Course guide
230051 - CDA SISTEL - Advanced Digital Communications

Last modified: 24/05/2024

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, English

LECTURER

Coordinating lecturer: JAUME RIBA SAGARRA - GREGORIO VAZQUEZ GRAU

Others: Primer quadrimestre:
JAUME RIBA SAGARRA - 40

Segon quadrimestre:
GREGORIO VAZQUEZ GRAU - 10

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

INTRODUCTION TO COMMUNICATIONS - Precorequisite

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 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

Type	Hours	Percentage
Hours large group	65,0	43.33
Self study	85,0	56.67

Total learning time: 150 h

CONTENTS

Tema 1. Introduction

Description:
Course introduction.

Full-or-part-time: 2h
Theory classes: 2h

Tema 2. Communication channel models

Description:
- Deterministic models
- Statistical Channel modelling

Full-or-part-time: 24h
Theory classes: 6h
Guided activities: 2h
Self study : 16h

Tema 3. Channel capacity

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

Full-or-part-time: 48h
Theory classes: 9h
Guided activities: 7h
Self study : 32h

Tema 4. Digital Modulation and Detection

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.

Full-or-part-time: 42h
Theory classes: 10h
Guided activities: 4h
Self study : 28h

Tema 5. Performance of digital communication systems

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

Full-or-part-time: 12h
Theory classes: 2h
Guided activities: 2h
Self study : 8h

Tema 6. Diversity and adaptive modulation

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

Full-or-part-time: 24h
Theory classes: 6h
Guided activities: 2h
Self study : 16h

Tema7. Multicarrier modulation and OFDM

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

Full-or-part-time: 27h
Theory classes: 6h
Guided activities: 3h
Self study : 18h

GRADING SYSTEM

- Class attendance and presentation of problems in class: 0% -5%, depending on participation.
- Partial exams (2) of Topics 2-3, and Topics 4-5: 45% -50%, depending on the weight of the previous section.
- Final exam, with two possible modalities:
i) A single problem (1P), if the average score of the two controls is greater than or equal to 5: 50%
ii) Two problems (2P), if the previous condition is not met or if the note of the controls is waived: 100%
This course will assess generic skills:
- Self learning (Middle Level)
- Ability to identify, formulate and solve engineering problems (Middle Level)

BIBLIOGRAPHY

Basic:
- Goldsmith, A. Wireless communications. Cambridge: Cambridge University Press, 2005. ISBN 978-0-521-83716-3.
- Tse, David; Viswanath, Pramod. Fundamentals of wireless communication. Cambridge: Cambridge University Press, 2005. ISBN 9780521845274.