DEGREE CURRICULUM

# STRUCTURAL AND MECHANICAL ANALYSIS

Coordination: ROCA ENRICH, JOAN

Academic year 2021-22

# STRUCTURAL AND MECHANICAL ANALYSIS 2021-22

## Subject's general information

<table>
<tr><td>Subject name</td><td>STRUCTURAL AND MECHANICAL ANALYSIS</td></tr>
<tr><td>Code</td><td>14535</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>Master's Degree in Industrial Engineering (M 2021)</td><td>1</td><td>OPTIONAL</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>ROCA ENRICH, JOAN</td></tr>
<tr><td>Department</td><td>COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>40% attendance<br>60% autonomus 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.<br>Also some material in spanish or in english</td></tr>
</table>

# STRUCTURAL AND MECHANICAL ANALYSIS 2021-22

| Teaching staff | E-mail addresses | Credits taught by teacher | Office and hour of attention |
|---|---|---|---|
| COMELLAS ANDRÉS, MARTÍ | marti.comellas@udl.cat | 3 | Monday, 17:00 a 19:00<br>CREA building, Office 0.19 |
| ROCA ENRICH, JOAN | joan.rocaenrich@udl.cat | 3 | |

## 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

**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.

- 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 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

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.

In the 2020-21 academic year, depending on the health situation of our territory, some of these sessions may be held online using the "Videoconferencia" tool of the virtual campus (SAKAI).

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

**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<br>Seminar | Unit 1: Theory<br>Unit 1: Seminar | 2<br>2 | 4 |
| 3 | Seminar<br>Work in group | Unit 1: Seminar<br>Work in group | 2<br>2 | 4 |
| 4 | Lectures | Unit 2: Theory | 2<br>2 | 4 |
| 5 | Lectures<br>Work in group | Unit 2: Theory<br>Work in group | 2<br>1 | 6 |
| 6 | Seminar<br>Work in group | Unit 2: Seminar<br>Work in group | 2<br>2 | 4 |
| 7 | Lectures<br>Seminar | Unit 3: Theory<br>Unit 3: Seminar | 2<br>2 | 4 |
| 8 | Lectures<br>Problems | Unit 3: Theory<br>Unit 3: Problems | 2<br>1 | 6 |
| 9 | Evaluation | Exam 1 | 2 | 5 |
| 10 | Lectures<br>Seminar | Unit 4: Theory<br>Unit 4: Seminar | 2<br>2 | 6 |
| 11 | Lectures<br>Problems | Unit 4: Theory<br>Unit 4: Problems 2 | 2<br>2 | 8 |
| 12 | Work in group<br>Visit | | 2<br>2 | 6 |
| 13 | Work in group | | 2<br>2 | 6 |
| 14 | Lectures<br>Seminar | Unit 5: Theory<br>Unit 5: Seminar | 2<br>2 | 6 |
| 15 | Lectures<br>Problems | Unit 5: Theory<br>Unit 5: Problems | 2<br>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 >= 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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ORTIZ BERROCAL. Resistencia de Materiales. Mc Graw Hill

ORTIZ BERROCAL. Elasticidad. McGraw Hill.

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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

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

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