Degree competences to which the subject contributes

Specific:
1. Knowledge of the scientific method and its applications in physics and engineering. Ability to formulate hypotheses and make critical analysis of scientific problems in the field of physics and engineering. Ability to relate the physical reality with their mathematical models and vice versa.
2. Ability to solve basic problems in mechanics, elasticity, thermodynamics, fluids, waves, electromagnetism and modern physics, and its application in solving engineering problems.

Generic:
1. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:
3. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
4. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 1. Analyzing the world’s situation critically and systemically, while taking an interdisciplinary approach to sustainability and adhering to the principles of sustainable human development. Recognizing the social and environmental implications of a particular professional activity.
4. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Teaching methodology

- In classroom
  Blackboard classes (theory + problems) with participation of the students. Practical work, individually or in team.

- Outside the classroom:
  Exercises and theoretical or practical projects. Preparation of evaluated activities.

Learning objectives of the subject

Knowledge of the basic concepts on the classical mechanics laws
## Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 65h</th>
<th>65h</th>
<th>43.33%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study:</td>
<td>Self study: 85h</td>
<td>85h</td>
<td>56.67%</td>
</tr>
</tbody>
</table>
## Content

<table>
<thead>
<tr>
<th>1. Vectors</th>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>1.1. Elementary operations with scalars and vectors: addition of vectors and multiplication by a scalar.</td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td>1.2. Scalar and vectorial product of two vectors.</td>
<td>Self study: 5h</td>
</tr>
<tr>
<td>1.3. Derivative and integral of a vectorial function with respect to a scalar variable.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Kinematics of one particle</th>
<th>Learning time: 16h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>2.2. Rectilinear, curvilinear, parabolic and simple harmonic motions.</td>
<td>Self study: 10h</td>
</tr>
<tr>
<td>2.3. Intrinsic components of the acceleration.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Forces and equations of motion of a particle</th>
<th>Learning time: 19h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td>3.1. Newton's laws of motion.</td>
<td>Practical classes: 3h 30m</td>
</tr>
<tr>
<td>3.2. Contact forces: normal reaction, dry friction, tension of ropes and Hooke's law.</td>
<td>Guided activities: 1h</td>
</tr>
<tr>
<td>3.3. Velocity dependent forces in fluids.</td>
<td>Self study: 10h</td>
</tr>
<tr>
<td>3.4. Numerical solution of the equations of motion.</td>
<td></td>
</tr>
<tr>
<td>3.5. Inertial reference systems, transformation and principle of relativity of Galileo.</td>
<td></td>
</tr>
</tbody>
</table>
### 4. Work and mechanical energy: conservation theorems

**Description:**
- 4.1. Impulse of a force and linear momentum: conservation of linear momentum.
- 4.2. Work, power and kinetic energy.
- 4.3. Fields of conservative forces and potential energy: conservation of mechanical energy.
- 4.5. One dimensional motion analyzed by using potential energy.

**Learning time:** 21h
- Theory classes: 4h
- Practical classes: 3h
- Self study: 14h

### 5. Oscillators

**Description:**
- 5.1. Small oscillations departing from an equilibrium point in one dimension.
- 5.2. Damped oscillators.
- 5.3. Forced oscillator: resonance.

**Learning time:** 17h
- Theory classes: 5h
- Practical classes: 4h
- Self study: 8h

### 6. Gravitational field

**Description:**
- 6.1. Newton’s universal law of gravitation.
- 6.2. Kepler’s laws.
- 6.3. Motion in a gravitational field: effective potential energy.
- 6.4. Orbits in a gravitational field.
- 6.5. Gravitational field and potential.

**Learning time:** 20h
- Theory classes: 6h
- Practical classes: 4h
- Self study: 10h
7. Dynamics of a particles system

Description:
7.1. Discrete and continuous distributions of mass. Center of mass and its motion.
7.2. Linear momentum and its conservation.
7.3. Angular momentum of a system and its conservation.
7.4. Mechanical energy of a system and its conservation.
7.5. Elastic and inelastic collisions, and explosions.
7.6. Systems with variable mass.

Learning time: 23h 30m
- Theory classes: 6h
- Practical classes: 3h 30m
- Self study: 14h

8. Rigid body

Description:
8.1. The rigid body as a system of particles. Statics of the rigid body.
8.2. Translation motion of the rigid body.
8.3. Moment of Inertia. Steiner’s Theorem.
8.4. Rotational motion of the rigid body around a fixed axis.
8.5. Kinetic and potential energies. Conservation of energy.
8.6. Rotation of the rigid body about an arbitrary axis in three dimensions.

Learning time: 26h
- Theory classes: 8h
- Practical classes: 4h
- Self study: 14h

Qualification system

The qualification system consists of a final exam (FE), a mid term exam (ME) and the presentation of a project (P). The final mark is given by: \( \text{max} \{ \text{FE}, 0.65 \times \text{FE} + 0.35 \times \text{ME} \} + 0.1 \times P \)
Bibliography

Basic:


Complementary:


