University of the Balearic Islands

Teaching guide

Academic year	2012-13
Subject	10925 - Digital Communication Systems and Applications
Group	Group 1, 1S
Teaching guide	E
Language	English

Subject identification

Subject	10925 - Digital Communication Systems and Applications
Credits	0.96 in-class (24 hours) 4.04 distance (101 hours) 5 totals (125 hours).
Group	Group 1, 1S(Campus Extens)
Teaching period	1st semester
Teaching language	Catalan

Lecturers

Lecturers	**Timetable for student attention**					
	Starting time	**Finishing time**	**Day**	**Start date**	**Finish date**	**Office**
Guillem Femenias Nadal guillem.femenias@uib.es	09:30h	11:30h	Monday	01/09/2012	31/07/2013	Despatx D-109
	11:30h	13:00h	Thursday	01/09/2012	31/07/2013	Despatx D-109
	11:30h	13:00h	Tuesday	01/09/2012	31/07/2013	Despatx D-109
Llorenç Huguet Rotger l.huguet@uib.es	12:00h	14:00h	Monday	03/09/2012	26/02/2013	D-224
Macià Mut Puigserver macia.mut@uib.es	There are no defined sessions					
Felipe Riera Palou felip.riera@uib.es	15:30h	17:30h	Monday	01/09/2012	31/07/2013	109

Degrees where the subject is taught

Degree	**Character**	**Course**	**Studies**
Master's Degree in Information Technologies	Optional		Postgraduate degree
Master's Degree in Physics of Complex Systems	Optional		Postgraduate degree

Contextualisation

This module, framed within the Research thread of the Master in Information Technologies (MTIN), is taught by faculty members from the Security & Electronic Commerce and Mobile Communications Reseach groups. Nevertheless, students with basic knowledge of digital communications and a keen interest in the topic, should be able to follow this module.

The module is comprised of two blocks:

-Foundation and applications block where an overview of basic results in Information Theory is given followed by an introduction to two important applications, namely, data compression and channel coding (error correction).

-Advanced digital communications block where the latest trends in wireless communications will be presented, with a special focus on the physical layer. Topics to be covered include: multicarrier techniques,

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MIMO systems and radio resource allocation. Some futuristic topics such as cognitive radios and relay-based/heterogeneous networks will also be briefly touched upon.

This module is very much related to the 2nd semester module "Modern Wireless Communication Systems".

Requirements

Essential requirements

Basic knowledge of linear algebra and statistics

Recommendable

Basic knowledge of digital communications (wireless channels, modulation, coding)

Skills

Specific

1. CFT01-Capacity to employ advanced mathematical methods in Information Technology problems.
2. CFT04-Capacity to balance advantages and inconveniences of different methods when solving Information Technology problems..

Generic

1. CTP02-Capacity to understand and apply the architecture of Internet and its underlying technology..
2. CTI03-Capacity to independently develop a research topic..
3. CTI02-Capacity to understand background work on a given research topic..
4. CTI04-Capacity to write a report supporting a reseach work..

Content

Theme content

A. Foundations and applications

A.1. Information theory in communications systems

- Information measure and entropy
- Channel capacity

A.2. Source coding

-Optimum Huffman codes

-Transmission error minimisation rules

-Bn and Sn codes

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-Markov sources

A.3. Data compression

-Huffman method: statistical and adaptive compression

-Contest-dependent compression: run-length code and its application to fax transmission

-Other compression techniques: LZxx and JPEG algorithms

A.4. Channel coding

-Convolutional codes and Viterbi algorithm

-Block codes: linear and cyclic

-BCH and RS codes

-Application of channel coding: RS codes in the CD system

B. Advanced digital communications

B.1. The MIMO radio channel

-Review of wireless propagation: AWGN channel, propagation losses, shadowing

-Multipath propagation: frequency and temporal selectivity

-The multiantenna channel

B.2. Multicarrier systems

-Basic concepts

-Orthogonal frequency division multiplexing

-Cyclic prefix /padding

-Disadvantages: PAPR, frequency offsets

-User multiplexing: Orthogonal frequency division multiple access (OFDMA)

-Other multicarrier archuitectures: Discrete Multitone (DMT), Single-Carrier frequency-domain equalisation (SC-FDE)

B.3. MIMO techniques

-History of MIMO

-MIMO capacity

-Spatial multiplexing

-Space-time block coding

-MIMO systems with channel state information at the transmitter

-MIMO-OFDM(A) architectures

B.4. Radio resource management

-Basic concepts and problem formulation

-Mathematical methods for resource management

-Scheduling

B.5. Futuristic topics

-Cognitive radio

-Relay-based networks

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-Femtocells

Teaching methodology

In-class work activities

Modality	Name	Typ. Grp.	Description
Theory classes	Lectures	Large group (G)	Presentation of the main concepts related to each topic
ECTS tutorials	Tutoring sessions	Small group (P)	Question resolution and individual directed study recommendations

Distance education work activities

Modality	Name	Description
Individual self-study	Self study	Consolidation of the concepts explained over the lectures
Group or individual self-study	Coursework	Task sheets and projects. The utilization of a high-level language (such as Matlab) might be required for some of the assignments.

Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

Workload estimate

Modality	Name	Hours	ECTS	%
In-class work activities		**24**	**0.96**	**19.2**
Theory classes	Lectures	20	0.8	16
ECTS tutorials	Tutoring sessions	4	0.16	3.2
Distance education work activities		**101**	**4.04**	**80.8**
Individual self-study	Self study	51	2.04	40.8
Group or individual self-study	Coursework	50	2	40
	Total	**125**	**5**	**100**

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to

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whether the subject work plan will be carried out through the schedule or through another way included in the Campus Extens platform.

Student learning assessment

Lectures

Modality	Theory classes
Technique	Attitude scales **(Non-retrievable)**
Description	Presentation of the main concepts related to each topic
Assessment criteria	Class attendance
	Attitude in class

Percentage of final qualification: 40% following path A

Tutoring sessions

Modality	ECTS tutorials
Technique	Attitude scales **(Non-retrievable)**
Description	Question resolution and individual directed study recommendations
Assessment criteria	Attitude during tutoring sessions

Percentage of final qualification: 10% following path A

Self study

Modality	Individual self-study
Technique	Papers and projects **(Non-retrievable)**
Description	Consolidation of the concepts explained over the lectures
Assessment criteria	Problem/Question list for each topic

Percentage of final qualification: 20% following path A

Coursework

Modality	Group or individual self-study
Technique	Papers and projects **(Non-retrievable)**
Description	Task sheets and projects. The utilization of a high-level language (such as Matlab) might be required for some of the assignments.
Assessment criteria	Timeliness in handing in courseworks
	Coursework quality

Percentage of final qualification: 30% following path A

Resources, bibliography and additional documentation

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Basic bibliography

Complementary bibliography

Other resources

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