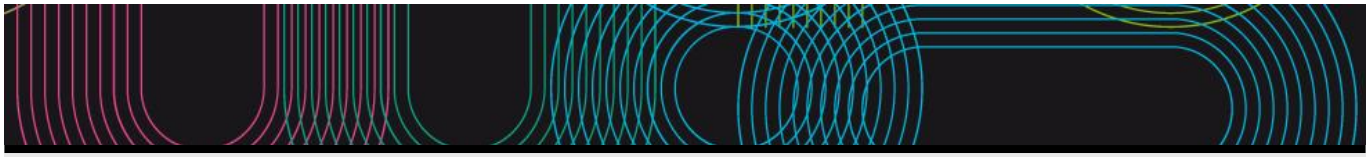

(*)Escola de Enxeñaría de Telecomunicación

Presentatiton

Telecommunications Technical Engineer

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

Master in Industrial Mathematicics

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Web page

www.teleco.uvigo.es

(*)Máster Universitario en Enxeñaría de Telecomunicación

Subjects

Year 2nd

Code	Name	Quadmester	Total Cr.
V05M145V01301		1st	5
V05M145V01302		1st	5
V05M145V01303		1st	5
V05M145V01309		1st	5
V05M145V01310		1st	5
V05M145V01311		1st	5
V05M145V01312		1st	5
V05M145V01313		1st	5
V05M145V01317		1st	5
V05M145V01318		1st	5
V05M145V01321		1st	5
V05M145V01322	Data analysis	1st	5
V05M145V01323		1st	5
V05M145V01324		1st	5
V05M145V01325		1st	5
V05M145V01326		1st	5
V05M145V01401	The Final Master Degree Work	1st	30

IDENTIFYING DATA				
(*)Procesado de Sinal en Tempo Real				
Subject	(*)Procesado de Sinal en Tempo Real			
Code	V05M145V01301			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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 The ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
B8	CG8 The 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
(*)Cartafol	0	0	0
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
Practice in computer rooms	Individual hands-on work on computing platforms and/or simulators to implement and compare study cases
Projects	In-depth practical development of an application/algorithm according to the specific interests of each student
(*)Cartafol	

Personalized attention

Methodologies	Description
Projects	Doubts will be solved and guidance provided for the autonomous work of the student during lab sessions and also in prearranged individual tutoring sessions
Practice in computer rooms	Doubts will be solved and guidance provided for the autonomous work of the student during lab sessions and also in prearranged individual tutoring sessions

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

Sen M. Kuo, Bob H. Lee, Wenshun Tian, **Real-Time Digital Signal Processing**, 2,

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

Khronos Group, **The OpenCL specifications**, 2.0,

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

Raymond Tay, **OpenCL Parallel Programming Development Cookbook**, 1,

Recommendations

Subjects that it is recommended to have taken before

(*)Tratamento de Sinal en Comunicacións/V05M145V01102

IDENTIFYING DATA				
(*)Sistemas Avanzados de Comunicacións				
Subject	(*)Sistemas Avanzados de Comunicacións			
Code	V05M145V01302			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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 system considerations.			

Competencies	
Code	
B4	CG4 The 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 Fundamentals of convex optimization 1.2 Lagrange duality 1.3 Network utility maximization
2. Multiple-access channels	2.1 Capacity regions 2.2 Random access schemes
3. Random matrices	3.1 Principles of random matrix theory 3.2 Applications in communications engineering

Planning	Class hours	Hours outside the classroom	Total hours
Seminars	10	30	40
Troubleshooting and / or exercises	0	20	20
Master Session	18	45	63
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, ranging from satellite to maritime scenarios, will be presented with special emphasis in those challenges which are at the core of modern solutions and require advanced mathematical tools.

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.
Master Session	Advanced mathematical tools will be introduced as background material to address practical solutions in modern communication systems.

Personalized attention

Methodologies	Description
Master Session	The instructor will be available during his regular office hours.
Seminars	The instructor will be available during his regular office hours.
Troubleshooting and / or exercises	The instructor will be available during his regular office hours.

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.	40	B4	C22
Short answer tests	Final exam with short questions and exercises.	60	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.

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

Books:

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

Stephen Boyd, Lieven Vandenberghe, "Convex Optimization", Cambridge University Press, 2004.

Papers will be also recommended during the course.

Recommendations

Subjects that it is recommended to have taken before

(*)Comunicacións Dixitais Avanzadas/V05M145V01204

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				
(*)Procesado Estatístico de Sinal				
Subject	(*)Procesado Estatístico de Sinal			
Code	V05M145V01303			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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 The 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 The 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. Asymptotic CRB for Gaussian processes. Sufficient statistics. - Best Linear Unbiased Estimator (BLUE) and Maximum Likelihood Estimator (MLE): definition, properties, and examples.
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	42	63
Practice in computer rooms	7	0	7
Autonomous troubleshooting and / or exercises	0	28	28

Autonomous practices through ICT	0	25	25
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 main topics, possibly with audiovisual aids.
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.
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.
Autonomous practices through ICT	Computer-based simulation of statistical signal processing applications to communications and multimedia, via Monte Carlo methods. Performance analysis.

Personalized attention

Methodologies	Description
Master Session	Student aid will be provided during office hours as well as on-line (email, chat). On-line discussion forums will be set up for each chapter, through the usual e-learning platform.
Practice in computer rooms	Student aid will be provided during office hours as well as on-line (email, chat). On-line discussion forums will be set up for each chapter, through the usual e-learning platform.

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
Long answer tests and development	Final test in which the student must solve a series of exercises and/or answer a series of questions.	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:

- comprehensive test (up to 6 points)

- homework assignments (up to 4 points)

A minimum grade of 30% in the comprehensive test is required in order to pass the course.

Homework grades from the first call will be kept for the second call, in which the student will be allowed to take a new comprehensive test.

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

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,

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 it is recommended to have taken before

(*)Tratamento de Sinal en Comunicacións/V05M145V01102

IDENTIFYING DATA				
(*)Tecnoloxías para o Desenvolvemento Web				
Subject	(*)Tecnoloxías para o Desenvolvemento Web			
Code	V05M145V01309			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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 The 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 To have 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, comprising even the object server and the database. 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	New HTML tags New APIs
Web applications	The javascript language Javascript frameworks: AngularJS
Content presentation: CSS3	A new box model Responsive design
Server side technologies	Programmable object servers: NodeJs Information management with non-relational databases

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	10	0	10
Laboratory practises	8	0	8
Presentations / exhibitions	2	5	7
Tutored works	5	0	5
Autonomous practices through ICT	0	95	95

*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.
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.
Presentations / exhibitions	Students will prepare a public presentation of the work carried out during the autonomous practices
Tutored works	A project with a fairly large magnitude will be posed to be developed as a teamwork during all the semester. This work will be supervised by the professors with periodic weekly meetings.
Autonomous practices through ICT	A project with a fairly large magnitude will be posed to be developed as a teamwork during all the semester.

Personalized attention	
Methodologies	**Description**
Autonomous practices through ICT	During tutoring time, the professors will be able to help the students either individually in the understanding of the theoretical concepts explained in the master sessions and/or in the demonstrative lab activities. In this works, the teacher will check the progress of the group task. There will also be discussions about the different solutions proposed by the group members and the share of the workload among the group members will also be checked.
Tutored works	During tutoring time, the professors will be able to help the students either individually in the understanding of the theoretical concepts explained in the master sessions and/or in the demonstrative lab activities. In this works, the teacher will check the progress of the group task. There will also be discussions about the different solutions proposed by the group members and the share of the workload among the group members will also be checked.

Assessment					
	Description	Qualification	Training and Learning Results		
Presentations / exhibitions	The students will have to expose in an oral proof the work realized of autonomous way. Of the clarity of this exhibition and of the answers that can give to the questions that formulate him the professors, depends 20% of the note.	20	B12		
Autonomous practices through ICT	The group project will determine the greater part of the final qualification. The value of the note will depend of the correction of the solution presented by the group, of the report that accompanies it, of the implication of the student in the development of the same and of the quantity of technologies presented in the subject employed in practice.	80	A1 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 (80%) and the note of the exhibition of the work (20%), that will be individually evaluated.

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 80% of the mark obtained in the final delivery of the work and 20% of the exhibition.

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 80% of the final mark while the remaining 20% corresponds with the individual presentation.
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. The remaining 20% corresponds with the exhibition of the work.

Sources of information
HTML5: Up and Running, **Mark Pilgrim**, 1ª,
Learning AngularJS, **Ken Williamson**, 1ª,
The book of CSS3, **Peter Gasston**, 2ª,
Smashing Node.js: JavaScript Everywhere, **Guillermo Rauch**, 2ª,
https://developer.mozilla.org/en/docs/Web, **Web technology for developers**,
MongoDB: The Definitive Guide, **Kristina Chodorow**, 2ª,

Recommendations

IDENTIFYING DATA				
(*)Desenvolvemento en Aplicacións Móbiles				
Subject	(*)Desenvolvemento en Aplicacións Móbiles			
Code	V05M145V01310			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	López Bravo, Cristina			
Lecturers	Costa Montenegro, Enrique Gil Castiñeira, Felipe José López Bravo, Cristina			
E-mail	clbravo@det.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 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 The 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 and intents - Services and notifications - Menus and preferences - User interfaces with views - Concurrency - 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.
Laboratory practises	Students will complete guided and supervised practices in the laboratory about the basic aspects of Android mobile applications.
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.
Presentations / exhibitions	Presentation and defense of the mobile application that has been developed throughout the course.

Personalized attention	
Methodologies	**Description**
Laboratory practises	The professors of the course will provide individual attention to the students during the course, solving their questions. In addition, the professors will advise and guide the students while performing their tasks, both in the laboratory and during the tutored works.
Tutored works	The professors of the course will provide individual attention to the students during the course, solving their questions. In addition, the professors will advise and guide the students while performing their tasks, both in the laboratory and during the tutored works.

Presentations / exhibitions	The professors of the course will provide individual attention to the students during the course, solving their questions. In addition, the professors will advise and guide the students while performing their tasks, both in the laboratory and during the tutored works.

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.	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.
- 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

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**, 3ª,

Recursos en Internet

- Android Developers [http://developer.android.com/index.html]
- Android Developer NanoDegree [https://www.udacity.com/course/android-developer-nanodegree--nd801]
- Programming Mobile Applications for Android Handheld Systems: Part 1 [https://www.coursera.org/course/androidpart1]
- Programming Mobile Applications for Android Handheld Systems: Part 2 [https://www.coursera.org/course/androidpart2]
- Android programning course: learn how to bluid your own applications [http://www.sgoliver.net/blog/curso-de-programacion-android/]

Recommendations

Other comments
It is recommended to have Java programming skills

IDENTIFYING DATA				
(*)Satélites				
Subject	(*)Satélites			
Code	V05M145V01311			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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 The ability to lead, plan and monitor multidisciplinary teams.
B4	CG4 The 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.
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.

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 the Satellite Toolkit (STK) 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

Sources of information

James R. Wertz, David F. Everett and Jeffery J. Puschell, **Space Mission Engineering: The New SMAD**, 4,
http://www.ecss.nl,
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,
http://help.agi.com/StartTraining/StartTraining.htm,

Recommendations

Subjects that it is recommended to have taken before

(*)Deseño de Circuitos Electrónicos Analóxicos/V05M145V01106

IDENTIFYING DATA				
(*)Sistemas Radio en Banda Ancha				
Subject	(*)Sistemas Radio en Banda Ancha			
Code	V05M145V01312			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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.
Mathematical description	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	Buliding 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. 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
UWB radar	1. Fundamentals. 2. Applications: - Ground penetrating radar - Medical imaging
Wideband aand UWB ntennas	1. Wideband antennas. Definition and requirements. 2. Characterization of wideband antennas 3. Examples and applications. 4U WB antennas. Definition and requirements. 5. Characterization of UWB antennas 6. Examples and applications.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	20	40	60
Laboratory practises	4	28	32
Tutored works	5	20	25
Short answer tests	1	7	8

*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	Master lecture given by the teacher
Laboratory practises	Building and testing wideband radio channel sounders
Tutored works	These are tutorial type classes for discussion and follow-up of the previously assigned project.

Personalized attention

Methodologies	Description
Master Session	The students will have the opportunity to ask their doubts and questions during the learning activities, attending to scheduled meetings with the lecturer, or by means of email
Laboratory practises	The students will have the opportunity to ask their doubts and questions during the learning activities, attending to scheduled meetings with the lecturer, or by means of email
Tutored works	The students will have the opportunity to ask their doubts and questions during the learning activities, attending to scheduled meetings with the lecturer, or by means of email

Assessment

	Description	Qualification	Training and Learning Results
Master Session	Short answer test	60	C19
Laboratory practises	Report	20	C19
Tutored works	Work report	20	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

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

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

Recommendations

IDENTIFYING DATA				
(*)Comunicacións Móbiles e sen Fíos				
Subject	(*)Comunicacións Móbiles e sen Fíos			
Code	V05M145V01313			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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	Students may attend customized teacher's office in the schedule that teachers establish for this purpose in the early going of course and that will be published on the website of the subject. They may also raise any inquiries electronically.
Autonomous troubleshooting and / or exercises	Students may attend customized teacher's office in the schedule that teachers establish for this purpose in the early going of course and that will be published on the website of the subject. They may also raise any inquiries electronically.
Case studies / analysis of situations	Students may attend customized teacher's office in the schedule that teachers establish for this purpose in the early going of course and that will be published on the website of the subject. They may also raise any inquiries electronically.
Troubleshooting and / or exercises	Students may attend customized teacher's office in the schedule that teachers establish for this purpose in the early going of course and that will be published on the website of the subject. They may also raise any inquiries electronically.
Tests	**Description**
Short answer tests	Students may attend customized teacher's office in the schedule that teachers establish for this purpose in the early going of course and that will be published on the website of the subject. They may also raise any inquiries electronically.
Practical tests, real task execution and / or simulated.	Students may attend customized teacher's office in the schedule that teachers establish for this purpose in the early going of course and that will be published on the website of the subject. They may also raise any inquiries electronically.
Self-assessment tests	Students may attend customized teacher's office in the schedule that teachers establish for this purpose in the early going of course and that will be published on the website of the subject. They may also raise any inquiries electronically.

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) a 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 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.

Continuous assessment involves making over quarter of all proposed tasks: active participation in the sessions of classroom and laboratory practices, autonomous work as solving exercises and online 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).

- 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
Oriol Sallent, **Fundamentos de diseño y gestión de sistemas de comunicaciones móviles celulares**, 2014,
Mª Teresa Jiménez Moya, Juan Reig Pascual, Lorenzo Rubio Arjona, **Problemas de comunicaciones móviles**, 2006,
Jose María Hernando Rábanos, **Comunicaciones Móviles**, 2004,
José Manuel Huidobro Moya, **Comunicaciones móviles : sistemas GSM, UMTS Y LTE**, 2012,

Recommendations
Subjects that continue the syllabus
(*)Antenas/V05M145V01208
(*)Laboratorio de Radio/V05M145V01209
(*)Redes sen Fíos e Computación Ubicua/V05M145V01211
(*)Satélites/V05M145V01311
(*)Sistemas Avanzados de Comunicacións/V05M145V01302

Subjects that it is recommended to have taken before
(*)Radio/V05M145V01103

IDENTIFYING DATA				
(*)Microwave and Millimetre Wave Circuit Design and CAD				
Subject	(*)Microwave and Millimetre Wave Circuit Design and CAD			
Code	V05M145V01317			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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 band (power amplifier, oscillator or mixer). Most of the presential hours of the subject 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.			

Competencies	
Code	
B1	CG1 The ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
B4	CG4 The 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 The 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 the scheduled experimental and computer practices, the lecturer will guide the student work and solve doubts that may arise as a consequence of the designated tasks. The student will have available additional time for tutorship, in which to solve his/her doubts and questions with respect to the designated personal works.

Laboratory practises	During the scheduled experimental and computer practices, the lecturer will guide the student work and solve doubts that may arise as a consequence of the designated tasks. The student will have available additional time for tutorship, in which to solve his/her doubts and questions with respect to the designated personal works.

Assessment

	Description	Qualification	Training and Learning Results	
Tutored works	The student 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.	90	B1 B4 B8	C32
Tutored works	The student 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.	10	B1 B4 B8	C32

Other comments on the Evaluation

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, fabrications, 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.

Sources of information

Artículos técnicos (revistas científicas, notas de aplicación, información fabricante componentes,...),
Manuais dos equipos e simulador,
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,
Guillermo Gonzalez, **Microwave Transistor Amplifiers: Analysis and Design**, 2,

Recommendations

Subjects that it is recommended to have taken before

(*)Electrónica e Fotónica para Comunicacións/V05M145V01202

IDENTIFYING DATA				
(*)Seguridade Multimedia				
Subject	(*)Seguridade Multimedia			
Code	V05M145V01318			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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. Teaching and exams are in English.			

Competencies	
Code	
B4	CG4 The 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 The 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	Students will have the opportunity to meet in person with the instructor at some office hours that will be announced at the beginning of the course. The schedule will published in the course webpage.
Tests	**Description**
Reports / memories of practice	Students will have the opportunity to meet in person with the instructor at some office hours that will be announced at the beginning of the course. The schedule will published in the course webpage.

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.

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.

Sources of information
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
(*)Procesado Estatístico de Sinal/V05M145V01303

IDENTIFYING DATA				
(*)Computación Distribuída				
Subject	(*)Computación Distribuída			
Code	V05M145V01321			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish Galician English			
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.			

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 The 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. System model and group communication 2. Fault-tolerant services 3. Case studies of high available services 4. Transactions with replicated data
3. Grid, Cluster, and Cloud computing	1. Basic concepts of grid computing 2. Basic concepts of cluster computing. 3. Basic concepts of cloud 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.
Autonomous practices through ICT	Practices in laboratory realised by means of computers connected in network and/or virtual machines.
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.

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.	20	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.	10	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".

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
    - 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

REFERENCE BIBLIOGRAPHY

"Cloud computing bible". Barrie Sosinsky. Wiley Publishing, Inc. 2011. ISBN: 978-0-470-90356-8

"Grid Computing and Cluster Computing". C. S. R. PRABHU. PHI Learning Pvt. Ltd. 2008. ISBN: 9788120334281

"Distributed systems. Concepts and design". George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair. Fifth Edition, published by Addison Wesley, May 2011. ISBN 0-13-214301-1

"Introduction to Grid Computing". Bart Jacob, Michael Brown, Kentaro Fukui, , Nihar Trivedi. http://www.redbooks.ibm.com/redbooks/pdfs/sg246778.pdf

- Michael Wooldridge, An Introduction to Multiagent Systems, Addison-Wesley, 2a, 2009.

- Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach,, Prentice Hall, 3a, 2014.

- A.E. Eiben, J.E. Smith. Introduction to Evolutionary Computing (Natural Computing Series). Springer, 2008.

- Dan Simon. Evolutionary Optimization Algorithms. Wiley, 1e, 2013.

- Rauber, Thomas, Rünger, Gudula. Parallel Programming for Multicore and Cluster Systems. Springer, 2013.

NOTE: Additional materials will be provided.

Recommendations

IDENTIFYING DATA				
Data analysis				
Subject	Data analysis			
Code	V05M145V01322			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	González Castaño, Francisco Javier			
Lecturers	Díaz Redondo, Rebeca Pilar Fernández Vilas, Ana González Castaño, Francisco Javier			
E-mail	javier@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.			

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 The 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 The 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 bility 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	In groups, the students will solve a practical case of data analysis in an application scenario.
Laboratory practises	During the course, students will develop solutions in laboratiry sessions to grasp the course content.
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.

Personalized attention

Methodologies	Description
Laboratory practises	Personal attention during official tutoring hours and via the FAITIC platform.

Assessment

	Description	Qualification	Training and Learning Results		
Short answer tests	Short-answer written exam (around week 5)	40			C25
Jobs and projects	Working groups will deliver their projects during the last week of the course. Then, a public defense will be scheduled in the official examination date.	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: Around the fifth week (4 points maximum).
2. Project: To be defended at the official examination date (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 project 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

- Advanced Statistics from an Elementary Point of View. Michael J. Panik. Academic Press; 1 edition (October 28, 2005) ISBN-10: 0120884941 ISBN-13: 978-0120884940

- OpenIntro Statistics: Second Edition. David M. Diez, Christopher D. Barr, Mine C. Cetinkaya-Rundel. CreateSpace Independent Publishing Platform. ISBN-10: 1478217200 ISBN-13: 978-1478217206

- R in a Nutshell, 2nd Edition. Joseph Adler. O'Reilly Media. ISBN-10: 144931208X ISBN-13: 978-1449312084

Recommendations

IDENTIFYING DATA				
(*)Redes Sociais e Económicas				
Subject	(*)Redes Sociais e Económicas			
Code	V05M145V01323			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish English			
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 relation between agents that arise in the fields of the telecommunication, the economy and the sociology. They study , in particular, dynamic models of diffusion of information, of contagion, of strategic balance and of training of coalitions. The theoretical contents apply to a practical case of study.			

Competencies	
Code	
A1	CB1 The 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 The 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 The 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	To. Empirical evidence b. Random networks c. Descriptive parameters, centrality and importance d. Scaling laws
2. Training of networks	To. Random models: static training *b. Random models: dynamic training *c. Strategic training: stability, efficiency and incentives
3. Diffusion and learning in social networks	To. Simple diffusion *SIR, *SIS and other *b. Learning and reinforcement in networks *c. Games in networks: *complementos 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	56	70
Master Session	14	35	49
Jobs and projects	1	2	3
Troubleshooting and / or exercises	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.
Master Session	Synthetic exposition in the classroom of the basic concepts that support the subject.

Personalized attention

Methodologies	Description
Master Session	*Tutorización Personalised on the concepts and technical of analysis of the networks of diffusion of information and of relations. Support and guide to the realisation of the practical project of the students.

Assessment

	Description	Qualification	Training and Learning Results		
Jobs and projects	Evaluation of the technical hypotheses, methods of analysis, results and contributions of the project realised.	50	A1 A3	B4 B8	C26 C27
Troubleshooting and / or exercises	Correction of the exercises proposed. They will deliver by writing.	50	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 project (50% of the qualification) and in the resolution written of problems along the course (50% 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.

Sources of information
A. D. Barbour, L. Holst and S. Janson, **Poisson Approximation**,
B. Bollobas, **Random Graphs**, 2ª,
R. Durrett, **Random Graph Dynamics**,
D. Easley, J. Kleinberg, **Networks, Crowds, and Markets: Reasoning About a Highly Connected World**,
G. Grimmett, **Percolation**, 2ª,
S. Janson, T. Luczak, A. Rucinski, **Random Graphs**,
R. Meester and R. Roy, **Continuum Percolation**,

Recommendations

IDENTIFYING DATA				
(*)Prácticas en Empresas I				
Subject	(*)Prácticas en Empresas I			
Code	V05M145V01324			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
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				
General description				

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 The 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 The ability to understand the responsibility and professional ethics of the activity of the profession of Telecommunications Engineering.
B10	CG10 The ability to apply principles of economics and human resources and projects management, as well as legislation, regulation and standardization of telecommunications.
B12	CG12 To have skills for lifelong, self-directed and autonomous learning.
B13	CG13 The knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Telecommunications 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 will have a tutor inside the company that will guide him and will supervise in the specific tasks that it will have to develop inside the company; and an academic tutor -professor of the University of Vigo- that will define together with the tutor of the company the general frame of the activity of the student, checking that it adjusts to the profile/quotation studied by the student.

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

The sources of information will be provided by the company advisor (and, where applicable, by the academic advisor) dynamically as they depend on the student activities undertaken in the company host; and may be from technical manuals for operation and maintenance of different technical equipment up even scientific or research is in the R & D departments.

Recommendations

Other comments

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

IDENTIFYING DATA				
(*)Prácticas en Empresa II				
Subject	(*)Prácticas en Empresa II			
Code	V05M145V01325			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web				
General description				

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 The 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 The ability to understand the responsibility and professional ethics of the activity of the profession of Telecommunications Engineering.
B10	CG10 The ability to apply principles of economics and human resources and projects management, as well as legislation, regulation and standardization of telecommunications.
B12	CG12 To have skills for lifelong, self-directed and autonomous learning.
B13	CG13 The knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Telecommunications 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	
(*)Tema	(*)O alumno realizará unha estancia na empresa desenvolvendo funcións propias dun/a Enxeñeiro/a de Telecomunicación.

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 will have a tutor inside the company that will guide him and will supervise in the specific tasks that it will have to develop inside the company; and an academic tutor -professor of the University of Vigothat will define together with the tutor of the company the general frame of the activity of the student, checking that it adjusts to the profile/quotation studied by the student.

Assessment

	Description	Qualification		Training and Learning Results
External practises	(*)Prácticas externas La evaluación se realizará en función de: 1) La memoria de actividades 2) La evaluación del tutor en la empresa	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.), thelevel 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

The sources of information will be provided by the company advisor (and, where applicable, by the academic advisor) dynamically as they depend on the student activities undertaken in the company host; and may be from technical manuals for operation and maintenance of different technical equipment up even scientific or research is in the R & D departments.

Recommendations

Other comments

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

IDENTIFYING DATA				
(*)Prácticas en Empresas III				
Subject	(*)Prácticas en Empresas III			
Code	V05M145V01326			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language				
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web				
General description				

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 The 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 The ability to understand the responsibility and professional ethics of the activity of the profession of Telecommunications Engineering.
B10	CG10 The ability to apply principles of economics and human resources and projects management, as well as legislation, regulation and standardization of telecommunications.
B12	CG12 To have skills for lifelong, self-directed and autonomous learning.
B13	CG13 The knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Telecommunications 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	
(*)Tema	(*)O alumno realizará unha estancia na empresa desenvolvendo funcións propias dun/a Enxeñeiro/a de Telecomunicación.

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 will have a tutor inside the company that will guide him and will supervise in the specific tasks that it will have to develop inside the company; and an academic tutor -professor of the University of Vigo that will define together with the tutor of the company the general frame of the activity of the student, checking that it adjusts to the profile/quotation studied by the student.

Assessment

	Description	Qualification	Training and Learning Results	
External practises	(*)Prácticas externas Prácticas externas La evaluación se realizará en función de: 1) La memoria de actividades 2) La evaluación del tutor en la empresa	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

The sources of information will be provided by the company advisor (and, where applicable, by the academic advisor) dynamically as they depend on the student activities undertaken in the company host; and may be from technical manuals for operation and maintenance of different technical equipment up even scientific or research is in the R &D departments.

Recommendations

Other comments

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

IDENTIFYING DATA				
The Final Master Degree Work				
Subject	The Final Master Degree Work			
Code	V05M145V01401			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	30	Mandatory	2nd	1st
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 The 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 The ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
B5	CG5 The 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 The 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 The ability to communicate (oral and written) conclusions, and the knowledge and reasons holding them, to specialists and non-specialists in a clear and unambiguous way.
B12	CG12 To have 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, *ordenación and structuring of information on some subject related with the Engineering of Telecommunication	A1 B8 B12
Preparation by heart of project in which they collect : antecedents, problematic or state of the art, aims, phases of the project, development of the project, conclusions and future lines.	B1 B8 B11 C17
Design of prototypes, computer programs, circuits, procedures, etc, according to specifications	A1 B1 B5 B8 B12

Contents
Topic

The contents of the *TFM define in the individual proposals offered by the professors tutors, according to the willing rule by the Academic Commission of *Máster, whose content can consult through the web of the School of Engineering of Telecommunication.	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 *alumnado.
Case studies / analysis of situations	It carries out a critical analysis of similar problems to the posed in the *TFM, with the end to extract ideas, *analogías, methods or partial results that help in the resolution of the problem posed in the *TFM.
Others	The student receives personalised attention of his tutor about the general approach, the definition of aims and the plan of development of his *TFM, as well as orientation more specific and explanations *sonde the particular technical problems that involves.
Projects	The student, of individual way, resolves a scientific problem-technical of interest, of original and notable form, on the thematic specific assigned, and is able to draft a memory written with the hypotheses, the solution and the conclusions reasoned of his work.
Troubleshooting and / or exercises	The student studies the possible solutions to a scientific problem-technical proposed for his *TFM, and elaborates a solution of synthesis (analytical, meteorological, experimental or combined) that allow him reach the aims that had foreseen.

Personalized attention	
Methodologies	**Description**
Others	Each tutor will devote a time to attend personally to each one of the students of *TFM to his charge, to orient his work and guide the process of learning, as well as to review and correct the memory and the oral presentation.

Assessment					
	Description	Qualification	Training and Learning Results		
Projects	The evaluation will do by means of the presentation and defence in front of a Court of the individual work realised by the student under the *tutoría of a professor of the degree, or a professor or extraneous engineer to the University, represented by a professor of the degree. In the evaluation, the Court will be able to take into account the opinions or the report reasoned of the professor tutor, as well as appearances 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 *TFM can consult in the web of the School of Engineering of Telecommunication.

Sources of information

Recommendations