# 220105 - Machine and Mechanism Theory

**Coordinating unit:** 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering  
**Teaching unit:** 712 - EM - Department of Mechanical Engineering  
**Academic year:** 2018  
**Degree:** BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)  
**ECTS credits:** 6  
**Teaching languages:** Catalan, Spanish

## Teaching staff

**Coordinator:** FRANCISCO JAVIER FREIRE VENEGAS  
**Others:** BEATRIZ PURAS GÓMEZ  
ANA MARANÓN MARTINEZ  
CARLOS GUSTAVO DIAZ GONZALEZ  
CARLOS RIO CANO

## Degree competences to which the subject contributes

### Specific:

1. An understanding of the principles of the theory of machines and mechanisms  
2. An understanding of, and skills for, the calculation, design and testing of machines.

## Teaching methodology

The course is divided into three parts:  
* Lecture sessions.  
* Practical sessions (exercises and problems).  
* Lab sessions.  
* Self-study and doing exercises and activities.  

In the lecture sessions, teachers will introduce the theoretical principles of the subject, concepts, methods and illustrate with examples appropriate to facilitate understanding.  
In practical sessions in the classroom, teachers guide students in applying theoretical concepts to problem solving, based on critical thinking at all times. Some exercises will be proposed to be solved in the classroom and outside the classroom, to promote contact and use the basic tools needed to solve problems.  
In the laboratory sessions, teachers will guide students in conducting experiments that illustrate theoretical concepts, based on critical thinking at all times. It will propose that students calculate theoretically the results of experiments and compare it with the experimental results.  
Students, autonomously, should work the material provided by the teacher and the result of the work sessions, to assimilate concepts. Teachers will provide a study and monitoring activities plan (ATENEA).

## Learning objectives of the subject

The machine and mechanism theory course introduces the theory course and principles of kinematics and dynamics of mechanical multi body systems. The motion force and mass basic concepts are introduced, to explain some methods to get the equations of motion of multi body systems.
# 220105 - Machine and Mechanism Theory

## Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>32h</th>
<th>21.33%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>14h</td>
<td>9.33%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>14h</td>
<td>9.33%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
### Content

#### kinematic

**Learning time:** 50h  
Theory classes: 10h  
Practical classes: 5h  
Laboratory classes: 5h  
Self study: 30h

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
</thead>
</table>
| Structural analysis of mechanisms  
Speed analysis  
Acceleration analysis |  

<table>
<thead>
<tr>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 5 y 6</td>
</tr>
</tbody>
</table>

#### Transmissions

**Learning time:** 19h  
Theory classes: 5h  
Practical classes: 2h  
Laboratory classes: 2h  
Self study: 10h

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
</thead>
</table>
| Gears  
Gear box. |  

<table>
<thead>
<tr>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3, 5, 6</td>
</tr>
</tbody>
</table>

#### Static mechanisms

**Learning time:** 24h  
Theory classes: 6h  
Practical classes: 2h  
Laboratory classes: 2h  
Self study: 14h

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
</thead>
</table>
| Strength, work and performance in mechanisms  
Force reduction: graphic method  
Virtual jobs and powers |  

<table>
<thead>
<tr>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3, 5, 6</td>
</tr>
</tbody>
</table>

**Dynamic mechanisms**

<table>
<thead>
<tr>
<th>Learning time: 57h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 11h</td>
</tr>
<tr>
<td>Practical classes: 5h</td>
</tr>
<tr>
<td>Laboratory classes: 5h</td>
</tr>
<tr>
<td>Self study : 36h</td>
</tr>
</tbody>
</table>

**Description:**
- Energy theorem
- Exerjian Equation
- Lagrange Equations
- D'Alembert method

**Related activities:**
1, 2, 3, 4, 5, 6
### Planning of activities

<table>
<thead>
<tr>
<th>LARGE GROUP SESSIONS / THEORY</th>
<th>Hours: 52h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 26h</td>
</tr>
<tr>
<td></td>
<td>Self study: 26h</td>
</tr>
</tbody>
</table>

**Description:**

Previous and subsequent preparation of theory sessions and assistance to them.

**Support materials:**

General bibliography of the subject.

**Descriptions of the assignments due and their relation to the assessment:**

During some of the sessions may be proposed no classroom exercises, individually or in small groups.

**Specific objectives:**

Transfer the necessary knowledge for a correct interpretation of the contents developed in the large group sessions, solving doubts in relation to the syllabus of the subject and development of the specific competence. To Know the principles of the theory of machines and mechanisms.

<table>
<thead>
<tr>
<th>SMALL GROUP SESSIONS / PROBLEMS</th>
<th>Hours: 43h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Practical classes: 13h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 10h</td>
</tr>
<tr>
<td></td>
<td>Self study: 20h</td>
</tr>
</tbody>
</table>

**Description:**

Pre-session and post-session preparation of problem and practice sessions and attendance.

**Support materials:**

General bibliography of the subject.

Exercises on the Athena platform

Collection of problems of the subject.

**Descriptions of the assignments due and their relation to the assessment:**

During these sessions, on-site and virtual exercises, either individually or in small groups, would be developed by the faculty and the student body. During some of the sessions, non-contact exercises can be proposed, individually or in small groups. These exercises will be presented by students in subsequent sessions and publicly defended. Represents 10% of the final grade of the subject.

**Specific objectives:**

Acquire the necessary skills for a correct interpretation of the problems of the subject, as well as a satisfactory resolution of these. Preparation for the practical part of the exams of the subject.

Development of specific competence Know the principles of the theory of machines and mechanisms.

<table>
<thead>
<tr>
<th>SMALL GROUP SESSIONS / PRACTICES</th>
<th>Hours: 16h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study: 12h</td>
</tr>
</tbody>
</table>
**Description:**

Pre-and post-preparation of laboratory practice sessions, problems workshop and assistance to them.

**Support materials:**

General bibliography of the subject  
Exercises on the Athena platform  
Notes of the subject

**Descriptions of the assignments due and their relation to the assessment:**

For each session of laboratory practices, a document accrediting the work developed will be delivered, according to the conditions specified in each particular case. Represents 10% of the final grade of the subject.

**Specific objectives:**

Recognize and apply the concepts studied in theory and problem activities.  
Compare the theoretical forecasts with the observed results and draw conclusions.

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**INFORMATIC SIMULATIONS**

**Hours:** 18h  
Self study: 18h

**Description:**

Freelance application of computer tools to solve problems of the subject.

**Support materials:**

General bibliography of the subject.  
Exercises of the Athena platform  
Collection of problems of the subject

**Descriptions of the assignments due and their relation to the assessment:**

For each simulation session to deliver a document accrediting the work developed, according to the conditions specified in each particular case. Represents 10% of the final grade of the subject.

**Specific objectives:**

Acquire the necessary skills for a correct interpretation of the problems of the subject, as well as a satisfactory resolution of these. Preparation for the practical part of the exams of the subject.  
Development of specific competence Know the principles of the theory of machines and mechanisms.

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**MIDTERM EXAM**

**Hours:** 9h  
Theory classes: 2h  
Practical classes: 1h  
Self study: 6h

**Description:**

Individual and written test on the contents of modules 1 and 2.
220105 - Machine and Mechanism Theory

Support materials:
Test text.

Descriptions of the assignments due and their relation to the assessment:
The deliverable will be the resolution of the test. It represents 20% of the final qualification of the subject.

Specific objectives:
The test must show that the student has acquired and assimilated the concepts, principles and basic fundamentals related to modules 1 and 2: Kinematics and Transmissions.

<table>
<thead>
<tr>
<th>FINAL EXAM</th>
<th>Hours: 12h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study: 8h</td>
</tr>
</tbody>
</table>

Support materials:
Test text.

Descriptions of the assignments due and their relation to the assessment:
The deliverable will be the resolution of the test. It represents 50% of the final grade of the subject.

Specific objectives:
The test must show that the student has acquired and assimilated the concepts, principles and basic fundamentals of the whole subject, especially those related to modules 3 and 4: Static and Dynamic.

Qualification system

The final grade depends on five evaluative acts:
* 1st and 2nd activities (problems): 10%
* 3rd activity (lab): 10%
* 4th activity (simulation): 10%
* 5th activity (partial exam): 25%
* 6th activity (final exam): 45%

In case of being unable to attend to the partial exam or not passing it, the student will have an automatic second opportunity for the day of the final exam. In this case, the grade will be:
* 1st and 2nd activities (problems): 10%
* 3rd activity (lab): 10%
* 4th activity (simulation): 10%
* 6th activity (final exam): 70%

NOTE: the final grade will be always the upper one.
Regulations for carrying out activities

Problems from activities 1 and 2 will be conducted in groups and writing. May be asked to defend publicly and are subject of discussion. Alternatively you can submit a collection of problems, but the score will be lower.

The activity 3 will be conducted in group. The laboratory work is necessary to grade this activity.

Activities 4, 5 and 6 will be held individually and written.

Bibliography

Basic:


Others resources:

Hyperlink

Documentació a ATENEA

Audiovisual material

Col.lecció de problemes sense solució, per treballar l’assignatura