300225 - CG-MN3 - Control and Guidance

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 748 - FIS - Department of Physics
707 - ESAII - Department of Automatic Control
739 - TSC - Department of Signal Theory and Communications

Academic year: 2019
Degree: BACHELOR'S DEGREE IN AIR NAVIGATION ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2015). (Teaching unit Optional)

ECTS credits: 4,5  Teaching languages: English

Teaching staff

Coordinator: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

Requirements

Prerequisite: Having passed the Linear Systems course
Prerequisite: Having passed the Flight Mechanics course

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)

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.

General:
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.
300225 - CG-MN3 - Control and Guidance

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>19.56%</td>
<td></td>
</tr>
<tr>
<td>Guided activities:</td>
<td>1h 30m</td>
<td>1.33%</td>
<td></td>
</tr>
<tr>
<td>Self study:</td>
<td>63h</td>
<td>56.00%</td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>Learning time: 18h 45m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ENG) Dynamic models and basic properties of feedback</td>
<td>Theory classes: 4h 45m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 4h</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self study : 10h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Description:**

- a) Review of Laplace, transfer function, open loop systems
- b) Parametrization
- c) Steady state error

**Related activities:**

Matlab 1 (autonomous work): basic control functions, parametrics, Simulink

<table>
<thead>
<tr>
<th>Content</th>
<th>Learning time: 22h</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ENG) Root locus method</td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study : 12h</td>
</tr>
</tbody>
</table>

**Description:**

- a. Root locus drawing rules
- b. Effect of poles and zeros
- c. Implementation of controllers

**Related activities:**

Matlab 2 (lab): root-locus controller design + simulink PID design
Short exam #1

<table>
<thead>
<tr>
<th>Content</th>
<th>Learning time: 15h 20m</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ENG) Frequency design method</td>
<td>Theory classes: 3h 15m</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 1h 30m</td>
</tr>
<tr>
<td></td>
<td>Self study : 8h 35m</td>
</tr>
</tbody>
</table>

**Description:**

- a) Frequency response
- b) Bode diagram
- c) Stability criterion

**Related activities:**

Partial Exam
### (ENG) Digital control

**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

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

### (ENG) Modern control techniques

**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

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

### (ENG) General concepts on autopilots

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

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

**Learning time:** 10h 35m
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 6h 35m
300225 - CG-MN3 - Control and Guidance

**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:**


