

## Course guide

### 320010 - SM - Mechanical Systems

**Last modified:** 19/04/2023

**Unit in charge:** Terrassa School of Industrial, Aerospace and Audiovisual Engineering  
**Teaching unit:** 712 - EM - Department of Mechanical Engineering.

**Degree:** BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 6.0    **Languages:** Catalan

#### LECTURER

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**Coordinating lecturer:** Arcos Villamarín, Robert

**Others:** Marañón Martínez, Ana  
Ripoll Garcia, Ruben  
Ciscar Adalid, Maria  
Clot Razquin, Arnau

#### PRIOR SKILLS

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Students will be expected to be fully proficient in statics as taught in Physics.

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

CE14-INDUS. Knowledge and use of principles of material resistance. (Common module in the industrial branch)

**Generical:**

CG05-INDUS. Knowledge for carrying out measurements, calculations, valuations, appraisals, expert opinions, studies, reports, work plans, and other similar tasks.

#### TEACHING METHODOLOGY

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- Face-to-face lectures and problem solving sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

In the lectures, the lecturer will introduce the theoretical fundamentals of the subject, concepts, methods and results, which will be illustrated with relevant examples to facilitate their understanding.

Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set.

Tools found on the ATENEA platform will be used to foster collaborative learning.

The transversal piece of work on the course will concentrate on the study of an object, machine or real mechanism. It will be completed outside of class time in groups.

## LEARNING OBJECTIVES OF THE SUBJECT

Provide students with the knowledge that will enable them to determine the parameters characteristic of a mechanical system.  
Examine the elements characteristic of power systems, for subsequent use in statics and dynamics.  
Model applied force and bonding actions so that diagrams of the free system can be plotted.  
Understand the kinematics and dynamics of simple mechanisms and the basic concepts behind them.  
The ultimate aim of the above set of skills is to apply them to the static study of various systems: particles, rigid bodies, trusses and cables. It is essential to acquire these skills as they will subsequently be used in many applications.

## STUDY LOAD

Type	Hours	Percentage
Hours medium group	30,0	20.00
Hours large group	30,0	20.00
Self study	90,0	60.00

**Total learning time:** 150 h

## CONTENTS

### TOPIC 1: INTRODUCTION

#### Description:

- 1.1. Fundamental concepts
- 1.2. Newton's laws
- 1.3. Vector study
- 1.4. Statics of particles

#### Specific objectives:

- Introduction to the subject, learning objectives, syllabus, coursework, assessment system and reading list.
- Introduction of the basic concepts of mechanics.
- Overview of all the vector concepts required to follow the subject.

#### Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

## TOPIC 2: STATICS OF RIGID BODIES

### Description:

- 2.1. Equilibrium in two dimensions
- 2.2. Reactions
- 2.3. Internal forces

### Specific objectives:

- Study of the conditions of equilibrium of a system of rigid bodies.
- Type of forces applied.
- Determination of bonding actions.
- Plotting of diagrams of free solids.
- Study of the internal forces that hold solids together.

### Related activities:

AV1, AV4

### Related competencies :

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

### Full-or-part-time: 38h

Theory classes: 5h 30m

Practical classes: 7h 30m

Self study : 25h

## TOPIC 3: BEAMS

### Description:

- 3.1. Internal forces
- 3.2. Beams with concentrated loads
- 3.3. Beams with distributed loads

### Specific objectives:

- Study of the internal forces that support beams.
- Plotting of diagrams of the bending moment and shear stress.

### Related activities:

AV1, AV3

### Related competencies :

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

CE14-INDUS. Knowledge and use of principles of material resistance. (Common module in the industrial branch)

### Full-or-part-time: 31h 30m

Theory classes: 6h

Practical classes: 7h 30m

Self study : 18h

#### TOPIC 4: TRUSSES

**Description:**

- 4.1. Types of truss
- 4.2. Statics study of anchors
- 4.3. Knot theory
- 4.4. Method of sections

**Specific objectives:**

- Study of forces that hold each part of a truss together.
- Application of various calculus methods.

**Related activities:**

AV2

**Related competencies :**

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

**Full-or-part-time:** 13h

Theory classes: 2h

Practical classes: 2h

Self study : 9h

#### TOPIC 5: CABLES

**Description:**

- 5.1. Cables with concentrated loads
- 5.2. Cables with distributed loads
- 5.3. The catenary

**Specific objectives:**

- Study of tension supported by cables.

**Related activities:**

AV1

**Related competencies :**

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

**Full-or-part-time:** 16h 30m

Theory classes: 3h 30m

Practical classes: 5h

Self study : 8h

## TOPIC 6: KINEMATICS AND MECHANISM DYNAMICS

### Description:

- 6.1. Introduction
- 6.2. Plane kinematics
- 6.3. Plane dynamics

### Specific objectives:

- Definitions of the basic components that make up a mechanism.
- Methodology for calculating velocity and acceleration.
- Introduction to dynamics.
- Transfer of movement

### Related activities:

AV1, AV4

### Related competencies :

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

### Full-or-part-time: 41h

Theory classes: 9h

Practical classes: 8h

Self study : 24h

## TOPIC 7: ANALYSIS OF SYSTEMS INVOLVING DRY FRICTION

### Description:

- 7.1. Laws of friction
- 7.2. Diverse applications

### Specific objectives:

- Study of forces that hold each part of a truss together.
- Application of various calculus methods.

### Related activities:

AV1

### Related competencies :

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

### Full-or-part-time: 6h

Theory classes: 2h

Self study : 4h

## ACTIVITIES

### AV1

**Description:**

Resolution of an exercise proposed by the teacher, on a group work based, during the class.

**Specific objectives:**

The estudiante has to be able to apply and consolidate the theoretical knowledge achieved on the subject. And also must be able to analyse the problem and design the plan for the resolution with the established time.

**Material:**

Class notes, theory's slides and the wording of the exercise.

**Delivery:**

The averaged mark of all the exercises doned during the course corresponds with a 10% of other deliveries assessment.

**Related competencies :**

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

CE14-INDUS. Knowledge and use of principles of material resistance. (Common module in the industrial branch)

**Full-or-part-time:** 4h

Practical classes: 4h

### AV2

**Description:**

Solve a case proposed by the teacher, develop it in a written format and do the oral exposition.

**Specific objectives:**

That the student learn to use strategies for preparing and giving oral presentations, writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors. Participate on working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

**Material:**

Bibliographical resources of the subject, class notes, rubric of the efficient oral and written communication.

**Delivery:**

The assessment of written and the oral work corresponds to a 15% in the qualification of the other deliveries.

**Related competencies :**

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

**Full-or-part-time:** 9h

Self study: 9h

### AV3

**Description:**

Development of the first examination of the subject.

**Specific objectives:**

Develop theoretical and practice classroom knowledge and show the level achieved. And also must be able to analyse the problem and design the plan for the resolution with the established time.

**Material:**

The wording to be solved and a formulary indicated by the teacher.

**Delivery:**

This activity is evaluated as oral and written tests of the global mark of the subject.

**Related competencies :**

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

CE14-INDUS. Knowledge and use of principles of material resistance. (Common module in the industrial branch)

**Full-or-part-time: 2h**

Theory classes: 2h

### AV4

**Description:**

Development of the second examination of the subject.

**Specific objectives:**

Develop theoretical and practice classroom knowledge and show the level achieved. And also must be able to analyse the problem and design the plan for the resolution with the established time.

**Material:**

The wording to be solved and a formulary indicated by the teacher.

**Delivery:**

This activity is evaluated as the item oral and written tests of the global mark of the subject.

**Related competencies :**

CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

**Full-or-part-time: 2h**

Theory classes: 2h

### AV5

**Description:**

Large group sessions

**Specific objectives:**

Establish the theoretical principles of the subject

**Material:**

Notes on Atenea platform and general bibliography on the subject

**Full-or-part-time: 66h 30m**

Theory classes: 26h

Self study: 40h 30m

## AV6

### Description:

Medium groups sessions

### Specific objectives:

Solve problems related to the subject

### Material:

Problem collection of the subject uploaded on Atenea

**Full-or-part-time:** 66h 30m

Practical classes: 26h

Self study: 40h 30m

## GRADING SYSTEM

- Oral and written tests 75% (25% first exam (AV3), 50% second exam AV4))
- Other deliveries 25% (Deliveries made in class (AV1) and project (AV2))
- Cross Competence (effective oral and written communication) embedded in the section on other deliveries.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of the activities 3 and 4 and the grades of the activities 1 and 2 will be kept.

If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

## EXAMINATION RULES.

Is essential to rate at other deliveries, to be present the date and time of the realization of the activity at the enrolled class.

The realization of the exams is without class notes.

The exam concerning the beam theme will be done compulsory with a calculator that does not make graphics.

## BIBLIOGRAPHY

### Basic:

- Hibbeler, R. C. Mecánica vectorial para ingenieros: estática. 10a ed. México: Pearson Educación, 2004. ISBN 9702605016.
- Meriam, J. L. Mecánica para ingenieros. Vol. 2, Dinámica [on line]. 3a ed. Barcelona: Reverté, 1998 [Consultation: 24/11/2021]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635460>. ISBN 8429142592.
- Beer, Ferdinand Pierre [et al.]. Mecánica vectorial para ingenieros, vol. 1, estática [on line]. 11ª ed. México: McGraw-Hill, 2017 [Consultation: 08/03/2023]. Available on : [https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=8077](https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8077). ISBN 9781456255275.

### Complementary:

- Meriam, J. L. Mecánica para ingenieros. Vol. 1, Estática [on line]. 3a ed. Barcelona: Reverté, 2004 [Consultation: 11/05/2022]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635461>. ISBN 8429142576.
- Shigley, Joseph Edward. Teoría de máquinas y mecanismos. México: McGraw-Hill, 1982. ISBN 968451297X.



## RESOURCES

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### Other resources:

Theory slides and problems collection puts on Atenea.