED EVALUATION			
Typology	Degree	Course	Character	Modality
	Master's Degree in Industrial Engineering	1	OPTIONAL	Attendance-based
Course number of credits (ECTS)	6			
Type of activity, credits, and groups	Activity type	PRAULA	TEORIA	
	Number of credits	3	3	
	Number of groups	1	1	
Coordination	ROCA ENRICH, JOAN			
Department	COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING			
Teaching load distribution between lectures and independent student work	40% attendance 60% autonomus work			
Important information on data processing	Consult <a href="#">this link</a> for more information.			
Language	Catalan. Also some material in spanish or in english			
Office and hour of attention	Joan Roca. Office 0.07, CREA buiding. Monday, 12:00 to 13:00. Wednesday, 17:00 to 18:00 Martí Comellas. Office 0.19, CREA buiding. Monday, 17:00 to 18:00. Thursday, 12:00 to 13:00			

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

The main previous knowledge necessary for the proper development of the subject are:

- Basic mathematics for engineering
- Computer Basics
- Sketching and graphical representation of multibody systems
- Kinematics and dynamics of rigid bodies with plane motion
- Kinematic and dynamic analysis of mechanisms with plane motion
- Fundamentals of materials science
- Fundamentals of Electrical Engineering
- Fundamentals of Fluid Mechanics

### 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 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>

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 gives students the basic knowledge, techniques, tools, skills and abilities to effectively develop professional activities involved in carrying out projects concerning mechanical systems engineering

### Specific objectives:

- To understand the functional structure of a machine
- To be able to approach the basic dynamic studies of a simple machine
- Acquire the basic knowledge of the different types of materials used in mechanical construction
- Achieve sufficient capacity to select the most appropriate structural design criteria for every part of a mechanical assembly
- Know the different systems and processes for manufacturing parts, especially the metallic ones, due to its great importance in the industrial world

## Competences

### General competences

- **CG1** Capacity of planning and organizing the personal work.
- **CG6** To have suitable knowledge of the scientific and technological issues 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.

**Specific competences**

- **CE2** Knowledge and capacity to project, calculate and design integrated manufacturing systems.
- **CE3** Capacity for the design and testing of machines.
- **CE11** Knowledge and capacities for the calculation and design of structures.

**Subject contents****1. DYNAMICS OF MACHINES WITH ONE DEGREE OF FREEDOM**

- 1.1 Main components of a machine: from the engine/motor to the functional group
- 1.2 Energy balance of a machine or a mechanical system
- 1.3 One axis equivalent model for a one degree of freedom mechanical system
- 1.4 Operating modes of a machine

**2. MATERIALS IN MECHANICAL ENGINEERING**

- 2.1 Properties of Materials
- 2.2 Classification of materials
- 2.3 Ferrous metals: steels and cast irons
- 2.4 Other non-ferrous metals
- 2.5 Polymers

**3. MECHANICS OF MATERIALS**

- 3.1 Introduction to the mechanics of materials
- 3.2 Types of internal loading
- 3.3 Stress
- 3.4 Relationship between stress and strain
- 3.5 Introduction to the linkage systems analysis

**4. MACHINE ELEMENTS**

- 4.1 Introduction
- 4.2 Gear transmissions
- 4.3 Belts and chains
- 4.4 Bearings
- 4.5 Transmission shafts

## 5. MECHANICAL MANUFACTURING PROCESSES

### 5.1 Introduction

### 5.2 Casting and molding

### 5.3 High temperature forming

### 5.4 Sheet cutting and forming

### 5.5 Machining processes

### 5.6 Welding

### 5.7 Other manufacturing processes

## 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.

**Work in group:** Learning activity that has to be done through collaboration between members of a group

**Visits:** Activity of a group of students, guided by the teachers, which consists of going to a certain place to get direct information that favours the learning process

## Development plan

Week	Methodology	Unit	Attendance hours	Autonomous work hours
1	Lectures	Unit 1: Theory	2	0
2	Lectures Seminar	Unit 1: Theory Unit 1: Seminar	2 2	4
3	Seminar Work in group	Unit 1: Seminar Work in group	2 2	4
4	Lectures	Unit 2: Theory	2 2	4

5	Lectures Work in group	Unit 2: Theory Work in group	2 1	6
6	Seminar Work in group	Unit 2: Seminar Work in group	2 2	4
7	Lectures Seminar	Unit 3: Theory Unit 3: Seminar	2 2	4
8	Lectures Problems	Unit 3: Theory Unit 3: Problems	2 1	6
9	Evaluation	Exam 1	2	5
10	Lectures Seminar	Unit 4: Theory Unit 4: Seminar	2 2	6
11	Lectures Problems	Unit 4: Theory Unit 4: Problems 2	2 2	8
12	Work in group Visit		2 2	6
13	Work in group		2 2	6
14	Lectures Seminar	Unit 5: Theory Unit 5: Seminar	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

Objectives	Evaluation activities	Criteria	%	Dates	M/V (1)	I/G (2)	Observations
Chapter 1-3	1st written exam		20	Week 9	M	I	The content to be evaluated is the one exposed and worked in class up to the date of this exam
Specific sections of the content	Seminars and case studies		20	(3)	M	I/G	Seminars and case studies presented in class and performed individually or in groups
Practical application of all chapters	Work in group		25	Delivery: Week 15	M	G	Work in group about a mechanical assembly study

Chapter 4-5	2nd written exam	(4)	35	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
Chapter 1-5	Recovery exam	(5) (6)	55	Week 19	V	I	Recovery exam of both written exams

(1) Mandatory / Voluntary

(2) Individual / in Groups

(3) Some seminars and case studies will be carried out throughout the course

(4) In order to pass the subject, it is necessary that the average weighted mark of the two individual written exam is  $\geq 3$

(5) A minimum mark of 3 over 10 is required to pass the subject

(6) If the minimum mark of 3 is not reached on the individual exams, the subject mark will be the minimum between the result of the percentages of the table above and 3

Note: in the case that the student does not attend any of the practices/visits or any of the reports is evaluated as Not Correct, the mark of the subject will be No Presented.

## Bibliography

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NORTON, R.L. *"Diseño de máquinas"*. Editorial Prentice Hall. 1999

RIBA, C. *"Disseny de Màquines IV. Selecció de materials 1"*. Edicions UPC. Barcelona. 1998

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"Materials Selection in Mechanical Design", Michael F. Asby, Ed. Elsevier

DOWLING, N.E. *"Mechanical Behavior of Materials"*. Ed. Pearson. 2013

ORTIZ BERROCAL. *Resistencia de Materiales*. Mc Graw Hill

ORTIZ BERROCAL. *Elasticidad*. McGraw Hill.

TIMOSHENKO. *Resistencia de Materiales*. Thomson

M.ROMERO,P.MUSEROS,M.MARTINEZ *Resistencia de Materiales*. Ed. Universitat Jaume I

RIBA, C. *"Disseny de Màquines II. Estructura constructiva"*. Edicions UPC. Barcelona. 1995

DECKER, K.H. *"Elementos de máquinas"*. Ediciones URMO. 1980

GROOVER, M.P. *"Fundamentos de manufactura moderna"*. Ed. Mc GrawHill 2007

SCHEY, J. *"Introduction to manufacturing processes"*. Ed. Mc GrawHill 2000

## 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.

In addition, prior explanations are recorded on video and using the whiteboard for initial explanations of the content and also for examples of problem developments.

The 3rd laboratory practice will be replaced by a small work in groups with the same learning objectives as the practice.

## Adaptations to the evaluation due to COVID-19

All individual exams will be conducted online