300250 - CA-MP1 - Airport Communications

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering

Teaching unit: 739 - TSC - Department of Signal Theory and Communications

Academic year: 2018

Degree: BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERINGS/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING - NETWORK ENGINEERING (AGRUPACIÓ DE SIMULTANEÏTAT) (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: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

Prior skills

Operability with complex numbers. Product and sum of complexes, rationalization, inversion, module and phase calculation of a complex number.
Operability with trigonometric functions.
Operability with matrices.
Knowledge of probability.
Operability with signals and systems in the frequency domain from the series and the Fourier transform, and apply the main properties of these.
Operability with convolutions of functions.
Knowledge of the concept of filter applied on signals.

Requirements

LINEAR SYSTEMS - Co-requisite

Degree competences to which the subject contributes

Specific:

6. CE 17 AERO. Conocimiento adecuado y aplicado a la ingeniería de: Los elementos fundamentales de los diversos tipos de aeronaves ; los elementos funcionales del sistema de navegación aérea y las instalaciones eléctricas y electrónicas asociadas; los fundamentos del diseño y construcción de aeropuertos y sus diversos elementos. (CIN/308/2009, BOE 18.2.2009)
7. CE 20 AEROP. Conocimiento adecuado y aplicado a la Ingeniería de: Los materiales utilizados en la edificación; las necesidades y desarrollo de las infraestructuras aeroportuarias y su impacto ambiental; las edificaciones necesarias para la operación y funcionamiento de los aeropuertos. (CIN/308/2009, BOE 18.2.2009)
8. CE 23 AEROP. Conocimiento aplicado de: edificación; electricidad; electrotecnia; electrónica; mecánica del vuelo; hidráulica; instalaciones aeroportuarias; ciencia y tecnología de los materiales; teoría de estructuras; mantenimiento y explotación de aeropuertos; transporte aéreo, cartografía, topografía, geotecnia y meteorología. (CIN/308/2009, BOE 18.2.2009)

Generical:

5. (ENG) CG9 - Utilizar eficientemente equipos e instrumentación. Caracterizar equipos terminales, medios de

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transmisión, sistemas y subsistemas. Diagnosticar, tomar decisiones y evaluar mediciones de equipos y subsistemas según las especificaciones globales del sistema y/o del servicio (competencia propia de la escuela).

Transversal:

1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
4. EFFECTIVE USE OF INFORMATI0N 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.

Teaching methodology

Through the material available for the subject (slides, class notes, solved exercises, practice manuals, catalogs, etc.) accessible from the ATENEA digital campus, the student has sufficient tools and resources to work autonomously, either in group or individually, that will allow him to make a better use of the presencial lessons to consolidate concepts and solve the doubts that have arisen to him.
In the theory sessions (large group), based on expository classes, the formal explanation of the teacher is combined with informal interrogations to the students that favor the understanding and the establishment of the basic concepts of the subject, thanks to the material of the subject of which previously arranged.
In the sessions of problems (middle group) students work in groups, at least three people, solving exercises related to the theory exposed in class. Subsequently, the teacher will solve jointly some of the exercises proposed and may propose exercises to be solved by the students in hours of autonomous learning. In the laboratory sessions, (small group with 20 students maximum), the practices will be carried out that will allow to consolidate the exposed theoretical knowledge and at the same time acquire the capacity to use the most common laboratory instruments.

Learning objectives of the subject

At the end of the course the student must be able to:
- Know the functional blocks that make up a communications system.
- Operate with modulated signals, both in the time domain and in the frequency domain.
- Operate with powers and gains of signals and systems, both in linear scale (W, V), and in logarithmic scale (dBW, dBm, dB).
- Calculate and analyze the main parameters and the basic quality criteria in analog and digital communication systems (signal-noise ratio and probability of error).
- Identify and model mathematically the different types and sources of noise and distortion existing in a communications system, to analyze their behavior and evaluate their effects.
- Calculate the power balance of a radiocommunication link and know its limitations.
- Know how to apply the radiofrequency technology and the mechanisms of transmission and propagation of electromagnetic waves in an airport infrastructure.
- Know the parameters and basic characteristics of the aeronautical communications equipment and radio-aids to the aerial navigation that are installed in the aerodromes.
- Use the RF instrumentation to characterize devices and systems.

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Study load

Total learning time: 150h	Hours large group:	36h	24.00%
	Hours medium group:	14h	9.33%
	Hours small group:	10h	6.67%
	Guided activities:	6h	4.00%
	Self study:	84h	56.00%

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Content

1. Communication Systems

Learning time: 33h

Theory classes: 8h
Practical classes: 4h
Laboratory classes: 2h
Guided activities: 1h
Self study : 18h

Description:
This block aims to introduce the student in the concepts of the subject through an overview of the telecommunication systems and their application in aeronautics. The theme defines the basic elements of a communication system that must be taken into account in any design: the electromagnetic spectrum; Bandwidth and channel capacity; Modes of transmission, etc. The concept of modulation is then explained and a global perspective of a communication system with all its elements (information sources, source coding, channel coding, modulation, multiplexing, multiple access, Transmission, reception, demodulation, equalization, synchronization, etc.).
Finally, the parameters of the signals (power, voltage, spectrum), noise (Noise temperature equivalent, Noise factor, Friis formula) and distortion (compression, intermodulation) are studied.

Related activities:
Lab no. 1. The RF Spectrum Analyzer.
Exercices and problems.
First short test on exercises.
Mid term exam.

2. Antennas, Radio links and propagation of electromagnetic waves.

Learning time: 14h

Theory classes: 3h
Practical classes: 2h
Guided activities: 1h
Self study : 8h

Description:
Antennas: properties, parameters and types. Mechanisms of propagation of electromagnetic waves. Wave polarization. Transmission equation. Radio links. Balance of power and noise links.

Related activities:
Exercices and problems.
First short test on exercises.
Mid term exam.

Specific objectives:
Know how to select the antennas and their optimal location inside the airport for CNS functions.
Know how to calculate radio links, taking into account the effects of noise and distortion.

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3. Analogue and digital modulation systems.

Learning time: 27h 30m

Theory classes: 7h
Practical classes: 2h
Laboratory classes: 2h
Guided activities: 1h
Self study : 15h 30m

Description:
This block will focus on analyzing analog and digital modulations of amplitude, frequency and phase, focusing on basic aspects such as bandwidth, power, recovery of the information signal and signal-noise ratio and protection against interferences.

Related activities:
Laboratory practice no. 2. Measurement and characterization of modulated signals.
Exercices and problems.
First short test on exercises.
Mid term exam.

4. Radiofrequency technology and systems.

Learning time: 35h 30m

Theory classes: 6h
Practical classes: 2h
Laboratory classes: 6h
Guided activities: 1h 30m
Self study : 20h

Description:
Measurement units. Impedance matching. Transmission lines: properties, parameters and types. Wave guides. Coefficients of reflection and transmission. Stationary wave ratio. Insertion loss and retorn loss: measurements. Passive and active RF devices. RF connectors. RF instrumentation.

Related activities:
Lab no. 3. Reflectometry in the time domain and in the frequency domain.
Lab no. 4. Measurement of insertion loss and return of devices.
Exercices and problems.
Second short test on exercises.
Final exam.

Specific objectives:
Know how to interpret and select from commercial component catalogs the properties of RF devices and systems commonly used in airport facilities.
Know how to use the most common RF instruments, and especially the spectrum analyzer.

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5. Radio airport equipment and systems.	Learning time: 40h Theory classes: 12h Practical classes: 4h Guided activities: 1h 30m Self study : 22h 30m

Description:
Ground-to-air aeronautical communications facilities at airports. Radio direction-finding and VDF systems. Airport surveillance systems and equipment: primary and secondary radar; Mode S and multilateration systems; ADS system. NDB, DME, VOR, DVOR, TACAN and VORTAC systems and facilities for radio navigation aids. Equipment and guidance systems on landing: ILS and MLS. GNSS guidance and navigation systems. Augmentation systems: SBAS and GBAS.

Related activities:
Exercices and problems.
Second short test on exercises.
Final exam.

Specific objectives:
Know how to select the characteristics of the aeronautical, radionavigation and surveillance communications equipment that will be installed in an airport infrastructure, selecting the location and defining the security and radio-easement requirements that they must have.

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Planning of activities

Lab no. 1. The RF Spectrum Analyzer.

Hours: 4h
Laboratory classes: 2h
Self study: 2h

Description:
The aim of the practice is to make a first approximation to the spectrum analyzer as a measurement instrument of great versatility in RF applications. Your main controls will be introduced progressively from the measurement of actual signals.

Laboratory practice no. 2. Measurement and characterization of modulated signals.

Hours: 4h
Laboratory classes: 2h
Self study: 2h

Description:
The RF spectrum analyzer will be used to observe the characteristics of different types of modulations of amplitude, frequency and pulses, as well as review the aspects related to the thermal noise and the distortion present in any communication system.

Descriptions of the assignments due and their relation to the assessment:
Lab report.

Lab no. 3. Reflectometry in the time domain and in the frequency domain.

Hours: 8h
Laboratory classes: 4h
Self study: 4h

Description:
It is a question of experimentally verifying the aspects of the propagation of pulses in transmission lines, verifying the effect of pulse reflection that occurs when there is no adaptation of impedances.

With the help of a temporary reflectometry system, several discontinuities in transmission lines will be identified, determining their position in the line and its characteristics.

We will also use the frequency domain reflectometry system or Distance to Fault (DTF) system that incorporates some spectrum analyzers, and that will allow us to perform the same measurement.

Descriptions of the assignments due and their relation to the assessment:
Lab report.

Lab no. 4. Measurement of insertion loss and return of devices.

Hours: 4h
Laboratory classes: 2h
Self study: 2h

Description:
It will try to measure the return and insertion losses of passive devices, such as filters, and the gain of active devices, such as amplifiers, using the spectrum analyzer with tracking generator.

Descriptions of the assignments due and their relation to the assessment:
Lab report.

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Exercices and problems.	Hours: 24h Practical classes: 12h Self study: 12h

Description:
Doing exercises and problems about the theoretical contents presented in class.

First short test on exercises	Hours: 1h Practical classes: 1h

Description:
The student must perform a short test where he will be asked to demonstrate the knowledge that he should have acquired in theory classes and problems prior to the control.

Specific objectives:
Verify that learning objectives are achieved.

Second short test on exercises	Hours: 1h Practical classes: 1h

Description:
The student must perform a short test where he will be asked to demonstrate the knowledge that he should have acquired in theory classes and problems prior to the control.

Specific objectives:
Verify that learning objectives are achieved.

Midterm exam.	Hours: 1h 30m Guided activities: 1h 30m

Description:
Examination of theoretical and practical contents relating to communication systems, antennas and radio-relays, and analogue and digital modulations.

Specific objectives:
Verify that learning objectives are achieved.

Final exam.	Hours: 1h 30m Guided activities: 1h 30m

Description:
Synthesis course exam, with theoretical and practical content, but focused towards the contents studied in the second half of the course.

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Specific objectives:
Verify that learning objectives are achieved.

Qualification system

Apply the evaluation criteria defined in Infoweb subject.

Bibliography

Basic:

Carlson, A. Bruce; Rutledge, Janet C.; Crilly, Paul B. Communication systems : an introduction to signals and noise in electrical communication. 4th. New York [etc.]: McGraw-Hill, 2002. ISBN 0070111278.

Sklar, Bernard. Digital communications : fundamentals and applications. 2nd. Upper Saddle River: Prentice Hall, 2001. ISBN 0130847887.

Faúndez Zanuy, Marcos. Sistemas de comunicaciones. Barcelona: Marcombo Boixareu, 2001. ISBN 8426713041.