### Degree competences to which the subject contributes

#### Specific:
1. **CE 21 AERON.** Conocimiento adecuado y aplicado a la Ingeniería de: Las instalaciones eléctricas y electrónicas. (CIN/308/2009, BOE 18.2.2009)
2. **CE 24 AERON.** Conocimiento adecuado y aplicado a la Ingeniería de: Los métodos de cálculo y de desarrollo de la navegación aérea; el cálculo de los sistemas específicos de la aeronavegación y sus infraestructuras; las actuaciones, maniobras y control de las aeronaves; la normativa aplicable; el funcionamiento y la gestión del transporte aéreo; los sistemas de navegación y circulación aérea; los sistemas de comunicación y vigilancia aérea. (CIN/308/2009, BOE 18.2.2009)
3. **CE 25 AERON.** Conocimiento aplicado de: Transmisores y receptores; Líneas de transmisión y sistemas radiantes de señales para la navegación aérea; Sistemas de navegación; Instalaciones eléctricas en el sector tierra y sector aire; Mecánica del Vuelo; Cartografía; Cosmografía; Meteorología; Distribución, gestión y economía del transporte aéreo. (CIN/308/2009, BOE 18.2.2009)

#### General:
6. **EFFICIENT USE OF EQUIPMENT AND INSTRUMENTS** - Level 2: Use the correct instruments, equipment and laboratory software for specific or specialized knowledge of their benefits. A critical analysis of the experiments and results. Correctly interpret manuals and catalogs. Working independently, individually or in groups, in the laboratory.

#### Transversal:
4. **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.
5. **THIRD LANGUAGE.** Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
7. **TEAMWORK** - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
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Teaching methodology

The course combines the following teaching (learning) methodologies:
- Autonomous learning, because students will work many self-learning materials at home.
- Cooperative learning, because students will solve many tasks in small groups (pairs).
- Problem and project-based learning, because the control of a laboratory platform will be the center of the activities.

Learning objectives of the subject

The main goal of the course is to understand the basic principles of flight control and automation. Classical control will be studied in depth (root locus technique, frequency design) as well as digital and state space control, and some advanced control techniques will be presented. The final part of the course will apply the acquired knowledge to the study of autopilots.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group:</th>
<th>26h</th>
<th>23.11%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group:</td>
<td>22h</td>
<td></td>
<td>19.56%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>1h 30m</td>
<td></td>
<td>1.33%</td>
</tr>
<tr>
<td>Self study:</td>
<td>63h</td>
<td></td>
<td>56.00%</td>
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</table>
### Content

<table>
<thead>
<tr>
<th><strong>(ENG) Dynamic models and basic properties of feedback</strong></th>
<th><strong>Learning time:</strong> 18h 45m</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Description:</em></td>
<td>Theory classes: 4h 45m</td>
</tr>
<tr>
<td>a) Review of Laplace, transfer function, open loop systems</td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>b) Parametrization</td>
<td>Self study: 10h</td>
</tr>
<tr>
<td>c) Steady state error</td>
<td></td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td></td>
</tr>
<tr>
<td>Matlab 1 (autonomous work): basic control functions, parametrics, Simulink</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>(ENG) Root locus method</strong></th>
<th><strong>Learning time:</strong> 22h</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Description:</em></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>a. Root locus drawing rules</td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>b. Effect of poles and zeros</td>
<td>Self study: 12h</td>
</tr>
<tr>
<td>c. Implementation of controllers</td>
<td></td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td></td>
</tr>
<tr>
<td>Matlab 2 (lab): root-locus controller design + simulink PID design</td>
<td></td>
</tr>
<tr>
<td>Short exam #1</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>(ENG) Frequency design method</strong></th>
<th><strong>Learning time:</strong> 15h 20m</th>
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<tbody>
<tr>
<td><em>Description:</em></td>
<td>Theory classes: 3h 15m</td>
</tr>
<tr>
<td>a) Frequency response</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>b) Bode diagram</td>
<td>Guided activities: 1h 30m</td>
</tr>
<tr>
<td>c) Stability criterion</td>
<td>Self study: 8h 35m</td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td></td>
</tr>
<tr>
<td>Partial Exam</td>
<td></td>
</tr>
</tbody>
</table>
### (ENG) Digital control

**Learning time:** 22h 50m  
Theory classes: 6h  
Laboratory classes: 4h  
Self study: 12h 50m

**Description:**
- a) Z transformation  
- b) digital transfer function  
- c) digital root locus  
- d) digital controllers  
- e) Dead beat design method

**Related activities:**
- Lab Matlab 3: Satellite attitude control  
- Short exam #2

### (ENG) Modern control techniques

**Learning time:** 23h  
Theory classes: 4h  
Laboratory classes: 6h  
Self study: 13h

**Description:**
- a) Introduction  
- b) Controllability, observability  
- c) Canonical/modal forms  
- d) Full state feedback controller (A-BK)  
- e) Optimal Control  
- f) Other advanced techniques

**Related activities:**
- Matlab 4: State space design

### (ENG) General concepts on autopilots

**Learning time:** 10h 35m  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 6h 35m

**Description:**
- Techniques and examples of autopilots

**Related activities:**
- Laboratori Matlab 5: Autopilot
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**Qualification system**

Defined at the course infoweb.

**Regulations for carrying out activities**

Attending the Laboratory Sessions is mandatory, and also the presentation of laboratory reports, which will be assessed giving more importance to the results interpretations than to their simple exposition. English use for those reports is mandatory.

**Bibliography**

**Basic:**


**Complementary:**


