Last update: 22-05-2017

300317 - IRA - Radio-Electrical Airport Infrastructures

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

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

Academic year: 2017

Degree: BACHELOR'S DEGREE IN AIR NAVIGATION ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AIRPORT ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS 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

Knowledge of communications systems, electromagnetic waves and aeronautical radionavigation systems.
Knowledge about the airport system and the elements that make up an airport. Airport management and operation.

Requirements

"Airport Engineering" - Required.
"Aeronautical Communications 1" or "Airport Communications". - Required

Degree competences to which the subject contributes

Specific:

5. 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)
6. 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)
7. 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:

1. 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.
2. EFFICIENT USE OF EQUIPMENT AND INSTRUMENTATION - Level 3: Design experiments, measurements, subsystems and systems, equipment and tools most appropriate laboratory. Knowing not only benefits but also the limitations of the equipment and resources. Conduct assessments and evaluations critically, making decisions according to the overall system specifications or service.
9. PROJECT MANAGEMENT - Level 3: Define the objectives of an extensive project and open, multidisciplinary. Schedule tasks and resources, track and integration of the parties. To evaluate the intermediate and final results, restating the objectives if necessary.

Last update: 22-05-2017

300317 - IRA - Radio-Electrical Airport Infrastructures

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. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.
8. 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.
10. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
11. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Teaching methodology

The theoretical lectures will be explained in the large group sessions. In the laboratory, students in groups of two will have to do the proposed activities in practice.
Because practices for 4 to 9 there is no equipment for all the students can perform simultaneously, we will establish a rotating schedule of practices depending on the number of students enrolled.
The Radio Direction Finder practice will be a Directed Activity that students have to do outside of class time, previously agreed with the teacher, the date and time of use of laboratory equipment.
Sessions devoted to the practical exercises and proposed problems will be participatory and students must solve the exercises under the guidance of the teacher.
Finally the project of installation of radioelectric infrastructure is an activity that students will perform in their hours of autonomous learning, in which teachers will tutor and guide student work. The project will be presented in public in the last week of class.

Learning objectives of the subject

Know how to apply radiofrequency technology and the mechanisms of transmission and propagation of electromagnetic waves in an airport infrastructure.
Know the parameters and characteristics of aeronautical communications equipment and radio-aids to air navigation that are installed at aerodromes.
Know and know how to apply the international and state legislation that regulates the aeronautical easements of communication and radio-aid equipment installed at aerodromes, and especially the Airport Manual.
Elaborate a project of installation of radio infrastructures in an aerodrome, integrated in the Manual of the Airport.
Learn how to use RF instrumentation to characterize devices and systems.
To learn to test and measure experimentally in the laboratory the operation and operation of the main aeronautical communications, navigation and surveillance systems.

Study load

Total learning time: 150h	Hours large group:	36h	24.00%
	Hours small group:	24h	16.00%
	Guided activities:	6h	4.00%
	Self study:	84h	56.00%

Last update: 22-05-2017

300317 - IRA - Radio-Electrical Airport Infrastructures

Content

1.- Aeronautical servitudes

Learning time: 23h

Theory classes: 3h
Laboratory classes: 2h
Self study : 18h

Description:
- The powers professional aeronautical engineer.
- Regulations concerning international and national airport infrastructures. ICAO regulations. AESA regulations.
- Protection and exclusion zones. Easements radio. The Airport's manual. Certification and verification of airports and airfields.
- Design criteria for the installation of airport radio infrastructures.

Related activities:
Draft a design project of radio facilities at an aerodrome in accordance with international and national standards, and forming part of the Airport Manual.

2.- Radiofrequency technology and systems.

Learning time: 56h

Theory classes: 15h
Laboratory classes: 12h
Guided activities: 1h 30m
Self study : 27h 30m

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. Antennas: properties, parameters and types. Mechanisms of propagation of electromagnetic waves. Wave polarization. Transmission equation. Thermal noise. Distortion. Radio links. RF instrumentation.

Related activities:
Session Lab no. 1: The RF spectrum analyzer.
Session Lab no. 2: Time domain and frequency domain reflectometry.
Session Lab no. 3: Measurements of insertion loss and return loss of devices.
Lab assessment no. 1
Midterm 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 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.
Know how to use the most common RF instruments, and especially the spectrum analyzer.

Last update: 22-05-2017

300317 - IRA - Radio-Electrical Airport Infrastructures

3.- Radio airport equipment and systems.

Learning time: 71h

Theory classes: 18h
Laboratory classes: 10h
Guided activities: 4h 30m
Self study : 38h 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:
Lab no. 4. Secondary Radar.
Lab no. 5. VOR and ILS.
Lab no. 6. Measure of electrical length of cables.
Lab no. 7. Radio direction finder.
Lab no. 8. HF Communications.
Lab no. 9. ADS-B System.
Lab assessment no. 2.
Exercises and problem solving.
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.
Know how to check and characterize in the laboratory the main CNS equipment and systems.

Last update: 22-05-2017

300317 - IRA - Radio-Electrical Airport Infrastructures

Planning of activities

Lab no. 1. The RF Spectrum Analyzer	Hours: 8h Laboratory classes: 4h Self study: 4h

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. It will be used to observe the characteristics of different types of amplitude, frequency and pulse modulations, as well as to review the aspects related to the thermal noise present in any communications system.

Lab no. 2. 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.

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.

Lab no. 4. Secondary Radar	Hours: 2h Laboratory classes: 1h Self study: 1h

Description:
The aim of the practice is to use and program a transponder in A/C/S modes (secondary radar - SSR) and test its operation using a test generator (interrogator) designed as a test system.

Lab no. 5. VOR and ILS.	Hours: 2h Laboratory classes: 1h Self study: 1h

300317 - IRA - Radio-Electrical Airport Infrastructures

Description:
The aim of the practice is to use a test signal generator to verify the operation of an embedded NAV/COM receiver and display the type of signals generated, in particular the VOR and ILS signals, both from the point of view of the time domain, as of the frequency domain.

Lab no. 6. Measures lengths of electrical cables.	Hours: 2h Laboratory classes: 1h Self study: 1h

Description:
The aim of this practice is to use the Vector Voltmeter option of the Anritsu spectrum analyzer to measure the electrical length of cables and their subsequent adjustment in both reflection and transmission.

Lab no. 7. Radio Direction Finder	Hours: 6h Guided activities: 3h Self study: 3h

Description:
The object of the practice is for students (organized in groups of two) to determine the location of different transmitting stations by using a DF station (Direction Finding) located on a tool that allows them to be moved outside the school. In this way, it is possible, based on the measurement of several locations of the received signals and their angle of arrival, to determine the origin of the emissions using the triangulation technique.

Lab no. 8. HF Communications.	Hours: 2h Laboratory classes: 1h Self study: 1h

Description:
The aim of the practice is to use a communications receiver in the 10 kHz band at 30 MHz, capable of demodulating in AM, DBL, BLU, FM and RTTY, to detect and demodulate aeronautical communications signals in the HF Band.

Lab no. 9. ADS-B system.	Hours: 2h Laboratory classes: 1h Self study: 1h

Description:
The aim of the practice is to use an ADS-B receiver and to check in real time the operation of this navigation system in the Barcelona airspace.

LAB ASSESSMENT NO. 1	Hours: 1h Laboratory classes: 1h

300317 - IRA - Radio-Electrical Airport Infrastructures

Description:
Control over the activities carried out in the lab sessions numbers 1, 2 and 3.

Specific objectives:
To verify that take the most from the sessions labs.

LAB ASSESSMENT NO. 1	Hours: 1h Laboratory classes: 1h

Description:
Control over the activities carried out in the lab sessions numbers 4, 5, 6, 7, 8 and 9.

Specific objectives:
To verify that take the most from the sessions labs.

EXERCISES	Hours: 6h Theory classes: 3h Self study: 3h

Description:
Performing simple problems on RF systems and radio aids.

MIDTERM EXAM	Hours: 1h 30m Guided activities: 1h 30m

Description:
Examination of contents for theme 2.

Specific objectives:
Verify the knowledge acquired by students in the first half of the semester.

FINAL SEMESTER EXAM	Hours: 1h 30m Guided activities: 1h 30m

Description:
Examination of contents for theme 3.

Specific objectives:
Verify the knowledge acquired by students in the second half of the semester.

Project design of radioelectrical facilities in an aerodrome.	Hours: 23h Theory classes: 3h Laboratory classes: 2h Self study: 18h

Last update: 22-05-2017

300317 - IRA - Radio-Electrical Airport Infrastructures

Description:

The project will consist of the elaboration of a proposal for aeronautical easements for an aerodrome. This proposal should follow the structure of the airport manual, defined by the current version of REAL DECRETO 862/2009, of May 14, which approves the technical standards of design and operations of aerodromes for public use and regulates the certification of the competing airports of the State, and in particular, Parts 0, 1 and 2 that correspond to the generic description of the aerodrome and its services, as well as the plans, and in detail, Part 4, paragraph q), following the guidelines set out in the ICAO Technical Standards for Design and Operation of Aerodromes for Public Use.

It should also include aeronautical easements, and in particular radioelectrical ones, following the established in DECRETO 584/1972, of February 24, of aeronautical easements, deciding the best site and location of aeronautical communications services and radio aids.

Descriptions of the assignments due and their relation to the assessment:

Project report. Class presentation of the project.

Specific objectives:

Summarized in a draft practical nature knowledge acquired throughout the course.

Qualification system

Apply the evaluation criteria defined in Infoweb subject.

Regulations for carrying out activities

The examinations and checks will be conducted individually. In laboratory controls, each student will be able to use their notes, notes and other written material, except for the use of electronic communication devices. The practice on Radio Direction Finfing will be assessed from the report submitted.

The project will be done in groups of two students, and assessed through a public presentation of the project done.

Last update: 22-05-2017

300317 - IRA - Radio-Electrical Airport Infrastructures

Bibliography

Basic:

Ministerio de la Presidencia. "Real Decreto 862/2009, de 14 de mayo, por el que se aprueban las normas técnicas de diseño y operación de aeródromos de uso público y se regula la certificación de los aeropuertos de competencia del E". BOE [on line]. Available on: <http://www.boe.es/buscar/act.php?id=BOE-A-2009-9043>.

U.S. Department of transportation. Pilots handbook of aeronautical knowledge [on line]. FAA, 2003Available on: <http://www.personal.psu.edu/lnl/001/faa/faa-h-8083-25-1of4.pdf>.

Aeródromos : normas y métodos recomendados internacionales : anexo 14 al convenio sobre aviación civil internacional. 5a ed. Montréal: Organización de Aviación Civil Internacional, 2009. ISBN 9789292313746.

Helfrick, Albert D. Principles of avionics. 4th ed. Leesburg, VA: Avionics Communications, 2007. ISBN 9781885544261.

Complementary:

Skolnik, Merrill I. Introduction to radar systems. 3rd. ed. Boston: McGraw-Hill, 2001. ISBN 0072909803.

Berenguer Sau, Jordi. Radiofreqüència : una introducció experimental [on line]. Barcelona: Edicions UPC, 1998Available on: <http://hdl.handle.net/2099.3/36367>. ISBN 8483012685.

Vizmuller, Peter. RF design guide : systems, circuits and equations. Boston, MA [etc.]: Artech House, cop. 1995. ISBN 0890067546.

Pérez Sanz, Luis. Introducción al sistema de navegación aérea. Madrid: Ibergarceta, 2013. ISBN 9788415452812.