Course guide
320010 - SM - Mechanical Systems

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: 2022 ECTS Credits: 6.0 Languages: Catalan

LECTURER

Coordinating lecturer: Arcos Villamarín, Robert
Others: Marañón Martínez, Ana
Ripoll Garcia, Ruben
Ciscar Adalid, Maria
Clot Razquin, Arnau

PRIOR SKILLS

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

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
4. IND_COMMON: Understanding of and ability to use the principles of strength of materials.
5. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

TEACHING METHODOLOGY

- 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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
</tbody>
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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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.
CE14. IND_COMMON: Understanding of and ability to use the principles of strength of materials.

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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

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 student 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:**
- CE14. IND_COMMON: Understanding of and ability to use the principles of strength of materials.
- CE13. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

**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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.
- 04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

**Full-or-part-time:** 9h  
Self study: 9h
AV3

Description:
Development of the first examination of the subject.

Specific objectives:
Develope theoretical and practice classroom knowledge and show the level achieved. And also must be able to analise 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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

CE14. IND_COMMON: Understanding of and ability to use the principles of strength of materials.

Full-or-part-time: 2h
Theory classes: 2h

AV4

Description:
Development of the second examination of the subject.

Specific objectives:
Develope theoretical and practice classroom knowledge and show the level achieved. And also must be able to analise 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. IND_COMMON: Understanding of the principles of the theory of machines and mechanisms.

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:

Complementary:

RESOURCES

Other resources:
Theory slides and problems collection puts on Atenea.