3200511 - TDMM1 - Theory and Design of Machines and Mechanisms I

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 MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: Rafel Sitjar

Degree competences to which the subject contributes

Specific:
1. MEC: Skills for the calculation, design and testing of machines.

Transversal:
3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

Teaching methodology
- Face-to-face lectures and problem solving sessions.
- Independent learning and exercises.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.

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

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

In the subject, students will become familiar with and apply the concepts covered in Mechanical Systems, Elasticity and Strength of Materials.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>45h</th>
<th>30.00%</th>
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<tr>
<td></td>
<td>Hours medium group:</td>
<td>15h</td>
<td>10.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>0h</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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### Content

<table>
<thead>
<tr>
<th>TOPIC 1: INTRODUCTION</th>
<th><strong>Learning time:</strong> 5h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 2h</td>
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<td>Self study: 3h</td>
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<tr>
<td>· Introduction to the study of mechanisms.</td>
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<tr>
<td>· Nomenclature used in the field.</td>
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<tr>
<td>· Definition of basic mechanical elements.</td>
<td></td>
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<tr>
<td>· Combination of mechanical elements.</td>
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<tr>
<th>TOPIC 2: Degrees of freedom</th>
<th><strong>Learning time:</strong> 5h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 3h</td>
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<tr>
<td>· Definition of degree of freedom.</td>
<td></td>
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<tr>
<td>· Application to basic mechanical elements.</td>
<td></td>
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<tr>
<td>· Calculation criteria for planar mechanisms.</td>
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<tr>
<td>· Application.</td>
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<tr>
<th>TOPIC 3: KINEMATIC INVERSION</th>
<th><strong>Learning time:</strong> 10h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 4h</td>
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<td></td>
<td>Self study: 6h</td>
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<tr>
<td>· Nature of thermal radiation.</td>
<td></td>
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<tr>
<td>· Black-body radiation. Fundamental Laws.</td>
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<tr>
<td>· Radiation properties of real physical bodies.</td>
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</table>
### TOPIC 4: DESCRIPTION OF MECHANISMS

**Learning time:** 20h  
- Theory classes: 8h  
- Self study: 12h

| Description |  
| --- | ---  
| · Classification.  
· Composition.  
· Geometric limitations.  
· Paths.  
· Dead points.  
· Equations of motion. |  

### TOPIC 5: SPEED AND ACCELERATION

**Learning time:** 40h  
- Theory classes: 16h  
- Self study: 24h

| Description |  
| --- | ---  
| · Reference systems.  
· Graphical analysis.  
· VECTOR CALCULUS.  
· Sliding and non-sliding mechanisms. |  

### TOPIC 6: FORCES AND TORQUES IN MACHINES

**Learning time:** 20h  
- Theory classes: 8h  
- Self study: 12h

| Description |  
| --- | ---  
| · External forces.  
· External moments.  
· Internal forces.  
· Moments of inertia.  
· Reduced mass. |  

The acquisition of knowledge, competencies and skills will be assessed based on:
- Assessment examination: 50%
- Final examination: 50%

For those students that have failed the first test, there will be a recovery question coinciding with the final exam. The maximum recovery mark will be 5 and it will only substitute the previous mark if it is higher.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations 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.

Qualification system

TOPIC 7: BALANCING OF MECHANISMS

- Balancing of masses in a common radial plane.
- Balancing of masses in a common axial plane.
- General case.
- Balancing of masses in alternating motion.
- Balancing of multiple alternating masses.

TOPIC 8: REGULATION OF MECHANISMS

- Degree of irregularity of machines.
- Flywheel calculation.
- Equivalent inertia of mechanisms.
- Flywheel placement.
- Starting torque.

Learning time:
- 30h
- Theory classes: 12h
- Self study: 18h

Regulations for carrying out activities

Students will be expected to have taken and preferably passed the following subjects: Mechanical Systems, Elasticity and Strength of Materials.
Bibliography

Basic: