

## 300037 - CSF - Wireless 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/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Compulsory) BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) 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 NETWORK ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Optional)
ECTS credits:	6
Teaching languages:	Catalan, Spanish, English

### Teaching staff

Coordinator:	Definit a la infoweb de l'assignatura.
Others:	Definit a la infoweb de l'assignatura.

### Prior skills

Operability with complex numbers, arrays, variables and random processes.  
Analysis of signals and systems uptime, analogue and digital, regarding temporal and frequency range.  
Both linear and logarithmic scale uptime (dB) scale.  
Basic knowledge of communications, antennas and propagation, senders and receivers

### Requirements

RADIO SOFTWARE ENGINEERING - Corequisite  
WIRELESS COMMUNICATIONS LABORATORY - Irequisite

### Degree competences to which the subject contributes

Specific:

1. CE 21 SIS. Capacidad para construir, explotar y gestionar las redes, servicios, procesos y aplicaciones de telecomunicaciones, entendidas éstas como sistemas de captación, transporte, representación, procesado, almacenamiento, gestión y presentación de información multimedia, desde el punto de vista de los sistemas de transmisión.(CIN/352/2009, BOE 20.2.2009.)

Transversal:

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. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
4. 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.
5. 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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6. 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.

### Teaching methodology

Thanks to the material produced by the teachers of the course: class notes, solved exercises, transparencies, digital campus, etc., available on the learner has sufficient tools ATHENA to work independently, whether in group or individually, and thus be able to take advantage of the classroom to consolidate the concepts and solve doubts that have arisen.

In theory sessions (groups of a maximum of 40 students) classes based on the formal explanation of the exhibition, combined with informal learners that favor teacher questioning, understanding and the establishment of basic concepts of the subject. This more active participation on the part of the pupil is possible thanks to material subject to the provisions, since there has to be a kind of simply taking notes.

Problems in sessions (groups of 20 students), students work in groups of at most 3 people, related the theory given in solving exercises classes exhibition. Then the teacher will solve some of the exercises may jointly propose and solve exercises in hours of autonomous learning for students.

In laboratory sessions (groups of 10 students) will consist of workshops on the student will be able to perform more activities and practices will receive very personalized attention. You will need to work will further activities of autonomous and cooperative work.

### Learning objectives of the subject

Upon completion of the course, the student wireless systems should be able to:

- Discover the main features of the regulations of the different systems of radio communications by radio (broadcasting, mobile communications, satellite positioning signals, terrestrial links, etc).
- Know and understand the mechanisms for advanced digital signal modulation for radio environments, especially being able to do all analyses and designs systems based on these devices.
- Know and understand the techniques of OFDM multi-carrier transmission, in particular, its technical features, parameters, their advantages, limitations and complexities of implementation. You will need to know these techniques, based on a radio link size as well as their functioning and adequately assess its performance parameters.
- Know and understand the main techniques of multiple access radio transmission used in environments (TDMA, FDMA, CDMA, MPDS, OFDMA). In all cases, you will need to size and evaluate a system that works with any of the techniques of access.
- Choose the most appropriate protection measures at the level of radio engineering, and to achieve maximum quality system, a radio transmission system: diversity, repeaters, antennas, coding, interlaced heights, relay channel equalisation techniques, etc.

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- Designing digital radio given the main effects of the atmosphere and the Earth about the spread as well as the presence of interference.
- Know and understand the main characteristics of a mobile communications system, its basic functions and the structure of a mobile network. Cellular mobile communications systems shall be designed to achieve a certain degree of order generic in terms of coverage and capacity. Learn the basic characteristics of the GSM system.
- Define the main features of a satellite communications system and take stock of geostacionari power of ascending and descending the link contemplating the effect of the interference.

### Study load

Total learning time: 150h	Hours large group:	26h	17.33%
	Hours medium group:	16h	10.67%
	Hours small group:	0h	0.00%
	Guided activities:	24h	16.00%
	Self study:	84h	56.00%

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### Content

<p>Regulation</p>	<p>Learning time: 7h Theory classes: 2h Laboratory classes: 2h Self study : 3h</p>
<p>Description: This bloc is focused on a general introduction to the wireless communications and their importance, and to describe the main elements on regulation, the institutions that dictate the regulations and recommendations, and the main standards.</p> <p>Related activities: Activity 1: performing a compilation of relevant information on regulation of wireless communications</p>	
<p>Advanced Modulations</p>	<p>Learning time: 19h Theory classes: 3h Practical classes: 2h Laboratory classes: 4h Self study : 10h</p>
<p>Description: In this bloc we'd studied and analyses the most suitable transmission for digital modulations for wireless systems, completing the study done on other subjects, introducing the concept of everything from constant differential modulation and coding environment.</p> <p>Related activities: Activity 2: learning with digital signal WinIQSim</p>	
<p>Multicarrier modulation, OFDM transmission</p>	<p>Learning time: 20h Theory classes: 4h Practical classes: 2h Laboratory classes: 2h Self study : 12h</p>
<p>Description: In this bloc we'd studied in depth the transmission techniques, focusing on technical study Multicarrier modulation for OFDM transmission, as well as the modulation DMT. Theoreticians described all details and features of implementation in real systems. It's equally dynamic adaptation mechanisms include the 'water filling's cone.</p> <p>Related activities: Activity 3: Control of transmission systems and multiple access techniques of Multicarrier modulation</p>	

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<p>Multiple Access Techniques, CDMA</p>	<p>Learning time: 23h Theory classes: 5h Practical classes: 3h Laboratory classes: 3h Self study : 12h</p>
<p>Description: (ENG) En aquest bloc s'estudien i analitzen les tècniques d'accés múltiple (FDMA, TDMA, CDMA, SDMA, CSMA, OFDMA) aplicables a sistemes de transmissió sense fils. Es farà especial èmfasi en les tècniques de transmissió de senyals d'espectre eixamplat (FH i DS-SS). S'estudiarà tota la cadena de transmissió i recepció, la generació i característiques dels codis d'eixamplament, el disseny i l'avaluació d'un sistema de transmissió CDMA.</p> <p>Related activities: (ENG) Activitat 3: Control de sistemes de transmissió multiprotectora i tècniques d'accés múltiple</p>	
<p>Radio Engineering</p>	<p>Learning time: 26h Theory classes: 5h Practical classes: 3h Laboratory classes: 4h Self study : 14h</p>
<p>Description: (ENG) En aquest bloc s'estudien i analitzen algunes de les opcions bàsiques que permeten combatre els efectes nocius del canal per diferents tipus de sistemes de transmissió sense fils, com són la codificació de canal, les tècniques de retransmissió clàssiques i híbrides (HARQ), els esquemes d'entrellaçat i la igualació de canal.</p> <p>Related activities: (ENG) Activitat 4: Estudi del efectes de la ISI en sistemes digitals</p>	
<p>Mobile Communications</p>	<p>Learning time: 13h Theory classes: 2h Practical classes: 1h Self study : 10h</p>
<p>Description: (ENG) En aquest bloc es proporciona una descripció dels paràmetres principals del disseny d'un sistema de comunicacions mòbils cel·lulars, considerant com a exemple el sistema GSM. S'explicaran les funcions bàsiques dels sistemes de comunicacions mòbils i l'estructura d'una xarxa mòbil amb els seus blocs principals. S'explicaran els conceptes de eficiència, sectorització, control de potència, control d'admissió, mecanismes de traspàs de trucada, estructura canals lògics, físics, i de transport, esquema de trames, multitrames, control del time advance i planificació freqüencial.</p> <p>Related activities: (ENG) Activitat 5: Control sobre sistemes de comunicacions mòbils</p>	

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<p>Terrestrial Radio Communications</p>	<p>Learning time: 22h Theory classes: 3h Practical classes: 1h Laboratory classes: 6h Self study : 12h</p>
<p>Description: (ENG) En aquest bloc es proporciona una descripció del principi de funcionament dels radioenllaços digitals emprant diferents tecnologies i dels sistemes de radiodifusió de senyals d'àudio i televisió. En tots els casos s'analitzaran els principals paràmetres de disseny de l'enllaç, les seves limitacions, els serveis i tipus de dades que transmeten, els càlculs de cobertures i capacitat. Es farà també una introducció a les xarxes de sensors sense fils.</p> <p>Related activities: (ENG) Activitat 6: Exercicis pràctics amb xarxes de sensors sense fils (Zigbee)</p>	
<p>Satellite Communications</p>	<p>Learning time: 20h Theory classes: 2h Practical classes: 1h Laboratory classes: 5h Self study : 12h</p>
<p>Description: (ENG) Aquest bloc pretén introduir l'alumne en el disseny d'un sistema de comunicacions per satèl·lit analitzant des de els diferents tipus d'òrbites, equipaments embarcats i estacions terrenes, càlculs d'enllaç en presència de soroll i interferències, com els serveis oferts.</p> <p>Related activities: (ENG) Activitat 7: Observació de les constel·lacions de satèl·lits i càlcul de l'enllaç mitjançant eines de planificació digitals</p>	

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### Planning of activities

(ENG) REALITZACIÓ D'UN RECULL D'INFORMACIÓ RELLEVANT SOBRE REGULACIÓ DE LES COMUNICACIONS SENSE FILS.	Hours: 3h Practical classes: 3h
(ENG) ESTUDI AMB WINIQSIM DE SENYALS DIGITALS	Hours: 4h Practical classes: 4h
(ENG) CONTROL DE SISTEMES DE TRANSMISSIÓ MULTIPORTADORA I TÈCNiques D'ACCÉS MÚLTIPLE	Hours: 2h Practical classes: 2h
(ENG) ESTUDI DELS EFECTES DE LA ISI EN SISTEMES DIGITALS	Hours: 4h Practical classes: 4h
(ENG) CONTROL SOBRE SISTEMES DE COMUNICACIONS MÒBILS	Hours: 1h Practical classes: 1h
(ENG) EXERCICIS PRÀCTICS AMB XARXES DE SENSORS SENSE FILS (ZIGBEE)	Hours: 6h Practical classes: 6h
(ENG) OBSERVACIÓ DE LES CONSTEL·LACIONS DE SATÈL·LITS I CÀLCUL DE L'ENLLAÇ MITJANÇANT EINES DE PLANIFICACIÓ DIGITALS	Hours: 5h Practical classes: 5h
(ENG) ACTIVITATS DE PLANIFICACIÓ, SEGUIMENT I AVALUACIÓ DEL TREBALL EN GRUP	Hours: 5h Practical classes: 5h

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### Qualification system

50% exams. Half and quarter final exams.

- 20% Controls. Throughout the year there will be two controls.
- 25% you'd have workgroups: documents the results obtained in respect of delivering projects and exercises.
- planning and monitoring of the operation of the group by 5%.

### Regulations for carrying out activities

The completion and delivery of activities is mandatory in order to pass the course.

### Bibliography

Basic:

Artés Rodríguez, A. Comunicaciones digitales. Madrid: Prentice Hall, 2007. ISBN 9788483223482.

Hernando Rábanos, José María. Transmisión por radio. 6ª ed. Madrid: Centro de Estudios Ramon Areces, 2008. ISBN 9788480048569.

Hernando Rábanos, José María. Comunicaciones móviles. 2ª ed. Madrid: Centro de Estudios Ramón Areces, 2004. ISBN 848004635X.

Sallent Roig, Oriol; Valenzuela González, José Luís; Agustí Comes, Ramon. Principios de comunicaciones móviles [on line]. Barcelona: Edicions UPC, 2003 Available on: <<http://hdl.handle.net/2099.3/36768>>. ISBN 8483017156.

Others resources: