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230051 - CDA SISTEL - Advanced Digital Communications

Coordinating unit:	230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit:	739 - TSC - Department of Signal Theory and Communications
Academic year:	2019
Degree:	BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory) BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)
ECTS credits:	6
Teaching languages:	Catalan, English

Teaching staff

Coordinator: Javier Rodríguez Fonollosa

Others: Javier Rodríguez Fonollosa

Prior skills

ALED (Determinant of Matrices and systems of equations. Inverse. Matrix Operations. Vector Spaces and subspaces. Subspace spanned by a set. Linear combination and linear independence. Dimension. Basis. Coordinates of a vector in a base. Base change), ACAL (Scalar product and topology: Norm and distance. Conditional and unconditional optimization. Lagrange multipliers), PPEE (full syllabus), SIS (Signals and systems in time and frequency domain, Fourier transform) and ICOM (full syllabus).

Requirements

PPEE, SIS y ICOM.

Degree competences to which the subject contributes

Transversal:

07 AAT N3. 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.

Teaching methodology

Application classes
Lecture classes
Group work (at home)
Individual work (at home)
Test of long answer (Control)
Test of long answer (Final Exam)

Learning objectives of the subject

- Is able to build, operate and manage networks, services, processes and telecommunications applications from the point of view of the transmission systems.
- Know when to apply the techniques are based networks, services and applications in both telecommunications fixed and mobile environments, personal local or long distance, with different bandwidths, including telephony, radio, television and

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data from the point of sight transmission systems.
- Plans and uses the information needed for a project or academic work from a critical appraisal of the information resources used.
- Apply the skills acquired in carrying out a task independently. Identifies the need for continuous learning and develop their own strategy to do so.
- Identify, model and raises problems from open situations. Explore alternatives and applies for its resolution. Use approaches.
- Identify and model complex systems. Performs analysis and qualitative approaches, establishing the uncertainty of the results.
- Raises hypotheses and experimental methods to validate. Identify the main components and establishes commitments and priorities.

Learning outcomes:

The student must finish the course having acquired the following skills:

- Analysis and design of a digital communications system.
- Characterization of the basic elements and their functions.
- Transmission of information generated by a source in digital format.
- Physical characteristics of the channel and its influence on the design of a communications system.
- Non-linear digital modulations and orthogonal modulations
- Access Techniques

Study load

Total learning time: 150h	Hours large group:	65h	43.33%
	Self study:	85h	56.67%

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Content

Tema 1. Introduction

Learning time: 2h

Theory classes: 2h

Description:
Course introduction.

Tema 2. Communication channel models

Learning time: 24h

Theory classes: 6h
Guided activities: 2h
Self study : 16h

Description:
- Deterministic models
- Statistical Channel modelling

Tema 3. Channel capacity

Learning time: 48h

Theory classes: 9h
Guided activities: 7h
Self study : 32h

Description:
- Capacity in AWGN .
- Capacity in non-frequency selective channels.
- Capacity in frequency selective channels.

Tema 4. Digital Modulation and Detection

Learning time: 42h

Theory classes: 10h
Guided activities: 4h
Self study : 28h

Description:
- The Signal Space. Geometric representation, optimum receiver and error probability .
- Amplitude and phase modulation in the signal space.
- Differential modulations.
- Frequency modulations: FSK , MSK and CPFSK .
- Phase Errors.

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Tema 5. Performance of digital communication systems	Learning time: 12h Theory classes: 2h Guided activities: 2h Self study : 8h

Description:
- Probability of error in AWGN .
- Fading Outage probability and average probability of error. Moment Generating Function.
- Doppler Effect and ISI.

Tema 6. Diversity and adaptive modulation	Learning time: 24h Theory classes: 6h Guided activities: 2h Self study : 16h

Description:
- Receiver Diversity.
- Transmitter Diversity.
- Introduction to channel coding. Coding Gain and interleaving .
- Adaptive modulation.

Tema7. Multicarrier modulation and OFDM	Learning time: 27h Theory classes: 6h Guided activities: 3h Self study : 18h

Description:
- Multicarrier modulations.
- OFDM signal modrl.
- Spread Spectrum Systems.

Qualification system

Mid-term exams and assignments 40%
Final exam: 60%

This course will assess generic skills:
- Self learning (Middle Level)
- Ability to identify, formulate and solve engineering problems (Middle Level)

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Bibliography

Basic:

Goldsmith, A. Wireless communications. Cambridge: Cambridge University Press, 2005. ISBN 978-0-521-83716-3.