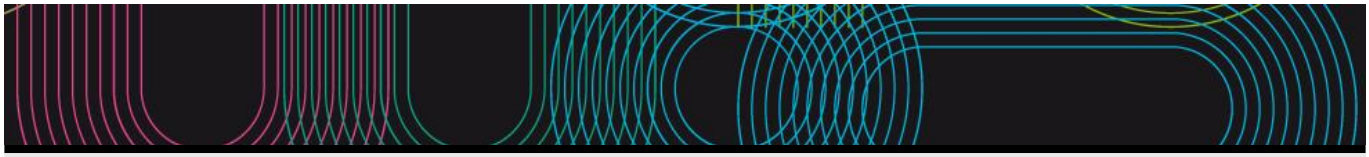

(*)Escola de Enxeñaría de Telecomunicación

(*)Páxina web

(*)

www.teleco.uvigo.es

(*)Presentación

(*)

A Escola Enxeñaría de Telecomunicación oferta para o curso académico 2017-18 un grao e dous másteres totalmente adaptados ao Espacio Europeo de Educación Superior, verificados pola ANECA axustándose á Orde Ministerial CIN/352/2009. A continuación indícanse os enlaces de acceso aos dípticos informativos dos tres títulos.

Grao en Enxeñaría de Tecnoloxías de Telecomunicación

http://teleco.uvigo.es/images/stories/documentos/gett/diptico-uvigo-eet-grao-gal.pdf

www: http://teleco.uvigo.es/index.php/es/estudios/gett

Máster en Enxeñaría de Telecomunicación

http://teleco.uvigo.es/images/stories/documentos/met/diptico-uvigo-eet-master-gal.pdf

www: http://teleco.uvigo.es/index.php/es/estudios/mit

Máster Interuniversitario en Matemática Industrial

http://teleco.uvigo.es/images/stories/documentos/promocion/M2i_Presentacion.pdf

www: http://m2i.es

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(*)

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COORDINACIÓN DO MESTRADO INTERUNIVERSITARIO EN MATEMÁTICA INDUSTRIAL

Coordinador Xeral: José Durany Castrillo (durany@dma.uvigo.es)

Telecommunication Engineering

Subjects

Year 2nd

Code	Name	Quadmester	Total Cr.
V05M145V01301	Real-Time Signal Processing	1st	5
V05M145V01302	Communication Advanced Systems	1st	5
V05M145V01303	Statistical Signal Processing	1st	5
V05M145V01304	Numerical Optimisation in Telecommunications	1st	5
V05M145V01305	Mathematical Modelling and Numerical Simulation	1st	5
V05M145V01306	Data Protection Cryptographic Techniques	1st	5
V05M145V01307	Machine Learning	1st	5
V05M145V01308	Administration of Networks and Systems	1st	5
V05M145V01309	Web Development Technologies	1st	5
V05M145V01310	Mobile Applications Development	1st	5
V05M145V01311	Satellites	1st	5
V05M145V01312	Wideband Radio Systems	1st	5
V05M145V01313	Wireless and Mobile Communications	1st	5
V05M145V01314	Radio Navigation	1st	5

V05M145V01315	Optical Networks	1st	5
V05M145V01316	Radar	1st	5
V05M145V01317	Microwave and Millimetre Wave Circuit Design and CAD	1st	5
V05M145V01318	Multimedia Security	1st	5
V05M145V01319	Intelligent Sensors	1st	5
V05M145V01320	Practicals in Digital Electronics for Communications	1st	5
V05M145V01321	Distributed Computing	1st	5
V05M145V01322	Data analysis	1st	5
V05M145V01323	Economical and Social Networks	1st	5
V05M145V01324	Internship in Companies I	1st	5
V05M145V01325	Internship in Companies II	1st	5
V05M145V01326	Internship in Companies III	1st	5
V05M145V01327	Network Information Theory	1st	5
V05M145V01328	Learning in Networks and Collaborative Work	1st	5
V05M145V01329	Human-Computer Interaction	1st	5
V05M145V01330	Photovoltaic Power Electronics	1st	5
V05M145V01331	Signal Conditioners	1st	5
V05M145V01332	Electronic Equipments Implementation and Exploitation	1st	5
V05M145V01333	Electronic Equipment Practicals	1st	5
V05M145V01334	Telecommunications Seminar	1st	5
V05M145V01335	Piezoelectric Transducers and Applications	1st	5
V05M145V01336	Numerical Linear Algebra in Telecommunications Engineering	1st	5
V05M145V01401	Master Thesis	2nd	30

IDENTIFYING DATA				
Real-Time Signal Processing				
Subject	Real-Time Signal Processing			
Code	V05M145V01301			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	Martín Herrero, Julio			
Lecturers	Martín Herrero, Julio			
E-mail	julio@uvigo.es			
Web				
General description	We deal with different architectures and techniques for realtime signal processing, including digital signal processors (DSP) and multicore computing platforms (CPUs and massively parallel GPUs). Standards such as OpenCL, OpenMP, PPL and AMP will be addressed. Our main focus will be on hands-on, practical work and the capability to adapt to new, emerging, constantly evolving technologies and tools.			

Competencies	
Code	
B1	CG1 Ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
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.
C21	CE21/PS1 Manage implementation of signal processing systems options to accelerate computationally complex algorithms.

Learning outcomes	
Expected results from this subject	Training and Learning Results
To handle advanced architectures for realtime signal and video processing	B1 B8 C21
To apply advanced techniques of DSP programming in realtime signal applications	B1 B8 C21
To understand the basic principles of realtime signal and video processing on standard GPUs and general purpose GPU	B1 B8 C21
To understand and apply the fundamentals of realtime application programming on graphic processing units, using multiplatform programming interfaces (OpenCL)	B1 B8 C21

Contents	
Topic	
High and low level DSP programming	High and low level DSP programming
GPU programming fundamentals	GPU programming fundamentals
General purpose programming of GPUs (GPGPU)	General purpose programming of GPUs (GPGPU)
OpenCL programming and integration in different architectures	OpenCL programming and integration in different architectures

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	8	0	8
Practice in computer rooms	17	0	17
Projects	0	95	95
Long answer tests and development	2	0	2
Practical tests, real task execution and / or simulated.	3	0	3
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Master Session	General introductions to fundamental concepts. All competencies are addressed.
Practice in computer rooms	Individual hands-on work on computing platforms and/or simulators to implement and compare study cases. All competencies are addressed.
Projects	In-depth practical development of an application/algorithm according to the specific interests of each student. All competencies are addressed.

Personalized attention	
Methodologies	**Description**
Projects	The professor will review with the student the design and the code of the student in each class session, and in individual office hours.
Practice in computer rooms	The professor will review with the student the design and the code of the student in each session.

Assessment				
	Description	Qualification	Training and Learning Results	
Long answer tests and development	Questions on general fundamental concepts of realtime signal processing	30	B1 B8	C21
Practical tests, real task execution and / or simulated.	Programming of realtime algorithms	70	B1 B8	C21

Other comments on the Evaluation

The assessment is continuous by default, based on the work carried on by the students during the lab classes and in their personal project. This can provide up to 100% of the final mark. There is an optional written final exam at the end of the period of classes, which can be used to raise the continuous evaluation mark, or as 100% of the qualification for those students not willing to follow the continuous assessment. Those students not succeeding in the first call will have access to a second call, where the whole mark will come out from the final written exam.

Sources of information

Basic Bibliography

Sen M. Kuo, Bob H. Lee, Wenshun Tian, **Real-Time Digital Signal Processing**, 3, Wiley, 2013

Matthew Scarpino, **OpenCL in Action**, 1, Manning, 2012

Complementary Bibliography

Gerassimos Barlas, **Multicore and GPU Programming: An Integrated Approach**, 1, 2015

Khronos Group, **The OpenCL specifications https://www.khronos.org/registry/cl/**, 2.2, 2016

Raymond Tay, **OpenCL Parallel Programming Development Cookbook**, 1, Packt Publishing, 2013

Recommendations

Subjects that it is recommended to have taken before

Signal Processing in Communications/V05M145V01102

Other comments

For a suitable progress in the course, proficiency in C and C++ programming is required.

IDENTIFYING DATA				
Communication Advanced Systems				
Subject	Communication Advanced Systems			
Code	V05M145V01302			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	Mosquera Nartallo, Carlos			
Lecturers	Mosquera Nartallo, Carlos			
E-mail	mosquera@gts.uvigo.es			
Web				
General description	This course covers the application of advanced mathematical tools to address some challenges in new and emerging satellite and terrestrial communication systems, with special emphasis on lower layers and multiuser systems.			

Competencies	
Code	
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.
C22	CE22/PS2 Ability to understand the impact of the requirements of the telecommunications systems design services, with special emphasis in the lower layers, while maintaining a global vision of the solutions employed in modern commercial systems of communications.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Understand the impact of telecommunication services requirements on system design, with special emphasis on lower layers.	B4 C22
Acquire a global view of the solutions developed for modern commercial communication systems.	B4 C22

Contents	
Topic	
1. Convex optimization	1.1 Basic concepts of convex sets 1.2 Introduction to convex functions 1.3 Quasiconvex functions 1.4 Convex optimization problems 1.5 Duality 1.6 Practical examples in communications
2. Multiple-access channels	2.1 Capacity regions: coordinated and uncoordinated access 2.2 Multiuser detection techniques 2.3 Random access schemes

Planning			
	Class hours	Hours outside the classroom	Total hours
Seminars	4	10	14
Troubleshooting and / or exercises	0	25	25
Master Session	24	60	84
Short answer tests	2	0	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Seminars	Different communication systems will be presented with special emphasis on those challenges which are at the core of modern solutions and require advanced mathematical tools. Skills CG4 and CE22 are developed here.

Troubleshooting and / or exercises	Every week a homework challenge will be proposed to be solved with the aid of mathematical analysis, software tools or both. Skills CG4 and CE22 are developed here.
Master Session	Advanced mathematical tools will be introduced as background material to address practical solutions in modern communication systems. Skills CG4 and CE22 are developed here.

Personalized attention

Methodologies	Description
Master Session	Student support will be provided during office hours and by e-mail.
Seminars	Student support will be provided during office hours and by e-mail.
Troubleshooting and / or exercises	Student support will be provided during office hours and by e-mail.

Assessment

	Description	Qualification	Training and Learning Results	
Troubleshooting and / or exercises	Every week a homework challenge will be proposed to be solved with the aid of mathematical analysis, software tools or both. If the solution is not turned in within the allocated deadline, the corresponding assignment will not be graded.	50	B4	C22
Short answer tests	Final exam with short questions and exercises.	50	B4	C22

Other comments on the Evaluation

The students need to obtain 50 out of 100 points to pass the course. In addition, a minimum grade of 30% is required in the final exam; if this grade is not achieved, the final grade will be that obtained in the final exam. This applies also to the second call.

The grades obtained from the weekly assignments are only valid for the current academic year, and cannot be redone after the corresponding deadline. A student can decide to opt out the evaluation of the weekly assignments; in such a case, his/her final score will be fully based on the final exam. This applies also to the second call. 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 her/his taking the final exam.

All the homeworks and exam will be given in English.

Sources of information

Basic Bibliography

Stephen Boyd, Lieven Vandenberghe, **Convex Optimization**, Cambridge University Press, 2004

Carlos Mosquera, **Class notes**, 2017

Complementary Bibliography

Dimitri P. Bertsekas, **Convex Optimization Theory**, Athena Scientific, 2009

Recommendations

Subjects that it is recommended to have taken before

Advanced Digital Communications/V05M145V01204
Signal Processing in Communications/V05M145V01102

Other comments

Attendance to physical classes is mandatory. If a minimum 80% attendance is not fulfilled, the grade will be entirely based on the final exam.

IDENTIFYING DATA				
Statistical Signal Processing				
Subject	Statistical Signal Processing			
Code	V05M145V01303			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	López Valcarce, Roberto			
Lecturers	López Valcarce, Roberto			
E-mail	valcarce@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Statistical Signal Processing, encompassing both estimation and detection theory, can be found at the core of many decision-making and information-extracting systems, including communications, audio and image processing, biomedicine, radar, and big data systems, just to name a few. In this course an introduction to the basics of estimation and detection theory is provided. Since the course is targeted to electrical engineering students, the focus is on the development of practical estimation and detection algorithms amenable to implementation in digital processing systems.			

Competencies	
Code	
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.
C23	CE23/PS3 Ability to apply methods of statistical processing of signal communications systems and audiovisual.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Ability to apply statistical estimation techniques in communications and multimedia systems	C23
Ability to apply statistical detection techniques in communications and multimedia systems	C23
Ability to determine and interpret fundamental limits in estimation and detection problems	B4 C23
Ability to evaluate the performance of estimation and detection techniques, by analytical as well as by Monte Carlo simulation methods	B8 C23

Contents	
Topic	
Part 1: Parameter Estimation	- The statistical estimation problem. Performance metrics: bias, variance, MSE. Minimum Variance Unbiased Estimator (MVUE). - Fisher Information and Cramer-Rao bound. Slepian-Bangs formula. - Best Linear Unbiased Estimator (BLUE) and Maximum Likelihood Estimator (MLE): definition, properties, and examples. - LMMSE estimation and Kalman filtering
Part 2: Detection Theory	- Hypothesis tests: types. Performance metrics: false positives and false negatives. ROC curves. - Neyman-Pearson theorem: likelihood ratio. - Detection under the Bayesian philosophy: probability of error, risk, optimum detector. - Examples: deterministic and random signals

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	21	23	44
Practice in computer rooms	7	0	7
Autonomous troubleshooting and / or exercises	0	28	28
Autonomous practices through ICT	0	25	25
Jobs and projects	0	21	21

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

Methodologies	
	Description
Master Session	Presentation of main topics, possibly with audiovisual aids. Skills involved: CG4, CG8
Practice in computer rooms	Computer-based simulation in the lab of statistical signal processing applications to communications and multimedia, via Monte Carlo methods. Performance analysis. Skilss involved: CG8, CE23
Autonomous troubleshooting and / or exercises	Students will be given a series of short homework assignments throughout the course that they should turn in by the set deadline. Skills involved: CG4, CG8, CE23
Autonomous practices through ICT	Computer-based simulation of statistical signal processing applications to communications and multimedia, via Monte Carlo methods. Performance analysis. Skills involved: CG8, C23

Personalized attention	
Methodologies	**Description**
Master Session	Student aid will be provided during office hours as well as on-line (email).
Practice in computer rooms	Student aid will be provided during lab hours and office hours, as well as on-line (email).

Assessment				
	Description	Qualification	Training and Learning Results	
Autonomous troubleshooting and / or exercises	Students will be given a series of short homework assignments throughout the course that they should turn in by the set deadline.	40	B4 B8	C23
Jobs and projects	Development of an individual final project in which students will apply the acquired tools and techniques to a practical problem.	60	B4 B8	C23

Other comments on the Evaluation

Students may choose one of the following two assessment options:

1) Continuous assessment: Final grade will consist of:

- final project (up to 6 points)

- homework assignments (up to 4 points)

A minimum grade of 30% in the final project is required in order to pass the course. Otherwise, the overall grade will directly be that of the final project.

Homework grades from the first call will be kept for the second call, in which the student will be allowed to resubmit the final project.

2) One-shot assessment: The final grade is the one achieved in the comprehensive test, for both the first and second call.

Any kind of plagiarism will result in automatically failing the course.

Sources of information

Basic Bibliography

S. M. Kay, **Fundamentals of Statistical Signal Processing, vol. I: Estimation Theory**, 1,

S. M. Kay, **Fundamentals of Statistical Signal Processing, vol. II: Detection Theory**, 1,

Complementary Bibliography

L. L. Scharf, **Statistical signal processing: detection, estimation and time series analysis**, 1,

T. K. Moon, W. C. Stirling, **Mathematical Methods and Algorithms for Signal Processing**, 1,

IEEE, **http://ieeexplore.ieee.org/**,

Recommendations

Subjects that are recommended to be taken simultaneously

Communication Advanced Systems/V05M145V01302

Subjects that it is recommended to have taken before

IDENTIFYING DATA				
Numerical Optimisation in Telecommunications				
Subject	Numerical Optimisation in Telecommunications			
Code	V05M145V01304			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Mathematical Modelling and Numerical Simulation				
Subject	Mathematical Modelling and Numerical Simulation			
Code	V05M145V01305			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Data Protection Cryptographic Techniques				
Subject	Data Protection Cryptographic Techniques			
Code	V05M145V01306			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Machine Learning				
Subject	Machine Learning			
Code	V05M145V01307			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Administration of Networks and Systems				
Subject	Administration of Networks and Systems			
Code	V05M145V01308			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Web Development Technologies				
Subject	Web Development Technologies			
Code	V05M145V01309			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Rodríguez Pérez, Miguel			
Lecturers	Rodríguez Pérez, Miguel			
E-mail	Miguel.Rodriguez@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Description of the most current techniques applications for the development of Web applications. The course will tech the students to develop multiplatform applications based on the HTML5 foundation.			

Competencies	
Code	
A1	CB1 Knowledge and understanding needed to provide a basis or opportunity for being original in developing and/or applying ideas, often within a research context.
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
B12	CG12 Skills for lifelong, self-directed and autonomous learning.
C35	CE50/OP20 Ability to deploy and manage server software application logic of a web service managers, to design and manage non-relational data bases , and understand the functional division of an existing Web application between the client and the server itself

Learning outcomes	
Expected results from this subject	Training and Learning Results
The students will be able to design, develop and manage the whole infrastructure of a web application. Besides, they will be able to develop the application logic and to create responsive user interfaces using web technologies.	A1 A5 B12 C35

Contents	
Topic	
Web applications architecture	
HTML5: A tagged language in permanent evolution	Introduction to the WHATWG New HTML tags Semantic Markup Forms New APIs
Content presentation: CSS3	A new box model Responsive design New CSS modules and standardization process Images and gradients New selectors
Web applications	The javascript language Web applications frameworks

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	9	18	27
Laboratory practises	9	18	27
Autonomous practices through ICT	5	64	69
Long answer tests and development	2	0	2

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

Methodologies	
	Description
Master Session	Presentation of the main concepts treated in the subject, and description of the technologies employed. The presentation will be based, most of the time, practical examples. Most work will be focused on the competence CE35.
Laboratory practises	In the labs the students will face several practical sessions (supervised by the professors) where they will settle the concepts learnt in the theoretical classes. The work will be focused in competencies CB5 and CE35.
Autonomous practices through ICT	A project with a fairly large magnitude will be posed to be developed as a teamwork during all the semester. The work will focus on competencies CB1, CB5, CG12 and CE35.

Personalized attention	
Methodologies	**Description**
Master Session	During the hours of tutoring, teachers will conduct a personalized attention, either individually to strengthen or guide the student na understanding of theoretical concepts explained in the sessions demonstrative lectures or practical sessions. In these hours also monitoring associated with the project of a certain size to be undertaken with colleagues work is done. In the group tutorials solutions raised by the group are discussed and reviewed the uniform participation of members in the final development.
Autonomous practices through ICT	During the hours of tutoring, teachers will conduct a personalized attention, either individually to strengthen or guide the student na understanding of theoretical concepts explained in the sessions demonstrative lectures or practical sessions. In these hours also monitoring associated with the project of a certain size to be undertaken with colleagues work is done. In the group tutorials solutions raised by the group are discussed and reviewed the uniform participation of members in the final development.

Assessment					
	Description	Qualification	Training and Learning Results		
Autonomous practices through ICT	Implementation of a small demonstration of a web application with the technologies exposed in the subject.	50	A1 A5	B12	C35
Long answer tests and development	Final exam.	50	A5	B12	C35

Other comments on the Evaluation

Continuous evaluation:

To opt to the continuous evaluation, it is necessary to attend at least to 80% of the practical laboratory sessions and produce the partial deliveries of the group project.

Each delivery will be evaluated individually, being the total mark of the practice the result to ponder 50% of the note obtained in the last delivery with the average of the previous deliveries. Each mark will be shared by all the members of the group.

The final mark of the subject will be the pondered average among the practical mark (50%) and the mark of the final exam (50%).

Final evaluation:

The students that prefer the final evaluation will have to indicate so to the professor before the date of the first partial delivery of the group project. In such case, his partial deliveries will not be taken into account for his mark, (although they are taken into consideration for those group members that had chosen the continuous evaluation). The final mark will be 50% of the mark obtained in the final delivery of the work and 50% of the final exam mark.

Second evaluation:

In the extraordinary evaluation students will be requested make some small modifications to the group project individually. For those students that had chosen final evaluation, this delivery will represent 50% of the final mark while the remaining 50% corresponds with a new final exam.
In the case of the students of continuous evaluation, the mark of the practice will be the largest of: 50% of the new delivery and the previous partial deliveries (50%) or 100% of the new delivery.

Sources of information
Basic Bibliography
Mark Pilgrim, **HTML5: Up and Running**, 1ª, O'Reilly, 2010
https://developer.mozilla.org/en/docs/Web, **Web technology for developers**,
Wesley Hales, **HTML5 and JavaScript Web Apps**, 1ª, O'Reilly, 2012
Complementary Bibliography
Peter Gasston, **The book of CSS3**, 2ª, No Starch Press, 2014

Recommendations

IDENTIFYING DATA				
Mobile Applications Development				
Subject	Mobile Applications Development			
Code	V05M145V01310			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	Costa Montenegro, Enrique			
Lecturers	Costa Montenegro, Enrique Gil Castiñeira, Felipe José López Bravo, Cristina			
E-mail	kike@gti.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The course "Development of Mobile Applications" shows an overview of the ubiquitous panorama, in particular of the mobile applications and of the different operating systems in which they run. Mobile applications market has big growth expectations due to the huge number of active mobile devices around the world (several millions), the deployment of smart cities or the evolution of the Internet to the Internet of Everything (people, processes, data and objects). Along the course, an example mobile application (a game) will be developed, through which the different characteristic and functionalities of the Android platform will be introduced: user interfaces, activities, services, context integration, data sharing and security. Besides, those who join the course have to develop their own project, which should include all the phases of development of a mobile application, from the initial design to the publication in online software shops such as Google Play. The documentation of the course will be available in English. The master sessions, the laboratory practises and the follow-up of the tutored works will be in English, as well.			

Competencies	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
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.
C33	CE46/OP16 Ability to understand the current development of mobile and ubiquitous services and market developments .
C34	CE47/OP17 Ability to design, create, integrate sources of context, and working group on the development of a mobile application

Learning outcomes	
Expected results from this subject	Training and Learning Results
Acquire an overview of the ubiquitous panorama, in particular of the mobile applications and of the different operating systems in which they run.	C33
Learn how to build mobile applications including different elements (interaction with the user, context integration, interconnection with other devices, notifications, ...)	A2 A5 B8 C34
Work in group to propose, build and defend a mobile application.	A2 A5 B8 C33 C34

Contents
Topic

Movile Operating Systems	- Overview of the leading operating systems for mobile devices (Android, IOS, Windows Phone). - Versions. - Market evolution.
Android Operating System	- Android architecture. - Components of an Android application: activities, services, content providers and broadcast receivers. - Applications life cycle.
Mobile applications in the market	- Planning the development of an application. - Publication of applications. - Description of mobile applications available in the market.
Building Android applications	- Android Studio SDK - Android emulator - Activities, actions and intents - Services and notifications - Menus, preferences and dialogs - User interfaces with views - Fragments - Concurrency - Permissions - Data persistence - Context integration: localization, sensors - Interconnection: bluetooth, wifi

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	4	4	8
Laboratory practises	12	36	48
Tutored works	4.5	49.5	54
Presentations / exhibitions	0.5	0.5	1
Multiple choice tests	1	1	2
Practical tests, real task execution and / or simulated.	3	9	12

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

Methodologies

	Description
Master Session	The professors of the course present the main theoretical contents related to the development of applications for mobile devices. Through this methodology the competency CE33 (CE46/OP16) is developed.
Laboratory practises	Students will complete guided and supervised practices in the laboratory about the basic aspects of Android mobile applications. Through this methodology the competencies CB2, CG8, CE33 (CE46/OP16) and CE34(CE7/OP17) are developed.
Tutored works	In groups, design, development and test of a mobile application. Students and professors will have regular meetings to check the correct evolution of the tutored works. Through this methodology the competencies CB2, CB5, CG8, CE33 (CE46/OP16) and CE34(CE7/OP17) are developed.
Presentations / exhibitions	Presentation and defense of the mobile application that has been developed throughout the course. Through this methodology the competencies CG8, CE33 (CE46/OP16) and CE34(CE7/OP17) are developed.

Personalized attention

Methodologies	Description
Master Session	The professors of the course will provide individual attention to the students during the course, solving their doubts and questions. Questions will be answered during the master sessions or during tutorial sessions. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Laboratory practises	The professors of the course will provide individual attention to the students during the course, solving their doubts and questions. Questions will be answered during the lab sessions or during tutorial sessions. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.

Tutored works	The professors of the course will provide individual attention to the students during the course, solving their doubts and questions. Questions will be answered during the supervising sessions or during tutorial sessions. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Presentations / exhibitions	The professors of the course will guide the students during the preparation of the presentation of the results of the guided work, mostly during the last sessions of the supervising sessions or during tutorial sessions.

Assessment

	Description	Qualification	Training and Learning Results
Tutored works	Whenever possible, the students will be divided in groups, to design, build and test an application for mobile devices. The result will be evaluated after the delivery, taking into account key aspects such as correction, quality, performance and functionalities of the developed application. Likewise, during the development of the project, professors will make a continuous follow-up of the design and the evolution of the implementation, which may include intermediate assessment tests.	45	A2 B8 C33 A5 C34
Presentations / exhibitions	At the end of the course, each group of students has to present and defend in English the developed application for mobile devices. The defence has to include a practical demonstration of the use of the application.	10	B8 C33 C34
Multiple choice tests	After each master session, students will make a multiple choice test (in English) to evaluate the understanding of the presented topics.	20	C33
Practical tests, real task execution and / or simulated.	In each practice session students will demonstrate the proper functioning of the developments carried out during the session.	25	A2 B8 C33 C34

Other comments on the Evaluation

FIRST OPPORTUNITY

Following the guidelines of the degree, two assessment systems will be offered to students attending this course: continuous assessment and final assessment. Before the end of the second week of the course, students must declare if they opt for the continuous assessment or the final assessment. Those who opt for the continuous evaluation system may not be listed as "not presented" if they make a delivery or an assessment test after the communication of their decision.

Continuous assessment system

Those students who opt for continuous assessment system must:

- Take a set of tests with multiple choice questions. These partial tests will be done at the end of each master session. These tests will account for 20 % of the overall grade of the course.
- Take a set of practical tests in the laboratory. These tests will be performed at the end of each practice session. These tests will account for 25 % of the overall grade of the course.
- Design, build and defend a mobile application (tutored work). This task will account for 55 % of the overall grade of the course. A 10 % is reserved for the presentation and defence of the developed mobile application. Though this task will be developed in groups (whenever possible), professors will make a continuous follow-up of the activities performed by each student of a group. If the performance of a student is not in line with the rest of his/her teammates, his/her expulsion of the group might be considered, or he or she might be assessed individually.

The final grade of the course will be equal to the weighted arithmetic mean of the three indicated tasks. To pass the course the final grade must be greater or equal to five.

Final assessment system

Those students who opt for the final assessment system must:

- Take a final test with short answer or multiple choice questions (a 20 % of the overall grade of the course).
- Make and demonstrate the proper functioning of the practices in the laboratory (a 25 % of the overall grade of the course).
- Design, build and defend a mobile application (tutored work), individually or if it is possible in groups (a 55 % of the overall grade of the course, with a 10 % reserved for the presentation and defence of the developed mobile application).
- Deliver a *dossier* that includes all the details about the development of the practices in the laboratory and, especially,

about the tutored work.

The final grade of the course will be equal to the weighted arithmetic mean of the three indicated tasks, if the *dossier* is delivered, or zero otherwise. To pass the course the final grade must be greater or equal to five.

SECOND OPPORTUNITY
The course final exam will only be held for students who failed the course in the first opportunity.
The assessment will consist in doing one, two or three of the following tasks, depending on the marks achieved in the equivalent tasks during the first opportunity:

- Make a final test with short answers or multiple choice questions (a 20 % of the overall grade of the course).
- Make and demonstrate the proper functioning of the practices in the laboratory (a 25 % of the overall grade of the course).
- Design, build and defend a mobile application (tutored work), individually or if it is possible in groups (a 55 % of the overall grade of the course, with a 10 % reserved for the presentation and defence of the developed mobile application).
- In addition, those who opt for the final assessment system should deliver a *dossier* that includes all the details about the development of the practices in the laboratory and, especially, about the tutored work.

If the mark of any of the tasks in the first opportunity, equivalent to these, is greater or equal to five, the student can choose between keeping his/her marks of the first opportunity or repeating the assessments again.

OTHER COMMENTS

- The obtained grades are only valid for the current academic year.
- Although the tutored work will be completed (if possible) in groups, the performance of each student in his or her group will be monitored continuously. In the case in which the performance of a member of the group wouldn't be adequate compared with the performance of his or her team mates, he or she could be excluded from the group and/or qualified individually. This criteria will be also apply to the presententaion of the developd application.
- The use of any material during the tests will have to be explicitly authorized.
- In case of detection of plagiarism in any of the tasks/tests done, the final grade will be "failed (0)" and the professors will communicate the incident to the head of the school to take the measures that they consider appropriate.

Sources of information

Basic Bibliography

Joshua J. Drake, **Android hackers's handbook**, 1ª,
Wei-Meng Lee, **Beginning Android 4 Application Develeoment**, 1ª,
Jesús Tomás Gironés, **El gran libro de Android**, 5ª,

Complementary Bibliography

Recommendations

Other comments

It is recommended to have Java programming skills

IDENTIFYING DATA				
Satellites				
Subject	Satellites			
Code	V05M145V01311			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	Aguado Agelet, Fernando Antonio			
Lecturers	Aguado Agelet, Fernando Antonio Pérez Fontán, Fernando			
E-mail	faguado@tsc.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The contents of this course cover the basics of satellite standards, system engineering, the different segments of satellite systems, an introduction to product assurance and assembly, integration and verification procedures as well as an introduction to satellite operations. The course will be entirely conducted in English; the use of Spanish or Galego will be optionally allowed in the last exam.			

Competencies	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
B3	CG3 Ability to lead, plan and monitor multidisciplinary teams.
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.
C18	CE18/RAD1 Capacity of elaborating, strategic planning, direction, coordination and technical and economic management of spatial projects applying spatial systems engineering standards, with knowledge of the processes a satellite operation.

Learning outcomes	
Expected results from this subject	Training and Learning Results
To know and apply ECSS management space project standards.	C18
To know the basics of the system engineering applied to space projects.	A2 B3 C18
To know the mission life cycle of a space mission.	A2 C18
To know the documentation generated in each engineering phase in a space mission	A2 B3 C18
To know and ellaborate the main technical studies and budgets in a space mission.	B3 B4 C18
To know applicable methodologies and standards to product assurance (PA) and Assembly, Integration and Verification (AIV) procedures in a space project.	A2 B3 C18
To know the basics of satellite operation procedures and standards	C18

Contents	
Topic	
International space project standards	ECSS, NASA, INCOSE.
Space project life cycle	Documentation and reviews.
Segments of a satellite project	- Space Segment. - Ground Segment. - User Segment. - Launchers.

Satellite subsystems	- Communication. - Mechanical & Thermal. - Power. - ADCS. - Propulsion. - On-board computer.
Product Assurance and Assembly, Integration and Verification Procedures in a space project.	- Product Assurance (PA) in space projects. - Assembly, Integration and Verifications (AIV) plans and procedures in space projects.
Introduction to satellite operations	- Telemetry and Telecommand definition. - Operation procedures.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	19	57	76
Seminars	10	20	30
Short answer tests	1	18	19

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

Methodologies

	Description
Master Session	We describe the different aspects of the subject providing all the necessary educational material. Through this methodology the competencies CB2, CG3 and CE18 are developed.
Seminars	Every student will apply the theoretical knowledge to different practical tasks covering the main part of the contents of the subject with the help of the software suites. Through this methodology the competencies CB2, CG4 and CE18 are developed.

Personalized attention

Methodologies	Description
Master Session	The students will have the opportunity to attend tutorial hours with the university lecturers in the schedule that will be established and published in the subject web-page. They may also send their queries by email.
Seminars	The students will have the opportunity to attend tutorial hours with the university lecturers in the schedule that will be established and published in the subject web-page. They may also send their queries by email.

Assessment

	Description	Qualification	Training and Learning Results		
Master Session	The evaluation will be based on the documentation written by the student for a proposed project.	45	A2	B3	C18
Seminars	The students will perform simulations using specific software. The evaluation will be based on the students' assistance to the seminars, his or her participation on the seminars and a final report.	35	A2	B4	C18
Short answer tests	A final test to complement the evaluation of the contents presented in the master sessions. The test will be individual with time limit.	20			C18

Other comments on the Evaluation

In case of detection of plagiarism in some of the works or tests, the final qualification of the subject will be "suspended (0)" and the lecturers will communicate to the direction of the School the matter in order to take the measures it deems appropriate.

Sources of information

Basic Bibliography

James R. Wertz, David F. Everett and Jeffery J. Puschell, **Space Mission Engineering: The New SMAD**, 4,

http://www.ecss.nl,

Complementary Bibliography

http://www.incose.org/,

NASA Systems Engineering Handbook, SP-2007-6105. Rev 1,

Peter Fortescue (Editor), John Stark (Editor), Graham Swinerd (Editor), **Spacecraft Systems Engineering**, 3,

Recommendations

Subjects that it is recommended to have taken before

Analog Electronic Circuits Design/V05M145V01106
Wireless and Mobile Communications/V05M145V01313

IDENTIFYING DATA				
Wideband Radio Systems				
Subject	Wideband Radio Systems			
Code	V05M145V01312			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	García Sánchez, Manuel			
Lecturers	García Sánchez, Manuel Santalla del Río, María Verónica			
E-mail	manuel.garciasanchez@uvigo.es			
Web	http://www.faitic.uvigo.es			
General description	Wideband radio systems.			

Competencies	
Code	
C19	CE19/RAD2 Ability to perform theoretical design, experimental band systems measurement and practical implementation broadband for current applications

Learning outcomes	
Expected results from this subject	Training and Learning Results
Theoretical and experimental knowledge of wideband systems	C19
Knowledge of designs of wideband active and passive elements	C19
Fundamentals of wideband signal generation and reception	C19
Fundamentals of wideband signal measurement	C19

Contents	
Topic	
Introduction	Definitions and basic concepts Communicaction systems Radio systems. Antennas. Radioelectric spectrum. Modulation. Radio channel. Propagation channel.
Description of the radio channel	Free space Undistorted transmission Attenuation. Multipath Fading. Doppler spread. Delay spread. Frequency selective channels. Precursors.
Mathematical characterization	Narrowband Statistical amplitude distributions Doppler spectrum Wideband Bello formulation
Channel sounders	Narrowband Doppler. Nyquist limit. Wideband. Frequency domain sounders: VNA Time domain sounders. RF pulse. Sliding correlation sounders. Sounder design and performance assesment. Narrowband sounder with spectrum analyzer 0 span. VNA based sounder. Sliding correlation sounder.
Channel sounders lab	Building a wideband sounder to measure the radio channel.

Wideband modulations	Delay spread. Inter symbol interference. Irreducible BER. Frequency hopping: GSM OFDM. Guard interval. Pilot tones. Equalization. PAPR. Amplifiers. DVB-T. 4G. CDMA. Processing gain. Noise. Adquisition and tracking. RAKE receiver. 3G. Power control. Cellular breathing.
UWB systems	1. Definition. Specificities. Regulation 2. Channel characteristics. 3. Impulse radio UWB. 4. Multiband OFDM approach to UWB. 5. Applications
Wideband and UWB antenna design	1. Wideband antennas. Definition and requirements. 2. Characterization of wideband antennas 3. Examples and applications. 4. UWB antennas. Definition and requirements. 5. Characterization of UWB antennas 6. Examples and applications.
UWB applications	Radar Ground penetrating radar Positioning and location Medical imaging Emerging applications

Planning

	Class hours	Hours outside the classroom	Total hours
Seminars	2	6	8
Laboratory practises	20	60	80
Master Session	6	18	24
Short answer tests	1	5	6
Practical tests, real task execution and / or simulated.	1	6	7

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

Methodologies

	Description
Seminars	Activities designed to work on a specific topic , which allow deepen or complement the contents of the subject.
Laboratory practises	Building and testing wideband radio channel sounders
Master Session	Master lecture given by the teacher

Personalized attention

Methodologies	Description
Master Session	The students could ask questions during classes, during sheduled hours for the professors to atend the students or by email.
Laboratory practises	The students could ask questions during classes, during sheduled hours for the professors to atend the students or by email.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practises	Practice written and oral reports.	40	C19
Master Session	Short answer test	60	C19

Other comments on the Evaluation

First call:

Following the guidelines of the master we offer to the students two schemes of evaluation: continuous assessment and final assessment. The students will have to opt by one of the two schemes before a given date.

Second call: just final exam.

Sources of information

Basic Bibliography

J.D. Parsons, **The Mobile Radio Propagation Channel**,

Complementary Bibliography

H. Schulze, **Theory and applications of OFDM and CDMA**,

Recommendations

IDENTIFYING DATA				
Wireless and Mobile Communications				
Subject	Wireless and Mobile Communications			
Code	V05M145V01313			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	Vazquez Alejos, Ana			
Lecturers	Pérez Fontán, Fernando Vazquez Alejos, Ana			
E-mail	analejos@uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	This subject introduces the student in the technology of the main present mobile and wireless communication systems, with training in analysis of coverage and quality planning at radio interface level.			

Competencies	
Code	
C20	CE20/RAD3 Ability to analyse and specify the basic parameters of a mobile or wireless radio network, as well as of quality of service.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Know the reference architectures of the 2G/3G/4G cellular systems, and also for short range radio systems and standards: WLAN, WPAN and others.	C20
Ability to compute the coverage and capacity of a mobile communications site and estimate the cellular radius.	C20
Dimensioning and capacity planning of mobile and wireless systems.	C20
Ability to carry out a mobile network deployment planning.	C20
Ability to select the radio technology most appropriate to a given application.	C20

Contents	
Topic	
Unit 1. Overview of mobile, cellular, WLAN, WPAN, and other wireless radio communication systems.	1.1. Introduction to mobile and wireless systems. 1.2. Mobile and wireless radio propagation channel.
Unit 2. Dimensioning and quality of service planning in mobile and wireless radio systems.	2.1. The cellular concept. 2.2. Cellular design fundamentals. 2.3. Dimensioning of a mobile radio system. 2.4. Quality of service.
Unit 3. Review of the standards of current cellular systems.	3.1. 2G mobile phone systems: GSM and GPRS. 3.2. 3G mobile phone systems: CDMA, UMTS, 3G, 3G+. 3.3. Next Generation Mobile phone systems: LTE 5G. 3.4. Security vulnerability in mobile communications systems.
Unit 4. Review of the standards of current wireless systems.	4.1. Introduction to wireless systems and services: WLAN, WPAN, BAN. 4.2. Design fundamentals: dimensioning and quality of service. 4.3. Security vulnerability in wireless communications systems.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	22	22	44
Case studies / analysis of situations	4	40	44
Troubleshooting and / or exercises	4	2	6
Autonomous troubleshooting and / or exercises	0	10	10
Short answer tests	0	1	1
Practical tests, real task execution and / or simulated.	0	10	10
Self-assessment tests	0	10	10

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

Methodologies	
	Description
Master Session	Presentation of the contents of the subject by teachers; it includes explaining the theoretical concepts; introduction of lab practices, on-line tests and exercises/problems of autonomous realisation.
Case studies / analysis of situations	Conducting case studies in laboratory with delivery of a memory/report to be assessed.
Troubleshooting and / or exercises	Resolution of problems and/or exercises in ordinary classroom.
Autonomous troubleshooting and / or exercises	Solving by the student of problems related with the subject applied to specific cases. The student must develop the analysis and resolution of the problems in an autonomous form. These exercises are proposed weekly in attendance hours and they are guided by the professor on the resolution.

Personalized attention	
Methodologies	**Description**
Master Session	Time scheduled by professors to attend and resolve doubts of the students.
Autonomous troubleshooting and / or exercises	Time that the lecturer of group A will use to attend the students that need some support in doing their autonomous work.
Case studies / analysis of situations	Time scheduled to help the students in preparing their work.
Troubleshooting and / or exercises	Time that the lecturer can use to help the students in preparing their work.
Tests	**Description**
Short answer tests	Time that the lecturer can use to help the students in preparing their tests.
Practical tests, real task execution and / or simulated.	Time to be used by professors to help the students to understand the lab practices and to resolve doubts.
Self-assessment tests	Time that the lecturer can use to help the students in preparing their tests.

Assessment			
	Description	Qualification	Training and Learning Results
Autonomous troubleshooting and / or exercises	It will evaluate the resolution of problems delivered to each student for troubleshooting in an autonomous form.	15	C20
Short answer tests	Final examination consists of a multiple choice test for assessing the skills acquired by students by solving simple problems and questions of theory. This test includes closed questions with different alternative of answer. Students select an answer from a limited number of possibilities.	35	C20
Practical tests, real task execution and / or simulated.	For each lab practice (case studies / analysis of situations) an individual report of results must be presented for assessment.	35	C20
Self-assessment tests	Multiple choice questions tests for each unit of the subject content. The questionnaires are performed through Faitic platform that shows the results after completing each test. Students perform the tests in an autonomous form, and indications are given during attendance and office hours.	15	C20

Other comments on the Evaluation

According to the specific guidelines of the degree, students enrolled in the subject can choose one of the two proposed assessment systems: continuous assessment or final evaluation.

Continuous assessment

Continuous assessment involves performing throughout the semester of the paragraphs disaggregated in the above table. Each of the blocks is of mandatory fulfillment in the form of continuous and individual assessment, and to pass the subject a minimum of 1/3 of the note assigned to each of the sections and the final mark accumulated within the five sections to be achieved must overcome at least 50% of the final grade.

The short answer test is multiple choice and is done the day indicated in the official exam schedule. Regarding the block of

laboratory practices, one report is required per practice and per student, made in a individual way. Evidences of report copying or cloning will drive to fail the related practice.

Continuous assessment involves making 100% of all proposed tasks: active participation in the sessions of classroom and laboratory practices, autonomous work as solving exercises and online/in-class self-assessment tests (questionnaires), and performing the final short answer test.

These tasks are not recoverable, that is, if a student does not satisfy the stipulated timing the teacher has no obligation to repeat, and also they will be only valid for the academic year in which they are made.

Evaluation by final exam

In compliance with the regulations of the University of Vigo, a student who does not opt for continuous assessment should be eligible for the highest rating by the final exam, which will consist of three parts:

- Part 1: realization of laboratory practices and delivery of reports due (35% of the final grade). One report is required per practice and per student, made in a individual way. Evidences of report copying or cloning will drive to grade as zero the related practice.

- Part 2: test exam (50% of the final grade).

- Part 3: troubleshooting (20% of the final grade).

It is considered that the subject is passed if the final grade is equal to or greater than 5.

Extraordinary exam (July)

For students who followed the continuous assessment, those ones who want to retain the mark obtained in the first part of the continuous assessment (70%) may choose to perform only the test (30%) provided they have exceeded the minimum requirement in each block .

For students who chose the final evaluation, the note will be the final exam that will consist of three parts: a practical examination (pass /non-pass), a standard test exam (50%) and an examination of problems (50%) .

It is considered that the subject is approved if the final grade is equal to or greater than 5.

Sources of information

Basic Bibliography

Ana Vazquez Alejos, **Lecture Notes and Powerpoint Slides**, 2017,

Oriol Sallent, **Fundamentos de diseño y gestión de sistemas de comunicaciones móviles celulares**, 2014,

Complementary Bibliography

Jose María Hernando Rábanos, **Comunicaciones Móviles**, 2004,

Mª Teresa Jiménez Moya, Juan Reig Pascual, Lorenzo Rubio Arjona, **Problemas de comunicaciones móviles**, 2006,

José Manuel Huidobro Moya, **Comunicaciones móviles : sistemas GSM, UMTS Y LTE**, 2012,

Qualcomm, 2014,

Martin Sauter, **From GSM to LTE: An Introduction to Mobile Networks and Mobile Broadband**, 2011,

Maciej Stasiak et al., **Modelling and Dimensioning of Mobile Wireless Networks: From GSM to LTE**, 2010,

W. Dargie, C. Poellabauer, **Fundamentals of Wireless Sensor Networks: Theory and Practice**, 2010,

Recommendations

Subjects that continue the syllabus

Antennas/V05M145V01208
Radio Laboratory/V05M145V01209
Wireless Networks and Ubiquitous Computation/V05M145V01211
Satellites/V05M145V01311
Communication Advanced Systems/V05M145V01302

Subjects that it is recommended to have taken before

Radiocommunication/V05M145V01103

IDENTIFYING DATA				
Radio Navigation				
Subject	Radio Navigation			
Code	V05M145V01314			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Optical Networks				
Subject	Optical Networks			
Code	V05M145V01315			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Radar				
Subject	Radar			
Code	V05M145V01316			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Microwave and Millimetre Wave Circuit Design and CAD				
Subject	Microwave and Millimetre Wave Circuit Design and CAD			
Code	V05M145V01317			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	Fernández Barciela, Mónica			
Lecturers	Fernández Barciela, Mónica			
E-mail	monica.barciela@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Communications systems are at the mercy of the available technology to fabricate their transceivers. To understand the complexities of modern communications transceivers, their performance requirements and limitations, especially in the microwave and mm-wave frequency bands, it is mandatory to have a closer look to their underlying electronics and fabrication methods. And this look requires not only a theoretical background in active devices and circuit design methodologies or fabrications methods, but most importantly, a practical background in circuit design, fabrication, measurement and performance evaluation. The student has already acquired this theoretical background through previous subjects. The present subject aim to provide the student with some practical background by fully designing, fabricating in hybrid integrated technology and characterizing a circuit prototype, in fact one of the analogue building components of modern transceivers for working in the microwave bands (power amplifier, oscillator or mixer). Most of the presential hours of the course and personal work of the student will be devoted to the design and fabrication of this prototype. Besides this practical work, some presential hours will be devoted to describe the design rules and methodologies of advanced transceiver circuit modules working in microwave and mm-wave bands. Among others, we may mention issues related to the design of efficient power amplifiers or the use of X-parameters to characterize and model these nonlinear components. The subject will be taught fully in english, both in oral and written communications with the students, and in provided technical documents and reports.			

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.
C32	CE38/OP8 Ability to design, manufacture (in hybrid technology) and characterize the analog components of transceivers of communications in microwave and millimeter-wave bands

Learning outcomes	
Expected results from this subject	Training and Learning Results
Learn to design analogue advanced active circuits (linear and nonlinear) for emitters and receivers for communications in the microwave and milimeter wave frequency bands.	B1 B4 C32
Learn to design high frequency circuits for the optoelectronic interface in optical communications systems.	B1 B4 C32
Learn the fabrication techniques of integrated circuits (hybrid and monolithic) for communications in the high frequency bands. Learn how to apply one of these techniques in circuit prototype fabrication.	B1 B4 B8 C32
Learn to characterize and asses the performance of microwave circuits for communication transceivers.	B1 C32

Contents	
Topic	
1. Advanced circuit design for communication transceivers in the microwave and millimeter wave bands.	a. Linear and Nonlinear Circuit Design Techniques. -CAD-based design and component models. -Measurement-based design. - S-parameters vs X-parameters b. Advanced Low Noise Amplifier Design c. High Eficiency Power Amplifier Design d. High Frequency Oscillator Design e. Frequency Converter Design
2. High frequency circuit design for optoelectronic transceivers in optical communications systems.	Broadband Amplifier Design Techniques
3. Fabrication techniques for Hybrid and Monolithic Microwave Integrated Circuits	Hybrid MIC processing techniques MMIC technologies and foundry processing techniques.
4. Advanced linear and nonlinear characterization techniques, and corresponding instrumentation, to guide design and evaluate performance.	Device linear characterization techniques and instruments: VNAs. Device nonlinear characterization techniques and instruments: NVNAs, VSAs, etc.
5. A Case Study: CAD-based prototype design, fabrication and performance evaluation.	Prototype Design using ADS simulator Prototype fabrication in Hybrid-MIC technology using microstrip transmission lines Prototype characterization to evaluate performance.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	5	10	15
Practice in computer rooms	14	0	14
Laboratory practises	4	0	4
Tutored works	0	78	78
Tutored works	2	12	14
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Master Session	It will be given in a classroom with the aid of a slate board and a video projector. Main concepts in the Chapters will be described, with the exception of the last Chapter that it will not be covered here, since it is an application work (case study) by the student. These classes are designed to aid in adquiring competencies: CG1,4,8 and CE38/OP8.
Practice in computer rooms	During these classes, with the aid of a commercial microwave circuits simulator, it will be designed by the student a circuit prototype, among those described in the subject. This work will be completed with through tutorized personal work by the student. These classes are designed to aid in adquiring competencies: CG1,4,8 and CE38/OP8.
Laboratory practises	The previously designed prototype by the student, during the practices in computer rooms and his/her personal work, will be fabricated in hybrid MIC technology and characterized using adequate instrumentation. These classes are designed to help in adquiring competencies: CG1,4,8 and CE38/OP8.
Tutored works	With the aid of the hours of practice in computer rooms, and through his/her personal work, the student will be guided to fully design - working individually- a circuit prototype. Then, he/her will fabricate this prototype and evaluate its performance during the laboratory practices. The student will write a final report of his/her work. This project with require most of the student effort in the subject. These classes are designed to help in adquiring competencies: CG1,4,8 and CE38/OP8.
Tutored works	Each student will prepare - working individually- a short writen report about one of the topics covered in the subject. This work will by assesed by an oral presentation in which he/she will answer short questions about the work. These classes are designed to help in adquiring competencies: CG1,4,8 y CE38/OP8.

Personalized attention	
Methodologies	**Description**
Practice in computer rooms	During these classes, students -individually- will perform the assigned tasks related to CAD design with the aid and personalized guidance of the lecturer.

Laboratory practises	During these classes, students -individually- will perform the assigned tasks related to prototyping and measurements with the aid and personalized guidance of the lecturer.

Assessment

	Description	Qualification	Training and Learning Results	
Tutored works	The student -individually- will design, fabricate in Hybrid Technology and evaluate the performance of a microwave circuit prototype. The assesment will be performed through the circuit design, the quality of the fabricated prototype, the final measured prototype performance and a written report. In this work, it will be evaluated competencies CG1, CG4, CG8 and CE32.	90	B1 B4 B8	C32
Tutored works	The student -individually, will write a report about a topic related to the subject. The assesment will be performed taking into account the quality of the report and the answers to short questions during the oral presentation of the work. In this work, it will be evaluated competencies CG1, CG4, CG8 and CE32.	10	B1 B4 B8	C32

Other comments on the Evaluation

The subject will be taught fully in english, both in oral and written communications with the students, and in provided technical documents and reports.

A) First summons : The work of the student in the subject will be evaluated through the development of the two tutorized works:

1. The circuit prototype: design, fabrication in hybrid integrated technology, performance evaluation, and written report (90% of the total subject qualification).

2. The written report about a given topic and his/her answers to the short questions. (10% of the total subject qualification).

If the student does not obtain the minimum qualification to pass the subject in the first summons and has been present at least in 80% of the presential hours, the lecturer will suggest changes/improvements to the prototype design and written report about the topic, for the second summons.

B) The second summons: Those students who have been present at least in 80% of the presential hours will have the opportunity to re-design his/her previous prototype design and improve the written report of the topic. Each of these tasks will be assigned the same qualification percentage as in the first summons Those students who have not been present in at least 80% of the presential hours, will have two weeks to design, fabricate, measure, evaluate performance and write a report of a circuit prototype chosen by the lecturer. The assessment of this work will be 100% of the subject qualification.

In case of plagiarism detection in any of the student works, the grade obtained by the student in this course will be a failing grade (0) and the course lecturer/s will communicate this issue to the school Board of Directors so they may take those measures deemed appropriate.

Sources of information

Basic Bibliography

Guillermo Gonzalez, **Microwave Transistor Amplifiers: Analysis and Design**, 2,

Complementary Bibliography

Technical papers (journals, application notes, data sheets,...),

Instrumentation and simulator manuals,

Steve C. Cripps, **Advanced Techniques in RF Power Amplifier Design**, 1,
Guillermo Gonzalez, **Foundations of Oscillator Circuit Design**,
D. Root, **X-Parameters: Characterization, Modeling, and Design of Nonlinear RF and Microwave Components**, 1,

Recommendations

Subjects that it is recommended to have taken before

Electronics and Photonics for Communications/V05M145V01202

IDENTIFYING DATA				
Multimedia Security				
Subject	Multimedia Security			
Code	V05M145V01318			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	Pérez González, Fernando			
Lecturers	Pérez González, Fernando			
E-mail	fperez@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Multimedia security is an increasingly important topic as most of the information exchanged nowadays over the Internet is multimedia. Traditional data protection solutions like cryptography only solve the problem partially, because contents, once decrypted, are no longer protected. In addition, there is a rising concern over the integrity of multimedia contents: modern editing tools jeopardize our trust on video, images or audio. Fortunately, a number of research groups and companies have addressed these problems and ingenious solutions exist. This course presents advanced topics in multimedia security, with emphasis on cryptography, watermarking, forensics and signal processing in the encrypted domain. 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	
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.
C31	CE37/OP7 Ability to model, operate, manage, and deal with the full cycle and bagging of networks, services and applications considering the quality of service, direct and costs of operation, the plan of implementation, monitoring, security, scaling and maintenance, managing and ensuring the quality of the development process

Learning outcomes	
Expected results from this subject	Training and Learning Results
Handle the most advanced information protection methods.	B4 B8 C31
Understand the potential and limitations of the different methods.	B4 B8 C31
Handle the use of different algorithms in current multimedia communications environments.	B4 B8 C31
Understand technical material in an autonomous way.	B4 B8 C31

Contents	
Topic	
Introduction to cryptography.	Application to multimedia systems. Integration with source and channel coding. Block and stream ciphers. Hashing and MAC codes. Specific algorithms.
Conditional access systems.	Requirements. History and state of the art. Design of a conditional access system.

Secret sharing.	Simple secret sharing systems. Visual cryptography.
Data hiding and watermarking.	Basic concepts. Watermarking versus data hiding. Spread-spectrum watermarking. Quantization-based watermarking. Application to images and video.
Forensic signal processing.	Quantization detection and estimation. Filtering detection and identification. Resampling detection and estimation. Source ballistics.
Signal Processing in the Encrypted Domain.	Privacy metrics and notions. Homomorphic encryption. Garbled cicruits. Signal representation and cipher blowup. Applications.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	14	28	42
Laboratory practises	9	42	51
Reports / memories of practice	0	30	30
Long answer tests and development	2	0	2

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

Methodologies

	Description
Master Session	The course is structured in several topics in multimedia security, including cryptography, watermarking, forensics and signal processing in the encrypted domain. Competences: CG4, CG8, CE31
Laboratory practises	Lab practices will cover different aspects of multiple-input data hiding, watermarking and forensics. This will allow students to practically implement and considerably expand some of the concepts seen in the lectures. Competences: CG4, CG8, CE31

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	
Reports / memories of practice	Reports of the practices and additional personal work that employ the techniques seen in the classroom. Quality of the reports and correctness of the results will be evaluated. Reports will be individual or collective, depending on the size of the unit that carried out the practices.	70	B4 B8	C31
Long answer tests and development	Final exam with short questions on the contents of the subject.	30	B4 B8	C31

Other comments on the Evaluation

A minimum score of 30% 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: 0.35*REP+0.15*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 he/she takes the final exam.

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

In the case that plagiarism is detected in any of the reports/exams done/taken, the final score for the subject will be 'fail' (0) and the teachers will inform the School authorities of the affaire so that they take the appropriate measures. Besides, the teachers will inform the School authorities of any conduct against ethics by the students, the possibility existing that the School authorities take the appropriate measures.

Sources of information

Basic Bibliography

Complementary Bibliography

Cox, Miller, Bloom, Fridrich, Kalker, **Digital Watermarking and Steganography**, 2nd,

Troncoso-Pastoriza, Perez-Gonzalez, **Secure Signal Processing in the Cloud: enabling technologies for privacy-preserving multimedia cloud processing**, Signal Processing Magazine,

A.J. Menezes, **Handbook of Applied Cryptography**, 1996,

A. Piva, **An Overview of Image Forensics**, Signal Processing,

Recommendations

Subjects that it is recommended to have taken before

Statistical Signal Processing/V05M145V01303

IDENTIFYING DATA				
Intelligent Sensors				
Subject	Intelligent Sensors			
Code	V05M145V01319			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Mariño Espiñeira, Perfecto			
Lecturers	Machado Domínguez, Fernando Mariño Espiñeira, Perfecto Pastoriza Santos, Vicente			
E-mail	pmarino@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The overall objective of this course is to provide the theoretical and practical skills for the design and characterization of the electronic instrumentation systems based on smart sensors in wired or wireless topologies. To achieve this, the main intelligent sensors structures, the sensor networks architectures and topologies, the energy harvesting smart sensors systems and the software tools and hardware platforms for designing smart multi-sensor systems will be studied.			

Competencies	
Code	
A4	CB4 Students must communicate their conclusions, and the knowledge and reasons stating them-, to specialists and non-specialists in a clear and unambiguous way.
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
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.
C36	CE43/OP13 Ability to characterize intelligent sensors and their specific characteristics in networks

Learning outcomes	
Expected results from this subject	Training and Learning Results
Know the different structures of the intelligent sensors.	A5 B8 C36
Know the topologies and architectures of the sensor networks.	A5 B8 C36
Know analyse and design systems of efficient sensors in consumption.	A4 B8 C36
Know software tools and hardware platforms for the design of sensor systems.	A5 B8 C36
Design applications based on data fusion of different sensors.	A4 B8 C36

Contents	
Topic	
Unit 1: Smart Sensors.	Definition. Classification. Architectures. Multisensorial systems. Standard IEEE 1451 for smart sensors. Applications: Internet of Things, Industry 4.0, Machine Learning.
Unit 2: Wired topologies.	General features. Classification. Practical examples: PROFIBUS and CAN. Intelligent Transportation Systems (ITS). Embedded buses for automotive applications: LIN, MOST, FLEXRAY, JSAE 1939 and others. Development tools.

Unit 3: Wireless topologies.	The ISM bands. Basic features of wireless networks. Multiplexing and modulation. The SDR concept. Standards for WLAN and WPAN. IEEE standards 802.15.1/4/3. Wireless sensor networks (WSNs). Other commercial networks.
Laboratory	
Unit 1. Wired smart sensors systems.	Analysis and test of smart sensors.
Unit 2. Wireless smart sensors systems.	Design, implementation and test of a wireless sensor network.
Unit 3. Project: Design and implementation of an electronic instrumentation system with smart sensors.	Design, implementation and test of an electronic instrumentation system with smart sensors, applying theoretical and practical concepts.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	4	4	8
Tutored works	1	18.5	19.5
Laboratory practises	7.5	15	22.5
Integrated methodologies	12.5	62.5	75

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

Methodologies

	Description
Master Session	The lecturer will explain in the classroom the main contents of the subject. The students have to manage the proposed bibliography to carry out a self-study process in a way that leads to acquire the knowledge and the skills related to the subject. The lecturer will answer the students questions in the classroom or at the office. In these sessions, the skills CB4, CB5, CG8, and CE43 will be developed.
Tutored works	The students have to manage basic concepts to search and select information in order to get a deeper understanding in some specific fields related to the subject. The lecturer will propose in the classroom the topic of this individual task and monitor the student s work in personalized attention sessions. In these sessions, the skills CB4, CB5, CG8 and CE43. will be developed.
Laboratory practises	Activities designed to apply the main concepts and definitions of the subject. The student will be asked to acquire the basic skills to manage the laboratory instrumentation, software tools and components in order to construct and test electronic circuits. The student has to develop and demonstrate autonomous learning and collaborative skills. He/she is supposed to be able to manage bibliography and recently acquired knowledge. Possible questions can be answered in the laboratory sessions or at the lecturer s office. In these sessions, the skills CB4, CB5, CG8, and CE43 will be developed.
Integrated methodologies	Project-based learning: students have to develop a group activity that goes on over a period of time and address a specific problem. They have to design, schedule and carry out a set of tasks to achieve a solution. The assessment will be based on the quality of the proposed solution, the depth of content understanding demonstrated and the final presentation. In these sessions, the skills CB4, CB5, CG8, and CE43 will be developed.

Personalized attention

Methodologies	Description
Master Session	The students can go to the lecturer s office (individually or in a group). The timetable will be available on the school website at the beginning of the term. In these sessions the lecturer will answer the students questions and also give instructions to guide the studying and learning process.
Laboratory practises	The students can go to the lecturer s office (individually or in a group). The timetable will be available on the school website at the beginning of the term. In these sessions the lecturer will help students understand the work to be developed in the laboratory (components, circuits, instrumentation and tools).
Integrated methodologies	The students can go to the lecturer s office (individually or in a group). The timetable will be available on the school website at the beginning of the term. The lecturers will be available to help students in order to deal with the project as well as the monitored work.
Tutored works	The students can go to the lecturer s office (individually or in a group). The timetable will be available on the school website at the beginning of the term. In these sessions the lecturer will help students to deal with the monitored work.

Assessment

	Description	Qualification	Training and Learning Results
Tutored works	The lecturers will consider the quality of the results obtained, their analysis, the final report, and the classroom presentation. The tutored work mark (TWM) will be assessed in a 10 points scale. In these works, the skills CB4, CB5, CG8 and CE43 will be evaluated.	20	A4 B8 C36 A5
Laboratory practises	The lecturers will check the level of compliance of the students with the goals related to the laboratory skills. The final mark of laboratory (FML) will be assessed in a 10 points scale. For the evaluation of the laboratory sessions, the lecturer will assess the group work (the same mark for each member), the individual preliminary tasks and the answers to personalized questions for each session. In these practices, the skills CB4, CB5, CG8 and CE43 will be assessed.	20	A4 B8 C36 A5
Integrated methodologies	The lecturers will consider the quality of the results obtained, their presentation and analysis, and the final oral presentation. The final mark of the project (FMP) will be assessed in a 10 points scale. For the evaluation of the project, the lecturer will assess the group work (the same mark for each member) and the individual oral presentation of the developed project. The skills CB4, CB5, CG8 and CE43 will be evaluated in these projects.	60	A4 B8 C36 A5

Other comments on the Evaluation

1. Continuous assessment

According to the guidelines of the master and the agreements of the academic commission, a continuous assessment learning scheme will be offered to the students.

In order to ***be assessed by continuous assessment***, the student cannot miss more than one theory session, more than one laboratory session and more than one project session; and only if this absence is duly justified.

The subject comprises three different parts: theory (20%), laboratory (20%) and project (60%). Once a task has been assessed, the students can not do/repeat the task at a later date. The marks are valid only for the current academic course.

1.a Theory

Attendance at the theory classes is compulsory. In order to pass the theory part, the student cannot miss more than one theory session and only if this absence is duly justified.

In the first weeks of the course each student will be asked to carry out a task individually with the help of the lecturer about a topic related to the subject. In order to assess the work, the lecturer will consider the results, their analysis and presentation, and the quality of the written report. The students will be informed of the deadline by the lecturer. The tutored work mark (TWM) will be assessed in a 10 points scale. If the students present their works after the deadline the TWM will be 0.

The final mark of theory (FMT) will be: FMT = TWM.

The minimum mark required to pass this part is of 5 (FMT>=5).

1.b Laboratory

Three laboratory sessions are scheduled. Each session lasts approximately 150 minutes and the students will work in pairs (whenever possible). This part also will be assessed by continuous assessment. Each session will be only evaluated according to the developed work at the schedule date. The lecturer will consider the work of the students carried out before the laboratory session to prepare the proposed tasks, the work in the laboratory to deal with them as well as the student□s behavior.

Marks for each laboratory session (LSM) will be assessed in a 10 points scale. A mark of 0 will be obtained for missing sessions. In order to pass the laboratory part the students can not miss more than one laboratory sessions and only if this absence is duly justified. The final mark of laboratory (FML) is calculated as the arithmetic mean of the individual laboratory session marks:

FML = (LSM1 + LSM2 + LSM3)/3

1.c Project

In the first session lecturer will present the objectives and the schedule of the project. They also assign a specific project to

each group (two students per project whenever possible). After that, the most important part of the workload will be developed in the laboratory: one laboratory session (B hours) and the project sessions (C hours).

In order to assess the project, the lecturer will consider the results, their analysis and presentation, and the final oral presentation. The final mark of project (FMP) will be assessed in a 10 points scale. The minimum mark required to pass this part is of 5 (FMP>=5). The students are only allowed to miss one project session and only if this absence is duly justified.

1.d Final mark of the subject

The weighted points from all assessed parts are added together to calculate the final mark (FM). The following weightings will be applied: 20% theory (FMT), 20% laboratory (FML) and 60% project (FMP).

In order to pass the subject, students will be required to pass the theory, laboratory and project parts. In this case the final mark (FM) will be:

$$FM = 0.2 \cdot FMT + 0.2 \cdot FML + 0.6\ FMP.$$

However, when the students do not pass both parts (FML < 5 or FMP < 5), or miss more than 1 theory session, or more than 1 laboratory session, or miss more than 1 project session, the final mark will be:

$$FM = \min\{4\ ;\ (0.2 \cdot FMT + 0.2 \cdot FML + 0.6\ FMP)\}.$$

A final mark higher than five points (FM >= 5) should be achieved in order to pass the subject.

2. Final Exam

The students who prefer a different educational policy can attend an exam on a scheduled date. The date will be specified in the academic calendar. This exam will comprise three parts: theory exam, laboratory exam and project. The student will prepare a written project report to be handed in just before the exam. The final project must be presented within one week of delivery of reports. In order to assign the project, the student has to contact to the lecturer at least four weeks before the exam.

In order to pass the theory, the student will have to attend to an exam with test questions and/or sort answer questions. The theory exam will be assessed in a 10 points scale and and the final mark of theory (FMT) will be the obtained mark.

In the laboratory exam the student will be asked to deal with some of the electronic circuits developed in the laboratory sessions as well as some short answer questions related to these sessions. The laboratory exam will be assessed in a 10 points scale and the final mark of laboratory (FML) will be the obtained mark.

In order to assess the project, the lecturer will consider the results, their analysis and presentation, and the quality of the written report. The project will be assessed in a 10 points scale and the the final mark of project (FMP) will be the obtained mark.

In order to pass the subject, students will be required to pass each part (FMT>=5, FML>=5 and FMP>=5). In this case the final mark (FM) will be:

$$FM = 0.2 \cdot FMT + 0.2 \cdot FML + 0.6\ FMP.$$

However, when the students do not pass all parts (FMT < 5 or FML < 5 orFMP < 5), the final mark will be:

$$FM = \min\{4\ ;\ (0.2 \cdot FMT + 0.2 \cdot FML + 0.6\ FMP)\}.$$

A final mark higher than five points (FM >= 5) should be achieved in order to pass the subject.

3. Second opportunity to pass the subject

The assessment policy in this call will follow the scheme described in the previous section. Dates will be specified in the academic calendar. This exam consist on a theory exam, a laboratory exam and a project. The student will prepare a written project report to be handed in just before the exam. The final project must be presented within one week of delivery of reports. In order to assign the project, the student has to contact to the lecturer at least four weeks before the exam.

The marks obtained in the previous continuous assessment or final exam are kept for those parts in which the student has not attended. The final mark will be calculated as it has described in:

- section 1 to students with the theory part passed in continuous assessment.
- section 2 for all other case.

Sources of information
Basic Bibliography
Fraden, J., **Handbook of modern sensors**, 5th, Springer, 2016
Gómez, C., Paradells, J. y Caballero, J.E., **Sensors Everywhere: Wireless Network Technologies and Solutions**, Fundación Vodafone España, 2010
Misra, S., Woungang, I. & Chandra, S., **Guide to Wireless sensor networks**, Springer, 2009
Slama, D., Puhlmann, F., Morrish, J. and Bhatnagar R.M, **Enterprise IoT: Strategies and Best Practices for Connected Products and Services**, O'Reilly, 2016
Rogers, L. a& Stanford-Clark, A, **Wiring the IoT: Connecting Hardware with Raspberry Pi, Node-Red, and MQTT**, O'Reilly, Upcomming
Complementary Bibliography
Mariño-Espiñeira, P., **Las comunicaciones en la empresa; normas, redes y servicios**, 2ª, RAMA, 2006
Faludi, R., **Building wireless sensor networks.**, O´Reilly, 2011
Parallax Inc., **Smart Sensors and Applications**, 3rd, Parallax Inc., 2006

Recommendations

IDENTIFYING DATA				
Practicals in Digital Electronics for Communications				
Subject	Practicals in Digital Electronics for Communications			
Code	V05M145V01320			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Distributed Computing				
Subject	Distributed Computing			
Code	V05M145V01321			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Mikic Fonte, Fernando Ariel			
Lecturers	Burguillo Rial, Juan Carlos Mikic Fonte, Fernando Ariel Rodríguez Hernández, Pedro Salvador			
E-mail	mikic@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course will provide a vision of group of the most usual technologies inside the distributed computing. They will tackle subjects such as the distributed transactions and the replication; the grid computing, cloud computing, and cluster computing; the distributed artificial intelligence; and the parallel and evolutionary computing. We will use Spanish language in classroom, and English language for the instructional materials.			

Competencies	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
A4	CB4 Students must communicate their conclusions, and the knowledge and reasons stating them-, to specialists and non-specialists in a clear and unambiguous way.
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
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.
C24	CE24/TE1 Ability to understand the fundamentals of distributed systems and distributed computing paradigms, and its application in the design, development and management in grid, ubiquitous computing scenarios and cloud systems.

Learning outcomes	
Expected results from this subject	Training and Learning Results
To earn skills in the design, development and management of distributed systems.	A2 B8 C24
To undertand the functional bases of the distributed systems.	A4 A5 C24
To know the distinct concepts related with the distributed computing: clustering, grids, cloud computing and ubiquitous computing.	A5 B8 C24
To earn skills for the application of intelligent systems in the distributed computing.	A2 A5 B8 C24
To learn how to distribute the execution of tasks for the resolution of problems and optimisation by means of evolutionary and parallel computing.	A2 A4 B8 C24

Contents
Topic

1. Transactions	1. Concurrency problems 2. Recoverability problems 3. Deadlocks 4. Optimistic concurrency control 5. Timestamps
2. Replication	1. Introduction to replication 2. Case studies of high available services (Bayou and Coda) 3. Transactions with replicated data 4. Design of distributed systems: Google case study
3. Grid and Cluster	1. Basic concepts of grid computing 2. Basic concepts of cluster computing.
4. Distributed artificial intelligence	1. Intelligent agents and multiagent systems 2. Theory of games applied to multiagent systems: coordination, competition, negotiation, auctions, electronic trade 3. Complex distributed systems and auto-organised ones
5. Parallel and evolutionary computation	1. Distributed Computing and parallelization 2. Algorithms and evolutionary programming: genetics, memetics, differential evolution, intelligence of swarm. 3. Optimisation by means of evolutionary technics and parallelization

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	17	0	17
Autonomous practices through ICT	7.5	0	7.5
Autonomous troubleshooting and / or exercises	0	92.5	92.5
Short answer tests	3	0	3
Reports / memories of practice	0	2.5	2.5
Systematic observation	2.5	0	2.5

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

Methodologies

	Description
Master Session	Theoretical classes with practical cases. Besides, problems will be proposed for solving them in autonomous way. Competencies related to this activity: CB5 and CE24
Autonomous practices through ICT	Practices in laboratory realised by means of computers connected in network and/or virtual machines. Competencies related to this activity: CB2, CB4, and CG8
Autonomous troubleshooting and / or exercises	Work of study on the contents of the theoretical classes, as well as of support to the realisation and achievement of the practices of laboratory. Competencies related to this activity: CB5 and CG8

Personalized attention

Methodologies	**Description**
Autonomous practices through ICT	The personalised attention will carry out in the practical part of the course, as in the tutorial time.
Tests	**Description**
Systematic observation	The personalised attention will carry out in the practical part of the course, as in the tutorial time.

Assessment

	Description	Qualification	Training and Learning Results		
Short answer tests	Examinations composed by a series of short answer questions and/or test type ones that the student will have to answer in the classroom individually.	70	A2 A4 A5	B8	C24
Reports / memories of practice	Detailed report of the tasks during the realisation of the practices of laboratory carried out in group.	10	A2 A4	B8	C24

Systematic observation	Observation by the professor of the work carried out by the students in the classroom during the realisation of the practices of laboratory carried out in group. Level of participation in those practices and functioning of the work carried out.	20	A2 A4 A5	B8	C24

Other comments on the Evaluation

The students can decide being evaluated according to a model of continuous evaluation (reviewed previously) or realise a final examination. The fact a student answer the first examination of continuous evaluation means he/she opts by this model of evaluation (in contrary case he/she opts by the model of final examination). Once the students opt by the model of continuous evaluation their qualification will not be able to be never "No presented".

Plagiarism and copy are not allowed.

1- CONTINUOUS EVALUATION

To surpass the course requires a minimum qualification of 5 points. The qualification will be the result to add the qualifications received in each one of the following parts:

- Written exam 1:
  - Dates: On the fourth week of the course
  - Individually
  - Contents: Given until this moment
  - Type: Series of short answer questions and/or test type ones
  - Maximum punctuation = 5 points
- Written exam 2:
  - Dates: Official calendar (coinciding with the final examination for those that opted by this modality)
  - Individually
  - Contents: Given until this moment excepting those that already were evaluated in the written exam 1.
  - Type: Series of short answer questions and/or test type ones
  - Maximum punctuation = 2 points
- Practices:
  - Dates: Weeks 6, 7, and 8
  - In group:
    - Reports / memories of practice: The same mark is asigned to each member of the group.
    - Systematic observation: A personalized mark is asigned to each member of the group. This mark is based on the observation by the professor of the work carried out by each student in the classroom during the realisation of the practices of laboratory.
  - Maximum punctuation = 3 points

2- FINAL EXAMINATION

To surpass the course requires a minimum qualification of 5 points.

- Written exam:
  - Dates: Official calendar
  - Individually
  - Contents: Given in the whole course (including practical).
  - Type: Series of short answer questions and/or test type ones
  - Maximum punctuation = 10 points

3- EXTRAORDINARY EVALUATION

The students will be evaluated using the modality of "final examination"

Sources of information
Basic Bibliography
George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, **Distributed systems. Concepts and design**, 5, Addison Wesley, 2011
Michael Wooldridge, **An Introduction to Multiagent Systems**, 2, Addison-Wesley, 2009
Thomas Rauber, Gudula Rúnger, **Parallel Programming for Multicore and Cluster Systems**, 2, Springer, 2013
A.E. Eiben, J.E. Smith, **Introduction to Evolutionary Computing (Natural Computing Series)**, 2, Springer, 2015
Tom White, **Hadoop: The Definitive Guide**, 3, O'Reilly Media, 2012
Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Data analysis				
Subject	Data analysis			
Code	V05M145V01322			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Fernández Vilas, Ana			
Lecturers	Fernández Vilas, Ana González Castaño, Francisco Javier			
E-mail	avilas@det.uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	Data analysis with a practical approach: data extraction and cleansing, data characterization with techniques such as statistical regression, clustering or outlier analysis, and knowledge generation with techniques such as intuitive visualization or automatic classification. The course is taught in Spanish.			

Competencies	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
A3	CB3 Students must integrate knowledge and handle complexity of formulating judgments based on information that was incomplete or limited, including reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.
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.
C25	CE25/TE2 Ability to manage the acquisition, structuring, analysis and visualization of data, extracting information and underlying knowledge, critically assessing the results, and applying it to strategic decision-making and innovation in different areas.

Learning outcomes	
Expected results from this subject	Training and Learning Results
- Knowledge of the different stages of knowledge extraction and the areas of application of data mining.	A2 A3 B4 B8 C25
- Knowledge of the importance of the preparation of the data and how to apply the main pre-processing techniques.	A2 B4 B8 C25
- Knowledge of the main techniques of data mining as well as the necessary premises for its application to a particular stage.	A2 A3 B4 B8
- Knowldge of the different types of data mining results evaluation and how to apply them.	C25
- Knowledge of statistical software and how to apply it to on-line and off-line data mining.	B4 C25
-Ability to to schedule, develop and evaluate a data analysis process.	B4 B8 C25
New	

Contents	
Topic	
Statistical analysis of data	- Correlation and causation. - Regressions. - Intervals of confidence and error. Hypothesis tests.

Data mining	- Cleaning, integration, reduction and transformation of data. - Classification and clustering.
Computational analysis of data	- Large-scale data analysis. - Visualisation of data and results. - Application scenarios.

Planning			
	Class hours	Hours outside the classroom	Total hours
Projects	2	36	38
Laboratory practises	8	16	24
Master Session	20	40	60
Short answer tests	2	0	2
Jobs and projects	1	0	1

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

Methodologies	
	Description
Projects	Arranged in groups, the students will solve a practical case of data analysis in an application scenario. CB2 CB3 CG4 CG8 CE25
Laboratory practises	During the course, students will develop solutions in laboratory sessions to grasp the course content. CB2 CB3 CG4 CG8 CE25
Master Session	Lectures that will illustrate the course content with small exercises. These will be solved by the lecturer of the students themselves, alone or in groups. The goal is to foster discussion and knowledge of course competencies. CB2 CB3 CG4 CG8.

Personalized attention	
Methodologies	**Description**
Master Session	Individual atention will take place during official tutoring times or via e-mail at any time.
Projects	Individual atention will take place during official tutoring times or via e-mail at any time.
Laboratory practises	Individual atention will take place during official tutoring times or via e-mail at any time.

Assessment					
	Description	Qualification	Training and Learning Results		
Short answer tests	Short-answer written exam.	40			C25
Jobs and projects	Working groups will generate two deliverables reporting their work on a dataset that will be handed to them at the beginning on the course.	60	A2 A3	B4 B8	C25

Other comments on the Evaluation

During the bimester, the evaluation of the course will only take place according to the continuous evaluation system.

CONTINUOUS EVALUATION

It will be based on the aforementioned methodologies. The grading of the activities is as follows:

1. Short answer test (4 points maximum).
2. Two deliverables on the work on a common dataset (6 points maximum)

To pass the course, the student must obtain 1,5/4 points at least in the short answer test and an overal mark (across all possible activities) above 5 points. The maximum mark is 10 points.

The contents of the short answer test and the deliverables will be balanced for a reasonable preparation effort.

FINAL COURSE EVALUATION

Final course evaluation, as an alternative to continuous evaluation, will consist on a single exam covering the whole course content, theoretical and/or practical. The maximum mark of this exam will be 10 points. The minimum mark to pass the exam is 5 points.

Sources of information
Basic Bibliography
Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Economical and Social Networks				
Subject	Economical and Social Networks			
Code	V05M145V01323			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Fernández Veiga, Manuel			
Lecturers	Fernández Veiga, Manuel			
E-mail	mveiga@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Social and Economic networks tackles the dynamic and structural study of networks of relationship between agents that arise in the fields of telecommunications, economy and sociology. We study, in particular, dynamic models of diffusion of information, of contagion, of strategic balance and of training of coalitions. The theoretical contents are applied to a practical study case.			

Competencies	
Code	
A1	CB1 Knowledge and understanding needed to provide a basis or opportunity for being original in developing and/or applying ideas, often within a research context.
A3	CB3 Students must integrate knowledge and handle complexity of formulating judgments based on information that was incomplete or limited, including reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.
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.
C26	CE26/TE3 Ability to understand and know to exploit the processes of training and dissemination of information in social networks, applying them to the improvement of Internet
C27	CE27/TE4 Ability to design and manage distributed systems based on learning and incentive

Learning outcomes	
Expected results from this subject	Training and Learning Results
Understand the static and dynamic phenomena that explain the structure of the social networks	B4 C26
Know how to analyse the mechanisms of training of networks in strategic terms	B4 B8 C26 C27
Know how to model and apply to real data the processes of diffusion of information in social networks	A1 A3 C26 C27
Know how apply the procedures of structural and dynamic analysis of the networks to analyse complex systems in the technological fields, biological, economic and social.	A1 A3 B4 B8 C26 C27
Know how to use the dynamics of learning in networks to characterise phenomena	A1 A3 B4 C27

Contents
Topic

1. Basic models	a. Empirical evidence b. Random networks c. Descriptive parameters, centrality and importance d. Scaling laws
2. Training of networks	a. Random models: static training b. Random models: dynamic training c. Strategic training: stability, efficiency and incentives
3. Diffusion and learning in social networks	a. Simple diffusion SIR, SIS and others b. Learning and reinforcement in networks c. Games in networks: strategic complements and strategic substitutes
4. Applications	a. Recommendations/punctuations b. Virality c. Origins of rumours d. Trending topics d. Meritocracy. Identification of experts and leaders

Planning

	Class hours	Hours outside the classroom	Total hours
Projects	14	45	59
Master Session	14	35	49
Troubleshooting and / or exercises	0	11	11
Long answer tests and development	1	2	3
Practical tests, real task execution and / or simulated.	1	2	3

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

Methodologies

	Description
Projects	Development of a practical project of analysis and modeling of a network of diffusion: technological, social, biological or economic. It will consist in the structural and dynamic explanation of the observable phenomena in the data that describe the network. Through this methodology, competencies CB1, CB3, CG4, CG8, CE26 and CE27 are developed.
Master Session	Synthetic exposition in the classroom of the basic concepts that support the subject. Through this methodology, competencies CB1, CB3, CG4, CG8, CE26 and CE27 are developed.

Personalized attention

Methodologies	Description
Master Session	Resolution of doubts, bibliographic recommendations, proposals of exercises or explanation of concepts and technical on any part of the program of the *asignatura. Individual attention to the students.

Assessment

	Description	Qualification	Training and Learning Results		
Troubleshooting and / or exercises	Correction of the exercises proposed. Written submission.	30	A1 A3	B4 B8	C26 C27
Long answer tests and development	Written examination paper.	50	A1 A3	B4 B8	C26 C27
Practical tests, real task execution and / or simulated.	Functional test of the practical project.	20	A1 A3	B4 B8	C26 C27

Other comments on the Evaluation

We leave to discretion of the students two methods of alternative evaluation in the subject: continuous evaluation and single evaluation. The continuous evaluation will consist in the realisation of a written exam (50% of the qualification), a laboratory project (30%) and in the resolution written of problems along the course (20% of the qualification). The single evaluation will consist in the realisation of a final examination writing (60% of the qualification) and in the development of a practical project (40% of the qualification) that will be due before the last day of the official period of examinations.

The students will choose one or another modality of evaluation in the moment in that the project is announced. They will be considered not presented in case no explicit election is made at in this moment. Those who do not pass the subject at the earliest opportunity of the announcement have of a second opportunity in the month of July in which his knowledge will be

tested with a written examination or his project will be assessed again if it had been improved or modified. The weights of each one of the tests (examination and project) will be the same that in the ordinary period of evaluation according to the modality that had chosen.

The qualification of the test has only effects in the academic course in that they were awarded, with independence of the itinerary of evaluation chosen.

Should any form of plagiarism be detected in a project or test, the final grade in the subject will be FAIL (0) and the event will be reported to the academic officers so that appropriate sanctions could be taken.

Sources of information
Basic Bibliography
B. Bollobas, **Random Graphs**, 2ª, Cambridge University Press, 2001
D. Easley, J. Kleinberg, **Networks, Crowds, and Markets: Reasoning About a Highly Connected World**, Cambridge University Press, 2010
Complementary Bibliography
A. D. Barbour, L. Holst and S. Janson, **Poisson Approximation**, 2ª, Oxford Science Publications, 1992
R. Durrett, **Random Graph Dynamics**, Cambridge University Press, 2010
G. Grimmett, **Percolation**, 2ª, Springer, 1999
S. Janson, T. Luczak, A. Rucinski, **Random Graphs**, Wiley, 2000
R. Meester and R. Roy, **Continuum Percolation**, Cambridge University Press, 2008
R. van der Hofstad, **Random graphs and complex networks**, Cambridge University Press, 2016

Recommendations

IDENTIFYING DATA				
Internship in Companies I				
Subject	Internship in Companies I			
Code	V05M145V01324			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The student develops own functions in a company as an Telecommunication Engineer with determinate profile by the technology that the student have studied (Electronics, Processed of signal for communications, Radiocommunication and Telematic) and supervised by the University adviser and the company adviser.			

Competencies	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
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.
B9	CG9 Ability to understand the responsibility and professional ethics in the activity of the profession of Telecommunications Engineering.
B10	CG10 Ability to apply principles of economics and human resources and projects management, as well as legislation, regulation and standardization of telecommunications.
B12	CG12 Skills for lifelong, self-directed and autonomous learning.
B13	CG13 Knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Telecommunication Engineering.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Experience in the practice of the profession of engineering of Telecommunication and his/her usual functions in some real company environment.	A2 A5 B8 B9 B10 B12 B13

Contents	
Topic	
Item	The student will realise a stay in the company developing own functions of a/to Engineer/to of Telecommunication.

Planning			
	Class hours	Hours outside the classroom	Total hours
External practises	125	0	125
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
External practises	Stay in a company developing functions of an Telecommunication Engineer.

Personalized attention

Methodologies	Description
External practises	The student develops own functions in a company as an Telecommunication Engineer with determinate profile by the technology that the student have studied (Electronics, Processed of signal for communications, Radiocommunication and Telematic).

Assessment

	Description	Qualification		Training and Learning Results
External practises	The evaluation will realise in function of:	100	A2	B8
	1) The memory of activities		A5	B9
	2) The evaluation of the company tutor			B10
				B12
				B13

Other comments on the Evaluation

REPORT OF ACTIVITIES: The student must submit a report explaining the activities undertaken during practices, specifying its duration, departments of the company that were conducted, training received (courses, software, etc.), the level of integration within the company and personal relationships.
The report must also include a section of conclusions, containing a reflection on the adequacy of the lessons learned during the university studies to performance practice (negative and positive aspects significant related to the development of practices). It also assessed the inclusion of information on the professional and personal experience with the practices (personal assessment of learning achieved over practices or own contributions and suggestions on the structure and operation of the company visited).
The assessment of memory will be 60% of the final qualification.
COMPANY TUTOR EVALUATION: The company tutor will submit a report assessing aspects with the practices carried out by students: punctuality, attendance, responsibility, teamwork ability and integration in the enterprise, quality of work done, etc.
The assessment of the tutor in the company will be 40% of the final qualification.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Other comments

It is recommended that the student have the greatest possible number of subjects studied and / or passed.

IDENTIFYING DATA				
Internship in Companies II				
Subject	Internship in Companies II			
Code	V05M145V01325			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The student develops own functions in a company as an Telecommunication Engineer with determinate profile by the technology that the student have studied (Electronics, Processed of signal for communications, Radiocommunication and Telematic) and supervised by the University adviser and the company adviser.			

Competencies	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
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.
B9	CG9 Ability to understand the responsibility and professional ethics in the activity of the profession of Telecommunications Engineering.
B10	CG10 Ability to apply principles of economics and human resources and projects management, as well as legislation, regulation and standardization of telecommunications.
B12	CG12 Skills for lifelong, self-directed and autonomous learning.
B13	CG13 Knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Telecommunication Engineering.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Experience in the practice of the profession of ingineering of Telecommunication and his usual functions in some real company environment.	A2 A5 B8 B9 B10 B12 B13

Contents	
Topic	
Item	The student will realise a stay in the company developing own functions of a/to Engineer/to of Telecommunication.

Planning			
	Class hours	Hours outside the classroom	Total hours
External practises	125	0	125
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
External practises	Stay in a company developing functions of an Telecommunication Engineer.

Personalized attention

Methodologies	Description
External practises	The student develops own functions in a company as an Telecommunication Engineer with determinate profile by the technology that the student have studied (Electronics, Processed of signal for communications, Radiocommunication and Telematic).

Assessment

	Description	Qualification		Training and Learning Results
External practises	The evaluation will realise in function of: 1) The memory of activities 2) The evaluation of the tutor in the company	100	A2 A5	B8 B9 B10 B12 B13

Other comments on the Evaluation

REPORT OF ACTIVITIES: The student must submit a report explaining the activities undertaken during practices, specifying its duration, departments of the company that were conducted, training received (courses, software, etc.), the level of integration within the company and personal relationships.
The report must also include a section of conclusions, containing a reflection on the adequacy of the lessons learned during the university studies to performance practice (negative and positive aspects significant related to the development of practices). It also assessed the inclusion of information on the professional and personal experience with the practices (personal assessment of learning achieved over practices or own contributions and suggestions on the structure and operation of the company visited).
The assessment of memory will be 60% of the final qualification.
COMPANY TUTOR EVALUATION: The company tutor will submit a report assessing aspects with the practices carried out by students: punctuality, attendance, responsibility, teamwork ability and integration in the enterprise, quality of work done, etc.
The assessment of the tutor in the company will be 40% of the final qualification.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Other comments

It is recommended that the student have the greatest possible number of subjects studied and / or passed.

IDENTIFYING DATA				
Internship in Companies III				
Subject	Internship in Companies III			
Code	V05M145V01326			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The student develops own functions in a company as an Telecommunication Engineer with determinate profile by the technology that the student have studied (Electronics, Processed of signal for communications, Radiocommunication and Telematic) and supervised by the University adviser and the company adviser.			

Competencies	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
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.
B9	CG9 Ability to understand the responsibility and professional ethics in the activity of the profession of Telecommunications Engineering.
B10	CG10 Ability to apply principles of economics and human resources and projects management, as well as legislation, regulation and standardization of telecommunications.
B12	CG12 Skills for lifelong, self-directed and autonomous learning.
B13	CG13 Knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Telecommunication Engineering.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Experience in the practice of the profession of ingineering of Telecommunication and his usual functions in some real company environment.	A2 A5 B8 B9 B10 B12 B13

Contents	
Topic	
Item	The student will realise a stay in the company developing own functions of a/to Engineer/to of Telecommunication.

Planning			
	Class hours	Hours outside the classroom	Total hours
External practises	125	0	125
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
External practises	Stay in a company developing functions of an Telecommunication Engineer.

Personalized attention

Methodologies	Description
External practises	The student develops own functions in a company as an Telecommunication Engineer with determinate profile by the technology that the student have studied (Electronics, Processed of signal for communications, Radiocommunication and Telematic).

Assessment

	Description	Qualification		Training and Learning Results
External practises	The evaluation will realise in function of: 1) The memory of activities 2) The evaluation of the tutor in the company	100	A2 A5	B8 B9 B10 B12 B13

Other comments on the Evaluation

REPORT OF ACTIVITIES: The student must submit a report explaining the activities undertaken during practices, specifying its duration, departments of the company that were conducted, training received (courses, software, etc.), the level of integration within the company and personal relationships.
The report must also include a section of conclusions, containing a reflection on the adequacy of the lessons learned during the university studies to performance practice (negative and positive aspects significant related to the development of practices). It also assessed the inclusion of information on the professional and personal experience with the practices (personal assessment of learning achieved over practices or own contributions and suggestions on the structure and operation of the company visited).
The assessment of memory will be 60% of the final qualification.
COMPANY TUTOR EVALUATION: The company tutor will submit a report assessing aspects with the practices carried out by students: punctuality, attendance, responsibility, teamwork ability and integration in the enterprise, quality of work done, etc.
The assessment of the tutor in the company will be 40% of the final qualification.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Other comments

It is recommended that the student have the greatest possible number of subjects studied and / or passed.

IDENTIFYING DATA				
Network Information Theory				
Subject	Network Information Theory			
Code	V05M145V01327			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Learning in Networks and Collaborative Work				
Subject	Learning in Networks and Collaborative Work			
Code	V05M145V01328			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Human-Computer Interaction				
Subject	Human-Computer Interaction			
Code	V05M145V01329			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Photovoltaic Power Electronics				
Subject	Photovoltaic Power Electronics			
Code	V05M145V01330			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Doval Gandoy, Jesús			
Lecturers	Doval Gandoy, Jesús			
E-mail	jdoval@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The subject describes the basic concepts of control and power electronic converters used in photovoltaic systems.			

Competencies	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
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.
C28	CE28/SE1 Capacity of technology integration of photovoltaic conversion for power systems of Telecommunication Engineering.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Knowledge of power conversion technologies used in photovoltaic systems.	A2 B4 B8 C28
Knowledge of control techniques of electronic power converters used in photovoltaic systems.	A2 B4 B8 C28

Contents	
Topic	
Chapter 1: Introduction to photovoltaic systems	Photovoltaic effect. Electrical characteristics of photovoltaic cells. Temperature dependence. Irradiation dependence. Electrical connection. Shadow effect.
Chapter 2: Topologies of power electronics converters in photovoltaics.	Electrical configuration photovoltaic cells. Topologies of power electronics converters.
Chapter 3: Control of photovoltaic inverters.	Control of stand-alone photovoltaic inverters. Control of grid-connected photovoltaic inverters. Synchronisation. Maximum power point tracking.
Chapter 4: Regulations and Standards in power electronics photovoltaics systems.	International regulations: IEEE, IEC, VDE, EN. Power quality, ride-through, anti-islanding.

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practises	10	31	41
Troubleshooting and / or exercises	5	16	21
Master Session	15	48	63
*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	Application of the knowledge to particular situations and acquisition of basic skills related with the topic. Competencies: CB2, CG4, CG8, CE28/SE1.
Troubleshooting and / or exercises	Formulation of problems and/or exercises related with the topic. The student has to develop the correct solutions by means of applying routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. Competencies: CB2, CG4, CG8, CE28/SE1.
Master Session	The professor presents the contents on the subject: theoretical basis and/or guidelines of the work to be developed by the students. Competencies: CB2, CG4, CG8, CE28/SE1.

Personalized attention

Methodologies	Description
Master Session	The professor will attend personally doubts and queries of the students, on the study of theoretical concepts, on exercises or on practices of laboratory. The students will have occasion to attend personal tutorials at the professor office. The tutorial hours will be published at the beginning of the semester in the website of the subject.
Laboratory practises	The professor will attend personally doubts and queries of the students, on the study of theoretical concepts, on exercises or on practices of laboratory. The students will have occasion to attend personal tutorials at the professor office. The tutorial hours will be published at the beginning of the semester in the website of the subject.
Troubleshooting and / or exercises	The professor will attend personally doubts and queries of the students, on the study of theoretical concepts, on exercises or on practices of laboratory. The students will have occasion to attend personal tutorials at the professor office. The tutorial hours will be published at the beginning of the semester in the website of the subject.

Assessment

	Description	Qualification	Training and Learning Results		
Laboratory practises	Development of the practices of laboratory.	33	A2	B4 B8	C28
Troubleshooting and / or exercises	Resolution of exercises proposed	33	A2	B4 B8	C28
Master Session	Theoretical concepts.	34	A2	B4 B8	C28

Other comments on the Evaluation

There are two ways to evaluate the students: continuous evaluation or evaluation by final examination.

1. Continuous evaluation

The continuous evaluation consists in the evaluation of the tasks proposed by the professor along the course. The students will execute the tasks and will deliver a report of each one of the tasks. The students will present the tasks in the classroom and they will have to answer quesions.

The professor will score the students from their work in the developed tasks, the reports and the oral presentation.

The marks will be valid only for the current academic course. It is understood that the student chooses the continuous assessment when it presents at least one task. His qualification will be the one of continuous evaluation.

2. Evaluation by final examination

The final examination is for students that do not participate in the continuous evaluation. It consists of theoretical questions, problems and exercises that will evaluate the knowledge of the student in the topic. The examination date will be established by the head of the Faculty.

3. Extraordinary examination (June-July)

The extraordinary examination of theoretical questions, problems and exercises that will evaluate the knowledge of the student in the topic. The examination date will be established by the head of the Faculty.This examination is the same for all the students, have followed or no the continuous evaluation.

Sources of information

Basic Bibliography

Remus Teodorescu, Marco Liserre, Pedro Rodríguez, **Grid Converters for Photovoltaic and Wind Power Systems**, John Wiley & Sons, Ltd.,

Complementary Bibliography

Ned Mohan, Tore M. Undeland, William P. Robbins, **Power Electronics: Converters, Applications, and Design**, John Wiley & Sons, Ltd.,

Andrés Barrado Bautista, Antonio Lázaro Blanco, **Problemas de electrónica de potencia**, Pearson Educación,

Recommendations

IDENTIFYING DATA				
Signal Conditioners				
Subject	Signal Conditioners			
Code	V05M145V01331			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Quintáns Graña, Camilo			
Lecturers	Quintáns Graña, Camilo			
E-mail	quintans@uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	In this subject the electronic circuits that condition the signals generated by sensors to be efficiently coupled to a data acquisition system or to a digital processor are studied. It is a subject that follows the Design of Analog Electronic Circuits, which is coursed in the first course of the master. Thus, in this new subject the basic conditioning circuits are expanded by including measuring active bridges, alternating current conditioning circuits, etc. Another important aspect that is included in the study is the evaluation of the measurement uncertainty. Student learns to characterize a measure provided by a sensor through the calibration curve and the uncertainty. The theory is complemented by laboratory practices that focus on providing students with the skills needed to address the realization of a complete measurement system, from the physical system up to the user interface. The key points of the laboratory work are: -The followed methodology to measure physical variables to the calculation of uncertainties. -Characterization of transducers. -Topologies of conditioning circuits. -The connection of the conditioned signals to a digital processor. -Instrumentation software for digitally conditioning and user interfaces.			

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.
C29	CE29/SE2 Ability to build a system of a physical variable measured from the transducer to the user interface, including knowledge of methodology, basic topologies of conditioning signal and instrumentation software

Learning outcomes	
Expected results from this subject	Training and Learning Results
To know the modeling and simulationing of analogic electronic systems by means of the hardware description language SPICE.	B1 B4 B8 C29
To know the evaluationing of the uncertainties in the measuring processes following the standards.	B4
To know how to handle and to program data acquisition systems.	B1 C29
To know the developing of complex electronic circuits for conditioning the sensors.	B1 B4 B8 C29
To konw to analyse and to design circuits for interfaces between the sensors and digital processors.	B1 C29
To know how to develop an instrumentation electronic systems.	B1 B4 B8 C29

Contents
Topic

Unit 1: Introduction to the measuring systems of physical variables.	Functional and working characteristics of sensors. Evaluation of measurement data. Sensor calibration. Measurement uncertainties. Parts of a conditioning circuit. Types of conditioners.
Unit 2: Introduction to the metrology. Evaluation of measurement uncertainty.	Methodology to measure and to calibrate sensors. Terminology. Statistical method.
Unit 3. Circuits to conditioning signal from measured sensors.	Active measuring bridges in direct and alternating current. Ac/dc converters. Selection and design of filtering stages. Frequency to voltage converters. Conditioners for output stages.
Unit 4: Interfaces between on-off sensors and digital processors.	Basic concepts of local interfaces of on-off sensors. Interfaces with and without galvanic isolation. Coupling in alternating and continuous current.
Unit 5: Conditioning circuits for inductive and magnetic measure sensors.	Study of the conditioners for several inductive and magnetic sensors according to his application.
Unit 6: Conditioning circuits for capacitive measureing sensors.	Study of the conditioners for capacitive sensors.
Unit 7: Conditioning circuits for generators sensors.	Study of the conditioning circuits for generators sensors according to his physical working principle.
Unit 8: Practical cases of conditioning circuits for measuring sensors.	Study of real cases with commercial sensors and circuits.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	7	14	21
Tutored works	5	25	30
Master Session	13	26	39
Reports / memories of practice	1	10	11
Practical tests, real task execution and / or simulated.	2	10	12
Short answer tests	1	5	6
Troubleshooting and / or exercises	1	5	6
*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	Application, at a practical level, of the knowledge and skills acquired in the lectures by mean of practices undertaken with test and measurement equipment, either in the laboratory or in other place.
Tutored works	The student, of individual way or in group, elaborates a document on the thematic of the matter or prepares seminars, investigations, memories, essays, summaries of reading, conferences, etc.
Master Session	Exhibition of the contents of the subject; it includes exhibition of concepts; introduction of practices and exercises; and resolution of problems and/or exercises in ordinary classroom.

Personalized attention

Methodologies	**Description**
Master Session	The professor will attend personally doubts and queries of the students on the study of the theoretical concepts and the exercises. The tutorships will do in the office of the professor in the schedule that establish at the beginning of the course and that will publish in the page Web of the subject.
Laboratory practises	The professor will attend personally doubts and queries of the students on the preparation of the practices of laboratory. The tutorships will do in the office of the professor in the schedule that establish at the beginning of the course and that will publish in the page Web of the subject.
Tutored works	The professor will attend personally doubts and queries of the students on the upervised works. The tutorships will do in the office of the professor in the schedule that establish at the beginning of the course and that will publish in the page Web of the subject.
Tests	**Description**
Reports / memories of practice	The professor will attend personally doubts and queries of the students on the preparation and presentation of the memories of the results of the laboratory practices. The tutorships will do in the office of the professor in the schedule that establish at the beginning of the course and that will publish in the page Web of the subject.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practises	It values the participation of the student in the practices of laboratory: preparation of previous tasks, fulfillment of the aims posed in each practice and back tasks in which the student analyses the results, compares them with the expected and presents the conclusions. They can apply to the tests of continuous or final assessment.	15	B1 B4 B8 C29
Tutored works	The student, individually or in group, elaborates a document on the thematic of the matter or prepares seminars, investigations, memories, essays, summaries of reading, conferences, etc.	10	B1 C29
Reports / memories of practice	Preparation of a document by part of the student in which they reflect the characteristics of the work carried out. The students have to describe the tasks and procedures developed, show the results obtained and observations realised, as well as the analysis and treatment of data.	15	B1 B4 B8 C29
Practical tests, real task execution and / or simulated.	Tests that include activities of laboratory and/or TIC, problems or cases to resolve. The students have to give answer to the activity formulated by reflecting, in a practical way, the theoretical and practical knowledge that have been learnt in the subject, using, if it is necessary, the equipment or instrumentation of the practices carried out in the course. They can apply to the tests of continuous or final assessment.	20	B1 B4 B8 C29
Short answer tests	Tests that include direct questions about an specific topic. The student has to answer of direct form in virtue of the knowledges that has on the subject. The answer is brief. They can apply to the tests of continuous evaluation or to the final examination.	20	B1 B4 C29
Troubleshooting and / or exercises	Proof in which the student has to solve a series of problems and/or exercises in a time/condition established/ace by the professor. Of this form, the student has to apply the knowledges that purchased. The application of this technique can be face-to-face or not. You can use different tools to apply this technique as, for example, chat, run or forum, audio, video, etc.	20	B1 B4 B8 C29

Other comments on the Evaluation

1. Continuous evaluation

The practical part (50% of the note) and the part of theory (50% of the note) are evaluated by continuous assessment. Each one of these parts are evaluated following the methodologies described before with his respective weights in the following way:

-Practical part: it is divided in the progress of the practices in the laboratory (15%), the report of practices (15%) and a practical exam (20%).

-Part of theory: it is divided in one exam with questions of short answer (20%), the supervised work (10%) and the exam with resolution of problems (20%).

The final mark, which is on a maximum of 10 points, is the sum of the notes of each part, if the students fulfill the following conditions:

-Have carried out a minimum of 80% of the laboratory practices.

-Obtain a minimum mark of 40% in each one of the two parts of the evaluation (theory and practice).

If it does not fulfill some of the previous requirements, the final mark will be the sum of the notes of each part, but limited to 40% of the maximum mark (4 points).

To pass, the students have to obtain an equal total mark or upper to the 50% of the maximum mark (5 points).

The practical test will take place in the last session of the laboratory classes. The tests of resolution of problems and of short answer can be divided in two sessions spread along the period of teaching.

The reports of the supervised work and of the practices have to be delivered before finalizing the period of final exams established for the term.

The assessment is particular for each student and the practices of laboratory will be done preferably by individual form. If it

is the case, the marks of the activities that the students do in groups will be the same for all the students that compose it.

2. Final exam

The students that do not opt by the continuous evaluation (have not carried out, at least, 80% of the practices) or have obtained a total mark below 5 (suspense), will be able to do to the final exam.

The final exam will consist of a practical exam at the laboratory and in an exam of theory with questions of short answer and resolution of problems, each one corresponding to 50% of the total mark. To pass the student must obtain a minimum of 40% in each part and sum in total, at least, 5 points.

3. Call for recovery

The call for recovery will be like the final exam.

Sources of information
Basic Bibliography
Pallás Areny, Ramón, **Sensors and signal conditioning**, Second Edition, John Wiley & Sons, inc., 2001
European co-operation for Accreditation, **Expression of the Uncertainty of Measurement in Calibration**, September 2013 rev 02, EA-4/02 M, 2013
Complementary Bibliography
Philip R. Bevington and D. Keith Robinson, **Data Reduction and Error Analysis for the Physical Sciences**, McGraw Hill, 2003
Grupo de Trabajo 1 del Comité Conjunto de Guías en Metrología (JCGM / WG 1), **Guía para la Expresión de la Incertidumbre de Medida**, 2008
C. Quintáns, **Simulación de Circuitos Electrónicos con OrCAD 16 DEMO**, 1, Marcombo, 2008

Recommendations

Subjects that it is recommended to have taken before
Digital and Analog Mixed Circuits/V05M145V01213
Analog Electronic Circuits Design/V05M145V01106
Advanced Digital Electronic Systems/V05M145V01203

IDENTIFYING DATA				
Electronic Equipments Implementation and Exploitation				
Subject	Electronic Equipments Implementation and Exploitation			
Code	V05M145V01332			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge Sánchez Real, Francisco Javier			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es/			
General description	This subject includes concepts related with dependability analysis of complex electronic systems as well as their models. Also includes metodologies for electronic systems design for safety applications and EMC analysis. Finally it includes asset management and human resources.			

Competencies	
Code	
B3	CG3 Ability to lead, plan and monitor multidisciplinary teams.
B7	CG7 Capacity for implementation and management of manufacturing processes of electronic and telecommunications equipment; guaranteeing safety for persons and property, the final quality of the products, and their homologation.
C30	CE30/SE3 Capacity planning, evaluation and decision-making in new environments relating to the packaging of networks, services and applications in the electromagnetic field, with knowledge of reliability and life cycle costing

Learning outcomes	
Expected results from this subject	Training and Learning Results
Ability to make an analysis of electromagnetic compatibility of an electronic system according the standards	B7
Ability to design electronic equipment that includes specifications of maintainability and availability	B7 C30
Ability to specify the stocks level required for a given equipment maintainability	B7
Ability to determine the life cycle cost of a product	C30
Capacity to implement and manage the operation of electronic equipment	B7
Ability to the assets management of an organization, related to the subject	B3
Ability to understand the impact of risks, human reliability and knowledge management, in an organization	B3

Contents	
Topic	
Item 1: Dependability analysis of electronic systems	Reliability allocation and optimization. Maintainability and availability analysis. Product life cycle.
Item 2: Modeling of electronic systems for dependability applications	Markov models and Petri Nets.
Item 3: Failure analysis	Failure modes of electronic components. Analysis of failure mechanisms and causes of the failure modes. Standards.
Item 4: Fail-safe systems	Fault-safe systems specification. Design methodologies. Validation. Practical examples.
Item 5: Production and assembly of equipment electronic	Materials and manufacturing processes. Mounting technologies. Lifetime assays. Installation cautions.
Item 6: Electromagnetic compatibility	Analysis of EMC in circuits, systems and electronic equipments. Circuits and systems in living areas. Circuits and equipment systems of information technologies. Circuits and systems in automotive systems. Applications.
Item 7: Asset Management	Asset management types. Management of physical assets: The Standard. Competence frames.
Item 8: The intellectual capital in organizations	Intangible assets: Management. Human capital. Decision making.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	18	0	18
Laboratory practises	10	15	25
Troubleshooting and / or exercises	0	10	10
Tutored works	0	40	40
Short answer tests	2	0	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Master Session	It will develop in the schedules fixed by the direction of the engineering school. It consist of a presentation by the teacher, of the contents of the subject. Also proceed to solving examples and/or problems that illustrate the problems to be solved adequately. The student may submit all doubts and questions deemed appropriate, during the session. We will promote the more active participation of the student possible. Competencias CG7, CG3 and CE30/SE3 are used
Laboratory practises	Students will perform practical examples of dependability analysis of electronic control systems, according to standards. The analysis will performed with specific software application. Competencies CG7 and CG3 are used
Troubleshooting and / or exercises	In this educational activity we will propose problems and/or exercises subject related. They are also used to highlight the doubts and also for feedback to teachers on this aspect. Competencias CG7, CG3 and CE30/SE3 are used
Tutored works	It consists in carrying out specific tasks that are elated to the subject and in collaboration with xternal entities, provided that this is possible. Competencias CG7, CG3 and CE30/SE3 are used

Personalized attention	
Methodologies	**Description**
Master Session	The teacher will personally attend doubts and queries of students, on the study of theoretical, laboratory or projects. Students will have opportunity to attend individual tutorials or in groups in the teacher's office on schedule to be established for this purpose at the beginning of the course and to be published on the page of the subject.
Laboratory practises	The teacher will personally attend doubts and queries of students, on the study of theoretical, laboratory or projects. Students will have opportunity to attend individual tutorials or in groups in the teacher's office on schedule to be established for this purpose at the beginning of the course and to be published on the page of the subject.
Troubleshooting and / or exercises	The teacher will personally attend doubts and queries of students, on the study of theoretical, laboratory or projects. Students will have opportunity to attend individual tutorials or in groups in the teacher's office on schedule to be established for this purpose at the beginning of the course and to be published on the page of the subject.
Tutored works	The teacher will personally attend doubts and queries of students, on the study of theoretical, laboratory or projects. Students will have opportunity to attend individual tutorials or in groups in the teacher's office on schedule to be established for this purpose at the beginning of the course and to be published on the page of the subject.

Assessment				
	Description	Qualification	Training and Learning Results	
Troubleshooting and / or exercises	Deliverables, problems and exercises will be assess.	40	B3 B7	C30
Tutored works	They will evaluate the contents (methodology of development, conclusions obtained, exhibition of results and capacity of work in team) For works in team the indivual note will be the same for all members of the team	50	B3 B7	C30

Short answer tests	It will realise a proof with 10 questions of theory or exercises on the matter.	10	B3 B7	C30

Other comments on the Evaluation

The deliverables of the troubles and exercises are provide for guidance, for weeks 2, 4, 6 and 8.

Following the own guidelines of the degree and the agreements of the academic commission, offers to the students the option of continuous evaluation or do the final examination in the date established by the centre.

The students that choose continuous evaluation will have to communicate it to the professor during the first week of class. The continuous evaluation supposes:

a) The students realise the problems and exercises proposed by the professor and deliver them in time and form. Maximum assessment 4 points (40% of the final note). Will have to obtain a minimum note of 2 points. These tasks will not be recoverable later.

b) The students realise a supervised work, in group. This work will procure , whenever it was possible, that realise with a company or external institution to the University. In this case the students will go to the company when it was necessary, for the realisation of the work. Maximum assessment 5 points (50% of the final note). Will have to obtain a minimum note of 2,5 points.

c) The students realise a examf of 10 short questions. Maximum assessment 1 point (10%).

Students do not exceed any of the two minimum requirements, the rating will be the lower of the average grade of the two scores and 4.5 points.

Students working in groups will have the same grade.

The final exam assessment by the end of the semester or in the extraordinary (June-July), involves:

a) That the students perform and deliver on exam day, the exercises and problems posed in the subject, which is referred to in paragraph a) above. Maximum rating 4 points (40% of the final mark). The students must obtain a minimum of 2 points.

b)That the students to take an exam with questions and problems 2h corresponding to both the theoretical and laboratory. Maximum rating 6 points (60% of the final grade). The students must obtain a minimum of 3 points.

Students in the final examination do not exceed any of the two minimum requirements, the rating will be the lower of the average grade of the two scores and 4.5 points.

It demands an ethical behaviour by part of the students. In case of plagiarism detection in any of the works/test realised the final qualification of the matter will be "suspense (0)" and the professors will communicate to the school direction the problem so that it take the measures that consider timely.

Sources of information

Basic Bibliography

David J. Smith, **Reliability, Maintainability and Risk**, 8ª, Butterworth Heinemann, 2011

López Veraguas, Joan Pere, **Compatibilidad electromagnética y seguridad funcional en sistemas electrónicos**, Marcombo, 2010

I. Fernández, A. Camacho, C. Gasco, A.M. Macías, M.A. Martín, G. Reyes, J. Rivas, **Seguridad Funcional en Instalaciones de Proceso: Sistemas Instrumentados de Seguridad y Análisis SIL**, ISA, 2012

M. Goble, H. Cheddie, **Safety Instrumented Systems Verification**, ISA, 2005

M. Goble, **Control Systems Safety Evaluation and Reliability**, 3ª, ISA, 2010

Complementary Bibliography

T.I. Bajenescu, M.I. Bâzu, **Reliability of Electronic Components**, Springer-Verlag, 1999

P. Kales, **Reliability**, Prentice-Hall, 1998

B. R. Mehta Y. J. Reddy, **Industrial Process Automation Systems Design and Implementation**, Elsevier, 2015

ISO, **UNE-ISO 55000:2015: Gestión de activos. Aspectos generales, principios y terminología**, AENOR, 2015

Recommendations

Subjects that are recommended to be taken simultaneously

Signal Conditioners/V05M145V01331
Photovoltaic Power Electronics/V05M145V01330

Subjects that it is recommended to have taken before

Digital and Analog Mixed Circuits/V05M145V01213
Hardware/Software Design of Embedded Systems/V05M145V01214
Integrated Circuits Design and Manufacturing/V05M145V01215

IDENTIFYING DATA				
Electronic Equipment Practicals				
Subject	Electronic Equipment Practicals			
Code	V05M145V01333			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Telecommunications Seminar				
Subject	Telecommunications Seminar			
Code	V05M145V01334			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Piezoelectric Transducers and Applications				
Subject	Piezoelectric Transducers and Applications			
Code	V05M145V01335			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Numerical Linear Algebra in Telecommunications Engineering				
Subject	Numerical Linear Algebra in Telecommunications Engineering			
Code	V05M145V01336			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Master Thesis				
Subject	Master Thesis			
Code	V05M145V01401			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	30	Mandatory	2nd	2nd
Teaching language	Spanish English			
Department				
Coordinator	Fernández Veiga, Manuel			
Lecturers	Fernández Veiga, Manuel			
E-mail	mveiga@det.uvigo.es			
Web	http://faiticuvigo.es			
General description	The Master Thesis (TFM) forms part, like module, of the plan of studies of the title of Master in Engineering of Telecommunication. It is an original and personal work that each student realises of autonomous form under educational permission, and has to allow him show of form integrated the acquisition of the formative contents and the competitions associated to the title. His definition and contents are explained of form more extensive in the rule for the realisation of the TFM, whose content can consult in the web of the School of Telecommunication Engineering.			

Competencies	
Code	
A1	CB1 Knowledge and understanding needed to provide a basis or opportunity for being original in developing and/or applying ideas, often within a research context.
B1	CG1 Ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
B5	CG5 Capacity for development, strategic planning, direction, coordination and technical and financial management of projects in all fields of Telecommunication Engineering following quality and environmental criteria.
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.
B11	CG11 Ability to communicate (oral and written) conclusions, and the knowledge and reasons supporting them, to specialists and non-specialists in a clear and unambiguous way.
B12	CG12 Skills for lifelong, self-directed and autonomous learning.
C17	CE17/TFM Embodiment, presentation and defense, once all credits of the curriculum are passed, of an original exercise performed individually in front of a university jury, consisting of a comprehensive project of Telecommunication Engineering with professional nature, in which skills acquired in the teachings are synthesized.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Research, classification and structuring of information on some topic relevant to Telecommunications engineering.	A1 B8 B12
Dissertation containing the fundamentals, the solution and an analysis of results about the problem addressed. It should include a review of the state of the art, an explanation of the methodology or approach, and a discussion of results.	B1 B8 B11 C17
Design of prototypes, computer programs, circuits, procedures, algorithms, designs, methods, etc, complying to specifications	A1 B1 B5 B8 B12

Contents	
Topic	
The contents of the Master's Thesis are established in the individual proposals offered by the advisors, according to the rules issued by the Academic Commission of the Master Programme, which is published in the website of the School of Telecommunications Engineering	The subject of each work is specific, given the individual character of the work.

Planning

	Class hours	Hours outside the classroom	Total hours
Previous studies / activities	0	60	60
Case studies / analysis of situations	0	20	20
Others	10	0	10
Projects	0	630	630
Troubleshooting and / or exercises	0	30	30

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

Methodologies

	Description
Previous studies / activities	Research, reading and work of documentation, proposals of resolution of problems and/or exercises that will realise in the classroom or the laboratory of autonomous form by the students.
Case studies / analysis of situations	It carries out a critical analysis of similar problems to the posed in the thesis, with the goal of extracting ideas, analogies, methods or partial results that help in the resolution of the problem posed in the thesis.
Others	The student receives personalised attention of his advisor about the general approach, the definition of aims and the plan of development of his/her thesis, as well as orientation more specific and guidance about the particular technical problems that involves.
Projects	The student, individually, solves a scientific problem, originally and independently, within the thematic area of his/her interest, and is able to write a dissertation with the hypotheses, the solution and the conclusions of his work.
Troubleshooting and / or exercises	The student analyzes the possible solutions to a scientific problem proposed for the thesis, and elaborates a synthesis solution (analytical, meteorological, experimental or combined) that allow him to fulfill the stated goals.

Personalized attention

Methodologies	Description
Others	Each student will gather regulate and periodically with his tutor or tutor to receive academic help on the realisation of his specific work.

Assessment

	Description	Qualification	Training and Learning Results		
Projects	The assessment is done after an oral presentation and defence in front of an examining committee. In the evaluation, the Committee might take into account the opinions or the report issued by the advisor, as well as questions like the quality of the presentation, the review of the state of the art, the quality of the technical proposal, the novelty and importance of the results, the capacity of initiative of the student, etc. System of qualifications: it will express by means of numerical final qualification of 0 to 10 according to the valid legislation.	100	A1	B1 B5 B8 B11 B12	C17

Other comments on the Evaluation

All the information related with the Master's Thesis can be accessed on the web of the School of Engineering of Telecommunication.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations