Course guide
330063 - SM - Mechanical Systems

Unit in charge: Manresa School of 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 ICT SYSTEMS ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR’S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2021). (Compulsory subject).

Academic year: 2023  ECTS Credits: 6.0  Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: ANAS AL OMAR MESNAOUI
Others: Alcelay Larrión, José Ignacio
        Català Calderón, Pau
        Ortuño Martin, Jose
        Peña Pitarch, Esteban

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Ability to know, understand and use the fundamental principles that govern the mechanical balance of rigid bodies, as well as the different calculation methods. Understand the problems of analysis and design of mechanical systems.

Transversal:
2. 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.
3. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

- Expository class of theory and problems: in this class it is not intended to make an exhaustive demonstration of the subject, but the student will be given a global vision of it insisting on the key concepts. Doubts will be discussed and standard problems and questions will be solved to ensure understanding of the subjects. The resolution of the problems in face-to-face class aims for the student to learn to analyze them and identify the key elements for their approach and resolution. For each face-to-face session, the student will be provided with enough notice in the virtual classroom, the notes on the topic covered in the session, and a series of problems. The reading of the theoretical content before the face-to-face session is mandatory and will be controlled by formulating questions during the class.
- Carrying out laboratory practices in small groups. Preparation of reports.
- Resolution and delivery of problems proposed individually.
- Tutoring, study and personal and team work.
- Exams and evaluation tests.
LEARNING OBJECTIVES OF THE SUBJECT

Once this course is finished, the student must be able to:
- Carry out the composition of a force system and analyze the equilibrium conditions of a rigid body subject to such a system.
- Solve the kinematic and dynamic problem of a mechanical system from the perspective of both analysis and synthesis.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
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<tr>
<td>Hours large group</td>
<td>45,0</td>
<td>30.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1. Force Systems

Description:

Related activities:
A 1, A 7 and A 9

Full-or-part-time: 25h
Theory classes: 8h
Laboratory classes: 2h
Self study: 15h

2. Balance of Rigid Bodies

Description:

Related activities:
A 2, A 7 and A 9

Full-or-part-time: 23h
Theory classes: 7h
Laboratory classes: 2h
Self study: 14h

3. Friction

Description:
Types of friction. Static and Kinetic Friction. Applications.

Related activities:
A 3, A 7 and A 9

Full-or-part-time: 15h
Theory classes: 4h
Laboratory classes: 2h
Self study: 9h
### 4. Kinematics of Rigid Bodies

**Description:**
Reference Systems. Plane Kinematics of Rigid Bodies. Instant Center of Rotation. Movement Relative to Axes in Rotation.

**Related activities:**
A 4, A 8 and A 9

**Full-or-part-time:** 30h
- Theory classes: 9h
- Laboratory classes: 3h
- Self study: 18h

### 5. Dynamics of Rigid Bodies

**Description:**

**Related activities:**
A 5, A 8 and A 9

**Full-or-part-time:** 30h
- Theory classes: 9h
- Laboratory classes: 3h
- Self study: 18h

### 6. Mechanisms as Rigid Body Systems

**Description:**

**Related activities:**
A 6, A 8 and A 9

**Full-or-part-time:** 27h
- Theory classes: 8h
- Laboratory classes: 3h
- Self study: 16h
ACTIVITIES

1. FORCES SYSTEMS

Description:
The activity consists of solving design-oriented problems using computer programs (spreadsheets, programs to solve equations and programs to draw graphs).

Specific objectives:
At the end of this activity the student should be able to:
Know, analyze and reduce the force systems applied to a mechanical system, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Series of Problems (available on the Digital Campus) and Teacher’s Notes.

Delivery:
Delivery of Proposed Problems.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

2. BALANCE OF RIGID BODIES

Description:
The activity consists of solving design-oriented problems using computer programs (spreadsheets, programs to solve equations and programs to draw graphs).

Specific objectives:
At the end of this activity the student should be able to:
Identify the reactions in the different joints of the mechanical system studied, apply the equilibrium equations correctly, work autonomously and as a team, and communicate effectively and clearly the results obtained.

Material:
Series of Problems (available on the Digital Campus) and Teacher’s Notes.

Delivery:
Delivery of Proposed Problems.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h
3. FRICTION

Description:
The activity consists of solving design-oriented problems using computer programs (spreadsheets, programs to solve equations and programs to draw graphs).

Specific objectives:
At the end of this activity the student should be able to:
Identify the types of friction and analyze the behavior of various mechanical systems in which friction plays a central role, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Series of Problems (available on the Digital Campus) and Teacher’s Notes.

Delivery:
Delivery of Proposed Problems.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

4. LABORATORY PRACTICE

Description:
Kinematic analysis of mechanical systems.

Specific objectives:
At the end of this activity the student should be able to:
Identify the most important aspects to carry out a kinematic analysis of any mechanical system, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Practice Script (available on the Digital Campus).

Delivery:
The students have to prepare, in groups of 5 people, a report of the practice, according to the instructions indicated and deliver it to the teacher within the deadline set for each practice.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h
5. LABORATORY PRACTICE

Description:
Dynamic analysis of mechanical systems.

Specific objectives:
At the end of this activity the student should be able to:
Identify the most important aspects to carry out a dynamic analysis of any mechanical system, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Practice Script (available on the Digital Campus).

Delivery:
The students have to prepare, in groups of 5 people, a report of the practice, according to the instructions indicated and deliver it to the teacher within the deadline set for each practice.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

6. LABORATORY PRACTICE

Description:
Kinematic and dynamic study of mechanisms.

Specific objectives:
At the end of this activity the student should be able to:
Interpret the theoretical concepts studied and apply them to the kinematic and dynamic analysis of some appropriately selected mechanisms, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Practice Script (available on the Digital Campus).

Delivery:
The students have to prepare, in groups of 5 people, a report of the practice, according to the instructions indicated and deliver it to the teacher within the deadline set for each practice.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h
7. FIRST INDIVIDUAL TEST OF CONTINUOUS EVALUATION

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply the concepts studied in the theoretical sessions taught so far.

Material:
Statement and Calculator

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 12h
Theory classes: 2h
Self study: 10h

8. SECOND INDIVIDUAL TEST OF CONTINUOUS EVALUATION

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply the concepts studied in the theoretical sessions taught so far.

Material:
Statement and Calculator

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 12h
Theory classes: 2h
Self study: 10h
9. FINAL TEST

Description:
Final test in the classroom that includes all the material, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply the concepts studied in all the theoretical sessions.

Material:
Statement and Calculator.

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 18h
Theory classes: 3h
Self study: 15h

GRADING SYSTEM

- Delivery of the Proposed Problems (Activities 1, 2 and 3): 15% of the grade for the course.
- First Individual Continuous Assessment Test (Activity 7): 35% of the grade for the subject.
- Second Individual Continuous Assessment Test (Activity 8): 35% of the grade for the subject.
- Preparation of reports on the results obtained in these practices (Activities 4, 5 and 6): 15% of the grade for the subject.

Therefore, the Note for Written Tests (NPE) = 35% * (First Written Test Note) + 35% * (Second Written Test Note) + 15% * (Practice Note) + 15% * (Delivery Note of the Proposed Problems).

It is important to point out that the partial written tests are liberatory, so that, if the student obtains an NPE ≥ 4.95, he will be exempted from passing the final test. Students who fail to pass the course by partial exams or those who want to improve their grade will have a second chance in a new final test.

Thus, the Final Test Note (NPF) = 70% * (Final Written Test Note) + 15% * (Practice Note) + 15% * (Delivery Note of Proposed Problems).

EXAMINATION RULES.

- In order to pass the course, it is mandatory to attend and carry out all the activities, delivering all the laboratory practice reports, and the resolution of all the proposed problems within the indicated deadlines.
- In solving the proposed problems, the students will use the contents studied in the expository part of the face-to-face session and will be able to clarify the doubts and difficulties they may encounter with the teacher. The deadline for delivery of the resolution of the proposed problems and the reports of the laboratory practices will be specified, and no delivery will be accepted after this deadline.
- The reports of the practices will be original, so that the copy of practices (total or partial) will be sanctioned with the global failure of the activity and the subject. It will be taken into account that the responsibility of the laboratory practice is shared by all the members of the group, so in case of detecting a copy the rule will be applied to all the members of all the groups involved in the copy (both those who They copy like those who let themselves be copied).
- In the delivery of the resolution of the proposed problems, any total or partial copy of the solutions will suppose the suspension in the activity. The student must ensure the privacy and security of their data.
- If it is detected that a student has copied in a written test, it will be evaluated as a failure of the course.
- It not allowed to use any type of notes or forms in the partial and final tests.
BIBLIOGRAPHY

Basic:

Complementary: