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: 2019
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.
## Study load

| Total learning time: 150h | Hours large group: 32h 21.33% | Hours medium group: 14h 9.33% | Hours small group: 14h 9.33% | Guided activities: 0h 0.00% | Self study: 90h 60.00% |
# Content

## Kinematic

<table>
<thead>
<tr>
<th>Learning time: 50h</th>
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<tbody>
<tr>
<td>Theory classes: 10h</td>
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<tr>
<td>Practical classes: 5h</td>
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<tr>
<td>Laboratory classes: 5h</td>
</tr>
<tr>
<td>Self study: 30h</td>
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**Description:**
- Structural analysis of mechanisms
- Speed analysis
- Acceleration analysis

**Related activities:**
1, 2, 5 y 6

## Transmissions

<table>
<thead>
<tr>
<th>Learning time: 19h</th>
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<tbody>
<tr>
<td>Theory classes: 5h</td>
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<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study: 10h</td>
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</tbody>
</table>

**Description:**
- Gears
- Gear box.

**Related activities:**
1, 2, 3, 5, 6

## Static mechanisms

<table>
<thead>
<tr>
<th>Learning time: 24h</th>
</tr>
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<tbody>
<tr>
<td>Theory classes: 6h</td>
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<tr>
<td>Practical classes: 2h</td>
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<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study: 14h</td>
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</tbody>
</table>

**Description:**
- Strength, work and performance in mechanisms
- Force reduction: graphic method
- Virtual jobs and powers

**Related activities:**
1, 2, 3, 5, 6
### Dynamic mechanisms

<table>
<thead>
<tr>
<th><strong>Description:</strong></th>
<th><strong>Learning time:</strong> 57h</th>
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<tbody>
<tr>
<td>Energy theorem</td>
<td>Theory classes: 11h</td>
</tr>
<tr>
<td>Exerjian Equation</td>
<td>Practical classes: 5h</td>
</tr>
<tr>
<td>Lagrange Equations</td>
<td>Laboratory classes: 5h</td>
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<tr>
<td>D'Alembert method</td>
<td>Self study: 36h</td>
</tr>
</tbody>
</table>

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

| LARGE GROUP SESSIONS / THEORY | Hours: 52h  
Theory classes: 26h  
Self study: 26h |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Previous and subsequent preparation of theory sessions and assistance to them.</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>General bibliography of the subject.</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>During some of the sessions may be proposed no classroom exercises, individually or in small groups.</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>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.</td>
</tr>
</tbody>
</table>

| SMALL GROUP SESSIONS / PROBLEMS | Hours: 43h  
Practical classes: 13h  
Laboratory classes: 10h  
Self study: 20h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Pre-session and post-session preparation of problem and practice sessions and attendance.</td>
</tr>
</tbody>
</table>
| **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. |

| SMALL GROUP SESSIONS / PRACTICES | Hours: 16h  
Laboratory classes: 4h  
Self study: 12h |
|-------------------------------|------------------|
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.

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.
**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.

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**FINAL EXAM**

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

**Description:**
Individual and written test on the contents of modules 3 and 4.

**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.

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**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