



Universitat de Lleida

# DEGREE CURRICULUM

# **CALCULUS AND MACHINE DESIGN**

Coordination: ROCA ENRICH, JOAN

Academic year 2023-24

## Subject's general information

<b>Subject name</b>	CALCULUS AND MACHINE DESIGN			
<b>Code</b>	102304			
<b>Semester</b>	2nd Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	<b>Degree</b>	<b>Course</b>	<b>Character</b>	<b>Modality</b>
	Bachelor's Degree in Mechanical Engineering	3	COMPULSORY	Attendance-based
	Double bachelor's degree: Degree in Mechanical Engineering and Degree in Energy and Sustainability Engineering	4	COMPULSORY	Attendance-based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRALAB	PRAULA	TEORIA
	<b>Number of credits</b>	0.4	2.6	3
	<b>Number of groups</b>	4	2	1
<b>Coordination</b>	ROCA ENRICH, JOAN			
<b>Department</b>	INDUSTRIAL AND BUILDING ENGINEERING			
<b>Teaching load distribution between lectures and independent student work</b>	Attendance work: 40 % Autonomous work: 60 %			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	Catalan. Also some material in spanish or in english			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ROCA ENRICH, JOAN	joan.rocaenrich@udl.cat	8,2	Tuesday, 12 to 13 Wednesday, 19 to 20 h CREA building, office 0.07 Online, Session "Consultes"
ROCA ENRICH, JOAN	joan.rocaenrich@udl.cat	0	Tuesday, 12 to 13 Wednesday, 19 to 20 h CREA building, office 0.07 Online, Session "Consultes"
SOLE CUTRONA, CRISTIAN	cristian.sole@udl.cat	1,6	

## Subject's extra information

The main background needed to take advantage of the subject are: graphic expression, materials science, kinematics and dynamics of mechanisms.

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

- Graphics Expression I
- Theory of Mechanisms
- Theory of Machines
- Materials for mechanical manufacturing
- Elasticity and Strength of Materials (I, II)

It is also advisable to be taking at the same time the subjects:

- Manufacturing technologies
- Graphic Expression II

### 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.spri.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

- Know and understand the different steps in the design process of a machine
- To introduce the basic principles of fatigue in machine design
- Acquire the basic knowledge for the calculation, selection or dimensioning of threaded elements
- Acquire the basic knowledge for the calculation, selection or dimensioning of flexible transmission systems

- Acquire the basic knowledge for the calculation, selection or dimensioning of gear transmissions
- Acquire the basic knowledge for the calculation, selection or dimensioning of rolling and sliding bearings
- Acquire the basic knowledge for the calculation, design and dimensioning of transmission shafts
- Acquire the basic knowledge for the analysis and design of clutches and brakes

## 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. SPECIFICATIONS AND REQUIREMENTS OF A MACHINE
2. BOLTS AND THREADED ELEMENTS
3. STRUCTURAL FATIGUE OF MACHINE ELEMENTS
4. FLEXIBLE TRANSMISSION SYSTEMS
5. CALCULATION OF GEAR TRANSMISSIONS
6. BEARINGS AND GUIDANCE SYSTEMS
7. CALCULATION OF TRANSMISSION SHAFTS
8. CLUTCHES AND BRAKES

## Methodology

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

Lecture classes may be supported by explanatory videos that will be made available to students.

**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 design parameters of mechanical systems, 1 practice about design of machinery using CAD (software CREO).

## Development plan

Week	Methodology	Unit	Attendance hours	Autonomous work hours
1	Lectures	Unit 1: Theory	2	0
2	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	4
3	Lectures Problems	Unit 2-3: Theory Work in group 1	2 2	4
4	Lectures Problems	Unit 3: Theory Practice 1	2 2	4
5	Lectures Practice	Unit 4: Theory Work in group 1	2 1	6
6	Lectures Problems	Unit 4: Theory Practice 2	2 2	4
7	Lectures Problems	Unit 5: Theory Unit 4: Problems	2 2	4
8	Lectures Practice	Unit 5: Theory Work in group 1	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 6: Theory Work in group 2	2 2	8
12	Lectures Problems	Unit 6: Theory Unit 6: Problems	2 2	6
13	Lectures Problems	Unit 7: Theory Work in group 2	2 2	6
14	Lectures Problems	Unit 7: Theory Unit 7: Problems	2 2	6

15	Lectures Problems	Unit 8: Theory Unit 8: Problems	2 2	6
16-17	Evaluation	Exam 2	2	7
18	Tutoring	Tutoring	2	4
19	Evaluation	Recovery exam	2	4

## Evaluation

There will be several evaluation activities, grouped in 3 blocks as indicated in the following table:

- 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.
- 2nd individual written exam (week 9). The content to be evaluated is the problems and the practice sessions realised up to the date of this exam.
- 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 1<sup>st</sup> and 2<sup>nd</sup> exams date on.
- 4th individual written exam (week 16 or 17). The content to be evaluated is the problems and the practice sessions realised from the 1<sup>st</sup> and 2<sup>nd</sup> exams date on.
- In order to pass the subject, a minimum mark of 3 out of 10 must be reached as the mark of Block II. If this minimum mark of 3 is not reached, the subject mark will be the minimum between the weighed mark of Block II and 3.
- Practice sessions: Report of each practice sessions
- Recovery exams of the Block II (week 20). In order to be able to sit for this exam, a minimum mark of 2.5 out of 10 must be reached as the mark of Block II

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

	Activitat	Weight
Block I Pruebas tipo test multi-respuesta	1st individual exam	14
	2n individual exam	14
Block II Pruebas tipo problemas	3rd individual exam	31
	4th individual exam	31
Block III Prácticas	Practice sessions	10
Recovery of Block II	Recovery exam of the individual exams 2 <sup>nd</sup>	31
	Recovery exam of the individual exams 4 <sup>th</sup>	31

### Alternative assessment

- There will be 2 final written exams in June, coinciding with tests 3 and 4 of the continuous assessment

- Multiple-choice written test of all course content. Weight: 28% of the subject grade.
- Written problem-type exam, corresponding to all the problems and practice sessions carried out during the course. Weight: 62% of the subject grade.



- Practice sessions. Realization and report of each practice.
- Recovery of the written problem type test, which will be divided into 2 parts just like in the continuous assessment (week 20). To be able to take these tests, the weighted grade of the two written tests must be equal to or higher than 2.5. The syllabus presented in class and worked on throughout the subject will be evaluated. If the student takes one of these tests, the grade obtained replaces the grade of the corresponding previous test, whether it is higher or lower.

## Bibliography

- DECKER, K.H. "Elementos de máquinas". Ediciones URMO. 1980
- RIBA, C. "Disseny de Màquines I. Mecanismes". Edicions UPC.Barcelona. 1995
- RIBA, C. "Disseny de Màquines II. Estructura constructiva".Edicions UPC. Barcelona. 1995
- RIBA, C. "Disseny de Màquines IV. Selecció de materials 1". Edicions UPC. Barcelona.1998
- RIBA, C. "Disseny de Màquines IV. Selecció de materials 2". Edicions UPC. Barcelona.1998
- RIBA, C. "Disseny de Màquines V. Metodologia". Edicions UPC.Barcelona. 1998
- FENOLLOSA, J. "Unions cargolades". Edicions UPC. Barcelona.1997
- NORTON, R.L. "Diseño de máquinas". Editorial Prentice Hall.1999
- SHIGLEY & MISCHKE. "Diseñoen Ingenieria Mecànica". Ed. McGraw Hill. España 1998