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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: 2018

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)

Generical:

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

Total learning time: 112h 30m	Hours large group:	26h	23.11%
	Hours small group:	22h	19.56%
	Guided activities:	1h 30m	1.33%
	Self study:	63h	56.00%

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Content

(ENG) Dynamic models and basic properties of feedback

Learning time: 18h 45m

Theory classes: 4h 45m
Laboratory classes: 4h
Self study : 10h

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

(ENG) Root locus method

Learning time: 22h

Theory classes: 6h
Laboratory classes: 4h
Self study : 12h

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

(ENG) Frequency design method

Learning time: 15h 20m

Theory classes: 3h 15m
Laboratory classes: 2h
Guided activities: 1h 30m
Self study : 8h 35m

Description:
a) Frequency response
b) Bode diagram
c) Stability criterion

Related activities:
Partial Exam

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(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:

Franklin, G. F.; Powell, J.D.; Emami-Naeini, A. Feedback control of dynamic systems. 5a ed. Upper Saddle River: Prentice Hall, 2002. ISBN 0131499300.

Blakelock, John H. Automatic control of aircraft and missiles. 2nd ed. New York: John Wiley and Sons, 1991. ISBN 0471506516.

Ogata, Katsuhiko. Modern control engineering. 4th ed. Englewood Cliffs, NJ: Prentice-Hall, 2002. ISBN 0130609072.

Complementary:

Lewis, Paul H.; Yang, C. Sistemas de control en ingeniería. Madrid: Prentice Hall, 1999. ISBN 8483221241.

Golnaraghi, F.; Kuo, Benjamin C. Automatic control systems. 9a ed. New York: John Wiley & Sons, 2010. ISBN 9780470048962.

Levine, William S. The control handbook. Florida: CRC Press: IEEE Press, 1996. ISBN 0849385709.

Dorf, Richard C.; Bishop, Robert H. Modern control systems. 11a ed. Upper Saddle River: Pearson Prentice Hall, 2008. ISBN 9780132270281.

Bolton, W. Control engineering. 2nd ed. Essex: Addison Wesley Longman Limited, 1998. ISBN 0582327733.

Anderson, David F.; Eberhardt, Scott. Understanding flight. 2nd ed. New York [etc.]: McGraw-Hill, 2010. ISBN 9780071626965.

Athans, Michael; Falb, Peter L. Optimal control : an introduction to the theory and its applications. New York [etc.]: Dover Publications, cop. 2007. ISBN 9780486453286.

Kirk, Donald E. Optimal control theory : an introduction. Mineola, N.Y.: Dover Publications, 2004. ISBN 0486434842.