IDENTIFYING DATA

Wireless and optical communication systems

Subject	Wireless and optical communication systems
Code	P52M182V01303
Study programme	Master Universitario en Dirección TIC para la defensa

Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	2nd	1st

Teaching language	Spanish
Department	
Coordinator	Núñez Ortuño, José María
Lecturers	Núñez Ortuño, José María
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General description	The course on Optical and Wireless Communications Systems aims to provide students with a comprehensive and generalist overview of the of the current state-of-the-art of microwave and fiber based communication systems. The course details the technologies involved, regulatory and safety aspects of this type of systems.

Training and Learning Results

Code	
A6	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context.
A7	CB7 - That students know how to apply the acquired knowledge and their ability to solve problems in new or poorly understood environments within broader (or multidisciplinary) contexts related to their area of study.
A8	CB8 - That students are able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
A9	CB9 - That students know how to communicate their conclusions and the knowledge and ultimate reasons that support them to a specialized and unspecialized public in a clear and unambiguous way.
A10	CB10 - That students possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.
B1	CG1 - Possess advanced and highly specialized knowledge and demonstrate a detailed and well-founded understanding of the theoretical and practical aspects dealt with in the different areas of study.
B2	CG2 - Integrate and apply the knowledge acquired, and possess the ability to solve problems in new or imprecisely defined environments, including multidisciplinary contexts related to their field of study.
B6	CG6 - Be able to make decisions in environments characterized by complexity and uncertainty, evaluating the different existing alternatives in order to select the one with the most favorable expected result, appropriately managing the risk associated with the decision.
C12	CISTT1 - Deepen the knowledge of telecommunications systems based on different technologies applicable to the tactical, operational and strategic fields; to fixed and mobile environments; with different types and volumes of data.
C13	CISTT2 - Analyze and optimize the deployment of communication systems in military operating environments.
D5	CT5 - Autonomous learning and work.
D6	CT6 - Properly manage information resources.

Expected results from this subject

Expected results from this subject	Training and Learning Results

LO1. To know the management of the electromagnetic spectrum and the basic elements of a communications system.	A6 A7 A8 A9 A10 B1 B2 C12 D5 D6
LO2. To know the operation and the characteristic parameters of a radio link.	A6 A7 A8 A9 A10 B1 B2 B6 C12 C13 D5 D6
LO3. To understand the basic operation of wireless networks, as well as the different technologies, existing topologies and standards for the implementation of such networks.	A6 A7 A8 A9 A10 B1 B2 B6 C12 C13 D5 D6
LO4. To understand the operation and main characteristics of mobile and optical networks.	A6 A7 A8 A9 A10 B1 B2 B6 C12 C13 D5 D6
LO5. To understand the operation of software defined radio (SDR), as well as the concepts of interoperability, modes of operation, upgrading and cost associated with this type of technology..	A6 A7 A8 A9 A10 B1 B2 B6 C12 C13 D5 D6

LO6. To know the different radiocommunication systems existing in the military field, as well as their most outstanding characteristics..	A6
	A7
	A8
	A9
	A10
	B1
	B2
	B6
	C12
	C13
	D5
	D6

Contents

Topic	
Subject 1: Introduction to the wireless technologies	- Basic concepts - Classification of the wireless communications systems - Standardization and regulation
Subject 2: Radio links	- Bands and channeling - Planning - Devices - Link protection - Link budget - Availability, quality and interferences
Subject 3: PAN and LAN wireless networks and technologies	- Historical evolution - WPAN vs WLAN networks - Existing technologies - Network topologies - Remarkable characteristics - Components
Subject 4: MAN and WAN wireless networks and technologies	- WMAN networks: WiMAX and WiMAX-2 - WMAN networks: cellular and satellite networks - Networks convergence: IMT-Advanced (4G)
Subject 5: Mobile networks	- PMR systems - GSM, GPRS and EDGE systems - UMTS and LTE networks - HSPA and 4G (LTE-A and WiMAX-2) networks - 5G networks - Network security
Subject 6: Optical networks	- Wireless optical networks - Wired optical networks - Advantages and disadvantages compared to other systems - Existing technologies - Network topologies - Remarkable characteristics - Components
Subject 7: Software Defined Radio (SDR)	- Evolution of radio systems - Introduction and basic concepts - Architecture and technologies used - SDR market - SDR in the military environment: JTRS and ESSOR - Cognitive radio - White spaces and efficient use of the spectrum - Cognitive radio networks - Architectures and applications

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	8	8	16
Problem solving	2	2	4
Previous studies	0	29	29
Practices through ICT	2	0	2
Autonomous problem solving	0	6	6
Seminars	2	0	2
Self-assessment	0	2	2
Presentation	2	1	3

Problem and/or exercise solving	0	7	7
Laboratory practice	4	0	4

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

Methodologies

	Description
Lecturing	Presentation by a lecturer of the contents of the subject of study, theoretical bases and/or guidelines of a work or exercise that the student has to develop.
Problem solving	Activity in which problems and/or exercises related to the subject are formulated. The student must develop the appropriate and correct solutions through the exercise of routines, application of formulas or algorithms, application of transformation procedures of the available information and interpretation of the results.
Previous studies	Research, reading, documentation work and / or autonomous performance of any other activity that the student considers necessary to enable the acquisition of knowledge and skills related to the subject. It is usually done before lectures, laboratory practices and/or evaluation tests. It includes the reading and analysis of documents and the viewing of multimedia resources.
Practices through ICT	Activities for the application of knowledge in a given context and the acquisition of basic and procedural skills related to the subject, through the use of ICT.
Autonomous problem solving	Activity in which students analyze and solve problems and/or exercises related to the subject in an autonomous way.
Seminars	Activity focused on working on a specific topic, which allows to deepen or complement the contents of the subject.

Personalized assistance

Methodologies	Description
Lecturing	Personalized answers to doubts related to the teacher's exposition of the contents of the subject matter, theoretical bases and/or guidelines for a work or exercise that the student has to develop.
Problem solving	Personalized comments on the resolution of problems and/or exercises related to the subject matter.
Seminars	Personalized comments on the work on a specific topic, which allows to deepen or complement the contents of the subject.
Practices through ICT	Personalized attention will be given individually and in person to the activities of application of knowledge in a given context and acquisition of basic and procedural skills in relation to the subject, through the use of ICT.

Tests	Description
Problem and/or exercise solving	Personalized comments and guidance on the work proposed in class, which allow to deepen or complement the contents of the subject.
Laboratory practice	Guidance in the realization of the different laboratory practices related to the syllabus of the course.

Assessment

	Description	Qualification	Training and Learning Results			
Self-assessment	Mechanism in which, by means of a series of questions or activities, it is possible for the student to evaluate autonomously his/her degree of acquisition of knowledge and skills on the subject, allowing a self-regulation of the personal learning process. There will be two intermediate tests (PE1 and PE2) to control the follow-up of the subject. Each control test has a weight of 20%. The first test, which will cover topics 1 to 4, will be carried out in the on-line phase and will have a duration of 1 hour. The second test, which will cover topics 5 and 6, will take place during the on-site phase and will last 30 minutes.	40	A6 A7 A8 A9	B1 B2 B6	C12 C13	D6
Presentation	Presentation by the students, individually or in groups, of a topic related to the contents of the subject or of the results of a work, exercise, project, etc. The work will be evaluated in the on-site phase (T).	20	A6 A7 A8 A9 A10	B1 B2 B6	C12 C13	D5 D6

Problem and/or exercise solving	Resolution of different exercises (E) proposed in class on assumptions applicable to each of the topics of the syllabus that will be evaluated during the on-line phase.	25	A6 A7 A8 A9 A10	B1 B2 B6	C12 C13	D5 D6
Laboratory practice	Evaluation of different laboratory practices related to the course syllabus by means of deliverable reports (PL).	15	A6 A7 A8 A9 A10	B1 B2 B6	C12 C13	D5 D6

Other comments on the Evaluation

If we call MED_CON the average grade of continuous assessment, which is calculated as:

MED_CON = 0.2*PE1 + 0.2*PE2 + 0.2*T + 0.25*E + 0.15*PL

It is necessary to obtain at least 50% of the grade to pass the course.

In case the student fails to pass the course in the ordinary call, he/she will have the right to a second evaluation opportunity (extraordinary call) on the dates established for this purpose by the Master's Academic Committee. The evaluation of the second call will be carried out in distance mode, through the evaluation of a deliverable (work) that will account for 60% of the grade and the completion of a written test (with development questions and / or test type) using telematic means, which will account for the remaining 40%. It will be necessary to obtain at least 50% of the grade to pass the course..

Assessment systems		
Denomination	**Qualification (%)**	**Competences**
Evaluation of deliverables (work)	60	CB6, CB7, CB8, CB9, CB10 CG1, CG2, CG6 CT5, CT6 CE12, CE13
Written test	40	CB6, CB7, CB8, CB9, CB10 CG1, CG2, CG6 CT5, CT6 CE12, CE13

ACADEMIC INTEGRITY:

Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of
the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*,**any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity,** regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.
In the event that there is any difference between the Galician/Spanish/English guides related to evaluation the Spanish guide will always prevaill.

Sources of information
Basic Bibliography
Miscellaneous, **Transparencies, notes, readings, activity statements, etc. (provided by teaching staff)**,
Complementary Bibliography
J. M. Hernando-Rábanos, J. M. Riera y L. Mendo, **Transmisión por Radio**, 7ª Edición, Editorial Universitaria Ramón Areces, 2013
C. A. Balanis, **Antenna Theory: Analysis and Design**, 4ª Edición, John Wiley & Sons Inc., 2016
Sigfredo Pagel, **Introducción a los radioenlaces**, 1ª Edición, Tórculo Ediciones, 1997
P. Morreale & K. Terplan, **CRC Handbook of Modern Telecommunications**, 2ª Edición, CRC Press, 2009
J. L. Olenewa, **Guide to Wireless Communications**, 4ª Edición, Cengage Learning, 2017
E. Dahlman, S. Parkvall & J. Skold, **4G: LTE/LTE-Advanced for Mobile Broadband**, 2ª Edición, Academic Press, 2013
Peter B. Kenington, **RF and Baseband Techniques for Software Defined Radio**, Artech House, 2005

Recommendations

Subjects that it is recommended to have taken before