Degree competences to which the subject contributes

Transversal:

04 COE N3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

Learning objectives of the subject

1. Calculate velocities and accelerations, and forces and moments, in a software of numerical programming.
2. Learn what the equations of motion are and how to use them.
3. Learn basic trajectory optimization methods.
Study load
# 820468 - SM - Movement Simulation

## Content

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Kinematic analysis</th>
<th>Dynamic analysis</th>
<th>Lagrange equations</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>- Generalized coordinates (absolute and relative) (1h)</td>
<td>- Linear and angular momentum theorems in 2D (reminder) (1h)</td>
<td>- Calculate kinetic energy (reminder) (1h)</td>
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<tr>
<td>- Open kinematic chain systems (3h)</td>
<td>- Inertia tensor, reminder (1h)</td>
<td>- Calculate potential energy (1h)</td>
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<td>- Linear and angular momentum theorems in 3D (3h)</td>
<td>- Lagrange equations (with no multipliers or generalized forces) (3h)</td>
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<td>- Equations of motion by momentum theorems (3h)</td>
<td>- Virtual power (3h)</td>
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<td>- Lagrange equations (with no multipliers), with generalized forces (4h)</td>
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<td>- Lagrange equations with multipliers (4h)</td>
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<tr>
<td>L1: Calculate velocities of a 2D system of an open kinematic chain and visualize the movement, in Matlab. (2h)</td>
<td>L3: Calculate the equations of motion by means of dynamics analysis of a double pendulum (2h)</td>
<td>L4: Calculate equations of motion by means of Lagrange equations of a double pendulum. Visualization of relations among moments and forces vs. positions, velocities and accelerations. (4h)</td>
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<tr>
<td>L2: Calculate velocities of a 3D system of an open kinematic chain and, recordatori gràfics, in Matlab. (2h)</td>
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**Learning time:**

- **Chapter 1: Kinematic analysis**
  - 10h
  - Theory classes: 6h
  - Guided activities: 4h

- **Chapter 2: Dynamic analysis**
  - 10h
  - Theory classes: 8h
  - Guided activities: 2h

- **Chapter 3: Lagrange equations**
  - 20h
  - Theory classes: 16h
  - Guided activities: 4h
This subject is based on practical lectures, it tries to familiarize the student with numerical methods usually used in movement simulation. The practical assignment, which the student will have to carry out and defend, represents 50% of the mark. This practical assignment will be followed-up during the course. The student will have to propose a mechanism (simple, between 2 and 4 degrees of freedom) and carry out a kinematics and dynamics analyses, and optimize the trajectory of one or more coordinates.

Qualification system

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Regulations for carrying out activities

Professors responsible for this subject will give the rules to carry out the exams and what are the materials that the students can bring during the exams. Overall, all exams will be carried out with no books or notes.

Bibliography

Basic:


Complementary: