320140 - DM - Mechanism Design

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 DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: Albert Català.
Others: Rafael Sitjar.
Catalan Artigas, Albert

Prior skills
Students should be complete courses in mechanics systems and Elastic and Strength of materials, even desirable that the student had passed them.

Degree competences to which the subject contributes

Transversal:
1. 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.
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. ENTREPRENEURSHIP AND INNOVATION - Level 2. Taking initiatives that give rise to opportunities and to new products and solutions, doing so with a vision of process implementation and market understanding, and involving others in projects that have to be carried out.
4. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Teaching methodology
Students should be complete courses in Mechanics Systems and Elastic and Strength of materials, even desirable that the student had passed them.

Learning objectives of the subject
To know and to understand all the concepts learnt in Mechanics Systems and Elastic and Strength of materials. To solve kinematic and dynamic problems.
### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<tr>
<td></td>
<td>Hours small group: 30h</td>
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<td></td>
<td>Guided activities: 0h</td>
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<td></td>
<td>Self study: 90h</td>
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## Content

### TOPIC 1: Introduction and degrees of freedom

**Learning time:** 4h  
Theory classes: 2h  
Practical classes: 2h

**Description:**  
- Introduction to the study of the mechanisms  
- Nomenclature used.  
- Definition of basic mechanical elements.  
- A combination of mechanical elements.  
- Degrees of freedom definition  
- Application of mechanical principles.  
- Calculation criteria mechanisms plan.  
- Application.

**Related activities:**  
- Terminology normally used  
- Conventions used  
- Schematic representation  
- Determine mobility mechanisms

### TOPIC 2: Inverse Kinematics

**Learning time:** 4h  
Theory classes: 2h  
Practical classes: 2h

**Description:**  
- Concept.

### TOPIC 3: Mechanisms Description

**Learning time:** 4h  
Theory classes: 2h  
Practical classes: 2h

**Description:**  
- Classification  
- Composition  
- Geometric limitations  
- Trajectories  
- Deadlocks  
- Equations of motion
### TOPIC 4: Velocities and accelerations

<table>
<thead>
<tr>
<th>Learning time: 4h</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Practical classes: 2h</td>
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#### Description:
- Reference systems
- Graphic Analysis
- Vector calculus
- Mechanisms with and without sliding

### TOPIC 5: Forces and couples in machines

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<tr>
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<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Practical classes: 2h</td>
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#### Description:
- External forces
- External moments
- Internal forces
- Moments of Inertia
- Reduced mass

### TOPIC 6: Balance of Mechanisms

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<thead>
<tr>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<td>Practical classes: 2h</td>
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#### Description:
- Mass balance in a common radial plane
- Mass balance in a common axial plane
- General situation
- Alternative masses balance
## TOPIC 7: Regulation of mechanisms

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<th>Learning time: 4h</th>
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<tr>
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<tr>
<td>Practical classes: 2h</td>
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### Description:
- Grades of irregularity
- Calculating the flywheel
- Equivalent inertia of mechanisms
- Location of the flywheel
- Starting torque

## TOPIC 8: Stress state

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<th>Learning time: 4h</th>
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<tr>
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<td>Practical classes: 2h</td>
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### Description:
- Definition
- Simple stress state
- Distribution of stresses in the interior parts
- Representation of the stress state
- Principal stresses
- Mohr Circle

## TOPIC 9: Breaking theories

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<th>Learning time: 4h</th>
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<tr>
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<td>Practical classes: 2h</td>
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### Description:
- Definition and limitations
- Safety factor
- Theory of the maximum normal stress
- Theory of the maximum tangential stress
- Theory of the maximum energy of distortion
- Applications
<table>
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<tr>
<th>TOPIC 10: Fatigue of materials I</th>
<th>Learning time: 4h</th>
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<tr>
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<td>Practical classes: 2h</td>
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**Description:**
- Wöhler tests Machine
- Finite life and infinite life
- Soderberg and Goodman diagrams

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<thead>
<tr>
<th>TOPIC 11: Fatigue of materials II</th>
<th>Learning time: 4h</th>
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<tr>
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<td>Theory classes: 2h</td>
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<td>Practical classes: 2h</td>
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**Description:**
- Coefficients that modify the fatigue strength
- Soderberg and Goodman diagrams
- Determination of the equations

<table>
<thead>
<tr>
<th>TOPIC 12: Machines elements</th>
<th>Learning time: 4h</th>
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**Description:**
- Calculation of axis
- Calculation of bolted joints

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<tr>
<th>TOPIC 13: Activities done in a company</th>
<th>Learning time: 4h</th>
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**Description:**
- Practical case about the analysis of a mechanical project
- The mechanical analysis tools
### Qualification system

- Exam 1: 25%
- Exam 2: 25%
- Exam 3: 25%
- Exam 4: 25%

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.
Bibliography

Basic:


