1. OVERVIEW

Subject area	Mechanical Engineering
Degree	Bachelor's Degree in Industrial Organisation Engineering
School/Faculty	Faculty of Science, Engineering and Design
Year	Second
ECTS	6 ECTS
Type	Compulsory
Language(s)	Spanish
Delivery Mode	On campus
Semester	First semester

2. INTRODUCTION

Mechanical Engineering is taught in the second year (first semester) of the Degree in Industrial Organisation Engineering. This subject has two separate parts: one dealing with knowledge of elasticity and resistance of materials and structural elements, while the other focuses on theory of machines and mechanisms.

Elasticity and resistance of materials is a core topic because it teaches the criteria for choosing the most suitable material, shape, characteristics and size for structural elements or machines so they can resist the external forces they will be subjected to during their useful lives.

Theory of machines and mechanisms builds knowledge of synthesis, kinematics and dynamics to design mechanisms and machines. Here, students will be able to solve some basic problems in this field including: dimensional and kinematic synthesis; and structural, kinematic and dynamic analysis. These are applied to planar and spatial mechanisms. Together with analysis, synthesis of mechanisms is also essential in the initial design of mechanical systems based on certain specifications, generally pre-determined movements, governed by how the general apparatus which incorporates the mechanism works.

3. SKILLS AND LEARNING OUTCOMES

Basic skills (CB, by the acronym in Spanish):

- CB2. Students can apply their knowledge to their work or vocation in a professional manner and possess the skills which are usually evident through the forming and defending of opinions and resolving problems within their study area.
- CB3. Students have the ability to gather and interpret relevant data (usually within their study area) to form opinions which include reflecting on relevant social, scientific or ethical matters.
- CB4. Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

- CB5. Students have developed the learning skills necessary to undertake further study in a much more independent manner.

Cross-curricular skills (CT, by the acronym in Spanish):

- CT02. Independent learning: skills for choosing strategies to search, analyse, evaluate and manage information from different sources, as well as to independently learn and put into practice what has been learnt.
- CT03. Teamwork: ability to integrate and collaborate actively with other people, areas and/or organisations to reach common goals.
- CT04. Written/spoken communication: ability to communicate and gather information, ideas, opinions and viewpoints to understand and be able to act, spoken through words or gestures or written through words and/or graphic elements.
- CT05. Analysis and problem-solving: be able to critically assess information, break down complex situations, identify patterns and consider different alternatives, approaches and perspectives in order to find the best solutions and effective negotiations.
- CT08. Entrepreneurial spirit: ability to take on and carry out activities that generate new opportunities, foresee problems or lead to improvements.

Specific skills (CE, by the acronym in Spanish):

- CE06. Ability to use basic knowledge of materials science, associate microstructure synthesis and processing, and use the properties of the materials for solving problems in engineering projects and activity.
- CE07. Ability to apply the knowledge of materials resistance and principles of machines and mechanisms to solve problems in industrial projects and activity in the field of engineering.
- CE08. Ability to use basic knowledge of production and manufacturing systems in industrial organisation processes.

Learning outcomes (RA, by the acronym in Spanish):

- RA1. Determine the structure and type of materials required for different engineering projects, taking into account their physical, mechanical and chemical properties together with their structure.
- RA2. Effectively solve basic problems in the field of mechanical engineering which arise in projects, whether they be regarding stress or mechanisms.
- RA3. Design and manage the manufacturing process in the production of the end product.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes (RA, by the acronym in Spanish)
CB2, CB3, CB4, CB5, CT2, CT3, CT4, CT5, CT8, CE6, CE7	RA1. Determine the structure and type of materials required for different engineering projects, taking into account their physical, mechanical and chemical properties together with their structure.
CB2, CB3, CB4, CB5, CT2, CT3, CT4, CT5, CT8, CE6, CE7	RA2. Effectively solve basic problems in the field of mechanical engineering which arise in projects, whether they be regarding stress or mechanisms.
CB2, CB3, CB4, CB5, CT2, CT3, CT4, CT5, CT8, CE8	RA3. Design and manage the manufacturing process in the production of the end product.

4. CONTENTS

The subject area is divided into four learning units, which are then divided into topics (the number of topics depends on the unit):

Unit 1. Principles of elasticity and resistance

- 1.1. Mechanics of rigid and deformable bodies
- 1.2. Basic hypotheses of elasticity and resistance of materials
- 1.3. Tension
- 1.4. Deformation
- 1.5. Tension-deformation. Hooke's law
- 1.6. Laboratory experiments on tension-deformation

Unit 2. Basic structural elements subjected to force

- 2.1. Concepts of parts and barrier structure. Elements
- 2.2. Supports and links. Reactions and linkage
- 2.3. Planar and spatial structures. Isostatic and hyperstatic configurations
- 2.3. Forces on a section and parts in a median plane
- 2.4. Axial force

Unit 3. Combined stress

- 3.1. Pure and simple bending.
- 3.2. Composite and skew bending.
- 3.3. Twisting moment.
- 3.4. Instability and sag.

Unit 4. Fundamentals of machine theory

- 4.1. Introduction to machine theory. Machines and mechanisms.
- 4.2. Links or elements.
- 4.3. Kinematic pairs. Lower or higher.
- 4.4. Pairs based on mechanical constraint. Gruebler's Equation.
- 4.5. Kinematic chain. Inversion.
- 4.6. Types of mechanisms. Grashof's law

Unit 5. Kinematic and dynamic analysis of mechanisms

- 5.1. Kinematics of rigid bodies
- 5.2. Kinematics of planar mechanisms
- 5.3. Dynamics of rigid bodies
- 5.4. Dynamics of mechanisms

Unit 6. Mechanical elements

- 6.1. Mechanical elements. Classification and functions
- 6.2. Transmission of movement mechanisms
- 6.3. Transformation of movement mechanisms

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- Master lecture / Web conference
- Collaborative learning
- Problem-based learning (PBL)
- Project-based learning
- Learning based on laboratory work (laboratory, workshop and simulation environments)
- Case study
- Gamification
- Field work (field trips, work experience)

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

Learning activity	Number of hours
Master classes	22
Problem-solving	9
Case studies and field studies	6
Laboratory work	12
Debates and discussions	6
Learning contract (definition of interests, needs and objectives)	1.5
Autonomous learning	49.5
Tutorials	5
Knowledge tests	1.5
TOTAL	**150**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
On Campus knowledge test	50%
Reports, written assignments, group work and workshops	30%
Attitude assessment tests (class participation)	10%
Self- and co-assessment (learning objectives).	10%

8. BIBLIOGRAPHY

The recommended bibliography is indicated below:

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Beer and Johnston, Mecánica Vectorial para Ingenieros: Estática y Dinámica, McGraw-Hill

R. C. Hibbeler, Ingeniería Mecánica: Estática y Dinámica, Prentice-Hall

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