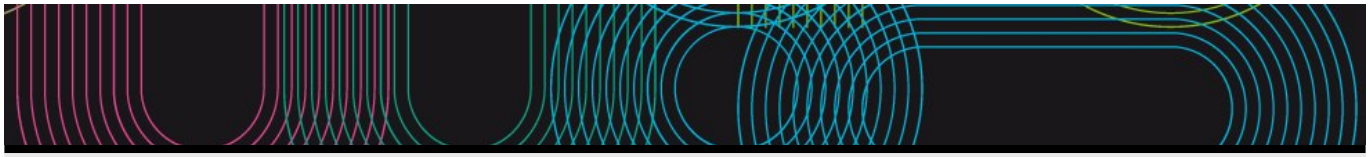

IDENTIFYING DATA				
Advanced Digital Communications				
Subject	Advanced Digital Communications			
Code	V05M145V01204			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Pérez González, Fernando			
Lecturers	Mosquera Nartallo, Carlos Pérez González, Fernando			
E-mail	fperez@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course presents advanced topics in digital communications with emphasis on modulations, coding and detection. The covered techniques are part of the state of the art in digital communications, and comprise novel aspects as MIMO systems, cognitive radio or dirty paper coding. Contents, teaching and exams are in English. Students may participate in classes and answer to exams preferably in English, but Spanish and Galician are also accepted.			

Competencies	
Code	
B1	CG1 Ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
B4	CG4 Capacity for mathematical modeling, calculation and simulation in technological centers and engineering companies, particularly in research, development and innovation tasks in all areas related to Telecommunication Engineering and associated multidisciplinary fields.
B8	CG8 Ability to apply acquired knowledge and to solve problems in new or unfamiliar environments within broader and multidiscipline contexts, being able to integrate knowledge.
C1	CE1 Ability to apply methods of information theory, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing systems and audiovisual communications.
C2	CE2 Ability to develop radio communication systems: antenna, equipment and subsystems design; channel modeling; link budgeting; and planning.
C3	CE3 Ability to implement systems by cable, line, satellite, in fixed and mobile communication environments.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Handle the mathematical tools needed to model, simulate and evaluate moderns communication systems.	B1 B4 C1 C2 C3
Solve problems whose solution does not derive from the application of a standardized procedure.	B1 B4 B8 C1 C2 C3

Understand the principles underlying modern communication standards.	B1 B4 B8 C1 C2 C3
Design transmitters, receivers and measurement equipment for modern communication systems.	B1 B4 B8 C1 C2 C3

Contents

Topic	
Lectures 1-4: MIMO communications	- Introduction. Array, spatial diversity and spatial multiplexing gains. MIMO channel and signal models. - MIMO transmitter design. Principles of precoding for MIMO. Space-time coding. Multiuser MIMO transmitter design. - MIMO receiver design. Multiuser MIMO receiver design. - MIMO channel capacity.
Lecture 5: Synchronization and spectrum sensing in cognitive radio.	- Motivation and requirements. Spectrum management. Synchronization in cognitive radio. Spectrum sensing.
Lecture 6: Dirty paper coding.	- Code design. Costa's theorem. Opportunistic low SNR codes. Applications in downlink channels.
Lecture 7: OFDM and beyond.	- Principles of orthogonal frequency division multiplexing. Filterbanks and multicarrier. Cooperative diversity.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	14	29.4	43.4
Master Session	14	57.6	71.6
Long answer tests and development	2	0	2
Reports / memories of practice	0	8	8

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Laboratory practises	Lab practices will cover different aspects of multiple-input multiple-output (MIMO) communications. This will allow students to practically implement and considerably expand some of the concepts seen in the lectures. Competences: CG1, CG4, CE1, CE2, CE3
Master Session	The course is structured in several advanced topics in digital communications with emphasis on multiple-input multiple-output (MIMO) communications. Competences: CG1, CG4, CG8, CE1, CE2, CE3

Personalized attention

Methodologies	Description
Master Session	The teachers will provide individualized and personalized attention to students during the course, solving their doubts and questions. Doubts will be answered in presential form (during the master session, or during the office hours). Office hours will be given at the beginning of the course and published in the subject's webpage.
Tests	**Description**
Reports / memories of practice	The teachers will provide individualized and personalized attention to students during the course, solving their doubts and questions. Doubts will be answered in presential form (during the work review sessions or during the office hours).

Assessment

	Description	Qualification	Training and Learning Results

Long answer tests and development	Final exam with short questions on the contents of the subject.	50	B1 B4 B8	C1 C2 C3
Reports / memories of practice	Reports of the practices that employ the techniques seen in the classroom.	50	B1 B4 B8	C1 C2 C3

Other comments on the Evaluation

A minimum score of 35% with respect to the maximum possible score in the final exam is required to pass the course.

In those cases in which the student decides not to carry out the continuous evaluation tasks, the final score will be solely based on the exam with questions of the subject. This applies as well to the second call.

In case the student does not achieve the minimum score in the final written exam, his/her global score will be obtained using the formula: 0.25*REP+0.25*TEST, where REP is the score achieved in the reports and TEST is the score achieved in the final exam.

In case of collective reports, the respective contribution of each student must be clearly stated, and the final score will be personalized as a function of such contribution. An interview with the lecturer may be required in order to assess the individual contributions.

Once the student turns in any of the deliverables, he/she will be considered to be following the continuous evaluation track. Any student that chooses the continuous evaluation track will get a final score, regardless of whether he/she takes the final exam.

Continuous evaluation tasks cannot be redone after their corresponding deadlines, and are only valid for the current year.

Sources of information

Basic Bibliography

Jerry Hampton, **Introduction to MIMO Communications**, First, Cambridge University Press, 2013

Complementary Bibliography

Ezio Biglieri et al., **MIMO Wireless Communications**, First,

David Tse and Pramod Viswanath, **Fundamentals of Wireless Communication**, First,

Ezio Bliglieri et al., **Principles of Cognitive Radio**, First,

Behrouz Farhang-Boroujeny, **Signal Processing Techniques for Sotware Radios**, Second,

Thomas Cover and Joy Thomas, **Elements of Information Theory**, Second,

Recommendations

Subjects that it is recommended to have taken before

Signal Processing in Communications/V05M145V01102