Universidade de Vigo

Educational guide 2014 / 2015

(*)Escola de Enxeñaría de Telecomunicación

(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación

Subjects

Year 1st

Code	Name	Quadmester	Total Cr.
V05G300V01101	Empresa: Fundamentos de empresa	1st	6
V05G300V01102	Física: Fundamentos de mecánica e termodinámica	1st	6
V05G300V01103	Informática: Arquitectura de ordenadores	1st	6
V05G300V01104	Matemáticas: Álxebra lineal	1st	6
V05G300V01105	Matemáticas: Cálculo I	1st	6
V05G300V01201	Física: Análise de circuítos lineais	2nd	6
V05G300V01202	Física: Campos e ondas	2nd	6
V05G300V01203	Matemáticas: Cálculo II	2nd	6
V05G300V01204	Matemáticas: Probabilidade e estatística	2nd	6
V05G300V01205	Programación I	2nd	6

Year 2nd

Code	Name	Quadmester	Total Cr.
V05G300V01301	Comunicación de datos	1st	6
V05G300V01302	Programación II	1st	6
V05G300V01303	Transmisión electromagnética	1st	6
V05G300V01304	Procesado dixital de sinais	1st	6
V05G300V01305	Física: Fundamentos de electrónica	1st	6
V05G300V01401	Tecnoloxía electrónica	2nd	6
V05G300V01402	Electrónica dixital	2nd	6
V05G300V01403	Redes de ordenadores	2nd	6
V05G300V01404	Técnicas de transmisión e recepción de sinais	2nd	6
V05G300V01405	Fundamentos de son e imaxe	2nd	6

Year 3rd

Code	Name	Quadmester	Total Cr.
V05G300V01501	Servizos de internet	1st	6
V05G300V01502	Circuítos electrónicos programables	1st	6
V05G300V01511	Circuítos de radiofrecuencia	1st	6
V05G300V01512	Sistemas de comunicacións por radio	1st	6
V05G300V01513	Tratamento de sinais multimedia	1st	6

V05G300V01521	Sistemas de adquisición de datos	1st	6
V05G300V01522	Sistemas electrónicos de procesado de sinal	1st	6
V05G300V01523	Enxeñaría de equipos electrónicos	1st	6
V05G300V01531	Fundamentos de enxeñaría acústica	1st	6
V05G300V01532	Sistemas de audio	1st	6
V05G300V01533	Vídeo e televisión	1st	6
V05G300V01541	Sistemas operativos	1st	6
V05G300V01542	Arquitectura e tecnoloxía de redes	1st	6
V05G300V01543	Seguridade	1st	6
V05G300V01611	Circuítos de microondas	2nd	6
V05G300V01612	Xestión e certificación radioeléctricas	2nd	6
V05G300V01613	Principios de comunicacións dixitais	2nd	6
V05G300V01614	Infraestruturas ópticas de telecomunicación	2nd	6
V05G300V01615	Redes e sistemas sen fíos	2nd	6
V05G300V01621	Instrumentación electrónica e sensores	2nd	6
V05G300V01622	Deseño microelectrónico	2nd	6
V05G300V01623	Sistemas electrónicos para comunicacións dixitais	2nd	6
V05G300V01624	Electrónica analóxica	2nd	6
V05G300V01625	Electrónica de potencia	2nd	6
V05G300V01631	Tecnoloxía audiovisual	2nd	6
V05G300V01632	Fundamentos de procesado de imaxe	2nd	6
V05G300V01633	Sistemas de imaxe	2nd	6
V05G300V01634	Procesado de son	2nd	6
V05G300V01635	Acústica arquitectónica	2nd	6
V05G300V01641	Programación concorrente e distribuída	2nd	6
V05G300V01642	Teoría de redes e conmutación	2nd	6
V05G300V01643	Redes multimedia	2nd	6
V05G300V01644	Sistemas de información	2nd	6
V05G300V01645	Arquitecturas e servizos telemáticos	2nd	6

Year 4th

Code	Name	Quadmester	Total Cr.
V05G300V01801	Xestión e dirección tecnolóxica	2nd	6
V05G300V01802	Laboratorio de proxectos	2nd	12
V05G300V01911	Teledetección	1st	6
V05G300V01912	Sistemas de navegación e comunicacións por satélite	1st	6
V05G300V01913	Procesado dixital en tempo real	1st	6
V05G300V01914	Comunicacións dixitais	1st	6
V05G300V01915	Fundamentos de bioenxeñaría	1st	6
V05G300V01921	Deseño de aplicacións con microcontroladores	1st	6
V05G300V01922	Dispositivos optoelectrónicos	1st	6
V05G300V01923	Deseño e síntese de sistemas dixitais	1st	6
V05G300V01924	Sensores electrónicos avanzados	1st	6
V05G300V01925	Comunicacións industriais	1st	6
V05G300V01931	Procesado e análise de imaxe	1st	6
V05G300V01932	Tecnoloxía multimedia e computer graphics	1st	6

V05G300V01933	Acústica avanzada	1st	6
V05G300V01934	Técnicas de medida de ruído e lexislación	1st	6
V05G300V01935	Produción audiovisual	1st	6
V05G300V01941	Servizos multimedia	1st	6
V05G300V01942	Redes sen fíos e móbiles	1st	6
V05G300V01943	Programación de sistemas intelixentes	1st	6
V05G300V01944	Deseño de sistemas integrados	1st	6
V05G300V01945	Novos servizos telemáticos	1st	6
V05G300V01981	Prácticas externas: Prácticas en empresa I	1st	6
V05G300V01982	Prácticas externas: Prácticas en empresa II	1st	6
V05G300V01991	Traballo de Fin de Grao	2nd	12
V05G300V01R02	Créditos optativos cursados en intercambio	1st	0

IDENTIFYING DATA				
Business: Company Fundamentals				
Subject	Business: Company Fundamentals			
Code	V05G300V01101			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Language	Spanish			
Department				
Coordinator	González Vázquez, Beatriz			
Lecturers	Álvarez Llorente, Gema González Vázquez, Beatriz			
E-mail	bgonza@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject has like objective give to know the organisation, management and institutional frame of the company.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A14	CE5/FB5: The necessary knowledge of business concepts, of law and institutional frameworks. business organization and management .

Learning aims		
Subject competences	Typology	Competences
Suitable knowledge of the management of companies: institutional and juridical frame of the company, organisation, strategies, economic management and of the production of companies.	know	A14
Capacity to resolve problems with initiative, for the taking of decisions, the creativity, and to communicate and transmit knowledges, skills and skills, comprising the ethical and professional responsibility of the activity of the Technical Engineer of Telecommunication.	know	A4
Know and apply basic elements of economy, organisation and planning of projects, as well as of legislation, regulation and normalisation in the telecommunications.	Know How	A8

Contents	
Topic	
Business administration	(*)1.1 The concept of company. 1.2 The aims of the company. 1.3 The company like system. 1.4 Forms and classes of companies. 1.5 Company and surroundings. 1.6 Surroundings Technologies of Information and Communication.
THE SYSTEM OF FINANCE	(*)2.1 The financial function. 2.2 The investment in the company. 2.3 Sources of finance of the company.
Subject 3: THE SYSTEM OF PRODUCTION I: GENERAL APPEARANCES	(*)3.1 Research, development and technological innovation. 3.2. Function of production. 3.3 Classification of the productive processes. 3.4 The economic programming of the production. 3.5 The productivity: indicators of productivity.

Subject 4: THE SYSTEM OF PRODUCTION II .	(*)4.1 The costs of production. 4.2 Capacity of production and location. 4.3 Control of inventories
Subject 5: THE SYSTEM OF COMMERCIALISATION	(*)5.1 The market. 5.2 The competition. 5.3 The system of commercialisation. 5.4 Marketing-mix.
Subject 6: THE SYSTEM OF *ADMINISTRAtION	6.1. The system of direction. 6.2. Human Resources.
	Practical 1: Typology and nature of the company Practical 2: Surroundings TIC Practical 3: Structure and economic analysis-financial Practical 4: Sources of Finance I Practice 5: Finance II Practice 6: Investment I Practice 7: Decisions of investment in the company II. Practical 8: Production Practical 9: Productivity Practical 10: Costs of Productivity Practical 11: Capacity of production Practical 12: Location business Practical 13: The plan of company

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	28	56	84
Laboratory practises	26	38	64
Multiple choice tests	1	0	1
Long answer tests and development	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
Master Session	Lesson magistral with material of support and audiovisual means.Realise an exhibition of the main contents of the matter so that the almno can understand the scope of the same and facilitate his understanding.
Laboratory practises	Development and resolution of practical cases by means of the use of suitable computer tools for the contents of the matter. The tools to use are inside the available software by the University or will be of free character.

Personalized attention

	Description
Master Session	In the classes of laboratory, the professor will guide and will assist to the students that will work in the classroom resolving cases and questions. In the sessions megistrales the professor will attend, will orient and will resolve the doubts to the students on the contents tackled in the theoretical classes. The students will have occasion to attend to tutorías personalised in the dispatch of the professor in the schedule that the professors will establish to such effect to principle of course and that will publish in the page of the asignatura. These tutorías are allocated to resolve doubts and orient to the students on the development of the contents tackled in the theoretical classes, the practical classes. Likewise, also it will keep a constant communication between the educational and the alumnado through the Network by means of the platform Fear in Faitic.

Laboratory practises	In the classes of laboratory, the professor will guide and will assist to the students that will work in the classroom resolving cases and questions. In the sessions megistrales the professor will attend, will orient and will resolve the doubts to the students on the contents tackled in the theoretical classes. The students will have occasion to attend to tutorías personalised in the dispatch of the professor in the schedule that the professors will establish to such effect to principle of course and that will publish in the page of the asignatura. These tutorías are allocated to resolve doubts and orient to the students on the development of the contents tackled in the theoretical classes, the practical classes. Likewise, also it will keep a constant communication between the educational and the alumnado through the Network by means of the platform Fear in Faitic.

Assessment

	Description	Qualification
Long answer tests and development	Final proof that can contain partial or totally the contents of the matter developed in the classes of theory and of practices. In these proofs evaluate the competitions A4, A8, A14.	60
Multiple choice tests	(*)Proofs scored that will realise along the course, distributed of uniform form and programmed so that they interfere the less possible in the rest of the matters. In these proofs evaluate the competitions A4, A8, A14.	40

Other comments and second call

Following the own guidelines of the degree will offer two systems of evaluation: continuous evaluation (two options) and non continuous evaluation at the end of the semester. In any of the two systems of evaluation all the competitions of the subject remain evaluated.

1. Continuous evaluation

It will consider that a student has opted by the continuous evaluation when, after knowing the qualification obtained in the first proof, participates in the second.

The continuous evaluation will consist of a group of proofs scheduled and developed along the course, and that will complete with an examination at the end of the semester that will cover total or partially the subject for those students that do not achieve to approve through the proofs realised along the course. The proofs will consist so much in the realisation of the practices of the matter, as in three proofs evaluables, that will effect roughly around the middle of october, November and the begginig od december. Said proofs do not free matter, but each one of them will treat on the contents seen until the moment of realisation of the proof, so much in classes of theory as of practices, is thus that will confer to the last proof a greater weight in the calculation of the qualification that the previous, so that the first proof weighs 20%, and the second and third proof 30% and 50%, respectively.

To approve the matter through the proofs and remain deleted of the realisation of the examination at the end of the semester, the student has to surpass 2/3 of the proofs realised –being one of them the last proof-, and obtain an average in the qualification of 5. The result that begin the student in this case will be the weighted average note of the three test .

The student has right to know the qualification obtained in each task in a reasonable term after his realisation or delivery. Likewise, these tasks are not recoverable, that is to say, if a student can not fulfil them in the day stipulated the professor does not have obligation to repeat them. The qualification obtained in the tasks evaluables will be valid so only for the academic course in which they realise.

The students that have not approved the matter through the proofs, will have to complete the continuous evaluation realising an examination at the end of the semester that will consist in a proof reduced that will suppose 60% of the note that will add to the note obtained in the continuous evaluation (40% in three proofs) .

2. Students that do not opt by continuous evaluation

To the students that do not opt by the continuous evaluation will offer them a procedure of evaluation that allow them reach the maximum qualification. This procedure will consist in a final examination that include the contents developed in the classes of theory and of practices.

3. On the announcement of recovery (July)

For the announcement of recovery (July) the student that did not approve the subject chooses and confirm by email (a week before the examination) if it wishes to be examined entirely on the maximum possible note or if it applies him the procedure of evaluation stipulated in the subject keeping the note obtained in the previous tasks. By defect, to the student save him the results of the proofs realised.

4. Qualification of No Presented

A student will consider no presented if, at most, has participated in the first proof of continuous evaluation. In any another case, the student will consider presented and will receive his corresponding note.

Sources of information
Bueno Campos, E., Curso básico de economía de la empresa, 2004, Pirámide
Fernández Sánchez, E. y otros , Iniciación a los negocios para ingenieros. Aspectos funcionales, 2008, Paraninfo
Pérez Gorostegui, E. , Curso de introducción a la economía de la empresa, 2009, Editorial Universitaria Ramón Areces
Suárez Suárez, A., Curso de economía de la empresa, 2001, Pirámide

Recommendations

IDENTIFYING DATA				
Physics: Fundamentals of Mechanics and Thermodynamics				
Subject	Physics: Fundamentals of Mechanics and Thermodynamics			
Code	V05G300V01102			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Language	Spanish			
Department				
Coordinator	Chiussi , Stefano			
Lecturers	Chiussi , Stefano Fernández Doval, Ángel Manuel Fernández Fernández, José Luís Mato Corzón, Marta María Salgueiriño Maceira, Verónica Stefanov , Stefan Val García, Jesús del Vijande López, Javier			
E-mail	schiussi@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Introduction to the basic concepts on the general laws of Mechanics and Thermodynamics as well as to their application to the resolution of problems in engineering.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A12	CE3/FB3: Comprehension and command of basic concepts about the general laws of mechanics, thermodynamics, electromagnetic fields and waves and electromagnetism and their application to solve Engineering problems.

Learning aims		
Subject competences	Typology	Competences
Understanding and mastering of the basic concepts on the general laws of Mechanics and Thermodynamics as well as of their application to solving problems in engineering.	know Know How	A12
Knowledge of fundamental and technological subjects which enable the students to learn new methods and technologies, as well as to endue them with versatility to get adapted to new situations.	know Know How	A3
Knowledge to perform measurements, calculations, assessments, valuations, expert's reports, surveys, reports, task planning and other similar labours into their specific scope of Telecommunications.	Know How	A5
Skilfulness to handle specifications, regulations and legally binding standards.	Know How	A6

Contents	
Topic	
1.- Physical magnitudes and units. The International System.	(*)
2.- Vectorial tools for Mechanics.	(*)
3.- Point Kinematics.	(*)
4.- Point Kinetics.	(*)
5.- Point Statics.	(*)

6.- Oscillations.	(*)
7.- Wave motion.	(*)
8.- Zero principle of Thermodynamics. Temperature.	(*)
9.- First principle of Thermodynamics.	(*)
10.- Second principle of Thermodynamics.	(*)
Lab 1.- Measurement instruments. Error and uncertainty. Estimation of uncertainties in direct measurements.	(*)
Lab 2.- Measurement of the reaction time to a given stimulus. Measurement of the gravitational acceleration by means of a pendulum. Estimation of uncertainty in indirect measurements.	(*)
Lab 3.- Verification of Hooke's Law. Linear fit.	(*)
Lab 4.- Longitudinal and transversal standing waves. Measurements by linearization of non-linear relations and linear fit. Graphical representation of measurement results.	(*)
Lab 5.- Simple harmonic motion. Free standing oscillation of a spring. Measurements by linearization of non-linear relations and linear fit. Graphical representation of measurement results.	(*)

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	22	22	44
Case studies / analysis of situations	6	12	18
Troubleshooting and / or exercises	15.5	46.5	62
Laboratory practises	9	13.5	22.5
Multiple choice tests	0.5	0	0.5
Short answer tests	1	0	1
Practical tests, real task execution and / or simulated.	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	Prior personal work: -Preliminary reading of the proposed bibliography on the subject. During the lectures: -Presentation of theoretical concepts. -Experimental demonstrations. -Audiovisual presentations. Ulterior personal work: -Revision of theoretical concepts. -Weak-point identification. -Consult the bibliography.
Case studies / analysis of situations	Application of the theoretical concepts to simple cases and situations. During the lectures: -Solving of examples. Ulterior personal work: -Solving of cases and situations from the bibliography. -Identification of weak points which require tutorial aid.
Troubleshooting and / or exercises	Solving of average-difficulty problems involving one or more theoretical concepts. During the lectures: -Presentation of solving strategies and techniques by solving example-problems. Personal work: -Solving of problems from the bibliography. -Identification of weak points which require tutorial aid.

Laboratory practises	Prior personal work: -Preparation of the practical session by studying the corresponding guide and reviewing the theory. During the practical session: -Description of the experiment highlighting which theoretical concepts are involved. -Training on material and instrumentation handling. -Execution of the experiment. -Preliminary result processing. Ulterior personal work: -Processing and analysis of the results. -Weak-point identification. -Consult the bibliography.

Personalized attention

	Description
Master Session	- During the practical sessions the lecturers will solve the questions that may arise as the experiments are executed. - The questions related to the theory, its application to the analysis of cases and situations, problem solving, the theory involved in the experiments and the processing of the resulting data, will be solved by the lecturers in their respective tutorial-aid time. - Tutorial aid will be given: = Individually or in small groups (typically of two or three students). = Unless stated otherwise, by appointment to the corresponding lecturer. The appointment will be arranged either by e-mail or in person at the beginning or end of a lecture. = Preferably, in the place and tutorial-aid hours of the corresponding lecturer that will be published in the subject's web page at the beginning of each semester.
Case studies / analysis of situations	- During the practical sessions the lecturers will solve the questions that may arise as the experiments are executed. - The questions related to the theory, its application to the analysis of cases and situations, problem solving, the theory involved in the experiments and the processing of the resulting data, will be solved by the lecturers in their respective tutorial-aid time. - Tutorial aid will be given: = Individually or in small groups (typically of two or three students). = Unless stated otherwise, by appointment to the corresponding lecturer. The appointment will be arranged either by e-mail or in person at the beginning or end of a lecture. = Preferably, in the place and tutorial-aid hours of the corresponding lecturer that will be published in the subject's web page at the beginning of each semester.
Troubleshooting and / or exercises	- During the practical sessions the lecturers will solve the questions that may arise as the experiments are executed. - The questions related to the theory, its application to the analysis of cases and situations, problem solving, the theory involved in the experiments and the processing of the resulting data, will be solved by the lecturers in their respective tutorial-aid time. - Tutorial aid will be given: = Individually or in small groups (typically of two or three students). = Unless stated otherwise, by appointment to the corresponding lecturer. The appointment will be arranged either by e-mail or in person at the beginning or end of a lecture. = Preferably, in the place and tutorial-aid hours of the corresponding lecturer that will be published in the subject's web page at the beginning of each semester.
Laboratory practises	- During the practical sessions the lecturers will solve the questions that may arise as the experiments are executed. - The questions related to the theory, its application to the analysis of cases and situations, problem solving, the theory involved in the experiments and the processing of the resulting data, will be solved by the lecturers in their respective tutorial-aid time. - Tutorial aid will be given: = Individually or in small groups (typically of two or three students). = Unless stated otherwise, by appointment to the corresponding lecturer. The appointment will be arranged either by e-mail or in person at the beginning or end of a lecture. = Preferably, in the place and tutorial-aid hours of the corresponding lecturer that will be published in the subject's web page at the beginning of each semester.

Assessment

	Description	Qualification
Multiple choice tests	Multiple-choice questions about theoretical concepts. Solving of elementary cases and situations related to the topics in both the classroom and laboratory syllabi.	25
Short answer tests	Short answer questions about theoretical concepts. Solving of elementary cases and situations related to the topics in both the classroom and laboratory syllabi.	25
Practical tests, real task execution and / or simulated.	Practical tests: Solving of problems involving one or more theoretical topics. Execution of real and simulated measurements. Real- and simulated-measurement result processing.	50

Other comments and second call

Â Â Following the particular guidelines of this degree, the students taking this subject will be offered two alternative assessment systems: continuous assessment and end-of-semester assessment.

Â Â It will be assumed that a student chooses continuous assessment if he or she takes the 3rd test (see below). Once this test is taken, it will be understood that the student has taken the current term's examination call and he or she will be qualified according to the following criterion regardless of whether he or she takes the final test or not.

1)CONTINUOUS ASSESSMENT

Â Â Continuous assessment consists of the tests detailed below in this guide which are not retakeable, i.e, if a student is not able to take them in the scheduled date the teaching staff will not be required to repeat them.

Â Â The publication date of the marks and the corresponding checking procedure will be given before the tests. As a general rule, the marks of each test will be published before the next one.

Â Â The marks obtained in the tests will be only valid for the academic term they have been obtained.

1st test:

a1) Experimental laboratory test comprising the execution of actual measurements and the processing of the results (mark: 0-1 point).

Length: 30 minutes at the end of experimental laboratory session number 3. Its date will appear in the assessment test schedule that the Academic Board of the Degree will approve.

2nd test:

b1) Combined test with multiple-choice and short-answer questions. Questions about theoretical concepts. Solving of elementary cases and situations related to the topics in the classroom syllabus (mark: 0-1 point).

Length: 30 minutes at the end of one of the problem-solving lectures. Its date will appear in the assessment test schedule that the Academic Board of the Degree will approve.

3rd test:

c1) Experimental laboratory test comprising the execution of actual measurements and the processing of the results (mark: 0-1 point).

Length: 30 minutes at the end of experimental laboratory session number 5. Its date will appear in the assessment test schedule that the Academic Board of the Degree will approve.

4th test, continuous assessment final test:

Combined test with:

d1) 8-12 multiple-choice and short-answer questions, (mark: 0-5 points distributed among them)

e1) solving of one or two problems, (mark: 0-3.4 points distributed between them)

f1) solving of a problem comprising the execution of real or simulated measurements and the processing of the results (mark: 0-1.6 points).

Length: 2 hours in the subject's official examination date.

Overall mark calculation.

g1) will be calculated as the sum of the marks obtained in blocks b1), d1) and e1) plus the lowest of 2 points and the sum of blocks a1), c1) and f1)

g1 = b1 + d1 + e1 + min{ 2 , a1 + c1 + f1 }

The overall mark will be the lowest of 10 points or g1)

overall mark = min{ 10, g1 }

2) END-OF-SEMESTER ASSESSMENT

Final overall test:

Combined test with:

d2) 8-12 multiple-choice and short-answer questions, (mark: 0-5 points distributed among them)

e2) solving of one or two problems, (mark: 0-3.4 points distributed between them)

f2) solving of a problem comprising the execution of real or simulated measurements and the processing of the results (mark: 0-1.6 points).

Length: 2 hours in the subject's official examination date.

Overall mark calculation:

g2) will be calculated as the sum of the marks obtained in blocks d2), e2) and f2)

g2 = d2 + e2 + f2

The overall mark will be g2)

overall mark = g2

3) JULY RESIT

Makeup exam:

Combined test with:

d3) 8-12 multiple-choice and short-answer questions, (mark: 0-5 points distributed among them)

e3) solving of one or two problems, (mark: 0-3.4 points distributed between them)

f3) solving of a problem comprising the execution of real or simulated measurements and the processing of the results (mark: 0-1.6 points).

Length: 2 hours in the subject's official resit date.

Final mark calculation:

The students who take the July resit will lose the mark of the previous final test and will get a new mark according to the following criteria:

3A) Students who have chosen continuous assessment

g3A) will be calculated as the sum of the marks obtained in blocks b1), d3) and e3) plus the lowest of 2 points and the sum of blocks a1), c1) and f3)

g3A = b1 + d3 + e3 + min{ 2 , a1 + c1 + f3 }

The overall mark will be the lowest of 10 points or g3A)

overall mark = min{ 10, g3A }

3B) Students who have chosen end-of-semester assessment

g3B)Â will be calculated as the sum of the marks obtained in blocks d3), e3) and f3)

g3B = d3 + e3 + f3

The overall mark will be g3B)

overall mark = g3B

The marks g1), g2), g3A) and g3B) will be considered instead of the corresponding overall marks to assign the "matricula de honor" distinction.

-Distribution of the learning aims of the subject which are assessed within each block:

ASSESSMENTÂ	LEARNING AIMS			
a1Â			A5	A6
b1	A12	A3		A6
c1			A5	A6
d1, d2, d3	A12	A3		A6
e1, e2, e3	A12			
f1, f2, f3			A5	A6

-Particulars of the learning aims which are assessed:

A12: Understanding of basic concepts on the general laws of Mechanics and Thermodynamics as well as of their application to problem solving.

A3: Knowledge of fundamental subjects which enable the students to learn new methods and technologies, as well as to endue them with versatility to get adapted to new situations.

A5: Knowledge to perform measurements and calculations.

A6: Knowledge and skill to handle specifications of measuring instruments as well as basic standards (SI and ISO80000 parts 1 to 5).

Sources of information

H.D. Young y R.A. Freedman, Sears-Zemansky. Física Universitaria, 12, Addison-Wesley

I.N. Bronshtein, K.A. Semendiaev, Manual de Matemáticas para Ingenieros y Estudiantes, 1, MIR

Recommendations

Subjects that continue the syllabus

Fundamentals of Sound and Image/V05G300V01405
Power Electronics/V05G300V01625
Fundamentals of Acoustics Engineering/V05G300V01531

Subjects that are recommended to be taken simultaneously

Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105

Other comments

To adequately follow this subject, it is highly advisable to master the contents of high-school subjects on Mathematics and Physics.

IDENTIFYING DATA				
Informatics: Computer Architecture				
Subject	Informatics: Computer Architecture			
Code	V05G300V01103			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Language	Spanish			
Department				
Coordinator	Llamas Nistal, Martín			
Lecturers	Álvarez Sabucedo, Luis Modesto Anido Rifón, Luis Eulogio Costa Montenegro, Enrique Fernández Iglesias, Manuel José Gil Solla, Alberto Llamas Nistal, Martín Santos Gago, Juan Manuel			
E-mail	martin@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Computers have become an essential tool. This fact is even more clear while studying the "Bachelor of Engineering in Telecommunications Technology" (Grado en Ingeniería de Tecnologías de Telecomunicación), where computers are not only manipulated from a user's --or specialized user's-- point of view, but also from the engineering perspective, as tools to be designed or to be integrated in more complex systems. Hence, the main motivation for the "Computer Architecture" (Arquitectura de Ordenadores) course is to provide students with an understanding of basic computer operation by studying the lower abstraction levels (over the electronic level). The subject "Computer Architecture" (Arquitectura de Ordenadores) is focused on the conventional machine level, describes the operating machine level and shows an example application for the Symbolic Machine domain through the introduction of the Database Management Systems.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A11	CE2/FB2: The basic knowledge about using and programming computers, operative systems, databases and Engineering applied software.

Learning aims		
Subject competences	Typology	Competences
(*)FB2: Basic knowledge on the use and programming of computers, operating systems, data bases and software applied to engineering.	know	A11
(*)CG3: Knowledge on basic subjects and technologies, enabling learning new methods and technologies, as well as endowed with the versatility to adapt to new situations.	know	A3
(*)CG4: Problem-solving capacity with initiative, decision making, creativity, and to communicate and transfer knowledge, skills and abilities, understanding the ethical and professional responsibility of the activity of Telecommunications Technical Engineering	know	A4

Contents
Topic

(*)1: PRELIMINARIES	(*)Information Representation in computers. von Neumann Model. Structural, procesal and functional models
(*)2. von Neumann Model	(*)Components of von Neumman machine. Simple Machine: Simplez. Central Processing Unit, Arithmetic and Logic Unit, memries, registries, buses. External Communication, active waiting, Introduction to addressing modes
(*)3. Symbolic Representation and Processing .	(*)Representation of basic data elements: integer, character, floating point. Conventions for data storage. Processing operations. Introduction to simbolic processing. Assembler language
(*)4. Instructions and addressing	(*)4. IInstructions and addressing Software considerations. Registries at the conventional machine level. Lenguage for register transfer (RT level). Instruction format. Addressing modes. Stacks and subprograms. Assembler languages
(*)5. Typical conventional machine	(*)Structural Model. Functional Model. Set of instuctions. Addressing modes, Assembler. Examples of programmes. Algortimez
(*)6. Peripheral management	(*)Types of peripherals. Management of variety. Models. Secondary memories. Interruptions. Service Rutines. ADM: justification.
(*)7. Operating Systems	(*)Operative Machine. Introduction to Operating Systems. Definition of an operating system. Interface operating system. Introduction to CPU management. Introduction to memory management. Introduction to file management. Introduction to I/O management.
(*)8. Data Bases	(*)Introduction to Data Bases. Relational Model. Entity-relation model. Query languages. Introduction to SQL

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	22	27.5	49.5
Introductory activities	5	5	10
Troubleshooting and / or exercises	10	17.5	27.5
Master Session	12	24	36
Self-assessment tests	0	3	3
Practical tests, real task execution and / or simulated.	4	8	12
Short answer tests	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
Laboratory practises	The course includes programming practices that will performed using a simple computer (SIMPLEZ) and a regular computer (ALGORITMEZ).
Introductory activities	Presentation of the course contents, methodology, office hours, evaluation, usage of the labs, and any other issue related to the subject.
Troubleshooting and / or exercises	Programming, information representation, and other problems and exercises will be solved during the classes. Some must be solved by students previously at home, and they will participate actively in the solution of some other problems.
Master Session	Theoretical concepts and their practical application will be introduced during the classes. Students will be encouraged to participate by alternating lectures with problem and exercise solving. Therefore, sessions will include lectures and time for exercises and problems.

Personalized attention

	Description
Master Session	
Laboratory practises	
Troubleshooting and / or exercises	

Assessment

	Description	Qualification
Self-assessment tests	Exam questions will be available for students, in order to perform autoevaluation.	0

Practical tests, real task execution and / or simulated.	Three practical exams (ongoing evaluation) will be performed in laboratory. Competencies A3, A4 and A11.	50
Short answer tests	Three exams (ongoing evaluation) will be performed to evaluate the theory.Competencies A3, A4 and A11.	50

Other comments and second call

This subject is organized in two parts: Theory and Practice.
The final grade for the course (FG) is the harmonic average (HA) of both parts, TG (Theory Grade) and PG (Practice Grade). Namely
FG = HA(TG,PG) = 2*TG*PG/(TG+PG)
If the two terms (TG and PG in this case) are zero, the harmonic average is zero (0).
To pass the course, FG must be greater than or equal to 5.
Both parts can be evaluated by Continuous Evaluation (CE) or by Final Exam (FE).
The FE will consist of Theory and Practice, and will take place in date and time officially established.
EC will consist of the tasks described in this guide, and are not recoverable, ie, if a student cannot comply within the stipulated period the teacher is not required to repeat them.
If one of the subject parts is passed in the December examinations, its grade will be kept for the July examinations where the student only must be evaluated of the other part. If the student has followed CE in part that remains, he/she will keep the grades.
The CE tasks grades are only valid for the current academic course, being discarded in case the student fails the course.

THEORY
The Theory part is divided into two subparts: T1 and T2. T1 covers approximately 66% of the syllabus, while T2 the 100% of the syllabus.
The Theory grade is the harmonic average of the grades of these two subparts, ie:
TG = HA(T1,T2) = 2*T1*T2/(T1+T2)

*CONTINUOUS EVALUATION (CE):
In CE in Theory, the T1 subpart consists of two exercises (CE1 and CE2) and T2 subpart of one exercise. They will be done approximately in the 5th week, 10th week and the final exam (ie, the third exercise is part of the Review Final) .
The syllabus is about 33% of the total for the first exercise (CE1), 66% for the second (CE2) Â and 100% for the third (T2).
The note of the first subpart is T1 = 0.35 * CE1 + 0.65 * CE2
If the student has followed CE but has failed the subject, the T1 and T2 grades will be kept for July examinations.

*SEMESTER FINAL EXAM
Any student, whether or not has followed the CE, can take the Final Exam. If the student followed the CE, he/she may discard the results obtained there, and take the Final Exam . In this case, the valid grade will be the FE, canceling the grades that had been obtained previously in the CE.
This Final Exam will have two exercises (T1 and T2) to be done in 90 minutes. Students who have not passed CE will have to present to the entire Final Exam (T1 and T2).

* RECOVERY IN JULY
The Theory Final Exam has the same structure as in the Semester Final Exam and will last 90 minutes. If CE was not followed, the student will have to do both T1 and T2, regardless of the grades in each exercise in December. If EC was followed, the student can do T1 and/or T2, canceling the grades that he/she had previously obtained.

PRACTICE
*CONTINUOUS EVALUATION:
The CE of Practice consists of 3 exercises P1, P2 and P3 . P1 will be about Simplez, P2 about Basic Algoritmez (over 60% of the syllabus) and P3 about Full Algoritmez (100% of the syllabus). The exercises will be done in the laboratory and will last approximately 1 hour. P1 will be around the 4th week, P2 around the 8th P2 and P3 around the last week .The Practice CE grade is the weighted average of these three exercises: PG = 0.20*P1 + 0.35*P2 + 0.45*P3

*SEMESTER FINAL EXAM
Any student, whether or not has followed the CE, can take the Final Exam. If the student followed the CE, he/she may discard the results obtained there, and take the Final Exam . In this case, the valid grade will be the FE, canceling the grades that had been obtained previously in the CE.
This Final Exam will have one exercise about Algoritmez to be done in the laboratory in 1 hour (approximately).
In this case, the Practice Grade is the grade of the Final Exam.

* RECOVERY IN JULY

In July, the student will have a Final Exam similar to the Semester Final Exam.

GENERAL ISSUES
ACTS- For the CE to be considered in Acts, the student will have do exercise P1 in Practice or EC1 in Theory. Any student following the CE who does not do any of these exercises (P1 or EC1):
His/her grade will not be registered in the acts and, for all purposes, will be treated as those presented for the first time, without having studied before.
He/she could not take the other CE exercises, as they will not be considered.
Note: Prior to an exercise or an exam, the date and procedure for the score review will be published sufficiently in advance.

Sources of information

Gregorio Fernández Fernández, Curso de Ordenadores. Conceptos básicos de arquitectura y sistemas operativos., 5ª, Servicio de Publicaciones de la E.T.S.I. Telecomun

Silberschatz, H.F. Horth y S. Sudarshan, Fundamentos de Bases de Datos. , 2ª, McGraw-Hill. 2002

A. S. Tanenbaum, Organización de Computadoras. Un enfoque estructurado. , 4ª , Pearson Educación. 2000

J.L. Hennessy y D.A. Patterson, Arquitectura de los Computadores. Un enfoque cuantitativo, , McGraw-Hill. 1993

Martín Llamas Nistal, Fernando A. Mikic Fonte y Manuel J. Fernández Iglesias, Arquitectura de Ordenadores: Problemas y Cuestiones de Teoría, 1ª, Editorial Andavira, 2012

Alberto Gil Solla, Ejercicios resueltos sobre Fundamentos de los Ordenadores, 1ª, Editorial Andavira, 2009

Alberto Gil Solla, Problemas resueltos de programación en ensamblador, 1ª, Editorial Andavira, 2009

Fernando A. Mikic Fonte y Martín Llamas Nistal, Arquitectura de Ordenadores: Problemas de Programación en Ensamblador, 1ª, Editorial Andavira, 2011

ADITIONAL BIBLIOGRABHY:

[Cos98] C. Costilla Rodríguez. 1996. Introducción a las Bases de Datos Modernas. Dpto. Publicaciones ETSIT Madrid. ISBN 84-605-6469-X

[Dat99] C.J. Date. An introduction to database systems (Vols. 1 y 2) . Séptima edición. Addion-Wesley. ISBN-10: 0201385902, ISBN-13: 978-0201385908

[Dat01] C.J. Date. 2001. Introducción a los Sistemas de Bases de Datos. Pearson Educación. ISBN : 968-444-419-2

[EN02] R.A. Elmasri and S.B. Navathe. 2002. Fundamentos de Sistemas de Bases de Datos. Pearson Educación. ISBN 978-84-782-9085-7

[FMH01] I.M. Flynn y A. McIver McHoes. 2001. Sistemas Operativos (tercera edición) . Thomson Learning. ISBN: 534376665

[GUW02] H. García-Molina, J.D. Ullman y J. Widom. 2002. Database Systems. The Complete Book . Prentice-Hall. ISBN 0137135262

[HVZ87] V.C. Hamacher, Z.G. Vranesic, S.G. Zaky, 1987. Organización de Computadoras (2ª ed.) McGraw-Hill.

[PH95] D. A. Patterson y J.L. Hennessy (Traducido por J.M. Sánchez), 1995. Organización y diseño de Computadores. La interfaz hardware/software. McGraw-Hill. 1-55860-281-X.

[SBG02] A. Silberschatz, P. Baer Galvin, G. Gagne. 2002. Sistemas Operativos (sexta edición). Limusa-Wiley. ISBN: 9681858220

Recommendations

IDENTIFYING DATA				
Mathematics: Linear Algebra				
Subject	Mathematics: Linear Algebra			
Code	V05G300V01104			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Language	Spanish			
Department				
Coordinator	Martín Méndez, Alberto Lucio			
Lecturers	Faro Rivas, Emilio Martín Méndez, Alberto Lucio Prieto Gómez, Cristina Magdalena			
E-mail	amartin@dma.uvigo.es			
Web	http://faitic.uvigo.es/			
General description	The subject Álgebra Lineal is taught in the first quadmester of the first course of the Grado en Ingeniería de Tecnologías de Telecomunicación, with the main objective of providing students with a correct management of the elementary mathematical symbolism, the basic techniques of the matrix calculus and an introduction to the methods of resolution of problems that serve as a basis for subjects to study later. It will be paid special attention to the applications of Linear Algebra, as well as to the part of Numerical Analysis which is related to the subject.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A10	CE1/FB1: The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial derivatives equations; numerical methods, numerical algorithms, statistics and optimization

Learning aims		
Subject competences	Typology	Competences
FB1 Capacity for the resolution of the mathematical problems that can pose in the engineering. FB1.1 Aptitude to apply the knowledges on linear algebra, geometry and differential geometry. FB1.4 Aptitude to apply the knowledges on numerical and algorithmic methods numerical.	Know How	A10
CG3 Knowledge of basic materials and technologies which enable the student to learn new methods and technologies, and provide to him with a big versatility to adapt itself to new situations.	know	A3
CG4 Ability to solve problems. CG4.1 Ability to solve problems with initiative, decision-making and creativity. CG4.2 Ability to communicate and transmit knowledge, abilities and skills.	Know How	A4

Contents	
Topic	
Subject 1. Complex numbers.	Operations with complex numbers. Geometric concepts associated with complex numbers. Euler's formula and its consequences.
Subject 2. Systems of linear equations and matrices.	Solution of a system of linear equations. Systems of linear equations and vector equations. The matrix equation Ax=b. Sets of solutions of systems of linear equations. Operations with matrices. Inverse of a matrix. Block matrices. LU decomposition. Determinants. Rank of a matrix.

Subject 3. Linear transformations	Relations of linear dependence. Subspaces. Basis. Dimension. Rank of a system of vectors. Introduction to linear transformations. Matrix of a linear transformation. Composition of linear transformations.
Subject 5. Eigenvalues and eigenvectors.	Eigenvalues and eigenvectors. Eigenspace. Diagonalizable matrices.
Subject 6. Orthogonallity.	Real Euclidean inner product. Complex Euclidean inner product. Orthogonallity. Diagonalization by unitary similarity. Singular value decomposition. Matrix rank reduction. The method of least squares. Quadratic forms.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	2	2	4
Master Session	38	76	114
Troubleshooting and / or exercises	9	9	18
Troubleshooting and / or exercises	5	5	10
Long answer tests and development	2	2	4

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

Methodologies

	Description
Laboratory practises	Use of the computer tool *MATLAB.
Master Session	Explanation and development by the professor of the contents of the various items that make up the course.
Troubleshooting and / or exercises	Resolution by part of the professor of suitable exercises adapted to each topic and suitable exercises to reveal the relations of the topics between themselves. The student will have to also take part in the resolution of exercises in order to strengthen their knowledge.

Personalized attention

	Description
Troubleshooting and / or exercises	Students will have the opportunity to attend personal tutoring in the professor's office in the hours established, as announced at the beginning of the course and published on the course web page. The professor will personally help students in order to clarify the doubts that they may have about the contents of the subject or the problems solved. He also personally attend students who have questions about exercises sought by themselves.
Laboratory practises	Students will have the opportunity to attend personal tutoring in the professor's office in the hours established, as announced at the beginning of the course and published on the course web page. The professor will personally help students in order to clarify the doubts that they may have about the contents of the subject or the problems solved. He also personally attend students who have questions about exercises sought by themselves.
Master Session	Students will have the opportunity to attend personal tutoring in the professor's office in the hours established, as announced at the beginning of the course and published on the course web page. The professor will personally help students in order to clarify the doubts that they may have about the contents of the subject or the problems solved. He also personally attend students who have questions about exercises sought by themselves.
Troubleshooting and / or exercises	Students will have the opportunity to attend personal tutoring in the professor's office in the hours established, as announced at the beginning of the course and published on the course web page. The professor will personally help students in order to clarify the doubts that they may have about the contents of the subject or the problems solved. He also personally attend students who have questions about exercises sought by themselves.

Assessment

Description	Qualification

Troubleshooting and / or exercises	Following the guidelines specific to the degree program, two systems of assessment will be offered: continuous evaluation and evaluation at the end of the quadmester. In the case of continuous evaluation planning will be in the following way: Four one hour testing, designed to assess competencies A3, A4 and A10: 1. Test of item 1 (week 3 approximately). 2. Test of items 2 and 3 (week 10 approximately). 3. Test of items 4 and 5 (week 14 approximately). 4. Exercise for solving by small groups and in an individual way (week 14 approximately). Each of these tests will have an evaluation of 1,10 points. In adittion, 6% of the rating will be obtained by means of tasks to deliver in the classroom	50
Long answer tests and development	An individual test of two hours of items 1, 2, 3, 4, 5 and 6.	50

Other comments and second call

Continuous evaluation:

It will be considered that a student has opted by the continuous evaluation when, after knowing the qualification obtained in the first test of an hour, he accept to take part in the elaboración of the groups of work. In this case, the final qualification for a student is given by the formula

N = (1/2) x T + (1/2) x E

whereÂ T is the qualification, between 0 and 10, obtained as the weighted average of the qualifications of the five tests of an hour and where E is the qualification, between 0 and 10, obtained in the test of two hours. In this mode, it is considered that a student has successfully completed the course when N is greater than or equal to 5. Before the completion or delivery of each test, the date and procedure for the review of the qualifications obtained will de indicated; these qualifications will be open to the students in a reasonable period of time. The tests are not recoverable, in other words, if a student cannot present himself to realize them in the day stipulated, the professor does not have obligation to repeat them.

Qualifications obtained in the evaluables tests will be valid only for the academic course in which they are realized.

Evaluation at the end of the quadmester:

Students who do not choose continuous evaluation may be submitted to an examination, which will not necessarily be the same as the single test of two hours of items 1, 2, 3, 4, 5 and 6 of the students that follow the continuous evaluation, which will be evaluated on 10 points.Â In this mode, it is considered that a student has successfully completed the course when the qualification of the examination is greater than or equal to 5.

Recovery in July:

The day of the test of recovery, students who have chosen continuous evaluación will be able to opt, if they wish it and before seeing it, for a test where the note is obtained as

N = (1/2) x T + (1/2) x D

whereÂ T is the qualification, between 0 and 10, obtained as the weighted average of the qualifications of the five tests of an hour and where D is the qualification, between 0 and 10, obtained in a three-hour maximum test of items 1, 2, 3, 4, 5 and 6. In this mode, it is considered that a student has successfully completed the course when NR is greater than or equal to 5.

In case of not choosing this option, or if they do not qualify to choose it because they have not participated in the continuous evaluation, the recovery examination, not necessarily the same as that taken by the students who have chosen the above mentioned option, will be also a three-hour maximum test of items 1, 2, 3, 4, 5 and 6. In this case, the test will be evaluated on 10 points and it will be considered that a student has successfully completed the course when the qualification of the test is greater than or equal to 5.

Qualification of Not Present:

A student will be deemed not present if he does not opt for continuous evaluation and, at most, he appears to the first individual test of one hour. Otherwise he shall be deemed present and he shall be granted the corresponding qualification.

Sources of information
D. C. Lay, Álgebra lineal y sus aplicaciones, 3ª, Pearson Education (2007)
D. Poole, Álgebra lineal: Una introducción moderna, 2º, Thomson (2007)
L. Merino; E. Santos, Álgebra lineal con métodos elementales, 1ª, Thomson (2006)

Recommendations

Subjects that continue the syllabus

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Mathematics: Calculus II/V05G300V01203
Mathematics: Probability and Statistics/V05G300V01204
Digital Signal Processing/V05G300V01304
Computer Networks/V05G300V01403

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus I/V05G300V01105

IDENTIFYING DATA				
Mathematics: Calculus I				
Subject	Mathematics: Calculus I			
Code	V05G300V01105			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Language	Spanish			
Department				
Coordinator	Calvo Ruibal, Natividad			
Lecturers	Calvo Ruibal, Natividad Cid Iglesias, María Begoña Fernández Manin, Generosa González Rodríguez, Ramón Martín Méndez, Alberto Lucio			
E-mail	nati@dma.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim that pursue with this subject is that the student know the basic technicians of the differential calculation in one and several real variables and his applications. Al term of this subject it expects that the student have achieved the understanding of the basic concepts of the differential calculation in one and several variables, the handle of the usual differential operators of the mathematical physics and of the technicians of differential calculation for the research of extremes, local approximation of functions and numerical resolution of systems of equations. Besides, it will have to know handle some computer program of symbolic calculation and graphic representation.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A10	CE1/FB1: The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial derivatives equations; numerical methods, numerical algorithms, statistics and optimization

Learning aims		
Subject competences	Typology	Competences
FB1 Capacity for the resolution of the mathematical problems that can pose in the engineering. FB1.2 Aptitude to apply the knowledges on differential and integral calculation. FB1.4 Aptitude to apply the knowledges on numerical and algorithmic methods numerical.	Know How	A10
CG4 Capacity to resolve problems with initiative, takes of desisiones and creativity and capacity to communicate and transmit knowledges, skills and destrezas.	Know How	A4
CG3 Knowledge in basic matters that them capacite for the learning of new methods and theories, and endow them of versatilidad to adapt to new situations.	know	A3

Contents	
Topic	
Subject 1. Introduction.	Sets of numbers and functions of one variable. n-dimensional space. Polar, cylindrical and spherical coordinates.
Subject 2. Continuity of functions of one variable.	Limits. Continuity. Theorem of the intermediate value. Theorem of Bolzano. Method of bisection.
Subject 3. Continuity of functions of several variables.	Functions of several variables. Limits. Continuity. Theorem of Bolzano.

Subject 4. Derivation of functions of one variable.	Derivation of a function in a point. Derivative function, derivative successive, properties. Rule of the chain. Implicit derivation. Derivation of reverse functions.
Subject 5. Applications of the derivative.	Maxima and minimum. Theorem of the mean value. Rule of L'Hopital. Local study of the graphic of a function. Taylor polynomial. Method of Newton.
Subject 6. Differential of functions of several variables.	Directional derivatives. Partial derivatives. Jacobian matriz. Rule of the chain. Higher order derivatives. Differential operators.
Subject 7. Applications of the differential calculation.	Extreme values. Extreme values with equality constraints. Method of Newton.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	38	66.5	104.5
Troubleshooting and / or exercises	10	14	24
Laboratory practises	2	1.5	3.5
Troubleshooting and / or exercises	4	8	12
Troubleshooting and / or exercises	2	4	6

*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 professor will expose the theoretical contents of the matter.
Troubleshooting and / or exercises	They will resolve problems and exercises of each one of the subjects and the student will have to resolve similar exercises.
Laboratory practises	They will use computer tools (Maxima and/or Matlab) to resolve exercises and apply the knowledges purchased in the theoretical classes.

Personalized attention

	Description
Master Session	The professor will attend personally the doubts and queries of the students. They will attend doubts so much of form presencial, especially in the classes of problems and in the schedules of tutorías, as of form no presencial by means of electronic post. The students will have occasion of to go to tutorías in the dispatch of the professor in the time that the professors will establish to such effect to principle of course and that will publish in the page of the subject.
Troubleshooting and / or exercises	The professor will attend personally the doubts and queries of the students. They will attend doubts so much of form presencial, especially in the classes of problems and in the schedules of tutorías, as of form no presencial by means of electronic post. The students will have occasion of to go to tutorías in the dispatch of the professor in the time that the professors will establish to such effect to principle of course and that will publish in the page of the subject.
Laboratory practises	The professor will attend personally the doubts and queries of the students. They will attend doubts so much of form presencial, especially in the classes of problems and in the schedules of tutorías, as of form no presencial by means of electronic post. The students will have occasion of to go to tutorías in the dispatch of the professor in the time that the professors will establish to such effect to principle of course and that will publish in the page of the subject.

Assessment

Description	Qualification

Troubleshooting and / or exercises	Competencies A3, A4 and A10 First session (1 hour): Subject 1. (Aprox. week 5). Second session (1 hour): Subjects 2 and 3. (Aprox. week 8). Third session (1 hour): Subjects 4 and 5. (Aprox. week 11). Fourth session (1 hour): Subject 6. (Aprox. week 14). The four previous sessions add 40% of the total note. The punctuation of each one of them will be of 10%.	40
Troubleshooting and / or exercises	Competencies A3, A4 and A10. Final examination on the subjects 1, 3, 6 and 7 of the matter. His punctuation will be 60% of the total note.	60

Other comments and second call

Following the own guidelines will offer two systems of evaluation: continuous evaluation and evaluation at the end of the term.

1. Evaluation continued will consider that a student has opted by continuous evaluation when, after having presented to the first session of continuous evaluation, deliver to the professor before 17 of October, the leaf of registration in this type of evaluation. Once expressed by writing his wish to take part, will not be able to change the option of evaluation. The continuous evaluation features of the four sessions that are presented in this guide and of the final examination. The sessions are not recoverable, that is to say, if a student can not present to realise them in the day stipulated by the professor, this does not have obligation to repeat them. Before the realisation of each session will indicate the date and procedure of review of the qualifications obtained that they will be public in a reasonable term of time (generally a week).

The final note of a student that do continuous evaluation will obtain by means of the formulae

$N = (1/10) \times C + (6/10) \times E$

C : Note, between 0 and 40, obtained like the sum of the notes of the sessions of an hour.

E : Note, between 0 and 10, obtained in the final examination on the subjects 1, 3, 6 and 7 of the matter.

In this modality, a student will be approved when N was main or equal than 5.The qualification obtained in the tasks evaluables will be valid so alone for the academic course in which realise .

2. Evaluation at the end of the cuatrimestre.

Students that do not follow continuous evaluation will be able to present to a final examination, that will not be necessarily the same that the one of the continuous evaluation, on all the subjects of the matter. The date of this examination will be the same in which will take place the final examination of the continuous evaluation. In this case, the examination will be evaluated between 0 and 10 points and a student will be approved when the note of his examination are main or equal than 5 .

3. Recovery in the month of July (second announcement)

The day of the examination of recovery, the students that chose continuous evaluation, will be able to opt, if they wish it, to an examination where the note obtain

$NR= (1/10) \times C + (6/10) \times D$

C : Note, between 0 and 40, obtained like the sum of the notes of the sessions of an hour.

D : Note, between 0 and 10, obtained in an examination on the subjects 1, 3, 6 and 7 of the matter.

In this modality a student will be approved when NR was main or equal than 5.

In case of no choose this option, or of not being able to do it by have not followed continuous evaluation, the examination of recovery will be on all the contents of the matter and will be marked between 0 and 10. This examination will have a maximum length of three hours and will not be necessarily the same that the one of the continuous evaluation. A student will be approved when the note of his examination are main or equal than 5.

4. Note of No Presented

A student will consider no presented if, at most, has taken part in the first session of continuous evaluation. In any another case, the student will consider presented and will receive his corresponding note.

Sources of information
J. Stewart, Cálculo de una variable, 4ª edición, Thomson-Learning, 2001
D.G. Zill y W.S. Wright, Cálculo de una variable, 4ª edición, Mc Graw Hill, 2011
E. Marsden y A.J. Tromba, Cálculo vectorial, 5ª edición, Pearson-Addison Wesley, 2004

Recommendations

Subjects that continue the syllabus

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Mathematics: Calculus II/V05G300V01203
Mathematics: Probability and Statistics/V05G300V01204
Digital Signal Processing/V05G300V01304
Electromagnetic Transmission/V05G300V01303

Subjects that are recommended to be taken simultaneously

Mathematics: Linear Algebra/V05G300V01104

IDENTIFYING DATA				
Physics: Analysis of Linear Circuits				
Subject	Physics: Analysis of Linear Circuits			
Code	V05G300V01201			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Language	Spanish			
Department				
Coordinator	Sánchez Sánchez, Enrique			
Lecturers	Díaz Otero, Francisco Javier García Mateo, Carmen García-Tuñón Blanca, Inés Gómez Araújo, Marta Prol Rodríguez, Miguel Sánchez Sánchez, Enrique			
E-mail	enrique.sanchez@uvigo.es			
Web	http://www.faitic.uvigo.es			
General description	The course introduces the fundamentals of the lumped circuit principles and abstractions on which the design of electronic systems is based. These include lumped circuit models for sources, resistors, inductors, and capacitors. It intends to present some techniques to analyze (to determine currents and voltages) such systems: conventional analysis (integer-differential analysis, phasors and impedances in sinusoidal regime) and linear systems theory based analysis (by using the Laplace and Fourier transforms).			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A13	CE4/FB4: Comprehension and command of basic concepts in linear systems and their related functions and transforms; electric circuits theory, electronic circuits, physical principles of semiconductors and logical families, electronic and photonic devices, materials technology and their application to solve Engineering problems.

Learning aims		
Subject competences	Typology	Competences
To know the elements and laws involved in lumped circuit analysis.	know	A13
To show the ability to analyse linear circuits in different circumstances. -. to know how to choose among different alternatives when solving a problem. -. to know simplifying techniques, their constraints, and how to decide which ones must be used.	know Know How	A4 A13
To translate the time domain into the transformed domains, by using transforms basic concepts.	know	A13
To be able to qualitatively justify the role played by circuit elements and their interactions.	Know How	A3 A13
To master the language and symbolism of the discipline	Know How	A3

Contents	
Topic	
I: Introduction	Fundamental and derived magnitudes. Active and passive elements and their functional relationships. Kirchhoff's laws. Simplifying techniques; Thévenin and Norton equivalent circuits. Analysis by the technique of mesh voltages. Analysis by the techniques of node currents.

II: Transient Response	Transient and steady-state regimes. Transient regime origin. Conditions of study (transient between two steady-state continuous regimes, two reactive elements as a maximum). Inductors and capacitors in steady-state continuous regime. Single reactive element networks: time expression, time constant. Two reactive elements networks: types of responses, time expressions, damping coefficient, angular resonant frequency. Networks changing in several time values. Partially coupled elements networks.
III: Steady-state sinusoidal response	Definition and parameters. Concepts of phasor and impedance. Mesh and node analysis of steady-state sinusoidal regime networks. Autoinductance and mutual inductance. Linear and ideal transformers. Power expressions: instantaneous power, complex power, average power, reactive power. Thévenin and Norton equivalent circuits. Frequency response. Using the superposition principle.
IV: Two-ports	Definition of a two-port circuit. Characteristic parameters. Sets of characteristic parameters. Characteristic parameters determination. Combining two-ports. A two-port in a circuit.
V: Signals and systems	lasses of signals. Some relevant signals: step function, unit impulse function, exponential function, sinusoidal function. Classes of systems. System properties; linear, time invariant systems; response to impulse.
VI: Laplace transform	Definition. Direct transforms. Inverse transform determination. Application to linear circuits. The transference function. Steady-state response in a circuit. Response for a sinusoidal input. Application of the superposition principle.
VII: Fourier transform	Fourier series expansion. Expressions of Fourier series expansion. Amplitude and phase spectra. Frequency response. Fourier transform. Fourier transform expressions. Properties: linearity, simmetry, time displacement, time/frequency scaling, modulation.
VIII: Filters.	Filter concept. Filter classes. Ideal and real filters. Low pass prototype based design. Filter responses.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Master Session	24	48	72
Laboratory practises	21	21	42
Forum Index	0	5	5
Troubleshooting and / or exercises	5	15	20
Practical tests, real task execution and / or simulated.	5	5	10

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

Methodologies	
	Description
Introductory activities	Presentation of the course: syllabus, bibliography, teaching methodology, and assessment and grading procedures.
Master Session	The goal of this methodology is the presentation of the theoretical contents and the practical assessment about students learning abilities. In 3 of these sessions, written quizzes will be conducted of 55 minutes each as a maximum.
Laboratory practises	Circuit simulation exercises will be done by using PSpice and Matlab software packages for 20 hours (in 3 of them evaluatiin exercices will be conducted). During 6 additional hours circuit implementation and measurement tasks will be done, with two evaluation exercises.
Forum Index	The course web site is hosted in UVIGO e-learning platform (http://faitic.uvigo.es). It includes all the information related to the course. Forums for ideas interchanging and comments will be available.

Personalized attention	
	Description
Master Session	Personal attention will be carried out under student demand, at the professor room and/or at the laboratories, during the time schedules established and posted by the instructors at the beginning of the course. Additionally, discussion forums at the web site will be used as communication channel between instructors and students.
Laboratory practises	Personal attention will be carried out under student demand, at the professor room and/or at the laboratories, during the time schedules established and posted by the instructors at the beginning of the course. Additionally, discussion forums at the web site will be used as communication channel between instructors and students.
Forum Index	Personal attention will be carried out under student demand, at the professor room and/or at the laboratories, during the time schedules established and posted by the instructors at the beginning of the course. Additionally, discussion forums at the web site will be used as communication channel between instructors and students.

Assessment		
	Description	Qualification
Practical tests, real task execution and / or simulated.	5 evaluation exercises will be done along the semester. They will be conducted in medium-size groups. 3 of them will concern circuit simulation, 0.75, 1 and 1.25 points, respectively, being assigned. The 2 remaining exercises will refer to circuit implementing and testing (with maximum qualifications of 0.5 and 1 points, respectively). In these exercises skills concerning join work will be evaluated. Capabilities A3 and A13 are evaluated by means of these tests.	45
Troubleshooting and / or exercises	3 exercises to be done during the time schedule for lecture sessions. Each one is referred to one or two of the most relevant topics in the course. Each exercise consists of two or more questions. Maximum qualifications of 1, 2, and 2.5 points will be assigned, respectively. Capabilities A4 and A13 are evaluated by means of these tests.	55

Other comments and second call

Additionally to the evaluation system above described, the student may choose to do a final exam. This exam will have the same characteristics than exercises named "Solving problems and/or exercises ", being evaluated among 0 and 10 points.Â

The student, in agreement to the official academic-year schedule, will have two opportunities during the academic year to pass the course.

1. First opportunity at the end of the semester (end of semester). The student is free to choose the continuous evaluation system above described, without excluding the possibility to do a final exam. Possible cases:

- Students only doing the continuous evaluation: they are graded with the points obtained in the evaluation.
- Students doing both the continuous evaluation and the exam: they are graded with the best of both qualifications.
- Students only doing the final exam: they are graded with the points obtained in the exam.

2. Extraordinary exam. Students not passing the course at the end of the semester may do a final exam like the aforementioned. Points reached in it (among 0 and 10) will be the final grade.

Additional comment: Doing 4 or more tests and/or the final exams will prevent the student to get the "Not presented" mark.

Re-scheduling of tests. In case of missing a test, instructors have not any compulsion to rescheduling.

Test results. Before each test, the date and revision procedure of assigned grading marks will be indicated. Such dates will imply a reasonable delay (in general, not greater than three weeks)Â between theÂ date of testÂ and the release of the grading marks.

Sources of information
James W. Nilsson, Electric Circuits, , Pearson
Enrique Sánchez, Carmen García Mateo, Material docente, Página web, faitic.uvigo.es
J.H. McClellan, R.W. Schafer, M.A. Yoder, Signal Processing First, , Pearson Prentice Hall

J. W. Nilsson's book will be the basic course reference. It is a book covering all the course content in more extension and by using a very clear language. It includes a number of exercises, both proposed and solved. A number of editions are available, in general with little differences among them. It is recommended to the students to use the English editions.

Additionally, the students will have available in the course web site some teaching material (extended lectures notes, practice handbooks, exam examples).

McClellan et al. book is mentioned as a complementary reference, specially indicated for signal processing and filtering lessons. This book will be used in a second year course devoted to digital signal processing.

Recommendations

Subjects that continue the syllabus

Physics: Fundamentals of Electronics/V05G300V01305
Digital Signal Processing/V05G300V01304
Signal Transmission and Reception Techniques/V05G300V01404
Microwave Circuits/V05G300V01611
Radio Frequency Circuits/V05G300V01511
Analogue Electronics/V05G300V01624
Engineering of Electronic Equipment/V05G300V01523

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus II/V05G300V01203

Subjects that it is recommended to have taken before

Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105

Other comments

It is strongly recommended that students are familiar with complex numbers, trigonometric functions, linear equation system solving, elemental function derivatives and computation of simple integrals.

IDENTIFYING DATA				
Physics: Fields and Waves				
Subject	Physics: Fields and Waves			
Code	V05G300V01202			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Language	Spanish Galician			
Department				
Coordinator	García Pino, Antonio			
Lecturers	Fraile Peláez, Francisco Javier García Pino, Antonio García-Tuñón Blanca, Inés Gómez Araújo, Marta Obelleiro Basteiro, Fernando Rubiños López, José Óscar			
E-mail	agpino@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Fields and Waves presents the first contact the student's degree with the phenomena of electromagnetic wave, which is the physical transmission of information. mathematical modeling of electromagnetic fields that provide insights into the behavior of electromagnetic waves in real environments will be introduced.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A10	CE1/FB1: The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial derivatives equations; numerical methods, numerical algorithms, statistics and optimization
A12	CE3/FB3: Comprehension and command of basic concepts about the general laws of mechanics, thermodynamics, electromagnetic fields and waves and electromagnetism and their application to solve Engineering problems.

Learning aims		
Subject competences	Typology	Competences
Understanding and mastery of the general laws of fields and waves	know	A12
Knowledge of basic topics and technologies, enabling students to learn new methods and technologies, as well as endowed with the versatility to adapt to new situations.	know	A3
Ability to solve math problems that may arise in engineering: Ability to apply knowledge of linear algebra, geometry and differential geometry.	Know How	A10
Ability to solve math problems that may arise in engineering: Ability to apply knowledge of differential and partial-differential equations	Know How	A10

Contents	
Topic	
1. Vector and differential analysis of fields	1.1 Scalar and vector fields 1.2 Systems of coordinates in space 1.3 Vector Algebra 1.4 Integral Operators 1.5 Differential operators 1.6 Properties of operators
2. Electrostatic fields	2.1 Sources of the electrostatic field 2.2 Equations of the electrostatic field, electric potential 2.3 Electrostatic fields produced by charge distributions 2.4 Electrostatic field in material media 2.5 Equations of Poisson and Laplace

3. Magnetostatic fields	3.1 Sources of magnetostatic field 3.2 Magnetostatic field equations 3.3 Magnetostatic field produced by current distributions
4. Fields in material media	4.1 Electrostatic field in material media 4.2 Magnetostatic field in material media
5. Maxwell Model	5.1 Maxwell's equations in integral form 5.2 Differential form of Maxwell's equations 5.3 Boundary conditions. 5.4 Energy balance of the electromagnetic field 5.5 Harmonic time variation 5.6 Harmonic time variation in material media
6. Wave equation and its solutions	6.1 Introduction. 6.2 Wave equation for time harmonic fields 6.3 Propagation, attenuation and phase constants 6.4 Solutions in rectangular coordinates 6.5 Progressive, stationary and evanescent waves in lossy and losseless media
7. Uniform plane waves	7.1 Expressions of the fields 7.2 Characteristic impedance 7.3 Poynting Vector 7.4 Time domain fields 7.5 Polarization
8. Wave reflection and transmission	8.1 Reflection and transmission coefficients 8.2 Standing waves 8.3 Polarization and power

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	25	37.5	62.5
Case studies / analysis of situations	13	18	31
Troubleshooting and / or exercises	13	19.5	32.5
Troubleshooting and / or exercises	3	9	12
Long answer tests and development	2	10	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	Exhibition by the professor of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student.
Case studies / analysis of situations	Analysis of a fact, problem or real event with the purpose to know it, interpret it, resolve it, generate hypothesis, contrast data, think about it, complete knowledges, diagnose it and train in alternative procedures of solution.
Troubleshooting and / or exercises	Problems and/or exercises related with the subject are formulated. The student has to develop the suitable or correct solutions by development of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. I complement of the lectures.

Personalized attention

	Description
Master Session	The students will have occasion of atend to personalized tutorial sessions in the officce of the professor during the schedule established for that at the begining of the course. The schedule will be published in the web page of the subject. Students will be able to also pose his queries by e-mail.
Troubleshooting and / or exercises	The students will have occasion of atend to personalized tutorial sessions in the officce of the professor during the schedule established for that at the begining of the course. The schedule will be published in the web page of the subject. Students will be able to also pose his queries by e-mail.
Case studies / analysis of situations	The students will have occasion of atend to personalized tutorial sessions in the officce of the professor during the schedule established for that at the begining of the course. The schedule will be published in the web page of the subject. Students will be able to also pose his queries by e-mail.

Assessment		
	Description	Qualification
Troubleshooting and / or exercises	Proof in which the students have to solve series of problems and/or exercises in a time/condition established by the professor. In this way, the students have to apply their knowledge. In this proof the skills A10 and A12 are assessed	60
Long answer tests and development	Final examination: Proof for evaluation of the skills that includes open questions on a subject. The students have to develop, relate, organise and present their knowledge about the subject in an extensive answer. In this proof the skills A3, A10 and A12 are assessed	40

Other comments and second call

Following the guidelines of the studies, two systems of evaluation will be offered to the students enrolled in this subject: either continuous evaluation or evaluation at the end of the semester. Criteria for both are detailed below.

1. CONTINUOUS EVALUATION.

- The student that receive it this system of evaluation will be able to achieve a maximum grade of 6 points.
- The students must complete three evauable tasks. The preliminary schedule and the weight of each task in the final grade are:
  - Task 1. Week 4 (approximately). Topic 1. Weight 10%. EC1 up to 1p.
  - Task 2. Week 8 (approximately). Topics 2 to 4. Weight 20%. EC2 up to 2p.
  - Task 3. Week 12(approximately). Topics 5 and 6. Weight 30%. EC3 up to 3p.
- The date and review procedure of the obtained marks will be officially communicated before the completion or delivery of eac task. Students will have the opportunity to be informed about the status of each task and review their evaluation within a reasonable period of time.
- The task are not recoverable. If a student cannot fulfilled them in the stipulated term, the professor is not bound to repeat them.
- The qualification for students who opt for continuous evaluation (EC) will be calculate as the sum of the obtained marks in the three tasks: EC=EC1+EC2+EC3.
- The obtained qualification (EC) will be valid only for the current academic course.
- It will be considerer that a student follows this continuous evaluation system when after completing the first task the student carries out the second task.

2. FINAL EVALUATION AT THE END OF SEMESTER.

- This procedure will consist in a final examination that includes the contents developed in the classes of theory and practice.
- This exam will be mandatory for all students. There are three cases:
  - For students that do not opt by the continuous evaluation points reached in it (among 0 and 10) will be the final grade.
  - Students doing the continuous evaluation: they are graded with the points obtained in the evaluation follow the next:
    - The part of the exam corresponding to topics 7 and 8 is mandatory for all of them. (Score EC4 up to 4p.)
    - If (EC1+EC2) is less than 1, the part of the exam corresponding to topics 1 to 4 is mandatoty. In other case thay can take this part to improve the sum (EC1+EC2)
    - If EC3 is less than 1, the part of the exam corresponding to topics 5 and 6 4 is mandatoty. In other case thay can take this part to improve the sum EC3
    - The final score is EF=(EC1+EC2)+EC3+EC4

3. RETAKE IN THE JULY SESSION.

- It will consists on a final examination as the aforementioned.
- For students in continuous evaluation, the exam is divided in three parts corresponding to the qualifications (EC1+EC2), EC3 and EC4. Students will take necessarily the parts of the exam with qualification less than 1. Optionally they will be able to take the rest in order to improve the corresponding qualification. The final qualification will be EF=(EC1+EC2)+EC3+EC4.

ADITIONAL COMMENTS:

- It will be considered as presented every student that receives any of the two final exams or two of the exercicies of continuous evaluation.
- If a student has participated in the continuous evaluation and does not pass the course he/she will be considered as presented and will receive a grade of fail, regardless of he/she takes the final exam or not.
- The subject is considered passed if the final grade obtained is equal or greater than 5p.

Sources of information

Basic:

Fundamentos de Electromagnetismo para Ingeniería, D.K. Cheng. Ed. Addison Wesley, 1998. (o su versión original en inglés: Fundamentals of Engineering Electromegnetics, D.K.Cheng, Ed. Addison Wesley 1993)
Campos electromagnéticos, F. Dios, D. Artigas et all. Ediciones UPC. 1998.
Fundamentos de la Teoría Electromagnética, J.R. Reitz, F.J. Milford, R.W. Christy, Ed. Addison Wesley, 1996

Complementary:

Field and Wave Electromagnetic, D.K. Cheng, 2ª edición, Ed.Addison-Wesley. 1989.
Electromagnetic Waves, U.S. Inam y A.S. Inan. Ed. Prentice Hall. 2000.
Teoría Electromagnética, 7ª Ed. W.H. Hayt Jr., J.A.Buck. Ed. Mc Graw Hill, 2006.
Ondas Planas, J.E. Page, C. Camacho. Serv. Pub. ETSIT Madrid. 1983.
Electromagnetic Fields and Waves, M. F. Iskander. Ed. Prentice Hall. 1992.
Problemas de campos electromagnéticos. Serv. Pub. ETSIT Madrid. 2001.

Recommendations

Subjects that continue the syllabus

Electromagnetic Transmission/V05G300V01303

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus II/V05G300V01203

Subjects that it is recommended to have taken before

Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105

IDENTIFYING DATA				
Mathematics: Calculus II				
Subject	Mathematics: Calculus II			
Code	V05G300V01203			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Language	Spanish			
Department				
Coordinator	García Lomba, Guillermo			
Lecturers	García Lomba, Guillermo Martín Méndez, Alberto Lucio Martínez Varela, Áurea María Prieto Gómez, Cristina Magdalena			
E-mail	guille@dma.uvigo.es			
Web	http://faitic.uvigo.es/			
General description	The matter of Calculus II of the Degree in Engineering of Technologies of Telecommunication provides basic and common training to the branch of the telecommunication. Such as it figures in the memory of the degree, students should be able to formulate, to solve and to interpret mathematically problems within engineering of telecommunication at the end of the lectures. For this, they should know how to calculate integrals of functions of one and several variables and its meaning and they should handle the basic numerical methods of approximation for this kind of integrals. On the other hand, they should become familiar with the developments of functions in Fourier series. Also, they will have to know how to solve differential equations of first and second order. Finally, they should know to handle the Laplace transform in order to solve differential equations. All of these contents are notable for several matters that they must to study simultaneously or later in the degree.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A10	CE1/FB1: The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial derivatives equations; numerical methods, numerical algorithms, statistics and optimization

Learning aims		
Subject competences	Typology	Competences
CE1/FB1 Capacity for the resolution of mathematical problems that can be posed in the engineering. FB1.2 Aptitude to apply the knowledges on differential and integral calculus. FB1.3 Aptitude to apply the knowledges on differential equations and in partial differential equations. FB1.4 Aptitude to apply the knowledges on numerical methods and algorithms.	Know How	A10
CG3 Knowledge of basic matters and theories that qualify the student for the learning of new methods and technologies, as well as that it endow him with a big versatility of adaptation to new situations.	know	A3
CG4 Capacity to solve problems with initiative, to take decisions, the creativity, and to communicate and transmit knowledges and skills.	Know How	A4

Contents
Topic

Theme 1. Integral calculus in R.	The Riemann integral Integrable functions. The fundamental theorem of the integral calculus. The theorem of the half value. The rule of Barrow. Calculus of primitives: integration by parts and change of variable. Improper integrals.
Theme 2. Orthogonal functions and Fourier series.	Orthogonal functions. Fourier series. Developments of Fourier series for odd and even functions. Convergence. The Fourier transform.
Theme 3. Numerical integration.	Interpolatory quadratures. Properties. Error of interpolation. Particular cases: Poncelet, tapezoidal and Simpson formulas. Formulas of composite quadrature.
Theme 4. The multiple integral in the sense of Riemann.	The double and triple integrals in elementary regions. Change of the order of integration. Theorems of change of variable. Cylindrical and spherical coordinates. Applications.
Theme 5. Introduction to ordinary differential equations.	Differential equations. Generalities Concept of solution. Differential equations of first order. Existence and uniqueness of solution. Autonomous equations. Separate variables. Homogeneous equations. Exact equations. Linear equations. Families of curves and orthogonal paths.
Theme 6. Ordinary differential equations of second order.	Differential equations of second order and of upper order. Homogeneous and non homogeneous linear differential equations. Linear differential equations with constant coefficients. Indeterminate coefficients. Variation of parameters. Cauchy-Euler equation.
Theme 7. The Laplace transform.	Definition of the Laplace transform. Properties. Application to the solution of differential equations.

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	17	17	34
Laboratory practises	3	6	9
Master Session	28	56	84
Troubleshooting and / or exercises	5	10	15
Practical tests, real task execution and / or simulated.	1	1	2
Troubleshooting and / or exercises	2	4	6

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

Methodologies

	Description
Troubleshooting and / or exercises	In these hours of work the professor will solve problems of each one of the subjects and will enter new methods of solution no contained in the master classes from a practical point of view. The student also will have to solve problems proposed by the professor with the aim to apply the obtained knowledges.
Laboratory practises	In these practices, the computer tools MATLAB or MAXIMA will be used to study and to apply the numerical methods of approximation of integrals described in the Theme 3 of the matter.
Master Session	The professor will expose in this type of classes the theoretical contents of the matter.

Personalized attention

	Description

Master Session	The professor will attend personally the doubts and queries of the students. He will solve doubts in his office, in the classes of problems, and in the laboratory. Also the Web platform Faitic will be used to help the students. They will have occasion of to attend tutorial sessions in a timetable established at the beginning of the course and which will be published in the Web page of the department.
Troubleshooting and / or exercises	The professor will attend personally the doubts and queries of the students. He will solve doubts in his office, in the classes of problems, and in the laboratory. Also the Web platform Faitic will be used to help the students. They will have occasion of to attend tutorial sessions in a timetable established at the beginning of the course and which will be published in the Web page of the department.
Laboratory practises	The professor will attend personally the doubts and queries of the students. He will solve doubts in his office, in the classes of problems, and in the laboratory. Also the Web platform Faitic will be used to help the students. They will have occasion of to attend tutorial sessions in a timetable established at the beginning of the course and which will be published in the Web page of the department.

Assessment

	Description	Qualification
Troubleshooting and / or exercises	Five "one hour sessions", in which the competencies A10/FB1, A3/CG3 y A4/CG4 will be assessed. - 1st session: Theme 1 (4th week aprox.) - 2nd session: Theme 2 (8th week aprox.) - 3rd session: Theme 4 (11th week aprox.) - 4th session: Theme 5 (13th week aprox.) - 5th session: Theme 6 (15th week aprox.) These five sessions account for 35% of the score with the following weights: - First: 10% (1 point) - Second: 5% (0,5 points) - Third: 10% (1 point) - Forth: 5% (0,5 points) - Fifth: 5% (0,5 points)	35
Practical tests, real task execution and / or simulated.	The students will do a practice of laboratory of the Theme 3 using MATLAB or MAXIMA (8th week aprox.), in which the competency FB1.4/A10 will be assessed. Its value will be of 5% (0,5 points)	5
Troubleshooting and / or exercises	Final examination of the Themes 4, 5, 6 and 7, in which the competencies A10/FB1, A3/CG3 y A4/CG4 will be assessed. Its value will be of 60% of the score (6 points)	60

Other comments and second call

The evaluation will preferably be continuous. The student will be enrolled in this kind of assessment if he attends the first evaluable session. Once enrolled, it is impossible to unsubscribe from continuous assessment.

The exams of continuous evaluation are not recoverable, ie, if a student can not assist to the test in the date stipulated by the teacher, it is impossible to require the repetition. Before performing each test, both the approximate date of publication of the qualifications and the date and procedure for review them will be communicated. The score obtained at the evaluable tasks will be only valid for the academic year in which the student make them.

In tests of continuous assessment the student will solve problems and exercises of the topics of matter.

1. Continuous assessment.

The final score for a student who makes continuous assessment is given by the formula

N = C + E

C: Note obtained by adding the scores of the six sessions of the items 1, 2, 3, 4, 5 and 6.
E: Note of the final examination of the items 4, 5, 6 and 7.

In this mode **a student will pass the subject when N is greater than or equal to 5**.

2. Final evaluation of the semester.

Those students who fail to continuous assessment may be submitted to a final exam of all topics in the subject on the same date that the final exam of continuous assessment. In this exam the competencies A10/FB1, A3/CG3 y A4/CG4 will be assessed.

These students will be evaluated from 0 to 10 points and **theywill pass the subject when the obtained score is**

greater than or equal to 5.

3. Recovery of July.

In the recovery day, students who chose continuous assessment may choose, if desired, for an exam of the items 4, 5, 6 and 7, in which the competencies A10/FB1, A3/CG3 y A4/CG4 will be assessed. The final grade is obtained as

NR = C + ER

C: Note obtained by adding the scores of the six sessions of the items 1, 2, 3, 4, 5 and 6.
ER: Note the final recovery examination of the items 4, 5, 6 and 7.

In this mode a student **will pass the subject when NR is greater than or equal to 5**.

If they do not choose that option, the student will be assessed in all the issues on the subject. In this exam the competencies A10/FB1, A3/CG3 y A4/CG4 will be assessed.

In this other method they will be evaluated from 0 to 10 points. A student **will pass the subject when the obtained score is greater than or equal to 5**.

4. Qualification of not presented.

Finally, a student is considered not presented **if he is not enrolled in the continuous assessment and he does not attend any of the examinations** of the subject. Otherwise he is considered presented.

Sources of information
D. Zill & W.S. Wright, Cálculo de una variable, 4ª, McGraw-Hill (2011)
E. Marsden & A.J. Tromba, Cálculo vectorial, 5ª, Pearson-Addison Wesley (2004)
D.G. Zill & M.R. Cullen, Ecuaciones diferenciales, 3ª, McGraw–Hill (2008)
A. Quarteroni & F. Saleri, Cálculo científico con Matlab y Octave, 1ª, Springer (2006)

Recommendations

Subjects that are recommended to be taken simultaneously

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Mathematics: Probability and Statistics/V05G300V01204

Subjects that it is recommended to have taken before

Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105

IDENTIFYING DATA

Mathematics: Probability and Statistics

Subject	Mathematics: Probability and Statistics			
Code	V05G300V01204			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Language	Spanish			
Department				
Coordinator	Fernández Bernárdez, José Ramón			
Lecturers	Alonso Alonso, Ignacio Comesaña Alfaro, Pedro Curty Alonso, Marcos Fernández Bernárdez, José Ramón Mojón Ojea, Artemio Santalla del Río, María Verónica			
E-mail	jramon.fernandez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this subject we review some basic concepts of statistics, probability and random processes. These concepts are necessary in order to easily follow other subsequent subjects.			

Competencies

Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A10	CE1/FB1: The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial derivatives equations; numerical methods, numerical algorithms, statistics and optimization
B1	The ability for critical reading of scientific papers and docs.

Learning aims

Subject competences	Typology	Competences
The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about statistics.	know	A10
The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations	know	A3
The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills.	Know How	A4
The ability for critical reading of scientific docs.	Know How	B1

Contents

Topic	
Probability theory	Concept of probability. Axiomatic definition. Conditional probability, total probability and Bayes theorems. Independence.

One-dimensional random variables	Concept of random variable (RV). Classification. Cumulative distribution function (CDF) and properties. Discrete random variables: probability mass function. Continuous random varriables: density function. Functions of RV. CDF and discrete RV. Transformation of continuous RV: fundamental theorem. Mean and variance.
Random vectors	CFD and continuous RV. Marginals. Point and line masses. Conditional density. Continuous versions of Bayes and total probability theorems. Two-dimensional transformations: fundamental theorem. Changes of dimension. Correlation and regression.
Estimation and limit theorems	Sample and population. Estimators. Estimation of mean and variance. Sequences of RV. Laws of the large numbers. Central limit theorem.
Stochastic processes	Description of a stochastic process. Statisticis of a stochastic process. Stationarity. Examples.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	24	24	48
Troubleshooting and / or exercises	13.5	28	41.5
Practice in computer rooms	14	7	21
Troubleshooting and / or exercises	1	4	5
Multiple choice tests	0.5	2	2.5
Practical tests, real task execution and / or simulated.	0.5	2	2.5
Jobs and projects	0	6	6
Other	0.5	1	1.5
Long answer tests and development	2	20	22

*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 divided in five main topics. Each topic will have a theoretical part that will be exposed by the teacher in big group. The students will be required to perform a previous reading of the contents.
Troubleshooting and / or exercises	Each topic will be complemented with problem resolution. The problems could be developed and solved in big or small group. The students will be required to work previously on these problems.
Practice in computer rooms	Each topic will be completed with one or several sessions of computer practices. For this, a software developed by the teachers and specific questionnaires for each topic will be used. The students will be required to perform a previous reading of the contents.

Personalized attention

	Description
Master Session	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Troubleshooting and / or exercises	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Practice in computer rooms	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.

Jobs and projects	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.

Assessment

	Description	Qualification
Troubleshooting and / or exercises	Twice the semester, students must solve a problem. In this proof the skils A10, A3 and A4 are evaluated	15
Multiple choice tests	The students must answer a test. In this proof the skils A10, A3 and A4 are evaluated	10
Long answer tests and development	Final exam. In this proof the skils A10, A3 and A4 are evaluated	50
Practical tests, real task execution and / or simulated.	In group B class, students must answer a questionnaire. The use of computer is allowed. Students can be distributed in pairs. Each couple answers a unique questionnaire. In this proof the skils A10, A3 and A4 are evaluated	10
Jobs and projects	The students, in groups of 3 or 4, should propose four test questions on a particular topic. In this proof the skils A4 and B1 are evaluated	10
Other	At the end of a group B class, each student will correct a problem made by somebody else. In this proof the skil B1 is evaluated	5

Other comments and second call

Following the guidelines of the studies, two evaluationÂ systemsÂ will be offered to the students inscribed on this subject: continuous evaluation and evaluation at the end of the semester.

The continuous evaluation consists of several tasks.Â

A student follows the continuous evaluation system if she/he participates in task 3 (approximately in the seventh week of the semester) or any later task. Tasks 1 and 2 may be performed without opting for the continuous evaluation.Â

Students who choose continuous evaluation:

Several tasks are evaluated. TheÂ approximate task calendar and the weight of each taskÂ in the final grade are listed below.

Task 1: Individual resolution of a problem. Weight 5%. Week 4

Task 2: Correction of the task 1 from somebody else. Weight 5%. Week 5

Task 3: Development of a test. This is done in groups of 4. Weight 10%. Week 7

Task 4:Â Individual resolutionÂ of a test. Weight 10%. Week 10

Task 5: Individual resolution of a problem. Weight 10%. Week 12

Task 6: Answer a questionnaire by couples with the help of the computer. Weight 10%. Week 14

The last task of the continuous evaluation will be a final exam. This will be a smaller version of the exam to be carried out by students who do not opt for continuous evaluation. The weight of the examination in the final grade will be 50 %

Before the completion or delivery of each task, the date and procedure for the review of the obtained marks will be indicated. Students will have the option to know the status of each task and review the correction within a reasonable period of time (a week, generally).

These tasks are not recoverable, what means that if a student cannot fulfill them in the stipulated period, teachers will not be committed to repeat them.

The obtained grade will be valid only for the current academic course.

If a student has participated in continuous evaluation and does not pass the course he/she will receive a grade of fail, regardless of he/she takes the final exam or not.

The final grade for students who opt for continuous evaluation will be calculated as the average between the final exam and the previous tasks marks. To minimize the impact of a possible miss on a task, the average of these will be computed excluding the worst obtained grade. Taking into account that tasks 1 and 2 are two parts of the same exercise, and that jointly weigh 10%, they will be considered as a whole for the purpose of excluding the worst mark.

Students who choose for evaluation at the end of the semester:

The possibility of a final examination will be provided to students who do not opt for the continuous evaluation. This exam will be rated between 0 and 10, and this will be the final grade obtained.

Retake in the July session

Previously to the exam (or at its beginning), students will be asked to choose to be evaluated by continuous evaluation system (described before) or only by the final exam.

The subject is considered passed if the final grade obtained is equal to or greater than 5.

Sources of information
H. Stark y J.W. Woods, Probability, Random Processes, and estimation theory for engineers, 2, Prentice Hall, 1994
X. Rong Li, Probability, Random Signals and Statistics, 1, CRC Press, 1999
R. Cao y otros, Introducción a la estadística y sus aplicaciones, 1, Pirámide, 2001
P. Peebles, Principios de probabilidad, variables aleatorias y señales aleatorias, 4, McGraw-Hill, 2006
A. Papoulis, Probability, random variables and stochastic processes, 4, McGraw-Hill, 2002
D. Peña, Estadística, modelos y métodos. Tomo 1: Fundamentos, 2, AUT, 1991

In addition to the bibliography above, the student will have the following support material:Â

- Notes of the course

- Bulletins of problems

- Questionnaires for laboratory

The main features of the notes of the course are:

- They include the theoretical contents of the course.

- They include space for exercises and problems. Some are resolved in class and others are proposed.

- At the end of each chapter there is a set of problems belonging to any of the books listed in the bibliography and recommended readings. In general these problems are somewhat easier than those from bulletins.

Â

Bulletins of problems contain useful exercises to understand the subject.

Â

Questionnaires for the laboratory include the statements and each practice problems and also some theoretical content. It is very important to read them in advance to carry out the practice.

Â

This material is available through faiTIC platformÂ (http://faitic.uvigo.es)

Recommendations
Subjects that continue the syllabus
Data Communication/V05G300V01301 Computer Networks/V05G300V01403 Signal Transmission and Reception Techniques/V05G300V01404 Fundamentals of Bioengineering/V05G300V01915

Subjects that are recommended to be taken simultaneously
Mathematics: Calculus II/V05G300V01203

Subjects that it is recommended to have taken before
Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105

IDENTIFYING DATA				
Programming I				
Subject	Programming I			
Code	V05G300V01205			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	1st	2nd
Language	Spanish			
Department				
Coordinator	Pazos Arias, José Juan			
Lecturers	García Palomares, Ubaldo Manuel Pazos Arias, José Juan Ramos Cabrer, Manuel Santos Suárez, José Manuel			
E-mail	jose@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim of the course is to provide students with basic skills to program in a high level language.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A15	CE6/T1: The ability to learn independently new knowledge and appropriate techniques for the conception, development and exploitation of telecommunication systems and services
A21	CE12/T7: The knowledge and use of basics in telecommunication networks, systems and service programing.

Learning aims		
Subject competences	Typology	Competences
Ability to express the solution of a simple problem with algorithms using top-down design.	Know How	A4 A21
Ability to identify the data needed to solve a problem and associate them with appropriate datatypes of the language.	Know How	A4 A21
Ability to encode simple algorithms with the basic types of instructions: assignment, selection and iteration.	Know How	A21
Ability to declare and define functions with proper use of parameters.	Know How	A21
Ability to manage the operations of I / O and file operations.	Know How	A21
Ability to define and use structured data types.	Know How	A21
Ability to define and manage dynamic data structures (lists, stacks, queues and trees).	Know How	A21
Ability to use library modules and create new functions.	know Know How	A15 A21
Ability to analize a sequence of statements	know	A21
Ability to handle basic tools in an integrated development environment: text editor, compiler, linker, debugger and tools for documentation.	Know How	A15
Ability to use basic concepts of software engineering in the formulation of a small scale project.	Know How Know be	A4 A9 A15 A21

Contents
Topic

Topic 1:The computer and programming languages	1. The computer 2. Programming concepts, software and programming paradigms 3. Stages of software development 4. High-level and low-level programming languages 5. Source code and object code 6. Compilers and interpreters 7. The concept of algorithm 8. Flowcharts, seudo code and natural language for the representation of algorithms 9. General structure of a C program
Topic 2: Basic elements (integers, characters, floats and pointers)	1. Tokens in C: data type, identifier, variable, constant, operator and expression 2. Basic data types and attributes: name, type, memory address, size, value, scope, life. 3. Identifiers 4. Arithmetic operations 5. Logical operations 6. Relacional operations 7. Type conversions 8. Declaration and assignment operations 9. Definition and declaration of pointer variables 10. Basic operations on pointers
Topic 3: Control Instructions (assignment, conditional, iterative and input / output)	1. Basic types of control instructions (sequence, selection and repetition) 2. Selection Instructions (if-else, switch, operator ?...:) 3. Iterative instructions (for, while, do-while), break; and continue; instructions 4.Instructions for standard input/output: printf, scanf 5. Compilation Directives
Topic 4: Functions	1. Modular or procedural programming, problem reduction 2. The structured programming paradigm 3. Declaration and definition of functions 4. Functions without parameters 5. Global variables, local and static 6. Parameter communication by value 7. Parameter communication by reference 8. Entering parameters via the Command window: argc, argv [] 9. Recursive functions
Topic 5: Structured data types	1. Data structures (array, struct, union) 2. One dimensional and two dimensional arrays 3. Strings 4. Declaration and use of data structures 5. Typedef declaration 6. Nested Structures 7. Library functions for string management
Topic 6: Files	1. Concept of file and stream 2. Standard Flows 3. Text files and binary files 4. Basic operations on files, opening and closing, reading, writing 5. Access Modes 6. Macros NULL and EOF 7. Input / output libraries 8. Formatted input/output
Topic 7: Dynamic Memory Management	1. Introduction to dynamic memory management 2. Library functions for dynamic memory management 3. Common linked lists: single, double, circular, circular double binary tree 4. Insertion, replacement and deletion of nodes in linked lists 5. Node structure in linked lists 6. Interaction between lists and files

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	2	4
Master Session	25	25	50
Laboratory practises	11	11	22
Projects	11	33	44

Group tutoring	0	3	3
Multiple choice tests	0	4	4
Practical tests, real task execution and / or simulated.	3	6	9
Troubleshooting and / or exercises	4	10	14

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

Methodologies

	Description
Introductory activities	Introduction to theoretical and practical activities.
Master Session	Plenary sessions that include the realisation of works and programs.
Laboratory practises	During the first weeks of the term the student codifies, compiles and documents programs guided by the instructor. Some of these activities will be evaluated.
Projects	During the second half of the term, the student must complete a medium complexity project, under the instructor supervision, which includes individual and in group activities.
Group tutoring	Both theoretical and practical issues are discussed in small groups with the instructor.

Personalized attention

	Description
Master Session	The webpage of the course informs on the prescheduled office hours that students can consult the instructors. This consulting will be devoted to discard doubts arisen in classroom, laboratory activities and the development of the project.
Laboratory practises	The webpage of the course informs on the prescheduled office hours that students can consult the instructors. This consulting will be devoted to discard doubts arisen in classroom, laboratory activities and the development of the project.
Projects	The webpage of the course informs on the prescheduled office hours that students can consult the instructors. This consulting will be devoted to discard doubts arisen in classroom, laboratory activities and the development of the project.

Assessment

	Description	Qualification
Laboratory practises	Assignments and exercises carried out in the laboratory. These exercises evaluate skills CG4 and CE12/T7.	10
Projects	The evaluation will consist of three activities: 1) report describing the design of the project, 2) a laboratory test focusing on the main ideas behind the project design and implementation, 3) a final report pointing out the main features and the flawless execution of the project. This projecto evaluate skills CG4, CG9, CE6/T1 and CE12/T7.	30
Practical tests, real task execution and / or simulated.	The student will implement one programming exercice. These test evaluate skills CE6/T1 and CE12/T7.	10
Troubleshooting and / or exercises	Exercises proposed during the development of the lectures. Final exam. These proofs will evaluate skills G4 and CE12/T7.	45
Multiple choice tests	(*)Realizarase un cuestionario tipo test ao longo do curso. Nesta proba avaliaranse as competencias CE6/T1 e CE12/T7.	5

Other comments and second call

Below is the planning of the subject by showing lectures and the estimated time of the most important milestones of assessment:

	Theory	**Laboratory Theory Evaluation**	**Laboratory Evaluation**
Week 1	Lecture 1Â		
Week 2	Lecture 2	Practice 1	
Week 3	Lecture 2 / Lecture 3	Practice 2	Practical assignmentÂ 1 (EP1)
Week 4	Lecture 3	Practice 2	
Week 5	Lecture 3	Practice 3	Practical assignment 2 (EP2)

Week 6	Lecture 4	Practice 3	Web Test 1 (CW1)	
Week 7	Lecture 4	PL1		Laboratory TestÂ (PL1)
Week 8	Lecture 4Â	Project	Classroom Test 1 (PA1)	
Week 9	Lecture 5	Project		Project Design Report (PR)
Week 10	Lecture 6	Project	Web Test 2 (CW2)	
Week 11	Lecture 6	Project		
Week 12	Lecture 7	Project	Classroom Test 2 (PA2)	
Week 13	Lecture 7	PL2		Project Test (PL2)
Week 14	Lecture 7	Project		
Period of examinations			Final proof on all the contents of the subject (PFT)Â	Delivery and defence of the project developed in the laboratory (PR)

In all courses the School offers two evaluation modes: Continuous evaluation and comprehensive evaluation. The student must opt to the latter one explicitily, no latter than the grade of the first practical evaluation in the course is officially reportedÂ (PL1).

The continuous evaluation will be considered as "approved" if the final grade obtained by the student is at least 5. This final grade is the harmonic mean between the theory and practice, calculated as follows:

N_F= Â (2*NP* N_T)/Â (NP+ N_T)

NP (Max. 100%) = EP (Max. 20 %)+ PL1 (Max. 20 %)+PL2 (Max. 20%)+PR (Max. 40 %)

N_T (Max. 100%) =CW (Max. 10 %)+PA1 (Max. 10 %)+PA2 (Max. 20 %)+PFT (Max. 60%)

The use of the harmonic means implies that both NPand $N_{TÂ}$ must be above 3.3 to approve the course. In any case, the harmonic means must no be inferior to 5.

No evaluation of any activity in the continous evaluation mode is repeatable; that is, an instructor is not obligued to reschedule an evaluated activity missed by a student. No evaluation will be enforced after the end of the term the student is enrolled to.Â

The comprehensive evaluation consists of practical programming exercices, in paper and with computer, and the presentation on a project report.Â

NP (no present) will be granted:

1. In continuous evaluation when no asssignment after the first is graded (PL1)
2. In comprehensive evaluation when no assignment is graded

University regulations allow students to take an aditional test to approve the course:

- In the continuos evaluation mode the student should approve a theoretical exam, should do a code implementacion on paper and/or computer and design and implement an extension of the project. The student can:
    - Waive the theoretical exam if his/herÂ theory grade is not under 5Â Â ($N_{TÂ}$ no lower than 50%);
    - Waive the practical test, i.e., project plus programming if the Laboratory grade obtained in the term was at least 50 %.
    - Nonetheless, the student can take, if he/she wishes so, the theoretical and lab exams.
- In the comprehensive evaluation mode the student should approve a theoretical exam, should do a code implementation on paper and/or computer and design and implement a project.Â Students under continuos evaluation mode can opt for this alternative evaluation mode.

The student that can opt of voluntary form by one or another optionÂ will be able to do it until the moment of delivery or realisation of the corresponding proofs.

The note obtained in the continuous evaluation does not save Â of a course for the following.

In case of detection of plagiarism in any of the works/test realised the qualification will be of suspense (0) and the professors will communicate to the direction of the school the subject so that it take the measures that consider timely. In the case that the plagiarism detect in any of the works/test of continuous evaluation will not allow that the student follow this procedure of evaluation.

Sources of information
Osvaldo Cairo Battistuti, Fundamentos de Programación, 2006, Pearson Education
José Rafael García-Bermejo Giner, Programación Estructurada en C, 2008, Prentice Hall
Brian W. Kernighan & Dennis M. Ritchie, El Lenguaje de Programación C, 1995, Prentice Hall
James L. Antonakos & Kenneth C. Mansfield Jr., Programación Estructurada en C, 2004, Prentice Hall
Jorge A. Villalobos S. & Rubby Casallas G., Fundamentos de Programación: Aprendizaje Activo Basado en Casos, 2006, Prentice Hall
Manuel Caeiro Rodríguez, Enrique Costa Montenegro, Ubaldo García Palomares, Cristina López Bravo, J, Practicar Programación en C, 2014, Andavira

Web resources

- http://www.Cprogramming.com
- José R. García-Bermejo Giner: Â http://maxus.fis.usal.es/FICHAS_C.WEB/11xx_PAGS/11xx.html

Recommendations

Subjects that continue the syllabus

Programming II/V05G300V01302

Subjects that it is recommended to have taken before

Informatics: Computer Architecture/V05G300V01103

Other comments

The subject Programming II is a continuation of this subject in the second course.

IDENTIFYING DATA				
Data Communication				
Subject	Data Communication			
Code	V05G300V01301			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Language	Spanish			
Department				
Coordinator	López García, Cándido Antonio			
Lecturers	Díaz Redondo, Rebeca Pilar Fernández Veiga, Manuel Herrería Alonso, Sergio López García, Cándido Antonio Sousa Vieira, Estrella			
E-mail	candido@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this subject the efficiency and reliability of data transmission using discrete memoryless channels will be analyzed, and the next issues will be introduced: * lossless data compression methods, * linear error control codes, * data link layer protocols, and * multiple access channels protocols and technologies.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A20	CE11/T6: The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact.
A26	CE17/T12: The knowledge and usage of concepts of communication network architecture, protocols and interfaces.
A27	CE18/T13: The ability to differentiate the concepts of access and transport networks, packet and circuit switched networks, mobile and fixed networks, as well as distributed newtwork application and systems, voice, data, video, audio, interactive and multimedia services.
A29	CE20/T15: The knowledge of national, European and international telecommunication regulations and laws.

Learning aims		
Subject competences	Typology	Competences
Knowledge of the foundations of discrete Information Theory	know	A3
Understanding of the basic properties of lossless data compression methods and linear error control codes	Know How	A4
Knowledge of logical link protocols and physical level interfaces	know	A26 A29
Understanding the principles and fundamental technologies of local area networks, as well as their interconnection possibilities among them and with other types of networks	Know How	A20 A27

Contents
Topic

Unit 1. Fundamentals of discrete Information Theory	1.1. A basic model of data communication systems 1.1.1. Discrete sources: discrete memoryless sources 1.1.2. Discrete channels: discrete memoryless channels 1.1.3. Source coding and channel coding 1.2. Information measures 1.2.1. Entropy. Joint entropy 1.2.2. Conditional entropy 1.2.3. Mutual information 1.3. Shannon's source coding theorem 1.3.1. Uniquely decodable codes: instantaneous codes 1.3.2. Kraft's theorem. McMillan's theorem 1.3.3. Optimal codes. Code redundancy 1.3.4. Shannon's source coding theorem 1.3.5. Compact codes. Huffman's algorithm 1.4. Shannon's noisy channels coding theorem 1.4.1. Channel capacity 1.4.2. Symmetric channels 1.4.3. Shannon's noisy channels coding theorem
Unit 2. Data transmission error control	2.1. Linear codes 2.1.1. Definition and matrix description 2.1.2. Syndrome decoding 2.1.3. Error detection and correction properties 2.1.4. Hamming codes 2.1.5. Cyclic codes 2.2. ARQ protocols 2.2.1. Stop and wait 2.2.2. Go-back n 2.2.3. Selective repeat
Unit 3. Multiple access channels and local area networks	3.1. Multiple access channels 3.1.1. The multiple access channel: definition and types 3.1.2. MAC protocols: Aloha, CSMA and variants 3.1.3. Performance of MAC protocols 3.2. Local area networks 3.2.1. Wi-Fi networks 3.2.2. Ethernet networks 3.2.3. Switching ethernet 3.2.4. Virtual local networks

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	0	26
Previous studies / activities	0	47	47
Troubleshooting and / or exercises	24	0	24
Autonomous troubleshooting and / or exercises	0	47	47
Long answer tests and development	6	0	6

*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	Systematic exposition of the theoretical contents of the subject, emphasizing the aims, fundamental concepts and relationships between the different units.
Previous studies / activities	Students will study the theoretical contents of the subject using the textbook and/or further material.
Troubleshooting and / or exercises	Selected problems and/or exercises will be solved in detail, emphasizing the theoretical concepts involved and the methodology of resolution.
Autonomous troubleshooting and / or exercises	Students will try to autonomously solve a problems and/or exercises from a proposed collection.

Personalized attention	
	Description
Previous studies / activities	Individual tuitition will be dispensed to the students in the office hours announced at the beginning of the term.
Autonomous troubleshooting and / or exercises	Individual tuitition will be dispensed to the students in the office hours announced at the beginning of the term.

Assessment		
	Description	Qualification
Long answer tests and development	Two partial examinations and a final examination. In each one of them we will evaluate all the competencies corresponding to the contents we have seen in class to date of the examination.	100

Other comments and second call

The students will choose their grading method between two possibilities: continuous assessment or single examination.

The continuous assessment comprises two midterm exams (20% each) and a final written exam (60%).

The single examination option will require the student to pass a written exam about the contents of the subject. The final grade will be equal to the points awarded to this exam.

Every student who commits to any of the midterms or the final exam will be graded. Attending one of the midterm exams will be considered as choosing the continuous assessment mode.

Any gradings are only valid during the academic year.

Those who fail the subject in the first call at the end of the ordinary term can use the second call in July, which consist in taking a single written exam. The students will be graded according to the option (continuos or single) of their preference, as marked in the exam cover.

Sources of information

C. López García, M. Fernández Veiga, Teoría de la Información y Codificación, 2/e, 2013, Andavira editora

C. López García, M. Fernández Veiga, Cuestiones de Teoría de la Información y Codificación, 2003, Tórculo edicións

J. F. Kurose, K. W. Ross, Computer Networking, 6/e, 2012, Addison Wesley

Recommendations

Subjects that continue the syllabus

Computer Networks/V05G300V01403

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204

IDENTIFYING DATA				
Programming II				
Subject	Programming II			
Code	V05G300V01302			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Language	Spanish			
Department				
Coordinator	Fernández Masaguer, Francisco			
Lecturers	Blanco Fernández, Yolanda Fernández Masaguer, Francisco Manso Vázquez, Mario Servia Rodríguez, Sandra			
E-mail	francisco.fernandez@det.uvigo.es			
Web	http://www.faitic.es			
General description	The general aim of this subject is to provide the students with the theoretical foundations and the practical competitions that allow them analyze, design, develop and debug computer applications following the paradigm of oriented objects programming (OOP). This is an essentially practical subject oriented to the work of the students in the development of software projects. To make this task easier, the subject includes an introduction to the Engineering of the Software. In this sense, the focus is not put on all the well-known phases of the processes of development software (ranging from capture and description of requirements to the deployment of the systems), but just on main stages related to analysis, design, implementation and debugging. Firstly, the engineering of the software is presented as an indispensable discipline for the development of big computer applications, showing the main challenges to face and the basic concepts behind them. Next, the elements of the OOP will be detailed by resorting to UML elements and diagrams, which will be used by the students in their developments. To reach this general aim the contents that will be handled in the subject are the following ones: OOP paradigm: basic concepts, classes and objects. Encapsulation. Concepts of decoupling and cohesion Inheritance, abstraction, polymorphism and reuse Relations between classes: Generalization, association and dependency Communication between objects: methods, events, messages Persistence. Storage in files and in databases Generation, capture and processing of exceptions Introduction to the Engineering of the Software Concepts of the Engineering of the Software. Historical review or Introduction and concept of Cycle of Life.			

Competencies	
Code	
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A59	(CE50/T18)The ability to develop, interpret and debug programs using basic concepts of Object Oriented Programming (OOP): classes and objects, encapsulation, relations among classes and objects, and inheritance.
A60	(CE51/T19) The ability of basic application of phases of analysis, design, implementation and debugging of OOP programs.
A61	(CE52/T20) The ability of manipulation of CASE tools (editors, debuggers).
A62	(CE53/T21) The ability of developing programs considering to the basic principles of software engineering quality taking into account the main existing sources of norms, standards and specifications.
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Subject competences	Typology	Competences

To understand the fundamental concepts of the Object Oriented Programming model (OOP) and carry them to practise iusing the most representative object oriented programing languaje (Java).	know Know How Know be	A9 A59
To introduce in the use of the UML language, the ISO standard language for software modeling, for the making of structure, behaviour and interaction diagrams, and fundamental for the documentation in the phases of analysis and design of OO programs.	know Know How	A6 A61 A62 B5
To develop skills in the process of analysis, design, implementation and debugging of OOP applications taking into account the main standards and quality norms.	Know How Know be	A60 A62
To adquiry maturity in development and debugging programming techniques to allow the autonomous learning of new capacities and programming languages.	know Know How Know be	A62
To adquiry familiarity with the use of a modern software development tool (Eclipse) to facilitate the design, development and debugging of programs.	Know How Know be	A60 A61

Contents

Topic	
1. Introduction to OO paradigm	a. Brief introduction to the subject and organization. b. Birth of the paradigm c. Bases: classes and objects d. Concepts of encapsulation, inheritance (generalization), and polymorphism e. Brief Introduction to UML
2. Encapsulation	a. Classes, interfaces and packages b. Methods and variable member. Visibility. Resolution of field. c. Method constructor d. Step of parameters: pointers and references e. Pointers to objects
3. Inheritance	a. Derived classes and types of inheritance b. Abstract Classes c. Multiple Inheritance d. Object class
4. Object-Oriented design	a. Design Basics b. Use of UML diagrams
5. Polymorphism	a. Overloading and overwriting b. Abstract classes and interfaces c. Generic classes
6. Exception Handling	a. Exception Basics b. Handling Java exceptions

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	28	42	70
Troubleshooting and / or exercises	9	9	18
Autonomous troubleshooting and / or exercises	4	10	14
Case studies / analysis of situations	1	1	2
Projects	9	31	40
Case studies / analysis of situations	0	1	1
Troubleshooting and / or exercises	3	0	3
Practical tests, real task execution and / or simulated.	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	Classes that will combine explanation of theoretical concepts and realisation of small exercises. These will be able to be resolved by the professor or by the own students individually and/or in group. The goal is to boost the debate in the class and reinforce the acquisition of skills. This methodology is oriented to the acquisition by the student of competences CE50, CE51 and CE53.

Troubleshooting and / or exercises	In the computer rooms, the professor will pose challenges to be resolved by the students, thus discussing collectively the possible options to face a solution. This methodology is oriented to competences CE50, CE51 and CE53.
Autonomous troubleshooting and / or exercises	Students individually will resolve the problems posed by the professor in the computer room. Solutions and doubts that arise in addressing these problems will be put together to agree the best way to fix each concern. This methodology is oriented to competences CE50, CE51, CE53 and A9.
Case studies / analysis of situations	Put in common of the designs posed to solve the project that have to carry out during the second part of the course. The comparison of the different proposals will serve to select the best options and be used, if it is timely, to improve the designs realised. This methodology is oriented to competences CE51 and CE52.
Projects	The students will develop a software project defined by the professor. The development of this project will require face-to-face work in the computer room (supported by the professor) and individual work. This methodology is oriented to competences CE50, CE53, A6 and A9.

Personalized attention

	Description
Troubleshooting and / or exercises	The personalized attention will consist of following-up the work of each student, tracking the solutions proposed for each problem posed in the sessions in the computer room and the exhibition of their UML designs for the proposed software project.
Projects	The personalized attention will consist of following-up the work of each student, tracking the solutions proposed for each problem posed in the sessions in the computer room and the exhibition of their UML designs for the proposed software project.
Autonomous troubleshooting and / or exercises	The personalized attention will consist of following-up the work of each student, tracking the solutions proposed for each problem posed in the sessions in the computer room and the exhibition of their UML designs for the proposed software project.
Case studies / analysis of situations	The personalized attention will consist of following-up the work of each student, tracking the solutions proposed for each problem posed in the sessions in the computer room and the exhibition of their UML designs for the proposed software project.

Assessment

	Description	Qualification
Projects	The students, organized into groups of 2 people, will submit a software project during the week from 2 to 6 of December of the course. This submission must include the UML diagrams of the final design, the code and the documentation about the implementation details. The software must run correctly on the computers of the educational laboratories. In the assessment, the professor will consider both the correct execution of the program and the designed adopted in the development. With this test CE53, CE50, A6 (CG6), A9(CG9) and B5 competences will be assessed.	30
Case studies / analysis of situations	The students, organized into groups of 2 people, will submit and present in the computer room the design defined for the project software, including UML class diagrams. This design will be submitted during the week from 4 to 7 of November of the course. With this test CE51, CE52 and A9 competences will be assessed.	10
Troubleshooting and / or exercises	Each student will take a final exam in the official date published in www.teleco.uvigo.es, which will consist of the following types of questions: resolution of problems, short-answer questions about the theoretical concepts explained in master sessions, true/false assessments, multiple-choice tests. Note that support materials are not allowed. The number and the combination of the aforementioned questions will be defined for each particular exam. With this test, CE50, CE51 and CE53 competences will be assessed.	50
Practical tests, real task execution and / or simulated.	The students, organized into groups of 2 people, will submit the Java initiation practices proposed in the computer room. This submission will take place during the week from 21 to 25 of October of the course. With this test, CE50, CE52 and CE53 competences will be assessed.	10

Other comments and second call

Thee are two modalities in the evaluation of this subject: continuous evaluation (EC) and traditional evaluation (ET). Â The students will have to choose one of the two modalities taking into account the following restrictions:

- The EC includes the 4 proofs described in the separated evaluation.Â Â
- So much by EC as by ET, the students will have to realise a project of laboratory. To facilitate the election of EC or ET the students will have in Faitic platform of the project to realise from the day 20 September.

- In ET the project will realise of individual form.
- The students that opt by the EC will have to deliver in the first week Â of November, the UML design of the project posed in the laboratory (corresponding to the 3ª proof of evaluation). By means of said delivers the students engage to be followed the EC and renounce to the ET. From this moment, these students will not be able to appear as "No presented".
- The students that do not deliver the UML design of the project in the week of the 4 to 7 November, renounce to the EC, so that they will be evaluated by means of the mechanism of ET. It does not exist the possibility to add to EC in the following intermediate proofs.
- The proofs of EC will not be in no case recoverable, not being able to repeat out of the dates stipulated by the educational.
- They will not save qualifications (of proofs of EC neither of practical projects or final examinations) of a course to another.
- The EC only will apply in the first announcement, in the rest of announcements governs only the ET.

First announcement. Students that opt by EC.Â They will beÂ evaluated as follows:

- Theoretical part:
  - Examination written (50%). Individual examination. It corresponds with the proof 3 described in the separated "Evaluation".Â It will not allow material of support.
- Practical part:
  - Practices of initiation in Java (10%). In groups of 2 students. It correspondsÂ with the proof 4 described in the separated "Evaluation".Â
  - Project (40%). In groups of 2 students. Divided in two parts:Â
    - Design (10%).Â It corresponds with the proof 2 described in the separated "Evaluation".Â
    - Implementation (30%).Â It corresponds with the proof 3 described in the separated "Evaluation".Â This project will have to beÂ deliveredÂ individuallyÂ the first week of December of the educational period.Â For his evaluation will realise , like previous requirement, a proof or interview of authorship:
      - If the student does not surpass it, the evaluation of the implementation realised by an examination practise.Â
      - If the student surpasses the proof of authorship, his note of evaluation (that it will be the same for both members of the group) will take into account: correct design, correct functionality, quality of the code and use of technicians of OOP.Â
- The requirements to approve will be:
  - AÂ minimumÂ of 1/3 on the total in the theoretical part.
  - A minimum of 1/3 on the total in the part of implementation of the project (or 1/3 on the total of the practical examination in his case).
  - A total note (sum of the 4 proofs) equal or upper to 5.

For the Â proof of authorshipÂ of the practical partÂ (that it can suppose individual questions of diverse nature) will be compulsory that theÂ code delivered can be compiled and executed in the teams of theÂ educational laboratories.

First announcement. Students that opt by ET.Â They will beÂ evaluated as follows:

- Theoretical part:
  - An examination written (whose description coincides with the proof 3 of EC). The result of this examination will suppose 50% ofÂ the final qualification.Â It will not allow material of support.
- Practical part:
  - The realisation of a software project that will suppose the other 50% of the final qualification. Of individual realisation. This projectÂ will consist of design (UML diagrams), the Java code and the documentation generated explanatory of the implementation. Â The note of evaluation will take into account: correct design, correct functionality, quality of the code and use of technicians of OOP model. This project will have to beÂ deliveredÂ individuallyÂ the first week of December.
  - The realisation of an interview with the tutor oriented to determine the authorship of the project. Said interview will take place in the laboratory thelast academic week of the course. Â If the student does not surpass the proof of authorship will have to go to an examination practise.
- The requirements to approve will be:
  - A minimum of 1/3Â on the total in the theoretical part.
  - A minimum of 1/3Â on the total in the project or practical examination according to the case.
  - A total note (sum of the 2 proofs) equal or upper to 5.

For the Â proof of authorshipÂ of the practical partÂ (that it can suppose individual questions of diverse nature) will be compulsory that theÂ code delivered can be compiled and executed in the teams of theÂ educational laboratories.

Second announcement / Announcement of end of course / extraordinary Announcement.Â In this announcement that does not govern the EC. The evaluation will be as follows:

- Theoretical part:
  - An examination written Â (whose description coincides with the proof 3 of EC). Â The result of this examination will

suppose 50% ofÂ the final qualification. It will not allow material of support.

- Practical part:
    - The students that do not deliver the project in the first announcement, will evaluate with an examination of individual programming in the laboratory that will take placeÂ in the date fixed by the Board of School for this. The evaluationÂ of this proof will suppose 50% of the final qualification.Â
    - The part practises to realise for the students that deliver the project in the first announcement, will depend on the note of the project obtained in the first announcement, as the following: Â
        - *It notices >= Â 1,5.Â* Â It will keep them the note, not having toÂ present to the practical examination of the second announcement.Â They will be able to, however,Â Â improve the punctuation of the project delivering a new versionÂ of the one of the first announcement Â together with the new functions to realise that they published in his momentÂ in the Faitic platform. Likewise, they will have to deliver a document Â that collect the changes andÂ updates realised to the project on Â the versionÂ that deliver in the first announcement. Â Â
        - *Note between 1.5 and 1.*Â They will be able to opt between going to the examination practise or realise the project of the second announcement. No it keeps them the note Â of the project of the first announcement, but if the one of initiation and the one of UML design.Â
        - *It notices Â < 1.Â* Â They will be able to opt between going directly to the examination practise or realise the project expanded. In any case loses the note of practices of the part of initiation and UML design. That is to say, it evaluated them on 5, independently of if they opt by the project or the practical examination. Â

- The requirements to approve will be:
    - A minimum of 1/3Â on the total in the theoretical part.
    - A minimum of 1/3Â on the total in the project or examination according to the case.
    - A total note (sum of the 2 proofs) equal or upper to 5.

Sources of information

Basic references:

[1] *"Absolute Java".* Walter Savitch, 4ª edición. 2010, Pearson.

[2] "*Introduction to Java programming*". Y. Daniel Liang, 8ª edición. 2010, Pearson.
[3] *"Java: How to program"/Java: cómo programa*r. P. Deitel y H. Deitel, 9ª edición. 2011, Pearson.
Â

Other references:

[1] *"Programación orientada a objetos con Java: una introducción práctica usando BlueJ*". D. J. Barnes, M. Kölling. 3ª edición. 2007, Pearson.

[2] *"The Java Tutorial. A Short course on the basics".* Sharon Zakhour, Scott Hommel, Jacob Royal, Isaac Rabinovitch, Tom Risser, Mark Hoeber, 4ª edición. 2006, Prentice-Hall.
[3] "*Data Scructures & Algorithms in Java*". Michale T. Goodrich, Roberto Tamassia, 5ª edición. 2010, Willey.

[4] *"Java Tools*". Andreas Eberhart, Stefan Fischer. 2002, Wiley

[5] *"Java In A Nutshell"*. David Flanagan, 5ª edición. 2005, O'Reilly.

[6] *"Thinking in Java"*. Bruce Eckel, 4ª edición. 2006, Prentice HallÂ Â

[7] *"Learning Java"*. Patrick Niemeyer, 3ª edición. O'Reilly Media

[8] *"How to Think Like a Computer Scientist.Â JavaTM Version"*. 4ª version. Online: http://www.greenteapress.com/thinkapjava/

[9] *"Java notes"*. Fred Swartz. Online: http://www.leepoint.net/notes-java/index.html

[10] *"Java SE. Oracle"*. Online: http://www.oracle.com/technetwork/java/javase/downloads/index.html

[11] *"Java 2 Platform Standard Edition 5.0. API Specification"*. Online: http://download.oracle.com/javase/1.5.0/docs/api/

[12] *"The Java Tutorials"*. Oracle. Online: http://download.oracle.com/javase/tutorial/

[13] *"Ingeniería del Software orientada a objetos con UML, Java e Internet".* Alfredo Weitzenfeld. 2005, Thomson.
[14] "*Open-oriented Analysis and Design with Applications"*. Grady Booch, Robert Maksimchuk, Michael Engel, Bobbi Young, Jim Conallen, Kelli Houston, 3ª edición. 2007, Addison Wesley.

[15]“Object-Oriented Analysis and Design with Applications”. Grady Booch. 2011, Addison Wesley.
[16] “UML Distilled: A Brief Guide to the Standard Object Modeling Language”. Martin Fowler. 3ª edición.
[17] “*Fundamentals of Object-oriented design in UML*”. Meilir Page-Jones. 2002, Addison Wesley.

Â Â Â Â

Recommendations

Subjects that it is recommended to have taken before

Programming I/V05G300V01205

IDENTIFYING DATA				
Electromagnetic Transmission				
Subject	Electromagnetic Transmission			
Code	V05G300V01303			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Language	Spanish			
Department				
Coordinator	Vera Isasa, María			
Lecturers	Aguado Agelet, Fernando Antonio Arias Acuña, Alberto Marcos Díaz Otero, Francisco Javier García-Tuñón Blanca, Inés Gómez Araújo, Marta Lorenzo Rodríguez, María Edita de Rubiños López, José Óscar Santalla del Río, María Verónica Vazquez Alejos, Ana Vera Isasa, María			
E-mail	mirentxu@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Fundamentals of electromagnetic guided and unguided transmission. Analysis of the operating principles of different transmission media models and their characterization in telecommunication engineering.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A17	CE8/T3: The ability to use software tools for bibliographical resources search or information related with electronics and telecommunications.
A18	CE9/T4: The ability to analyze and specify the main parameters of a communications system.
A22	CE13/T8: The ability to understand the electromagnetic and acoustic wave mechanisms of propagation and transmission, and their corresponding receiving and transmitting devices.
A29	CE20/T15: The knowledge of national, European and international telecommunication regulations and laws.

Learning aims		
Subject competences	Typology	Competences
To understand the mechanisms of propagation and transmission of electromagnetic waves.	know	A3 A22
To identify and define the main parameters that characterize transmission media of electromagnetic waves.	know	A3 A17 A18
To solve problems that require the handling of basic concepts related to guided and radio transmission.	Know How	A4 A22
To estimate transmission losses in different media.	Know How	A3 A5
To measure antenna basic parameters.	Know How	A5 A18 A29

To search updated information about specifications and regulations.	know	A3 A17 A29

Contents	
Topic	
1. Introduction	Types of transmission media, advantages and disadvantages, characterisation.
2. Transmission lines	Getting started with some of the most commonly used transmission lines: coaxial, twisted pair. Circuit model of distributed parameters ,general equations, characteristic parameters (characteristic impedance, propagation velocity, attenuation and phase coefficients). Attenuation, dispersion and crosstalk. Transmission line in circuit (reflection coefficient, standing wave ratio, input impedance). Smith Chart.
3. Waveguides and optical fiber.	Rectangular waveguide: TE and TM modes, cutoff frequency, guided wavelength, wave impedance. Optical fiber: structure, types, numerical aperture, acceptance cone , attenuation and dispersion.
4. Radiowaves and antennas	Characteristics of radiowaves: far field, radiation integral. Antenna concept and fundamental parameters (radiation pattern, secondary lobe level, beamwidth, directivity, gain, polarisation, impedance). Reception: power balance in free space (Friis equation), polarization loss factor. Center feed dipoles. Radiosystems evaluation.
Labs	- Management of software tools to search information: technical, scientific and regulation of telecommunications. - UTP and coaxial. - Basic matching technics. - Radiation pattern plots. - Measurement of basic parameters in transmission lines, waveguides and antennas. - Problem resolution.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	2.5	3.5
Master Session	17	25.5	42.5
Laboratory practises	12	6	18
Practice in computer rooms	8	4	12
Presentations / exhibitions	2	16	18
Autonomous troubleshooting and / or exercises	12	24	36
Troubleshooting and / or exercises	2	8	10
Multiple choice tests	2	8	10

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

Methodologies	
	Description
Introductory activities	Activities focused to take contact and get information about the students and to introduce the subject.
Master Session	Presentation by the teacher of the contents of the subject of study (theoretical basis). Learning aims T4, T8 and CG3.
Laboratory practises	Application of knowledge to specific situations and acquisition of basic skills and procedures related with CG5 aim. They are developed in laboratories with specialized equipment.
Practice in computer rooms	Activities of acquisition of basic skills related with the matter. Learning aims T3 and T15 are specifically worked with this methodology.

Presentations / exhibitions	Student presentation of the results of a group work about T15 aim.
Autonomous troubleshooting and / or exercises	Activity in which problems are formulated related to the subject. The student must develop the analysis and solving problems independently. The solutions are provided in ordinary class hours. Learning aim CG4.

Personalized attention	
	Description
Master Session	Students will have the opportunity to attend personalized tutoring in the schedule that teachers establish for this purpose at the beginning of the course and will be published in the course website. The teacher will resolve in the classroom the doubts that arise in the moment of the class and in the tutoring schedule those that arise when realising the autonomous study.
Autonomous troubleshooting and / or exercises	Students will have the opportunity to attend personalized tutoring in the schedule that teachers establish for this purpose at the beginning of the course and will be published in the course website. The teacher will resolve in the classroom the doubts that arise in the moment of the class and in the tutoring schedule those that arise when realising the autonomous study.

Assessment		
	Description	Qualification
Laboratory practises	Performing lab practices that require instrumentation handling in which CG5 learning aim is assessed.	20
Presentations / exhibitions	Performing lab practices of software tools to search of information and a work about telecommunication regulation. Learning aims T3 and T15 are jointly assessed.	10
Multiple choice tests	Tests for evaluation of acquired skills including direct questions about a particular aspect. Students must respond directly and briefly based on their subject knowledge. Learning aims T4, T8 and CG3.	30
Troubleshooting and / or exercises	Proof in which the student has to solve a series of problems in a time and conditions established by the teacher, applying the acquired knowledge. Assessment of T4, T8, CG3 and CG4 learning aims.	40

Other comments and second call

Following the guidelines of the degree two evaluation systems will be offered: continuous assessment or final exam.

Continuous assessment includes a series of tasks performed during the course (70%) and a multiple-choice test (30%) performed on date according to the official exam schedule. To pass the subject by this evaluation system, 1/3 of the maximum score of each item in the above table must be obtained (except for the multiple choice test) and 50% minimum of the global score (sum of the four blocks) must be reached.

The tasks in the course include the active participation in ordinary classroom and laboratory sessions, autonomous working, information search, development and submission of a report and two tests of problem solving (the first scheduled at the middle of the term and the second by the end). These tasks are **not recoverable**, ie if a student cannot fulfill on time the teacher has no obligation to repeat them and will **only be valid for the academic year in which they are made**.

The students must decide if they choose the ongoing evaluation after the realization of the first test of problem solving on the 8 th - 9 th week of class, in which case they receive a grade that corresponds,Â independently that they present to other tasks or not. If the score is high as 50% without getting 1/3 in some of the items, the official grade will be 4.5

Evaluation by final exam

In addition to the continuous assessment system described above, the student may choose to perform one final exam that will have three parts:
- Part I: practice and report (pass or fail).
- Part II: multiple-choice test (40%).
- Part III: problem solving (60%).

It is necessary to pass the first part to be submitted to the other two. Obtaining a "fail" translates into a 2 official grade. If you have made the qualifying practices and the oral presentation of the report (essential) and have passed the third corresponding to, you do not need to perform the first part of the final exam.

July exam

It consists of a final exam with the same characteristics and weights as indicated in the previous section.

Students who want to preserve the grade obtained in the first tasks of the continuous assesment (70%) can elect to perform only the multiple-choice test (30%) provided that minimum requirements had been got.

To pass the subject at least 50% in the total qualification must be obtained in any of the evaluation systems and calls.

Sources of information
F.T. Ulaby, Fundamentals of Applied Electromagnetics, 6ª, Pearson, 2010
S.M. Wentworth, Applied electromagnetics. Early transmission line approach, 1ª, Wiley, 2007
D. K. Cheng, Fundamentos de electromagnetismo para ingeniería, , Addison-Wesley, 1997

Additional references:

B.M. Notaros, **Electromagnetics**, Pearson 2011.

N.N.Rao, **Elements of engineering electromagnetics**, Pearson, 6ª ed., 2004.

J.D. Krauss, **Electromagnetismo con aplicaciones**, McGraw-Hill 2000.

D. K. Cheng. **Field and Wave Electromagnetics,** Addison-Wesley, 2ª ed.,1989.

Recommendations

Subjects that continue the syllabus

Fundamentals of Sound and Image/V05G300V01405
Signal Transmission and Reception Techniques/V05G300V01404
Microwave Circuits/V05G300V01611
Radio Frequency Circuits/V05G300V01511
Spectrum Management/V05G300V01612
Optical Telecommunication Infrastructures/V05G300V01614
Wireless Systems and Networks/V05G300V01615
Radio Communication Systems/V05G300V01512

Subjects that are recommended to be taken simultaneously

Digital Signal Processing/V05G300V01304

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Mathematics: Calculus I/V05G300V01105
Mathematics: Calculus II/V05G300V01203

IDENTIFYING DATA				
Digital Signal Processing				
Subject	Digital Signal Processing			
Code	V05G300V01304			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Language	Spanish			
Department				
Coordinator	García Mateo, Carmen			
Lecturers	Abreu Sernández, María Victoria Alonso Alonso, Ignacio García Mateo, Carmen Márquez Flórez, Óscar Willian			
E-mail	carmen.garcia@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Digital signal processing is nowadays a feature of most everyday communications and entertainment devices. The aim of this course is to equip students with a mathematical grounding in general signal and systems analysis. In subsequent course subjects, this knowledge will be applied to specific applications of signals and systems, including audio, image, video and voice signals. Objectives cover the following areas: • Managing signals and systems mathematically and visually, including learning and applying their properties. • Studying the different domains for signal and systems analysis: time domain, frequency domain and Z domain. • Learning how to transfer a problem in one domain to a domain in which it is easier to solve. • Mastering the concept of filter frequency response and learning to interpret the system function. • Understanding the relationship between the poles and zeros of the system function and the frequency response. • Acquiring basic notions of filter design in the Z domain. • Managing specific digital signal processing software. • Applying the above knowledge to simple and practical laboratory examples.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A57	(CE48/T16) The knowledge of the appropriate techniques to develop and exploit signal processing subsystems .
A58	(CE49/T17) The ability to analyze digital signal processing schemes.

Learning aims		
Subject competences	Typology	Competences
Managing specific software for digital signal processing	Know How	A57
Applying mathematical knowledgements for signal filtering	know	A58
Mastering filtering opperations in frequency domain.	know	A3 A58
Learning mathematical issues for understanding the processes of sampling and windowing signals.	Know How	A4 A57
Analysis of simple processing systems.	Know How	A58

Contents
Topic

Subject 1. Introduction to Sampling and Aliasing	Sampling and digital frequency. Analog frequency vs discrete frequency. Aliasing. The sampling theorm.
Subject 2. FIR Filters	Difference equation. Filter Coefficients. Block Diagrams. Causality, linearity and time-invariance. LTI systems and convolution. FIR frequency response. Cascaded LTI systems.
Subject 3. Z Transform	Definition and properties. Linear-phase filters.
Subject 4. IIR Filters	Difference equation. Filter Coefficients. Block Diagrams. Impulse response. Relation between the position of poles and zeros of the system function and the frequency response.
Subject 5. Continuous-Time Signals and Systems	The unit impulse. The unit step. Time delaying. Linearity and time-invariance. Convolution
Subject 6. Continuous-Time Fourier Transform	Definition. Basic pairs. Properties
Subject 7. Sampling and Reconstruction in the Frequency Domain	The sampling theorem in the frequency domain
Subject 8. Windowing and Discrete Fourier Transform (DFT)	Relation of the spectrum of a continuous-time signal to the spectrum of the time-sampled signal. Windowing. DFT and FFT.
Project 1. A/D and D/A Conversion	Digitalisation of Continuous-Time Signals. Aliasing.
Project 2. Digital Filters	Digital filters in the time and frequency domains.
Project 3. Spectral Analysis	Windowing. FFT. Examples

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Master Session	22	44	66
Laboratory practises	11	18	29
Troubleshooting and / or exercises	15	30	45
Forum Index	0	2	2
Multiple choice tests	1.5	0	1.5
Short answer tests	1	0	1
Troubleshooting and / or exercises	4.5	0	4.5

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

Methodologies

	Description
Introductory activities	Course presentation: programme, reading materials, teaching methodology and assessment system
Master Session	Instructor presentation of the main concepts of each subject. Classes do not cover all content that is examination material. The student should take the content indicated in the guidelines for each subject into account as orientation for exams. During the 5 minutes before the lecture, a student will summarize the main concepts presented in the previous session. Students will participate by answering questions during the explanation and by doing exercises. Student will work alone afterwards on the concepts studied in class and on expanding this content using the guidelines provided for each subject. Identification of doubts that need to be resolved in personalized tutorials.
Laboratory practises	Application of Matlab functions and commands for digital signal processing to solve practical exercises. Identification of doubts that need to be resolved in personalized tutorials.
Troubleshooting and / or exercises	Problems and exercises formulated according to the content of the lectures and the guidelines for each subject. Students solve problems and exercises prior to the class in which one or several students explain the solution on the board. Identification of doubts that need to be resolved in personalized tutorials.
Forum Index	The website for the course is included in the TEMA platform (http://faitic.uvigo.es). Subscription to this platform, including a photograph, is mandatory. The website provides all the information related to the course. It also publishes continuous assessment grades and runs forums for students to exchange ideas and discuss doubts.

Personalized attention

	Description

Master Session	Students will have the opportunity to attend personal tutorials in their lecturer’s office at times established by lecturers for this purpose at the beginning of the academic year and published on the course website. These tutorials are aimed at resolving student doubts and providing guidance regarding: • The content of the lectures and approaches to study. • Laboratory projects and the software used. • Problems and exercises proposed and solved in the classroom as well as other problems and exercises arising during the course.
Laboratory practises	Students will have the opportunity to attend personal tutorials in their lecturer’s office at times established by lecturers for this purpose at the beginning of the academic year and published on the course website. These tutorials are aimed at resolving student doubts and providing guidance regarding: • The content of the lectures and approaches to study. • Laboratory projects and the software used. • Problems and exercises proposed and solved in the classroom as well as other problems and exercises arising during the course.
Troubleshooting and / or exercises	Students will have the opportunity to attend personal tutorials in their lecturer’s office at times established by lecturers for this purpose at the beginning of the academic year and published on the course website. These tutorials are aimed at resolving student doubts and providing guidance regarding: • The content of the lectures and approaches to study. • Laboratory projects and the software used. • Problems and exercises proposed and solved in the classroom as well as other problems and exercises arising during the course.

Assessment

	Description	Qualification
Troubleshooting and / or exercises	These tests are a requirement to pass the subject. See details in the "Other comments and second call" section. In these tests the skills A3, A4 and A58 will be evaluated.	100
Multiple choice tests	These tests are a requirement to pass the subject. See details in the "Other comments and second call" section. In these tests the skill A57 will be evaluated.	0
Short answer tests	These tests are a requirement to pass the subject. See details in the "Other comments and second call" section. In these tests the skill A53 will be evaluated.	0

Other comments and second call

ASSESSMENT PROCEDURE:

A. Overview

The acquired skills are assessed by a series oftests grouped into three parts, with different requirements:

1. Lab assessment.
2. Basic knowledge test.
3. Problem assessment.

To pass the course it is necessary to pass all three parts.

- For each part one or more tests are performed to obtain an independent grade on each.
- There are tests for each part both during the lecture period and final evaluation periods. In total there are three opportunities to pass each part throughout the academic year.
- A pass grade in any part is valid for the entire academic year.
- The final grade for Basic knowledge test and Lab assessment is Pass or Fail.
- The final grade for the Problem assessment is a numerical mark between 0 and 10.
- The course mark is obtained roughly as follows:
  - If you have passed all three parts, the final grade is the grade of the Problem assessment.
  - If you have not passed any of the three parts, the final grade is the lowest of the three, calculated as specified later on.

    - It is also important to note that:
        - The course can be passed with full marks from continuous assessment, with no need to sit the final exam.
        - Students who have done continuous assessment and have failed any part, at the end of the term or at the end of the academic year, may need to perform only the failed parts.
        - Students who sit any of the tests corresponding to continuous assessment will obtain amark that will be listed in the academic records.

The following sections explain in detail how each part is graded.

B. Details of the assessment procedure

B1. Lab assessments

- Their goal is to determine whether the student has acquired all the knowledge and/or skills corresponding to the laboratory practice, emphasizing the use of MatLab for digital signal processing.
- Content to be assessed: content of the lab manuals and related theory content.
- Type of test: The test consists of a combination of multiple-choice questions and short questions. Students may use MatLab, lab manuals with personal notes, and text book. Students may not use a calculator for this test.
- Students are graded as pass or fail.
- There are 3 opportunities to pass:
    - Opportunity 1 (Continuous assessment)
        - There will be three mandatory tests in the lab room
        - The test consists of series of questions at the end of each Practice assignment
        - The tests will be graded between 0 and 10. The student will pass this part if he/she gets an average greater than or equal to 5. It is compulsory to sit all three tests.
        - Exact dates will be announced on the web site at the beginning of the lecture period.
    - Opportunities 2 and 3. A test in the End-of-Term exam period, and a test in the End-of-Academic-Year exam period. Students must obtain a pass grade in this test in order to pass the course. The pass mark for this test is 5 out of 10.
- Remarks:
    - Once the pass grade is obtained, this is valid for the entire academic year.
    - While the pass grade is not obtained, it is possible to sit any of the three opportunities.

B2. Basic knowledge test

- The goal of this test is to determine whether the student has acquired the minimum knowledge and skills needed to pass the course.
- Content to be assessed: as specified in the guidelines for each topic in the section "Basic Skills". Knowledge of MatLab is excluded from this test. The test consists of a combination of multiple-choice questions and short theoretical and practical questions. Students may not use books, notes or a calculator for this test.
- Students are graded as pass or fail. Students must obtain a pass grade in this test in order to pass the course. The pass mark for this test is 7 out of 10.
- There are 3 opportunities to pass this test: in an hour of classroom time in the second-last week of the course, in the End-of-Term exam period and in the End-of-Academic-Year exam period. Exact dates will be announced on the web site at the beginning of the lecture period.
- Remarks:
    - Once the pass grade is obtained, this is valid for the entire academic year.
    - While the pass grade is not obtained, it is possible to sit any of the three opportunities.

B3. Problem Assessment

- Their goal is to determine whether the student has acquired all the knowledge and/or skills corresponding to course and knows how to apply them to solve problems.
- Content to be assessed: as specified in the guidelines for each topic in the section "Content to be assessed". MatLab knowledge is not assessed.
- Type of test: an exam of problems. Students may not use books or notes. The use of calculators may be granted on an exam basis.
- It will be graded between 0 and 10. The pass mark is 5.
- There are 3 opportunities to pass:
    - Opportunity 1 (Continuous assessment)
        - There will be three mandatory tests in the classroom. Each test will be graded between 0 and 10.
        - The mark will be obtained as : 0,25* Test1Mark+ 0,35*Test2Mark + 0,4*Test3Mark
        - Test1: from Subject 1 to Subject 3. It will take place during the sixth week of the course.
        - Test2: from Subject 1 to Subject 6. It will take place during the tenth week of the course.
        - Test3: from Subject 1 to Subject 8. It will take place during the last week of the course.
        - Exact dates will be announced on the web site at the beginning of the lecture period.

    - Opportunities 2 and 3. An exam in the End-of-Term exam period, and an exam in the End-of-Academic-Year exam period. In each exam, all content is evaluated according to the information contained in the guidelines for each subject. The pass mark for this test is 5 out of 10.
    - Remarks:
        - Once the pass mark is obtained, this is valid for the entire academic year.
        - While the pass grade is not obtained, it is possible to sit any of the three opportunities.
        - It is always possible to sit the second opportunity to try to get a better mark.

C. Other comments

- The grade obtained at the end of the term will be part of the academic record of the student. This grade will be final if the mark is above or equal to 5. Otherwise a provisional fail grade will be recorded on their academic record.
- The provisional mark will become definitive fails for students who do not sit at the end of the academic year exam period, or gets a lower mark. Otherwise the better mark will be part of the academic record and becomes final.
- The final mark is computed as:
    - If the student passes all three parts, the mark is that of the problem assessment part.
    - If the student fails any part, the mark is the minimum of:
        - The average mark of the lab assessment.
        - (5/7)* Mark of the Basic knowledge test.
        - Mark of the problem assessment.
        - In case of more than one mark for any part, the highest one will be used.
- Tests performed as continuous assessment may not be rescheduled.
- The grades obtained in the basic knowledge test, the lab assessment, and problem assessment are only valid for the current academic year.
- The use of books, notes or electronic devices such as phones or computers is not permitted in any test or exam. Mobile phones must be turned off and out of reach of the student. If calculator use is permitted, the calculator must be a conventional scientific calculator. Under no circumstances may calculators be used that allow formulas to be saved or that have libraries that automatically perform operations with complex numbers, calculation of roots, etc.

Sources of information
J.H. McClellan y R.W. Schafer, R, Signal Processing First, Pearson Prentice Hall, 2003
A. Quarteroni y F. Saleri, Cálculo científico con Matlab y Octave, Springer, 2006
M. J. Roberts, Señales y Sistemas, McGraw Hill, 2005
A.V. Oppenheim y R.W. Schafer, Tratamiento de señales en tiempo discreto, Prentice Hall, 2ª edición, 2000

It is recommended to purchase the *Signal Processing First (SPF)* book, as it constitutes the main source of content for the course.

Students will be provided with guidelines for each subject that includes the following sections:

- Theoretical content: The theory that will be evaluated in exams.
- Basic knowledge: Content considered essential for the course and tested by the basic knowledge test described in the section on assessment.
- Problems proposed: A set of problems recommended for each subject.
- Â SPF vocabulary: A Spanish-English vocabulary with a set of selected terms is included to facilitate reading of the book.

Students will also be provided with a document describing the Matlab content considered essential for the course.

Recommendations
Subjects that continue the syllabus
Fundamentals of Sound and Image/V05G300V01405 Signal Transmission and Reception Techniques/V05G300V01404 Fundamentals of Image Processing/V05G300V01632 Sound Processing/V05G300V01634 Audio Systems/V05G300V01532 Imaging Systems/V05G300V01633 Electronic Systems for Signal Processing/V05G300V01522 Multimedia Signal Processing/V05G300V01513 Video and Television/V05G300V01533

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105
Mathematics: Calculus II/V05G300V01203

IDENTIFYING DATA				
Physics: Fundamentals of Electronics				
Subject	Physics: Fundamentals of Electronics			
Code	V05G300V01305			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	2nd	1st
Language	Spanish			
Department				
Coordinator	Domínguez Gómez, Miguel Ángel			
Lecturers	Domínguez Gómez, Miguel Ángel Pérez López, Serafín Alfonso Raña García, Herminio José Rodríguez Pardo, María Loreto			
E-mail	mdgomez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main purpose of this course is to provide students the basis for understanding and mastery of the principles of operation of devices and electronic circuits. It begins with a brief introduction to electronics in order to provide students with a global vision. After, basic concepts about devices and electronic circuits are taught: · Diodes and circuits with diodes, including concepts such as load line, ideal diodes, rectifiers, shaping circuits, logic circuits, voltage regulators and devices physics. · Characteristics of bipolar transistors, analysis of load line, large-signal models, polarization, amplification and small-signal equivalent circuits. · Study of the FET similar to the previous highlighting the MOSFET. · Check the circuit designs studied using SPICE. Mounting and verification using laboratory electronic instrumentation. · Basic concepts about logic digital circuits. On the other hand, in the framework of the course takes place first contact of students with the electronics lab. Therefore, the main objective of the practical part of the course is that the student acquires the bases for a correct management of the most common instruments in the laboratories of electronics. The student, at the end of the course, must know handle the laboratory instruments, should distinguish and characterize the different components, and have practical skills in assembly and measurement. Students will also start with simulation of circuits, in order to introduce them to computer-aided design.			

Competencies	
Code	
A13	CE4/FB4: Comprehension and command of basic concepts in linear systems and their related functions and transforms; electric circuits theory, electronic circuits, physical principles of semiconductors and logical families, electronic and photonic devices, materials technology and their application to solve Engineering problems.
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Subject competences	Typology	Competences
Understanding and control of the basic concepts of the physical principles of semiconductors.	know	A13
Understanding and control of the basic concepts of operation of the electronic and photonic devices.	know	A13
Understanding and control of simple electronic circuits based on the electronic and photonic devices and their applications.	Know How	A13
Understanding and control of the basic concepts of the logic families.	know	A13
Basic knowledges on CAD (Computer Aided Design) tools for the simulation of electronic circuits.	Know How	B4
Capacity utilization of CAD tools for designing simple electronic circuits.	Know How	B4

Contents	
Topic	
Subject 1: Introduction	Electronic systems. Design process. Integrated circuits.
Subject 2: Diodes and circuits with diodes	Characteristics of the diode. Zeners. Analysis of the load line. Ideal model of the diode. Circuits with diodes (rectifiers, clipping and voltage regulator circuits). Small signal equivalent linear circuits. Basic concepts of semiconductors. Physics of the diode. Capacity effects. LED and laser diodes. Photodiodes.
Subject 3: Principles of amplification	General aims: Voltage, current and power gains. Ideal amplifier. Amplifier Models. Limits. Introduction to amplifier frequency response.
Subject 4: Bipolar Junjction Transistors (BJT)	Operation of the npn Bipolar Junction Transistor (BJT). Load-Line Analysis of a Common-Emitter Amplifier. The pnp Bipolar Junction Transistor. Models of circuits. Analysis of circuits with BJTs. Phototransistors and optocouplers.
Subject 5: Analysis of amplifiers with Bipolar Junction Transistors	Small-Signal Equivalent Circuits. Analysis in medium frequencies: the Common-Emitter amplifier, the Emitter-Follower amplifier, the Common-Collector amplifier and the Common-Base amplifier.
Subject 6: Field Effect Transistors (FET)	NMOS Transistor. Analysis of the load line of a simplified NMOS amplifier. Polarization circuits. JFET and depletion MOSFET transistors and channel p devices.
Subject 7: Analysis of amplifiers with Field Effect Transistors	Small-Signal Equivalent Circuits. Analysis in medium frequencies: the Common-Source amplifier and the Source Follower amplifiers.
Subject 8: Digital logic circuits	Digital logic circuits. Basic concepts. Electrical specifications of the logic gates. The inverter CMOS. CMOS gates NOR and NAND.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	4	6
Master Session	13	24	37
Troubleshooting and / or exercises	14	33	47
Laboratory practises	14	30	44
Troubleshooting and / or exercises	8	0	8
Practical tests, real task execution and / or simulated.	5	0	5
Self-assessment tests	0	3	3
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	Presentation of the subject. Presentation of the laboratory practices and the instrumentation and software to be used.
Master Session	Exposition of contents. Later personal work of the student reviewing the concepts seen in the classroom and preparing the subjects using the proposed bibliography. Identification of doubts that require to be resolved in personal tutorships.
Troubleshooting and / or exercises	Activity to formulate and resolve problems and/or exercises related with the subject. Complement of the theoretical sessions. Personal work of the student with resolution of problems and/or exercises proposed in the classroom and extracted of the bibliography. Identification of doubts that require to be resolved in personal tutorships.
Laboratory practises	Activities of application of the theoretical knowledges. It will learn to handle the typical instrumentation of an electronic laboratory and it will implement basic electronic circuits seen in the theoric sessions. Also they will purchase skills of handle of simulation tools. Personal work of the student preparing the practices using the available documentation and reviewing the theoretical concepts related. Development and analysis of results. Identification of doubts that require to be resolved in personal tutorships.

Personalized attention	
	Description

Master Session	Students will have opportunity to go to personal tutorships in the professor office. The doubts about the contents given by the professor will be resolved in the tutorships and students will be oriented about how to study it. Also, the doubts arisen to the students on the problems and/or exercises proposed and resolved in the classroom will be resolved as well as other problems and/or exercises that can appear along the study of the subject. The doubts arisen to the students on the development of the laboratory practises, the handle of the instrumentation, the implementation of the electronic circuits and the software of simulation will be resolved too.
Troubleshooting and / or exercises	Students will have opportunity to go to personal tutorships in the professor office. The doubts about the contents given by the professor will be resolved in the tutorships and students will be oriented about how to study it. Also, the doubts arisen to the students on the problems and/or exercises proposed and resolved in the classroom will be resolved as well as other problems and/or exercises that can appear along the study of the subject. The doubts arisen to the students on the development of the laboratory practises, the handle of the instrumentation, the implementation of the electronic circuits and the software of simulation will be resolved too.
Laboratory practises	Students will have opportunity to go to personal tutorships in the professor office. The doubts about the contents given by the professor will be resolved in the tutorships and students will be oriented about how to study it. Also, the doubts arisen to the students on the problems and/or exercises proposed and resolved in the classroom will be resolved as well as other problems and/or exercises that can appear along the study of the subject. The doubts arisen to the students on the development of the laboratory practises, the handle of the instrumentation, the implementation of the electronic circuits and the software of simulation will be resolved too.

Assessment

	Description	Qualification
Troubleshooting and / or exercises	Tests will be carried out in the classroom throughout the year to evaluate the competencies of the student to resolve problems and/or the exercises over a part of the contents of the subject. The skill A13 will be evaluated in these tests.	60
Practical tests, real task execution and / or simulated.	Tests will be carried out in the laboratory along the course about management of instrumentation, mounting of electronic circuits and simulation. The skills acquired by the student about the contents of the subject laboratory practices will be evaluated. The skills A13 and B4 will be evaluated in these tests.	35
Self-assessment tests	Techniques aimed to collect data about the participation of the student in the proposed self-assessment tests.	5

Other comments and second call

1. Continuous evaluation

A system of continuous evaluation will be offered to the students following the guidelines of the bachelor and the agreements of the academic commission. Students who take the first test of resolution of problems and/or exercises deem to opt for continuous evaluation. Those students who do not take the first test of resolution of problems and/or exercises deem to renounce to the continuous evaluation and they will only have the possibility to take the final exam. Students who do not follow the continuous evaluation and do not take the final exam will be considered "not presented".

1.a Self-assessment tests

The professors will evaluate the execution of the proposed self-assessment tasks, getting the student a rating from 0 to 10 (AE).

The final mark of self-assessment tests (NAE) will be:

NAE = 0.05*AE

1.b Theory

Students will carry out 3 exams (multiple choice test and/or short answer test and/or resolution of problems and/or exercises) properly programmed along the course (PT1, PT2 and PT3). PT1 will be about themes 1 and 2 (block 1), PT2 about themes 3, 4 and 5 (block 2) and PT3 about themes 6, 7 and 8 (block 3). These exams will be valued from 0 up to 10 and the final mark will be the average (NPT -> Mark of theory exams):

NPT = (NPT1 + NPT2 + NPT3)/3

It is necessary to obtain a minimum of 3 points out of 10 in each of these exams (NPT1 >= 3, NPT2 >= 3 and NPT3 >= 3) to pass the subject.

The final mark of theory (NT) will be:

NT = 0.6*NPT

The exams are not recoverable, that is to say, if a student cannot assist the day they are scheduled, the professors do not have obligation to repeat them. The mark of the missed exams will be 0.

1.c Practical

Students will carry out 2 practical tests properly programmed along the course. These tests will be valued from 0 up to 10 and the final mark of the practical (NP) will be:

NP = 0.35*[(NP1 + NP2)/2]

The practical tests are not recoverable, that is to say, if a student cannot assist the day they are scheduled, the professors do not have obligation to repeat them. The mark of the missed tests will be 0.

1.d Final mark of the subject

It must get a minimum of 4 points out of 10 in theory (NT >= 2.4) and practices (NP >= 1.4) to pass the subject. Also it is necessary to get a minimum of 3 points out of 10 in each of the 3 theory exams (NPT1 >= 3, NPT2 >= 3 and NPT3 >= 3).

The final mark (NF) will be:

If NT >= 2.4 and NP >= 1.4 and NPT1 >= 3 and NPT2 >= 3 and NPT3 >= 3 => NF = NAE + NT + NP

If NT < 2.4 or NP < 1.4 or NPT1 < 3 or NPT2 < 3 or NPT3 < 3 => NF = min {4.5; NAE + NT + NP}

2. Final exam

The students who do not follow the continuous evaluation or had a final mark lower than 5 (failed) in the continuous evaluation, will be able to present to a final exam.

The final exam will have a theoretical part and a practical one. The theoretical part will be carried out in the dates established by the School and it will consist in an exam (multiple choice test and/or short answer test and/or resolution of problems and/or exercises). This exam will have 3 parts, one for each block specified in section 1.b. Each part will be evaluated from 0 up to 10 and the final mark of theory (NT) will be the average multiplied by 0.6. It is necessary to get a minimum of 3 points in each of these parts (NPT1 >= 3, NPT2 >= 3 and NPT3 >= 3) and a minimum of 4 points out of 10 in theory (NT >= 2.4) to pass the subject.

The practical exam will be carried out in the laboratory in the dates established by the School and it will consist in a practical test which will be evaluated from 0 up to 10 and the final mark of practices (NP) will be the points of the test multiplied by 0.4. It must get a minimum of 4 points out of 10 in the practical exam (NP >= 1.4) to pass the subject.

By reasons of organisation of the groups of examination, the professors will open a period so that the students inscribe to the final exam of practices. Only those students who have inscribed in due time and form, according to the rules indicated by the professors in the corresponding announcement, will be able to take the final exam of practices.

The students who have opted for the continuous evaluation and have failed and present to the final exam, can do it only to the theoretical part or to the practical one or both. They will conserve the mark got in the continuous evaluation of the missed part if the minimums specified in the continuous evaluation process were achieved. The students who take the theoretical part will be able to carry out the blocks they want. The mark of the continous evaluation of the missed blocks (NPT1, NPT2 and NPT3) will be kept. If they do not take the practical part, the practice note (NP) of the continuous evaluation is recalculated multiplying by 0.4 instead of by 0.35.

The final mark (NF) will be:

If NT >= 2.4 and NP >= 1.6 and NPT1 >= 3 and NPT2 >= 3 and NPT3 >= 3 => NF = NT + NP

If NT < 2.4 or NP < 1.6 or NPT1< 3 or NPT2 < 3 or NPT3 < 3 => NF = min {4.5; NT + NP}

3. Recovery (July)

The recovery call (July) will have a theoretical part and practical one with the same format as the final exam.

The students who present to this call can do it only to the theoretical part, the practical one or both. They will conserve the mark got in the ordinary call (continuous evaluation or final exam). The calculation of the final mark of the subject will be as described in section 2.

The final mark of the subject will be the best of the ordinary call and the recovery one.

By reasons of organisation of the groups of examination, the professors will open a period so that the students inscribe to the recovery practices exam. Only those students who have inscribed in due time and form , according to the rules indicated by the professors in the corresponding announcement, will be able to take this exam.

4. Validity of the qualifications

The qualifications of the student of the theoretical and practical parts of the subject will be valid only for the academic course in which they was got.

Sources of information
Hambley, A. R., Electrónica, 2ª ed., Prentice Hall, 2001
Quintáns, C., Simulación de circuitos electrónicos con OrCAD 16 Demo, Marcombo, 2008

Recommendations

Subjects that continue the syllabus
Digital Electronics/V05G300V01402 Electronic Technology/V05G300V01401

Subjects that it is recommended to have taken before
Physics: Analysis of Linear Circuits/V05G300V01201

IDENTIFYING DATA				
Electronic Technology				
Subject	Electronic Technology			
Code	V05G300V01401			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Language	Spanish			
Department				
Coordinator	Raña García, Herminio José			
Lecturers	Cao Paz, Ana María Quintáns Graña, Camilo Raña García, Herminio José Río Vázquez, Alfredo del Sánchez Real, Francisco Javier Valdés Peña, María Dolores			
E-mail	hrana@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course devotes to the utilisation of integrated circuits, in particular operational amplifiers, as well as to the following fields: Electronics of Power, Electrotechnics in his slope of electrical installations and to the conversion of photovoltaic solar energy and thermal.			

Competencies	
Code	
A23	CE14/T9: The ability to analyze and design combinatory and sequential, synchronous and asynchronous circuits and the usage of integrated circuits and microprocessors.
A25	CE16/T11: The ability to use different energy sources, especially photovoltaic and thermal ones, as well as the fundamentals of power electronics and electronics
B4	The ability to use software tools that support problem solving in engineering
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Subject competences	Typology	Competences
CE14/T9 Capacity of analysis and design of combinational and sequential circuits , both synchronous and asynchronous, and utilisation of microprocessors and integrated circuits.	Know How	A23
CE16/T11 Capacity to use several sources of energy and especially the solar photovoltaic and thermal, as well as the fundamentals of electrotechnics and power electronics.	Know How	A25
B4 CG13 Capacity to handle software tools that support the resolution of problems in engineering.	Know How	B4
CG14 Capacity to use computer tools of research of bibliographic resources or information.	Know How	B5

Contents	
Topic	
Operational amplifiers and other integrated circuits	Introduction to amplifiers: Appearances of frequency response in amplifiers. Bode diagrams. Principles of operation of an operational amplifier. Application circuits for operational amplifiers. Other integrated circuits of general application.
Power Electronics (I)	Introduction to Power Electronics. Power electronic devices .
Power Electronics (II)	DC power supplies. DC-DC converters.
Power Electronics (III)	Single-phase rectifiers. Single-phase inverters.
Electrotechnics	Electrical installations. Protections.

Photovoltaic and thermal solar energy	Photovoltaic and thermal solar installations. Photovoltaic cells. Photovoltaic panels. Photovoltaic systems of energy conversion.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	18	18	36
Laboratory practises	22	22	44
Troubleshooting and / or exercises	6	12	18
Short answer tests	3	15	18
Troubleshooting and / or exercises	3	15	18
Practical tests, real task execution and / or simulated.	4	12	16

*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 teachers explain the theoretical contents.
Laboratory practises	They include circuit mounting and testing and computer electronic circuits simulation. Some practical clases will also include some web search made by the student, about some technical information about some specific electronic devices used in the practical classes (e.g. some kind of transistors or operational amplifiers).
Troubleshooting and / or exercises	The teacher will solve exercises about most of the chapters.

Personalized attention

	Description
Master Session	The professor will attend personally doubts and queries of the students, about the study of theoretical concepts, about exercises or about practices of laboratory. The students may attend to these doubt/query sessions in the professor office in the schedule that the professors will establish at the beggining of the academic course. This schedule will be published in the page of the course. Some practical clases will include some web searchs made by the student, about some technical information about some specific electronic devices used in the practical classes (e.g. some kind of transistors or operational amplifiers).
Laboratory practises	The professor will attend personally doubts and queries of the students, about the study of theoretical concepts, about exercises or about practices of laboratory. The students may attend to these doubt/query sessions in the professor office in the schedule that the professors will establish at the beggining of the academic course. This schedule will be published in the page of the course. Some practical clases will include some web searchs made by the student, about some technical information about some specific electronic devices used in the practical classes (e.g. some kind of transistors or operational amplifiers).
Troubleshooting and / or exercises	The professor will attend personally doubts and queries of the students, about the study of theoretical concepts, about exercises or about practices of laboratory. The students may attend to these doubt/query sessions in the professor office in the schedule that the professors will establish at the beggining of the academic course. This schedule will be published in the page of the course. Some practical clases will include some web searchs made by the student, about some technical information about some specific electronic devices used in the practical classes (e.g. some kind of transistors or operational amplifiers).

Assessment

	Description	Qualification
Short answer tests	They make part of each partial examination of theory, in which they are half of its value. The number of tests and how they work are detailed in "Other comments and second call".	35
Troubleshooting and / or exercises	They make part of each partial examination of theory, in which they are half of its value.The number of tests and how they work are detailed in "Other comments and second call".	35

Practical tests, real task execution and / or simulated.	They are made in the laboratory. They consist of the kind of tasks made or prepared during the practices of the course: the practical exams consist of: 1) mounting of circuits, taking measures on them and answering questions related with these circuits and 2) simulation circuits equal or similar to the ones studied in the practices and answering questions related with this simulation. In the examinations of practices of laboratory the student will be allowed to use some especific technical information collected by the student during the practices (eg datasheets from manufacturers).	30

Other comments and second call

NOTE: the lengths of the partial proofs specified in this section 'assesments' as "half an hour", "an hour", "two hours", probably will be shortened in a small percentage to make fit the proofs to the length of the class sessions. During the class period of teaching of the course, the exact length of these proofs will be published.

1. Continuous assesment:

The assesment of the course is made by means of a continuous assesment, that consists of partial proofs, both theoretical partial proofs as well as lab partial proofs. Nevertheless the student may choose instead a final examination as an alternative. The rules for the assesment are described in the following paragraphs.

If a student can not attend to a partial proof on the date it is programmed, the professors do not have obligation to repeat it. The qualifications of the partial proofs will be valid only for the academic course in which they take place .

To participate in the partial proofs of practices of laboratory the student must attend to all the laboratory practical classes. The students that do not fulfil this requirement can anyway attend to the partial proofs of theory and liberate themselves from its contents for the final examination of theory, according with the following explanations.

1.1. Theoretical proofs:

On the contents of theory there are during the four-month period two partial proofs that cover the 1st block and the 2nd block of the theory contents. There is no standalone '3rd partial proof'; the 3rd block of the theory is evaluated as a part of the final theory proof in the May final proof, in which participate all the students.

If the student gets a mark of 5 points (out of 10) in a partial proof, then he or she does not attend to the proof of its content in the final proof and the mark obtained is saved for the final proof (or May proof). If a student does not pass the partial proof, his/her mark is not saved for the final proof and so this marks works as a zero.

The weight of the theoretical proofs is 70% on the total of the final mark. This weight is 70%/3 for each block.

The partial proofs ('1st partial proof' and '2nd partial proof', either of theory or of laboratory practices) take place on the usual weekly scheduling of the classes. Their length is 2 hours. They include both one half (in time and in mark) of short answer questions and one half exercises.

1.2. Assesment of laboratory practices:

The practices evaluate by means of practical tests, described above (laboratory proofs). There are two laboratory partial proofs that, unlike the theory, cover the contents of all the course. The two lab partial proofs allow the student to liberate from its contents; i.e.,Â if the student gets a mark of at least 5 points (out of 10) in a lab partial proof, this mark is saved as mark for this block for the lab final proof in May; if so, the student will not attend the proof of this part in the lab final proof in May.

If the student gets a mark greater than 5 point in both lab partial proofs, he/she will have a lab mark note greater than 5 and he/she will not attend to the lab partial proof in May. In the same way as the theory, if the student has a mark smaller than 5 points in a lab partial proof, then his/her mark is not saved for the final proof and so this mark works as a zero.

The two lab partial proofs have both the same weight.

1.3. Students presented:

The student joins continuous evaluation if and only if he/she attends to any of the partial proofs (either theoretical or laboratory ones) . From that moment, the student is considered as presented, and if he/she doesn't attend to any other partial proof, his/her mark on it will be zero.

1.4. Requirements to pass the course

The requirements a student has to fulfil to pass the course are explained in the following paragraphs. We begin the explanation back to forth in time: from July proof towards the May proof until the continuous assesment:

To pass the course the student needs a mark greater than 5 points as a whole. It must be taken in account that the weights are 7 points for the theory and 3 points for the lab. In addition, the mark in each section (i.e. both theory and lab) must be greater than 30% (3 points out of 10), in either type of evaluation (either continuous assesment or final examination whithout having joined the continuous assesment or july examination).

In the second call (July) (in which the evaluation of theory is no longer divided into blocks and the evaluation of practice is neither divided into blocks) the student must fulfill only the conditions stated in the previous paragraph. Nevertheless, in the final examination of May, in which the evaluation is made by blocks (three blocks in the contents of theory and two blocks in the contents of practices), the student needs a mark greater than 30 % (3 points out of 10) on every block.

To pass the course, the “provisional final note” of the course is considered. It is defined as:

ProvisionalFinalMark = TheoryMark x 0.7 + LabMark x 0.3

If TheoryMark and LabMark are both greater or equal that 3, then:

FinalMark = ProvisionalFinalMark

Else:

FinalMark = minimum {4.5 ; ProvisionalFinalMark}

The student passes the course if FinalMark is at least 5.

Being

TheoryBlockMark1, TheoryBlockMark2 and TheoryBlockMark3 the marks of each block of theory expressed over 10 points and

ProvisionalTheoryMark = (TheoryBlockMark1 + TheoryBlockMark2 + TheoryBlockMark3) /3, then:

If the mark of every block of theory is at least 3 points (out of 10), then:

TheoryMark = ProvisionalTheoryMark

Else: TheoryMark = minimum {ProvisionalTheoryMark ; 2.5}

In the same way:

Being LabBlockMark1 and LabBlockMark2 the marks of each lab block expressed on 10 points and

ProvisionalLabMark = (LabBlockMark1 + LabBlockMark2) /2, then:

If the mark of each one of the two blocks of practices is at least 3 (out of 10) , then:

LabMark = ProvisionalLabMark;

Else: LabMark = minimum {ProvisionalLabMark; 2.5}.

2. Evaluation by final proof

The students who do not join the continuous evaluation are evaluated in the final proof which consists of theoretical part and lab part. The theoretical part is the same for all the students that have not passed any partial proof, both the ones who failed them and the ones who didn't attend to them (the rules are explained in paragraph 1.1). For the "provisional final mark", the theory keeps the same weight as in the continuous assesment: 70%, divided into three equal parts for the three blocks, each of them divided into two halves of short answer questions and exercises.

The evaluation of lab practices for the students that did not join the continuous assesment is made by means of lab practices proof in the period of final proofs, in the dates fixed in the calendar of final proofs. His length is two hours.

The weight of the lab mark on the “provisional final mark” is the same as for the students of continuous assesment: 30%.

To pass the course in the final proof, the student must fulfill the same conditions for "provisional final mark" and conditions of minimum theory mark and lab mark stated on the paragraph 1.4.

VERY IMPORTANT: The students who want to attend to the final proof of the course must enroll for it, prior to the proof, by communicating with the professors of the course, either in person or by e-mail on May 13th, 2015. This preinscription is necessary to schedule the shifts for the lab proof, but does not force the student to attend; a student may enroll and finally do not attend to the proof. Only the students who enroll on that date will have right to do the lab proof.

3. Second call (July)

The second call (July) proof, like the final proof of first call (May), consists of a theory proof and a practice proof, in the laboratory.

For the second call proof, all the paragraphs of the point 2 apply (“evaluation by final proof”).

To pass the course in this call, the student must fulfill the same conditions of "provisional final mark" and conditions of minimum theory mark and lab mark explained in the point 1.4, except that there is not minimum mark by blocks, i.e. :

To pass the course, we define the “provisional final mark” of the course, which is:

ProvisionalFinalMark = TheoryMark x 0.7 + LabMark x 0.3.

If TheoryMark and LabMark are both greater or equal that 3, then:

FinalMark = ProvisionalFinalMark

Else:

FinalMark = minimum {4.5 ; ProvisionalFinalMark}

The student passes the course if FinalMark is at least 5.

All the students that have not passed the course in the first call (May) may attend to the two sections (theory and lab) of this proof. The rule of “highest mark” which is compulsory for the total mark of all the courses, will apply in this course also extended to each section; i.e., the theory mark of each student to calculate ProvisionalFinalMark for the July markwill be the highest between the May theory mark and the July theory mark. The same for the lab mark.

VERY IMPORTANT: In the same way as stated in section 2 for the May final proof, the students who want to attend to the July proof must enroll to attend to it, by communicating with the professors of the course, either in person or by e-mail on June 17th,Â 2015 . This preinscription is necessary to schedule the shifts for the lab proof, but does not force the student to attend; a student may enroll and finally do not attend to the proof. Only the students who enroll on that date will have right to do the lab proof.

Sources of information
Hambley, A. R., Electrónica, Prentice-Hall, 2ª ed. en español, 2001
Hart, D. W., Electrónica de potencia, Prentice-Hall, 2001
Rashid, Muhammad H. , Electrónica de potencia: circuitos, dispositivos y aplicaciones, Pearson Education, 2004
, Reglamento Electrotécnico para Baja Tensión (REBT) e Instrucciones Técnicas Complementarias (ITC), ,
Schneider Electric España, S.A., Guía de diseño de instalaciones eléctricas (PDF de uso libre disponible en www.schneiderelectric.es), Schneider Electric España, S.A, 2008
Guirado, R., Tecnología eléctrica, McGraw-Hill, 2006
AENOR, Norma UNE 60617 de Símbolos gráficos para esquemas eléctricos, ,
Carta, J. A. y otros, "Centrales de energías renovables: Generación eléctrica con energías renovables", Pearson-UNED, 2009
Quintáns Graña, C., Simulación de circuitos con OrCAD 16 DEMO, Marcombo, 2008

Recommendations

Subjects that continue the syllabus

Analogue Electronics/V05G300V01624
Power Electronics/V05G300V01625

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fundamentals of Electronics/V05G300V01305

Other comments

The student should have good knowledge about the course "Física: Fundamentos de Electrónica"/V05G300V01305 ("Physics: Electronics Fundamentals"/V05G300V01305), in both its theoretical contents as well as in the laboratory practic classes.

IDENTIFYING DATA				
Digital Electronics				
Subject	Digital Electronics			
Code	V05G300V01402			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Language	Spanish			
Department				
Coordinator	Machado Domínguez, Fernando			
Lecturers	Álvarez Ruíz de Ojeda, Luís Jacobo López Sánchez, Óscar Machado Domínguez, Fernando Moure Rodríguez, María José Pérez López, Serafín Alfonso Raña García, Herminio José			
E-mail	fmachado@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course is an introduction to the basic principles of digital design and the analysis and design of digital circuits and systems. First, logic circuits, basic digital devices and logic gates representation will be introduced. Then, hardware description languages (HDL) based design, description and simulation methods will be described. Combinational and sequential logic design will be explained using the top-down design paradigm. Finally, the common combinational and sequential logic circuits will be described: operation, diagrams, symbols and VHDL description and simulation.			

Competencies	
Code	
A23	CE14/T9: The ability to analyze and design combinatory and sequential, synchronous and asynchronous circuits and the usage of integrated circuits and microprocessors.
A24	CE15/T10: The knowledge and application of the fundamentals of description languages for hardware devices.
B4	The ability to use software tools that support problem solving in engineering
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Subject competences	Typology	Competences
Knowledge of digital design principles, components and tools.	know	A23
Ability to analyse and design combinational systems.	Know How	A23
Knowledge of the combinational functional blocks and their aplications.	know	A23
Knowledge of the basic storage elements, the sequential blocks and their aplications.	know	A23
Ability to analyse and design synchronous sequential systems.	Know How	A23
Knowledge of description and simulation methods based on hardware description languages (HDL).	know	A24
Ability to use softwaare tools to describe and simulate digital systems.	Know How	B4
Ability to use software tools to search digital circuit data sheets and information resources.	Know How	B5

Contents	
Topic	
Unit 1: Introduction to digital electronics	Introduction to Digital Electronics. Number systems and digital codes. Boolean Algebra. Truth Tables. Logic Gates. Boolean Funtions Simplification.
Unit 2: Introduction to VHDL	Introduction to hardware description languages. Basic VHDL syntax. Data types and objects. Operators. Concurrent and sequential sentences. Component instantiation.

Unit 3: Basic combinational systems	Functional blocks. Technologies and output types of the digital circuits. Decoders. Encoders. Multiplexers. Demultiplexers. Application examples. VHDL description.
Unit 4: Programmable gate arrays	Introduction to the programmable circuits. PLA and PAL. Application examples.
Unit 5: Arithmetic combinational systems	Comparators. Parity detection and generation. Arithmetic circuits. Application examples. VHDL description.
Unit 6: Sequential logic systems principles	Definition and classification. Latches and flip-flops. Application examples. VHDL description.
Unit 7: Synchronous sequential systems	General theory. Counters. Multibit registers. Shift registers. Application examples. VHDL description.
Unit 8: Synchronous sequential logic design	Synchronous sequential systems design. Application examples. VHDL description.
Unit 9: Programmable logical devices	Introduction to the PLDs. Application examples.
Unit 10: Memory units	Classification. Active and pasive random access memories. Random access memories. Sequential acces memories. Associative memories.

PRACTICE 1. INTRODUCTION TO XILINX ISE	General ISE flow diagram. Schematic description. Practical examples.
PRACTICE 2. INTRODUCTION TO VHDL DESIGN	Description and synthesis of combinational systems using VHDL. Practical examples.
PRACTICE 3. DIGITAL SYSTEMS TEST: FUNCTIONAL SIMULATION	Obtaining symbols from schematic. Component instantiation. Stimulus definition. Test-bench Functional simulation. Practical examples.
PRACTICE 4. DIGITAL SYSTEMS COMPILATION AND IMPLEMENTATION. TEMPORAL SIMULATION	PLD architecture (Xilinx CoolRunner 2 family). Compilation and implementation. Temporal simulation. Practical examples.
PRACTICE 5. TESTING DIGITAL SYSTEMS TEST IN THE DEVELOPMENT BOARD	PLD development board CoolRunner 2 starter kit from Xilinx. Configuration file. PLD Technology and configuration methods. PLD programming. Digital systems test in the development board. Implementation examples.
PRACTICE 6. COMBINATIONAL CIRCUITS	Design and implementation of combinational circuits using VHDL: truth table, logic function and behavioural descriptions.
PRACTICE 7. ARITHMETIC CIRCUITS	Design and implementation of arithmetic circuits usign VHDL: truth table, logic function and behavioural descriptions.
PRACTICE 8. ARITHMETIC SYSTEMS	Design and implementation of arithmetic systems usign VHDL. Arithmetic and logic unit (ALU).
PRACTICE 9. SEQUENTIAL CIRCUITS I	Design and implementation of sequential circuits usign VHDL (flip-flops, registers and counters).
PRACTICE 10. SEQUENTIAL CIRCUITS II	Design and implementation of sequential circuits usign VHDL (counters, shift registers). Design and implementation of synchronous sequential logic systems usign VHDL (state machines).
PRACTICE 11. COMPONENT ASSEMBLY AND CONNECTION. DIGITAL INSTRUMENTATION.	Logic analyser. Connection of external push-buttons, switches, LEDs, 7-segments displays. Test of sequential circuits using the logic analyser.
PRACTICE 12. SEQUENTIAL SYSTEMS I	Design and implementation of a sequential system based on functional blocks usign VHDL. Dynamic controller of a 4-digit, 7-segment display.
PRACTICE 13. SEQUENTIAL SYSTEMS II	Design and implementation of a complex sequential system. Reading system of a row and column based button keypad .

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	1	2
Master Session	13	21	34
Laboratory practises	26	26	52
Troubleshooting and / or exercises	8	20	28
Practical tests, real task execution and / or simulated.	2	2	4
Troubleshooting and / or exercises	6	24	30

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

Methodologies

	Description

Introductory activities	Subject presentation. Presentation of laboratory sessions, instrumentation and software resources to be used.
Master Session	The lecturer will explain in the classroom the main contents of the subject. The students have to manage the proposed bibliography to carry out a self-study process in a way that leads to acquire the knowledge and the skills related to the subject. The lecturer will answer the students' questions in the classroom or in the office. In these sessions the students will develop the skils A23 and A24 ("know").
Laboratory practises	Activities designed to apply the main concepts and definitions of the subject. The students will be asked to acquire the basic skills to manage the laboratory instrumentation, software tools and components in order to construct and test electronic circuits. The students have to develop and demonstrate autonomous learning and collaborative skills. Possible questions can be answered in the laboratory sessions or in the lecturer's office. In these sessions the students will develop the skils A24, B4 and B5 ("know how").
Troubleshooting and / or exercises	Activities designed to apply the main concepts of the subject to solve problems and exercices. The lecturer will explain a set of problems and the students have to solve diferent take-home sets of problems. The answers to selected problems will be provided later on. The lecturer will answer the students' questions in the classroom or at the office. In these sessions the students will develop the skils A23 and A24 ("know how").

Personalized attention	
	Description
Master Session	The lecturer will answer the students' questions and also give instructions to guide the studying and learning process. The students can go to the lecturer's office. The timetable will be available on the subject website at the beginning of the term.
Troubleshooting and / or exercises	The lecturer will answer the students' questions and also give instructions to guide the studying and learning process. The students can go to the lecturer's office. The timetable will be available on the subject website at the beginning of the term.
Laboratory practises	The lecturer will answer the students' questions and also give instructions to guide the studying and learning process. The students can go to the lecturer's office. The timetable will be available on the subject website at the beginning of the term.

Assessment		
	Description	Qualification
Laboratory practises	The lecturers will check the level of compliance of the students with the goals related to the laboratory skills. Marks for each session will be assessed in a 10 points scale. Final mark of laboratory, FML, will be assessed in a 10 points scale. The skils A24, B4 and B5 will be evaluated in these laboratory practices.	35
Troubleshooting and / or exercises	The lecturers will check the students' skills to solve exercices and troubleshooting. Marks for each test will be assessed in a 10 points scale. Final mark of theory, FMT, will be assessed in a 10 points scale. The skils A23 and A24 will be evaluated in these tests.	65

Other comments and second call

1. Continuous assessment

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

When the students perform a troubleshooting test or attend at least two laboratory sessions, ***they will be assessed by continuous assessment***.

The subject comprises two different parts: theory (60%) and laboratory (35%). Once a task has been assessed, the students can not do/repeat the task at a later date. The marks are valid only for the current academic course.

1.a Theory

Three exercises and troubleshooting tests (ETT) are scheduled. The first and second test (ETT1 and ETT2) will be respectively performed after unit 4 and 7 (~ in weeks 6 and 12), in the usual weekly scheduling of the theoretical classes. The third test (ETT3) will be performed during the examination period in the date specified in the academic calendar. Marks for each test will be assessed in a 10 points scale. The minimum mark required to pass this part is of 4 (ETTi>=4). The weighted points from all assessed tests are added together to calculate the final mark of theory (FMT):

FMT = 0.3·ETT1 + 0.3·ETT2 + 0.4·ETT3

The students cannot do the tests at a later date. The student who miss a test will be assessed with a mark of 0 for that test.

If the minimun mark in the first or second test is not achieved (ETT1 or ETT2Â less than 4), the students can repeat these parts in the same date of the third test.

1.b Laboratory

Thirteen laboratory sessions are scheduled. Each session lasts approximately 120 minutes and the students will work in pairs.

The first five sessions are guided practices. In these sessions, the instrumentation and software resources will be presented and the students will configure a programmable logic device following the design flow. These five sessions are mandatory but will not be assessed. The following seasons will be assessed by continuous assessment. The marks for these laboratory sessions (LSM) will be assessed in a 10 points scale.

In order to pass the laboratory part the students can not miss more than two laboratory sessions. Only sessions 6 to 13 will be assessed. The weighted points from all assessed sesions are added together to calculate the final mark of laboratory (FML):

FML = (LSM6 + LSM7 + LSM8 + LSM9 + LSM10 + LSM11 + 2·LSM12 + 2·LSM13) / 10

1.c Final mark of the subject

The weighted points from all assessed parts are added together to calculate the final mark (FM). The following weightings will be applied: 65% theory (FMT) and 35% laboratory (FML). In order to pass the subject, students will be require to pass the laboratory and theory parts and to obtain at least a mark of 5 in each part (FMT>=5 and FML>=5). In this case the final mark (FM) will be:

FM = (0.65·FMT + 0.35·FML)

However, when the students do not pass both parts (FMT or FML less than 5) or do not reach the minimum mark of 4 required to pass each exersices and troubleshooting test or miss more than 2 laboratory sessions, the final mark will be:

FM = (0.65·FMT + 0.35·FML)·4.9/8.8

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

2. Final Exam

The students who prefer a different educational policy can attend an exam on a scheduled date. This exam consist on a theory part and laboratory part. In order to attend the laboratory exam, the students have to contact to the lecturer according to an established procedure. The procedure will be published in advance.

The theory exam will be assessed in a 10 points scale. The minimum mark required to pass this part is of 5 (FMT>=5).

The laboratory exam will be assessed in a 10 points scale. The minimum mark required to pass this part is of 5 (FML>=5).

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

FM = (0.65·FMT + 0.35·FML)

However, when the students do not pass both parts (FMT or FML less than 5) the final mark will be:

FM = (0.65·FMT + 0.35·FML)·4.9/8.8

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

3. Second opportunity to pass the subject

The assessment policy in this call will follow the scheme described in the previous section. Dates will be specified in the academic calendar. This exam consist on a theory exam and a laboratory exam. In order to attend the laboratory exam, the students have to contact to the lecturer according to an established procedure. The procedure will be published in advance.

The marks obtained in the previous continuous assessment or final exam are kept for those parts in which the student has not attended. The final mark will be calculated as it has described in section 2.

Sources of information
Wakerly J. F., Diseño Digital. Principios y prácticas, 3ª, Prentice Hall. 2001
S. Pérez, L. J. Álvarez, M.J. Moure, F. Machado, Electrónica Digital, Curso 2012-2013, Plataforma TEMA
Wakerly J. F. , Digital Design. Principles and Practices, 4ª, Prentice Hall. 2005
E. Mandado, Sistemas Electrónicos Digitales, 9ª, Marcombo. 2008
Thomas L. Floyd, Fundamentos de Sistemas Digitales, 9ª, Prentice Hall. 2006
L.J. Álvarez, E. Mandado, M.D. Valdés, Dispositivos Lógicos Programables y sus aplicaciones, 1ª, Thomson-Paraninfo. 2002
S. Pérez, E, Soto, S. Fernández, Diseño de sistemas digitales con VHDL, , Thomson-Paraninfo. 2002
L.J. Álvarez, Diseño Digital con Lógica Programable, 1ª, Tórculo. 2004

Recommendations

Subjects that it is recommended to have taken before

Informatics: Computer Architecture/V05G300V01103
Mathematics: Linear Algebra/V05G300V01104
Physics: Fundamentals of Electronics/V05G300V01305

IDENTIFYING DATA				
Computer Networks				
Subject	Computer Networks			
Code	V05G300V01403			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Language	Spanish Galician			
Department				
Coordinator	López Ardao, José Carlos			
Lecturers	López Ardao, José Carlos López Bravo, Cristina Manso Vázquez, Mario Rodríguez Pérez, Miguel Sousa Vieira, Estrella Suárez González, Andrés			
E-mail	jardao@det.uvigo.es			
Web	http://www.socialwire.es			
General description	Operating principles, architecture, technology and norms of computer networks, especially of Internet. Design-oriented course, complemented by practical skills			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A20	CE11/T6: The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact.
A26	CE17/T12: The knowledge and usage of concepts of communication network architecture, protocols and interfaces.
A27	CE18/T13: The ability to differentiate the concepts of access and transport networks, packet and circuit switched networks, mobile and fixed networks, as well as distributed newtwork application and systems, voice, data, video, audio, interactive and multimedia services.
A28	CE19/T14: The knowledge of methods of networking and routing, as well as the fundamentals of planning and network evaluation based on traffic parameters.

Learning aims		
Subject competences	Typology	Competences
CG1 The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.	know Know How	A1
CG3 The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations	know	A3

CG4 The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.	know Know How	A4
CG6: The aptitude to manage mandatory specifications, procedures and laws.	know	A6
CG9 The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics	Know How	A9
CE11/T6 The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact.	know Know How	A20
CE17/T12 The knowledge and usage of concepts of communication network architecture, protocols and interfaces	know Know How	A26
CE18/T13 The ability to differentiate the concepts of access and transport networks, packet and circuit switched networks, mobile and fixed networks, as well as distributed newtwork application and systems, voice, data, video, audio, interactive and multimedia services	know	A27
CE19/T14 The knowledge of methods of networking and routing, as well as the fundamentals of planning and network evaluation based on traffic parameters	know Know How	A28

Contents	
Topic	
1. Introduction	a) Network Infrastructure: Nodes, links and netwoks b) Circuit and Packet Switching c) Communications Architecture: Layers, encapsulating, models
2. Packet Networks. Internet	a) Performance: Throughput, delays, losses b) The Internet ecosystem
3. Links and subnetworks	a) Concept of link and subnetwork b) Interconnection of networks at level 2: Bridges
4. Ethernet and WiFi	a) Ethernet Switching. b) VLANs and trunking c) Spanning Tree d) WiFi networks
5. Internet and IP	a) Interconnection of subnetworks. Routers b) IP Addressing c) IP datagram format d) Fragmentation e) The ICMP protocol
6. IP Forwarding	a) IP Forwarding mechanism b) Connected and Next-Hop Routes c) The DHCP protocol
7. Name and address translation	a) ARP b) DNS c) NAT
8. Routing	a) Graph theory. Shortest distance paths b) Link state: Dijkstra's algorithm c) Distance vector: Bellman-Ford d) Broadcast routing
9. Internet routing	a) Routing hierarchy b) Intradomain routing: RIP, OSPF c) Interdomain routing: BGP
10. Midterm Exam	Lectures 1 to 7
11. Transport protocols	a) Service model b) TCP & UDP c) Transport connections: establishment, retransmissions, flow control
12. Congestion control	a) Network model b) Dynamics, fairness and stability c) TCP Reno, Vegas, FAST
13. Web. Content distribution networks	a) HTTP protocol b) Proxy web. Caching. Persistence c) Content distribution networks: architecture and operations

14. Network security	a) Vulnerabilities. Protection c) Secure network and transport layers c) Denial of service. Spoofing d) Fundamentals of cryptography e) Digital signatures

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	39	65
Troubleshooting and / or exercises	10	15	25
Autonomous practices through ICT	6	15	21
Integrated methodologies	0	10	10
Practice in computer rooms	10	15	25
Long answer tests and development	2	0	2
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	Exposition of ideas, concepts, techniques and algorithms that shape every lecture.
Troubleshooting and / or exercises	Resolution by part of the students of problems and exercises of some of the lessons, and resolution by the teacher in the classroom
Autonomous practices through ICT	The students must develop a network program. There will be several sessions for tutoring with the professor and development, test and debugging of the programs in the laboratories where these will be tested and evaluated
Integrated methodologies	Participation in on-line activities to be proposed along the course, and in activities of making questions and answer of these
Practice in computer rooms	Practices in the computers of the computer classroom, guided by the professor

Personalized attention

	Description
Master Session	Individual tuitition will be dispensed to the students in the office hours announced at the beginning of the term. It is not mandatory to book the appointment.

Assessment

	Description	Qualification
Autonomous practices through ICT	The students must develop a network program. There will be several sessions for tutoring with the professor and development, test and debugging of the programs in the laboratories where these will be tested and evaluated	20
Integrated methodologies	Participation in on-line activities to be proposed along the course, and in activities of making questions and answer of these	10
Long answer tests and development	Final exam	50
Long answer tests and development	Midterm exam	20

Other comments and second call

The students can choose the method of evaluation, continuous or single.

The Continuous Evaluation (CE) consist of three previous tests plus a final exam:

- A midterm exam (ME) in the 10th week, which will cover the contents of lectures 1 to 7, and represents 20% of the final grade (FG)
- The development of a network program (NP). The deadline will be the day of the final exam. The compliance of prescriptions and the quality of the software will determine the qualification of this test. Depending on the number of students, teachers may allow this program to be done by couples of students but in that case both members of the couple

must belong to the same group of laboratory and both of them must follow continuous assessment. The NP represents 20% of the final (NF)
- Participation in online activities (AO) that will be proposed along the course and in the activities of raising questions and answer them. The OA represents 10% of the final grade (NG)
- A final exam (FE) covering all the contents, which has a weight of 50% of the final grade (FG)

FG-CE = 0.2xME + 0.1xOA + 0.2xNP + 0.5xFE

The Single Evaluation (SE) will consist of the same Final Exam at the end of the semester and the same Network Program (NP) proposed for CE. In this case, the program must be made mandatory and delivered individually.

The grade of NP in this case is simply APT (with a numeric value 1), if it meets the minimum requirements or NOT APT (with a numeric value 0) in the other case or if the NP is not delivered, in which case the grade will be 40% of the FE. That is,

FG-SE = (0.4 + 0.6xNP) x FE

It is considered that a student choose CE when presenting to the midterm exam. The students not doing this exam must opt for SE.

In July there will be a new FE and also it will be allowed the delivery of a new NP consisting of a modified version of the May program, and whose specifications will be published with at least 4 weeks with respect to the deadline of the Final Exam. Any student, regardless opting for CE or SE, will be able to do this FE and present a new NP

For students who chose CE, these FE and NP represent an opportunity to improve the grade in these with respect to May, and so the calculation of the final grade considers the best grade obtained between May and July.

For students who chose to SE, the FE and the NP are considered joint and inseparable, that is,Â

FG-SE = Max[(0.4 + 0.6xNP-May) x FE-May,Â (0.4 + 0.6xNP-July) x FE-July]

The grades of all written tests, partial or final, programs and activities will only take effect in the academic year in which they are proposed.

Sources of information
J.F. Kurose, K.W. Ross, Computer networking: a top-down approach featuring the Internet, 6, 2012
L. Peterson, B. Davie, Computer networks: a systems approach, 5, 2011
C. López, M. Rodríguez, S. Herrería, M. Fernández, Cuestiones de redes de datos: principios y protocolos, 1, 2008

Recommendations
Subjects that continue the syllabus
Data Networks: Technology and Architecture/V05G300V01542 Network and Switching Theory/V05G300V01642

Subjects that are recommended to be taken simultaneously
Data Communication/V05G300V01301

Other comments
Though advisable, it is not necessary prior exposure to computer programming.

IDENTIFYING DATA

Signal Transmission and Reception Techniques

Subject	Signal Transmission and Reception Techniques			
Code	V05G300V01404			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Language	Spanish			
Department				
Coordinator	López Valcarce, Roberto			
Lecturers	Comesaña Alfaro, Pedro Fernández Barciela, Mónica González Prelcic, Nuria Isasi de Vicente, Fernando Guillermo López Valcarce, Roberto Márquez Flórez, Óscar Willian Rodríguez Banga, Eduardo Romero González, Daniel			
E-mail	valcarce@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The course "Techniques for Signal Transmission and Reception" is an introduction to the different existent methods for the exchange of information in digital format at the physical layer level. Its main focus is on pulse amplitude modulation (PAM) as illustrative example. The main components of a digital transmitter and receiver are described, as well as the different effects caused by the communication channel and the different performance parameters of a digital system.			

Competencies

Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A16	CE7/T2: The ability to use communication and software applications (ofimatics, databases, advanced calculus, project management, visualization, etc.) to support the development and operation of Electronics and Telecommunication networks, services and applications.
A18	CE9/T4: The ability to analyze and specify the main parameters of a communications system.
A19	CE10/T5: The ability to evaluate the advantages and disadvantages of different technological alternatives in the implementation and deployment of communication systems from the point of view of signals, perturbations, noise and digital and analogical modulation systems.
A29	CE20/T15: The knowledge of national, European and international telecommunication regulations and laws.

Learning aims

Subject competences	Typology	Competences
Ability to use communication and office computer applications (databases, advanced computation, project management, visualisation tools, etc.) to support the development and exploitation of networks, services, and telecommunication and electronics applications.	know Know How	A16
Ability to analyse and specify the fundamental parameters of a communications system.	know	A18
Ability to evaluate the advantages and drawbacks of different technological alternatives for the deployment or implementation of analog and digital communication systems, from the signal space point of view, and taking into account the perturbations and the noise.	know	A19

Knowledge of basic technologies that enable the student to learn new methods and techniques, with the flexibility required to adapt to new situations.	know	A3
Ability to solve problems with initiative, decision making, and creativity.	know Know be	A4
Familiarity with telecommunication regulations and standards at the national, European and world levels.	know	A29
(*)	Know How	A6

Contents	
Topic	
1. Introduction to digital communication systems	-Basic elements and general description of a communication system. -Analog and digital communications -Description of a digital transmitter -Description of a digital receiver
2. Signals, systems and stochastic processes in communications	-Review of basic concepts: signals, systems, transforms. -Autocorrelation function of a stochastic process. -Power spectral density. Transmitted power, transmission bandwidth. -Noise characterization
3. Frequency conversion and analog processing	-Amplitude modulation (AM): with large carrier, with suppressed carrier -I/Q Modulation and demodulation. - Transceiver requirements and specifications -Receiver architectures: direct conversion, intermediate frequency. Analog and digital stages.
4. Pulse amplitude modulation (PAM)	- Baseband PAM - Bandlimited channels and intersymbol interferences (ISI) - Nyquist criterion, raised cosine pulses, eye diagram - Bandpass PAM
5. Modulation and detection in Gaussian channels	-Introduction to the Signal Space -Derivation of the Matched Filter -Maximum A Posteriori (MAP) and Maximum Likelihood (ML) detectors -Probability of error
6. The communication channel	-Transmission media -Signal to noise ratio -Multipath and frequency selectivity -Fading -Doppler effect

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	24	24	48
Practice in computer rooms	21	31.5	52.5
Troubleshooting and / or exercises	2	8	10
Laboratory practises	6	9	15
Long answer tests and development	2	16	18
Short answer tests	1	5.5	6.5

*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	Presentation and discussion of the fundamental theory
Practice in computer rooms	The concepts presented in class will be further illustrated and developed by means of Matlab-based simulation and signal processing tools
Troubleshooting and / or exercises	Students will be given different take-home sets of problems. The answers to selected problems will be provided later on.
Laboratory practises	Experimental study of different components and effects in analog transmitter/receiver frontends

Personalized attention	
	Description

Laboratory practises	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.
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.
Troubleshooting and / or exercises	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
Long answer tests and development	Final examination. It will cover all of the material covered during the course and will take place during the exam period as established by the Center. In this exercise, skills A3, A4, A6, A18, A19 and A29 will be assessed.	60
Short answer tests	Three short tests will be given during the semester. These exercises will assess skills A3, A4, A16, A18 and A19.	40

Other comments and second call

The final grade will consist of:Â - grade of comprehensive test (up to 4 points)- lab reports (up to 4 points)- final project (up to 2 points)

Grades from lab reports will be kept for the second call, in which the student will be able to resubmit his/her final project, as well as take a new comprehensive test.

Sources of information

C.R. Johnson Jr., W.A. Sethares, Telecommunication Breakdown, 1, 2004

A. Artés, F. Pérez González et al., Comunicaciones Digitales, 1, 2007

Leon W. Couch, Digital & Analog Communication Systems, 7, 2007

Bernard Sklar, Digital Communications: Fundamentals and Applications, 2, 2001

J. G. Proakis, M. Salehi, Fundamentals of Communication Systems, 1, 2005

B. Razavi, RF Microelectronics, 1, 1998

R. Sobot, Wireless communication electronics : introduction to RF circuits and design techniques, 1, 2012

Recommendations

Subjects that continue the syllabus

Principles of Digital Communications/V05G300V01613

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Mathematics: Probability and Statistics/V05G300V01204
Digital Signal Processing/V05G300V01304

Other comments

It is assumed that the student has basic knowledge of analog and digital signal processing, as well as of probability and statistics.

IDENTIFYING DATA				
Fundamentals of Sound and Image				
Subject	Fundamentals of Sound and Image			
Code	V05G300V01405			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Language	Spanish			
Department				
Coordinator	Pena Giménez, Antonio			
Lecturers	Abreu Sernández, María Victoria Docio Fernández, Laura Márquez Flórez, Óscar Willian Martín Rodríguez, Fernando Pena Giménez, Antonio Rodríguez Banga, Eduardo			
E-mail	apena@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	"Fundamentos de Sonido e Imagen" presents the basic concepts of sound and image, as well as the processes operating over the audiovisual signals.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A22	CE13/T8: The ability to understand the electromagnetic and acoustic wave mechanisms of propagation and transmission, and their corresponding receiving and transmitting devices.

Learning aims		
Subject competences	Typology	Competences
Analysing the basic properties of the sound.	know	A3 A22
Explaining different sound production systems: human sound production, musical instruments, machines and other vibrant systems.	know	A22
Interpreting results of acoustic measures and selecting tools for the appropriate analysis.	Know How	A5
Describing the human perception of sound based on the physiological interface and the psychology of the perception.	know	A3 A22
Reviewing diffrent processes and systems associated to the sound production	Know How	A3 A5
Applying the basic rules of the colorimetry.	know	A3
Analysing lens systems.	Know How	A3
Choosing the most suitable capture and presentation image sytems.	Know How	A3 A5
Choosing the most adapted formats for image and video.	Know How	A3 A5
Relating the influence of the coding parameters with the results of compression and quality.	Know How	A3 A5

Contents
Topic

S1. Acoustic waves	Introduction. Acoustic wave equation. Harmonic plane waves. Spherical waves. Power and Intensity. Diffraction
S2. Sound propagation and transmission	Acoustic field. Propagation.Transmission between different media.
S3. Sound radiation and production	Impedances. Transductors. Mechanical vibration. Radiation of simple sources. Directivity.
S4. Sound perception	Human audition. Auditory losses. Equal loudness contours.
I1. Colorimetry	Fiixed image signals and video signals. Visual human system. Light and colour. Visual effects.
I2. Capture and representation of images	Cameras and lens. Monitors. 3D Visualisation.
I3. Image and video coding	Fixed image: format of colour YUV; standards of compression. Image in movement: H.261 standard; MPEG formats.
Projects S1 and S2. Sound analysis.	Time, frequency and spectrograms.
Projects S3 and S4. Sound measurements	Sound pressure level. Sonometer. Octave-filter banks
Project I1. Colorimetry	Basic functions
Project I2. Fixed images coding	Functions for JPEG coding
Project I 3. Video coding	Time-predictive coding

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Master Session	26	50	76
Troubleshooting and / or exercises	6	12	18
Practice in computer rooms	17	20	37
Forum Index	0	1	1
Multiple choice tests	0	2	2
Practical tests, real task execution and / or simulated.	1	0	1
Long answer tests and development	4	0	4
Short answer tests	1	0	1
Reports / memories of practice	0	9	9

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

Methodologies

	Description
Introductory activities	Course presentation: programme, reading materials, teaching methodology and assessment system
Master Session	Instructor presentation of the main concepts of each subject. Classes do not cover all content that is examination material. The student should take the contents of the documents provided for each subject. Student will work alone afterwards on the concepts studied in class and on expanding this content using the documents provided for each subject. Identification of doubts that need to be resolved in personalized tutorials. Competencies A3, A5 and A22 are developed.
Troubleshooting and / or exercises	Problems and exercises formulated according to the content of the lectures and the documents for each subject. Students solve problems and exercises prior to the class. Identification of doubts that need to be resolved in personalized tutorials. Competency A22 is developed.
Practice in computer rooms	Handling of analysis tools and algorithms. Identifying which one must to be used to solve each specific problem. Identification of doubts that need to be resolved in personalized tutorials. Competencies A3, A5 are developed.

Forum Index	The website for the course is included in the TEMA platform (http://faitic.uvigo.es). Subscription to this platform, including a photograph, is mandatory. The website provides all the information related to the course. It also publishes continuous assessment grades and runs forums for students to exchange ideas and discuss doubts. Competency A3 is developed.

Personalized attention	
	Description
Troubleshooting and / or exercises	Students will have the opportunity to attend personal tutorials in their lecturer’s office. These tutorials can be individual or in reduced groups (typically with a maximum of 2-3 students). Previous appointment with the corresponding professor will be requested and fixed by email, preferably in the schedules and place established by lecturers at the beginning of the academic year and published on the course website.
Practice in computer rooms	Students will have the opportunity to attend personal tutorials in their lecturer’s office. These tutorials can be individual or in reduced groups (typically with a maximum of 2-3 students). Previous appointment with the corresponding professor will be requested and fixed by email, preferably in the schedules and place established by lecturers at the beginning of the academic year and published on the course website.
Master Session	Students will have the opportunity to attend personal tutorials in their lecturer’s office. These tutorials can be individual or in reduced groups (typically with a maximum of 2-3 students). Previous appointment with the corresponding professor will be requested and fixed by email, preferably in the schedules and place established by lecturers at the beginning of the academic year and published on the course website.
Reports / memories of practice	Students will have the opportunity to attend personal tutorials in their lecturer’s office. These tutorials can be individual or in reduced groups (typically with a maximum of 2-3 students). Previous appointment with the corresponding professor will be requested and fixed by email, preferably in the schedules and place established by lecturers at the beginning of the academic year and published on the course website.

Assessment		
	Description	Qualification
Short answer tests	Exam with questions and problems. In these tests the skill A3 will be evaluated.	5
Reports / memories of practice	Report about the perfomed work during several weeks in the computer classroom. In these tests the skill A5 will be evaluated.	15
Multiple choice tests	On the faitic website. In these tests the skill A3 will be evaluated.	7.5
Long answer tests and development	To evaluate theorical knowledges and problems resolution. In these tests the skills A3, A5 and A22 will be evaluated.	65
Practical tests, real task execution and / or simulated.	Exam related to the work performed during several weeks of laboratory. In these tests the skill A5 will be evaluated.	7.5

Other comments and second call

CONTINUOUS ASSESSMENT

The continuous assessment consists of several activities. If the student can not do them in the fixed date, this activity will not be evaluated. The grades of these activities will be valid only for the present academic course.Â
If the student does the "Examen 1", she/he will be evaluated by continuous assessment.Â

Types and assessment of activities:

1. Exam 1 (Weight: 15%): weeks 7-8. It includes the subjects explained until this week.
2. Tests Â (Weight: 7.5%): Â developed Â along the course on the faitic website.
3. Exam of practices (Weight: 7.5%): Â week 6-7.
4. Short answer exam (Weight: 5%): Â week 13.Â It includes several subjects.
5. Lab project report (Weight: 15%): Â weeks 13 and 14.
6. Exam 2 (Weight: 50%): on the date of the final exam. It includes all the subjects, except those evaluated in the Exam 1 and the contents of lab projects.

In order to ensure that students acquire a balanced minimum on the subject competences, they will pass the course if they meet these two conditions:

1) get a final mark equal to or greater than 5 (on a ten-points scale)Â

2) and a score equal to or greater than 3.5 (on a ten-points scale) in each one of these two sets:

* assessment of sound-related scores

* assessment of image-related scores

NON CONTINUOUS ASSESSMENT

Students will be evaluated by means of an only exam, in the official date, if they don't do theÂ Â "Exam 1". Â The grades for this final exam are between 0 and 10 points. It Â includes all the subjects of the course, including the laboratory works.Â

In order to ensure that students acquire a balanced minimum on the subject competences, they will pass the course if they meet these two conditions:

1) get a final mark equal to or greater than 5 (on a ten-points scale)Â

2) and a score equal to or greater than 3.5 (on a ten-points scale) in each one of these two sets:

* assessment of sound-related scores

* assessment of image-related scores

Student can do the activities of Continuous Assessment, except the Exam 2.

Â June/July exam:

â‡' Students evaluated by Continuous Assessment can opt between two possibilities the same day of the exam:

1. Do again the Exam 2 and be evaluated according to the stipulated for the system of "Continuous Assessment".Â
2. Be evaluated with an only final exam in the official date assigned by the Centre.Â The grades for this final exam are between 0 and 10 points. It Â includes all the subjects of the course, including the laboratory works.Â "Non Continuous Assessment" rules apply.

â‡' Studentss Â not evaluated by Continuous Assessment:
The grades for this final exam are between 0 and 10 points. It Â includes all the subjects of the course, including the laboratory works.Â "Non Continuous Assessment" rules apply.

Sources of information
Finn Jacobsen et al., FUNDAMENTALS OF ACOUSTICS AND NOISE CONTROL, , Technical University of Denmark
Lawrence Kinsler, Austin Frey, Alán Coppens, James Sanders, FUNDAMENTALS OF ACOUSTICS, , John Wiley & sons, Inc
R. J. Clarke, Digital Compression of Still Images and Video, , Academic Press.
T. Perales Benito, Radio y Televisión Digitales: Tecnología de los Sistemas DAB, DVB, IBUC y ATSC, , Creaciones Copyright
Ulrich Reimers, DVB : the family of international standards for digital video broadcasting, , Springer

In addition to the previous bibliography, students will be providedÂ with:

* Documents for each subject: main material for an appropriate preparation of the course.

* Documents with the project's contents for each practise session.
* Copy of the graphic material used in the master sessions.
* Problems proposed: A set of problems recommended for each subject.

Recommendations

Subjects that continue the syllabus

Room Acoustics/V05G300V01635
Fundamentals of Acoustics Engineering/V05G300V01531
Fundamentals of Image Processing/V05G300V01632
Sound Processing/V05G300V01634
Audio Systems/V05G300V01532
Imaging Systems/V05G300V01633
Audiovisual Technology/V05G300V01631
Video and Television/V05G300V01533

Subjects that are recommended to be taken simultaneously

Signal Transmission and Reception Techniques/V05G300V01404

Subjects that it is recommended to have taken before

Physics: Fields and Waves/V05G300V01202
Physics: Fundamentals of Mechanics and Thermodynamics/V05G300V01102
Digital Signal Processing/V05G300V01304
Electromagnetic Transmission/V05G300V01303

IDENTIFYING DATA				
Internet Services				
Subject	Internet Services			
Code	V05G300V01501			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	1st
Language	Spanish			
Department				
Coordinator	Burguillo Rial, Juan Carlos			
Lecturers	Álvarez Sabucedo, Luis Modesto Burguillo Rial, Juan Carlos Caeiro Rodríguez, Manuel Gil Solla, Alberto López Nores, Martín			
E-mail	jrial@uvigo.es			
Web				
General description	This subject will provide to the student a global vision of the group of current services of Internet, between which fits to quote the email, the WWW, the technologies XML, the Services Web, the sharing of resources among peers (P2P), the Semantic Web and the cloud computing. This subject will be taught in Spanish.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A20	CE11/T6: The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact.
A27	CE18/T13: The ability to differentiate the concepts of access and transport networks, packet and circuit switched networks, mobile and fixed networks, as well as distributed newtwork application and systems, voice, data, video, audio, interactive and multimedia services.

Learning aims		
Subject competences	Typology	Competences
To know the basic services of Internet, as well as comprise the basic principles of his operation.	know	A3 A6 A20 A27
To dominate the main technical standards in the field of development of telematic services.	know	A6
To understand the importance of organising the structured information for his suitable utilisation.	know	A3 A20 A27
To Know the basic concepts of semantic management of the information.	know	A3 A27
To understand the principles and the general organisation of a web service.	know	A3 A6 A27

To improve the skill in the design and development of basic telematic services.	know Know How	A4 A9

Contents	
Topic	
1. Internet basic services	a) Electronic mail b) World Wide Web: languages, protocols, architecture and Web applications.
2. XML and related technologies	a) Document Type Definition (DTD) b) NameSpaces c) XML Schema d) Document Object Model (DOM) e) Extensible Stylesheet Language Transformations (XSLT) f) Other related technologies
3. Web Services	a) Simple Object Access Protocol (SOAP) b) Universal Description, Discovery and Integration (UDDI) c) Web Services Description Language (WSDL)
4. Additional services	To) Sharing resources among peers (P2P) b) Semantic Web c) Cloud Computating

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	2	4
Master Session	24	36	60
Practice in computer rooms	26	26	52
Forum Index	0	4	4
Self-assessment tests	0	2	2
Practical tests, real task execution and / or simulated.	2	4	6
Long answer tests and development	2	20	22
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	In the first classes we will describe the activities to be performed along the subject, along the theory and along the practices in the computing laboratory.
Master Session	Along the theory classes we will describe the main contents of the subject by means of slides. The exam for this part evaluates the competencies: A3, A4, A6, A27.
Practice in computer rooms	The subject also will require the development and delivery of 3 practices (the first one is compulsory) that the students will perform in the corresponding computer laboratory. The applications to develop in these practices will be done by means of the languages common used in the Internet: Javascript, PHP, Java, etc. This practices evaluates the compentences: A3, A4, A6, A9, A20, A27.
Forum Index	During the course we will discuss several topics, related with the concepts seen in theory, in the forums of the subject. This forum evaluates the competencies: A3, A6.

Personalized attention	
	Description

Forum Index	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along all course in order to improve the understanding of the basic concepts and for the realisation of the projects and activities to be evaluated.
Practice in computer rooms	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along all course in order to improve the understanding of the basic concepts and for the realisation of the projects and activities to be evaluated.
Practical tests, real task execution and / or simulated.	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along all course in order to improve the understanding of the basic concepts and for the realisation of the projects and activities to be evaluated.
Long answer tests and development	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along all course in order to improve the understanding of the basic concepts and for the realisation of the projects and activities to be evaluated.

Assessment

	Description	Qualification
Self-assessment tests	They will do two test of self-evaluation along the subject on the theoretical concepts that the students have learnt up to such point. These test self-evaluate the competencies: A3, A6.	0
Practical tests, real task execution and / or simulated.	The code that implements the projects will be evaluated to discover if all works according to the requirements and specifications established by the teachers. These test evaluate the compentences: A3, A4, A6, A9, A20, A27.	50
Long answer tests and development	There will be a theoretical examination at the end of the subject concerning the contents seen in it. After finishing the theoretical examination, the student must PASS a practical exam in the laboratory (related with the practical tasks) to check that the student dominates properly his/her own code. The exam evaluates the competencies: A3, A4, A6, A27.	50

Other comments and second call

The subject is composed by a theoretical and a practical part. Each one of them have a value Â of 5 points, having to reach at least a 2 in each part to do the average with the another.

Following the degree guidelines we will offer Â the students two evaluation possibilities: continuous evaluation and evaluation at the end of the semester.

Continuous evaluation (EC):

- The theoretical part means a final examination (with a value of 5 points). This final examination will be equal for all the students, independently that they have opted or no by the EC.
- The student follows the continuous evaluation from the moment in that it delivers the first practice in time.
- The practical part is composed of three practices, that will cost 1, 2 and 2 points respectively. This first practice is compulsory and the student must deliver, at least, any of the two others.

- The first practice will be delivered in the week 6.
- The second practice is valued with 2 points and it will divided in two parts, to facilitate its realisation, that will be delivered in the weeks 11 and 15 respectively. After the delivery of each part, the student might be able to do a second delivery, if they do not fulfil the requirements established, that will imply some penalty in the mark. After such second delivery, the code delivered will be evaluated in it is.
- The third practice will cost 2 points and will be able to deliver until the week 16.
- After finishing the theoretical examination, the students will perform a basic practical exam in the laboratoryÂ (related with the practices done)Â to check that the studentÂ dominates properly his/her own code. This practical exam provides a mark (Npp) between 0 and 1, as a function of time needed to solve it. The global mark for the practices will be obtained by multiplying the practices marks and the practical exam mark: Note for practical part =Â (P1+P2+P3) x Npp
- In the case that the resulting value is below 2 points, the student must perform the practices again in the next call, and do again this practical exam.
- To pass the subject, the student will have to obtain at least 5 points adding the theoretical part and the practices (with a minimum of 2 in each one of them).

Evaluation at the end of the semester: The student that have not opted by the EC will have to perform the theoretical examination and deliver, before the day of the final exam, the practical proposalsÂ along the subject (with the possible modifications that can be specified), to addÂ a minimum of 5 points in the final mark. Besides, it will must obtain a PASS in the practical proof after the theoretical examination.Â Therefore, the conditions imposed are the same than in the EC case, and the only difference is the timing for delivering the practical tasks (notified in time) and that there is no possibility to submit two times every practical task.

Passing the subject: Both in the case of EC as assessment at the end of the semester, to approve the student must obtain at least 5 points by adding the theoretical and practical parts (with a minimum of 2 in each) and get a PASS in practical exam.

Evaluation at the end of the second semester: the student will have to perform the part that have not surpassed (examination, practical, and/or practical exam). The practices can suffer modifications or incorporate additional features.Â

The practical tasks performed in this course are not recoverable and only are valid for the current course.

Sources of information
H.M Deitel et al., Internet and World Wide Web How to Program: International Edition, 5, 2012
Robert W. Sebesta, Programming the World Wide Web, 7, 2012
Andrew S. Tanenbaum, Computer Networks, 5, 2012
Priscilla Walmsley, Definitive XML Schema, 2/E, 2, 2012
Kevin Howard Goldberg, XML: Visual QuickStart Guide, 2/E, 2, 2008
Michael Papazoglou, Web Services and SOA: Principles and Technology, 2/E, 2, 2012
Steve Graham et al., Building Web Services with Java: Making Sense of XML, SOAP, WSDL, and UDDI, 2, 2004
Thomas Erl, Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services, 1, 2004
W. Stallings, Data and Computer Communications, 9, 2013

Recommendations
Subjects that continue the syllabus
Architectures and Services/V05G300V01645

Subjects that it is recommended to have taken before

Programming II/V05G300V01302
Computer Networks/V05G300V01403

IDENTIFYING DATA				
Programmable Electronic Circuits				
Subject	Programmable Electronic Circuits			
Code	V05G300V01502			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	1st
Language	Spanish Galician			
Department				
Coordinator	Álvarez Ruíz de Ojeda, Luís Jacobo			
Lecturers	Álvarez Ruíz de Ojeda, Luís Jacobo Machado Domínguez, Fernando Moure Rodríguez, María José Poza González, Francisco Verdugo Mates, Rafael			
E-mail	jalvarez@uvigo.es			
Web	http://www.faitic.uvigo.es/			
General description	The main learning goals of this course are: Architecture of microprocessors, microcontrollers and configurable devices. Design methods and tools to acquire the necessary skills to design systems based on these devices.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A16	CE7/T2: The ability to use communication and software applications (ofimatics, databases, advanced calculus, project management, visualization, etc.) to support the development and operation of Electronics and Telecommunication networks, services and applications.
A17	CE8/T3: The ability to use software tools for bibliographical resources search or information related with electronics and telecommunications.
A23	CE14/T9: The ability to analyze and design combinatory and sequential, synchronous and asynchronous circuits and the usage of integrated circuits and microprocessors.
A24	CE15/T10: The knowledge and application of the fundamentals of description languages for hardware devices.
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Subject competences	Typology	Competences
To understand the basic architecture of microprocessors, microcontrollers and configurable devices (FPGAs).	know	A3 A23 A24
To study the methods and techniques of design of integrated hardware/software systems (System on Chip – SoC).	know	A3 A23 A24
To know the hardware and software tools for the design of systems based in programmable devices.	know	A3 A23 A24 B4
To handle the design tools for the design of systems based on programmable devices.	Know How	A23 A24 B4

To design simple integrated systems (System on Chip – SoC) applied to the telecommunications fields.	Know How	A4 A16 A17 A23 A24

Contents	
Topic	
LESSON 1 THEORY (1 h.). INTRODUCTION TO FPGAs.	1.1.- Introduction. 1.2.- Definition of FPGA. FPGA classification. 1.3.- FPGA architectures. 1.3.1.- Logical resources. 1.3.1.1.- Configurable Logic Blocks. 1.3.1.2.- Internal Logic Blocks. 1.3.1.3.- Input/Output Blocks. 1.3.1.4.- Embedded circuits. Memories. PLL digital circuits. Arithmetical circuits. Multipliers. DSP blocks. Serial transceivers. 1.3.2.- Interconnection resources. 1.3.2.1.- Interconnection lines. 1.3.2.2.- Configurable connection points. 1.3.3.- Examples of commercial FPGAs. 1.4.- FPGA technologies. 1.4.1.- FPGA manufacturing technologies (LVTTL, LVCMOS, etc.). 1.4.2.- FPGA configuration technologies. 1.4.2.1.- Static RAM technology (SRAM). 1.4.2.2.- Antifuse technology. 1.4.2.3.- Non-volatile memory technology (EEPROM). 1.4.3.- FPGA configuration. Methods. External programmer. In System Programmable (ISP). 1.5.- General characteristic of the FPGAs. 1.6.- Advantages of the FPGAs. 1.7.- Stages of the design of digital systems with FPGAs. 1.7.1.- Design implementation with FPGAs. 1.8.- FPGA CAD tools. 1.9.- FPGA applications. 1.10.- FPGAs versus other circuits. Comparative analysis.
LESSON 2 THEORY (1 h.). XILINX SPARTAN 3 FPGA FAMILY. ARCHITECTURE.	2.1.- Introduction. 2.2.- Xilinx Virtex 2 family architecture. 2.2.1.- Logical resources. CLBs. “Slices”. RAM-based shift registers. 2.2.2.- Internal memories. Distributed memory. Embedded memory. 2.2.3.- Clock circuits. 2.2.4.- Hardware multipliers. 2.2.5.- Input / Output technologies. 2.3.- Spartan 3 vs. Virtex 2. 2.4.- Spartan 3E vs. Spartan 3. 2.5.- Synthesis guidelines.
LESSON 3 THEORY (2 h.). INTRODUCTION TO MICROCONTROLLERS.	3.1.- Introduction. Definition of microcontroller. 3.2.- Internal architecture. Harvard. Von Neumann. 3.2.1.- Control Unit. 3.2.2.- ALU. 3.2.3.- Instruction set. RISC. CISC. 3.3.- External architecture. 3.3.1.- Access to memory. Program memory. Data memory. 3.3.2.- Access to peripherals. Input / Output ports. 3.3.3.- Interrupt control. 3.4.- Integrated peripherals. 3.4.1.- Timers. 3.4.2.- Serial communication. UART RS232. SPI. I2C. 3.4.3.- A/D and D/A converters. 3.5.- Examples of commercial microcontrollers. 3.6.- Microcontroller applications. 3.7.- Tools for programming and verification.
LESSON 4 THEORY (2 h.). XILINX PICOBLAZE MICROPROCESSOR (I).	4.1.- Introduction. 4.2.- Versions of the Xilinx Picoblaze microprocessor. 4.3.- Internal architecture of the Picoblaze microprocessor. 4.4.- Instruction set of the Picoblaze microprocessor.

LESSON 5 THEORY (1 h.). SOFTWARE DEVELOPMENT FOR XILINX PICOBLAZE MICROPROCESSOR.	5.1.- Introduction. 5.2.- Syntax of an assembler program for the Picoblaze microprocessor. 5.3.- Program development with pBlazeIDE environment for Picoblaze .
LESSON 6 THEORY (3 h.). XILINX PICOBLAZE MICROPROCESSOR (II).	6.1.- Introduction. 6.2.- External architecture. 6.2.1.- Input / Output instructions. 6.2.2.- Connection of input peripherals. 6.2.3.- Connection of output peripherals. 6.2.4.- Initial state. 6.2.5.- External interrupts. 6.3.- Design of peripherals for the Picoblaze microprocessor.
LESSON 7 THEORY (1 h.). INTRODUCTION TO SYSTEMS ON CHIP (SOC).	7.1.- Introduction to digital design methods. 7.1.1.- Software method. 7.1.2.- Hardware method. 7.2.- Systems On Chip (SOC). 7.3.- Systems On a Programmable Chip (PSOC). Microprocessors embedded in FPGAs. 7.3.1.- Hardware Microprocessors. 7.3.2.- Software Microprocessors. 7.4.- Embedded microprocessor applications.
LESSON 8 THEORY (3 h.). HARDWARE / SOFTWARE CODESIGN.	8.1.- Introduction. 8.2.- Software design. 8.3.- Hardware design. 8.4.- Stages of hardware / software codesign. 8.5.- Hardware / software partition. 8.6.- Examples hardware / software codesign. 8.7.- Peripheral design. How to split functions between “hardware” and “software”.
LESSON 9 THEORY (4 h.). DESIGN OF COMPLEX SYSTEMS.	9.1.- Introduction. 9.2.- Previous analysis of the most suitable solution. 9.3.- Application specific peripherals. Design methods. 9.3.1.- Practical examples.
LESSON 10 THEORY (2 h.). INTRODUCTION TO CORRECT DESIGN METHODS.	10.1.- Introduction. 10.2.- Design of digital systems with FPGAs. 10.2.1.- Hierarchical design. 10.2.2.- Independent technology design. 10.2.3.- Timing design.
LESSON 11 THEORY (4 h.). SYNCHRONOUS DIGITAL SYSTEM DESIGN.	11.1.- Introduction. 11.2.- Synchronous design. 11.3.- Synchronous sequential systems. FPGA design tips. 11.4.- Synchronisation of input variables.
LESSON 1 LABORATORY (2 h.). STAGES OF DIGITAL SYSTEM DESIGN WITH FPGAs.	1.1.- Introduction. Xilinx ISE tool flow diagram. 1.2.- VHDL description. 1.3.- Behavioural simulation. 1.4.- Synthesis. 1.5.- Implementation. 1.6.- Implementation options for the Xilinx Spartan 3E FPGA family. 1.7.- FPGA Editor. 1.8.- Timing simulation. 1.9.- Timing analysis report. 1.10.- Technology and configuration methods for Xilinx FPGAs. 1.11.- Development boards based on FPGAs of Xilinx. 1.12.- Configuration file (.BIT). 1.13.- FPGA programming. ‘iMPACT’. 1.14.- Digital system testing. Frequent problems. 1.15.- Examples.
LESSON 2 LABORATORY (2 h.). PERIPHERAL CIRCUIT DESIGN FOR THE PICOBLAZE MICROPROCESSOR.	2.1.- Introduction. 2.2.- Guidelines on synchronous design with VHDL. 2.3.- Basic register in VHDL. 2.4.- Data memory in VHDL. 2.5.- Timer in VHDL.
LESSON 3 LABORATORY (2 h.). PERIPHERALS INTERFACE CIRCUIT DESIGN FOR THE PICOBLAZE MICROPROCESSOR.	3.1.- Introduction. 3.2.- Input peripheral interface circuit in VHDL. 3.3.- Output peripheral interface circuit in VHDL. 3.4.- Interrupt storing circuit in VHDL.

LESSON 4 LABORATORY (2 h.). XILINX PICOBLAZE MICROPROCESSOR SOFTWARE TOOLS.	4.1.- Introduction. 4.2.- Program assembler and simulator in Mediatronix. Picoblaze IDE. 4.3.- Basic examples.
LESSON 5 LABORATORY (6 h.). DESIGN OF DIGITAL SYSTEMS BASED ON THE PICOBLAZE MICROPROCESSOR.	5.1.- Introduction. 5.2.- Picoblaze microprocessor source files. 5.3.- Design stages for digital systems based on the Picoblaze microprocessor. 5.3.1.- Choosing the right Picoblaze microcontroller. 5.3.2.- Picoblaze program design. 5.3.3.- Picoblaze program simulation. 5.3.4.- Generation of the necessary VHDL files for the implementation of the Picoblaze Microprocessor in Xilinx Spartan 3E FPGA family. 5.3.5.- Peripheral circuit design for the Picoblaze microcontroller. Additional circuits needed. 5.3.6.- Simulation of the peripheral and additional circuits. 5.3.7.- Implementation of the complete digital system. 5.3.8.- Test of the complete digital system. 5.4.- Design of a basic example with use of interrupts, based on the Picoblaze microprocessor.
LESSON 6 LABORATORY (12 h.). PROJECTS. DESIGN OF DIGITAL SYSTEMS BASED ON THE PICOBLAZE MICROPROCESSOR.	6.1.- Design and implementation of a medium-complexity digital system based on the Picoblaze 3 microprocessor, according to the instructions supplied by the teacher through FaiTIC website.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	12	16	28
Troubleshooting and / or exercises	12	19	31
Laboratory practises	14	20	34
Tutored works	12	24	36
Introductory activities	2	2	4
Short answer tests	4	13	17

*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	Conventional lectures. Through this methodology the outcome CG3 is developed.
Troubleshooting and / or exercises	These sessions will include the realisation of exercises and works by part of the professor and of the students. Through this methodology the outcomes CG3, CG4, CE8/T3, CE14/T9 and CE15/T10 are developed.
Laboratory practises	VHDL design of digital circuits and development of assembler programs. Implementation in FPGAs. Through this methodology the outcomes CG3, CG4, CG13, CE7/TE2, CE8/T3, CE14/T9 and CE15/T10 are developed.
Tutored works	The students must design the circuits and programs needed to build a complete embedded system based on a FPGA. Through this methodology the outcomes CG3, CG4, CG13, CE7/TE2, CE8/T3, CE14/T9 and CE15/T10 are developed.
Introductory activities	Introduction to the subject key topics both theoretical and practical. Through this methodology the outcome CG3 is developed.

Personalized attention

	Description
Laboratory practises	In class the teacher will assist the students. Besides, the students will have the opportunity to consult with the teacher in office hours which will be published in the faculty website.

Tutored works	In class the teacher will assist the students. Besides, the students will have the opportunity to consult with the teacher in office hours which will be published in the faculty website.

Assessment

	Description	Qualification
Laboratory practises	Design of digital circuits in VHDL and assembler programs. It will be necessary to deliver the design source files and to show the teacher the correct operation of each one of the circuits and programs.. The assessment will be based on the operation of the circuits and programs developed in the practical sessions corresponding to the laboratory lessons 1 to 5, according to the published criteria. Through this methodology the outcomes CG3, CG4, CG13, CE7/TE2, CE8/T3, CE14/T9 and CE15/T10 are assessed.	25
Tutored works	Autonomous Project. Design of a medium-complexity embedded digital system with at least a complex peripheral designed by the students. It will be necessary to deliver the design source files and a report of maximum 10 pages, describing the work done, according to the index supplied by the professor. The content corresponds with laboratory lesson 6. The assessment will be based on the operation of the digital system and the correct application of the theoretical concepts, according to the published criteria. Through this methodology the outcomes CG3, CG4, CG13, CE7/TE2, CE8/T3, CE14/T9 and CE15/T10 are assessed.	25
Short answer tests	Two exams based on multiple choice questions or short questions about the theoretical topics of the subjects. Through this methodology the outcomes CG3, CG4, CE14/T9 and CE15/T10 are assessed.	50

Other comments and second call

The total mark will be the sum of the marks obtained in the different tasks of the subject.

The mark of each one of the theoretical exams has to be equal or greater than 5 over 10 in order to pass the subject.

The global mark of the laboratory guided practices has to be equal or greater than 5 over 10 in order to pass the subject.

The mark of the practical work has to be equal or greater than 5 over 10 in order to pass the subject.

All the students, both those who follow the subject continuously and those who want to be assessed in the final exam at the end of the term or at the end of the year (second opportunity), will have to do the tasks described in the previous section.

The students that do not attend classes regularly will also have to do the same tasks as the students who attend classes.

The final mark will be expressed in numerical form ranging from 0 to 10, according to the valid regulation (Royal decree 1125/2003 of 5 September; BOE 18 September).

Following the guidelines of the degree the students will be offered two assessment systems: continuous assessment and final assessment at the end of the term.

CONTINUOUS ASSESMENT:

The students are considered to have chosen the continuous assessment when they have done 2 laboratory practices and/or have sat the first theoretical examination.

The students who want to be assessed in the continuous assessment can only miss two sessions as a maximum. If they miss more than 2 sessions, it will be compulsory to do an additional individual task or an examination.

The students that have chosen continuous assessment, but do not pass the course, will have to do the final assessment at the end of the year (second opportunity), that is, will have to repeat all the tasks, included those that had passed.

The students that pass the course by means of continuous assessment will not be allowed to repeat any task in the final assessment in order to improve the mark.

The different tasks should be delivered in the date specified by the teacher, otherwise they will not be assessed for the continuous assessment.

The students will develop the theoretical exercises, the laboratory practices and the laboratory projects in groups of two students during the continuous assessment.

FINAL ASSESMENT:

The students that opt for the final assessment will have to do all the theoretical and practical tasks and the project individually.

The tasks for the final assessment have to be delivered before the official date of the examination set by the faculty.

In case the students pass the four tasks (mark of each task >= 5), the final mark (FM) will be the weighted sum of the marks of each part of the subject:

FM = 0'25 * TE1 + 0'25 * TE2 + 0'25 * LP + 0'25 * AP

In case the students do not pass any of the four tasks of the subject(mark of some task < 5), the final mark (FM) will be:

FM = Minimum [4'5; (0'25 * TE1 + 0'25 * TE2 + 0'25 * LP + 0'25 * AP)]

Being:

TE1 = First partial theoretical examination.

TE2 = Second partial theoretical examination.

LP = Global mark of the guided Laboratory Practices corresponding to the lessons 1 to 5.

AP = Laboratory Autonomous Project.

ASSESSMENT CRITERIA.

1) Theoretical examinations.

The first theoretical examination will be scheduled around the sixth week of classes in the place and date determined by the professors and the faculty. At least, it will be scheduled after having studied the theoretical lessons 1 to 8.

The second theoretical examination will be scheduled around the fourteenth week of classes in the place and date that determined by the professors and the faculty.

The students will have to properly answer the exam questions.

2) Laboratory guided practices.

The correct operation of the circuits and programs developed in the laboratory sessions will be evaluated, according to the marks stated in the practice bulletin. Each practical lesson will be marked over 10. Afterwards, its influence will be weighted in the total mark of the subject, according to the number of hours assigned to each lesson. As a consequence, the global mark of the practices corresponding to the lessons 1 to 5 of laboratory, is obtained through the following equation:

LP = (Practice 1L Mark + 2 * Practice 2L Mark + Practice 3L Mark + Practice 4L Mark + 2 * Practice 5L Mark) / 7

The total mark of the guided laboratory practices (LP) corresponds to 25% of the total mark of the subject.

It will be necessary to deliver the required source files.

The assessment criteria refer only to the functionality of the circuits and programs developed, that is, the circuits and programs have to work perfectly in all his aspects to obtain the maximum mark, whether it is the software simulation, the behavioural and timing simulation of the different hardware circuits and complete system, or the test in the development board.

3) Autonomous laboratory work.

Autonomous project. The students must design a medium-complexity embedded system with at least a complex peripheral designed by the students. It will be necessary to deliver a short report on the work done.

The assessment criteria of the autonomous work are the following:

1) Suitable hardware / software partitioning.

2) Suitable hardware organisation and suitable assembler program structure.

3) Design correctness.

Optimisation of the VHDL description and circuit use.

Application of synchronous design techniques.

4) Analysis of the FPGA implementation.

Analyse the FPGA logical resources used and their justification.

Analyse the internal system delays.

5) Functionality.

Software simulation.

Behavioural simulation of the different hardware circuits.

Simulation of the complete embedded system (hardware + software).

Board test of the complete embedded system (hardware + software).

All the sections have to work perfectly to obtain the maximum mark.

6) Documentation of the design and FPGA implementation.

a. Report.

i. Clear structure and order.

ii. Clear explanations.

iii. Enough explanations to understand the work done.

iv. Inclusion of suitable figures.

v. Inclusion of relevant data.

b. Source design files.

i. Enough comments in the VHDL files to explain the sentences used.

ii. Enough comments in the assembler files to be understood.

Sources of information

BASIC BOOKS OF THE SUBJECT:

[ÁLVAREZ 04] ÁLVAREZ RUIZ DE OJEDA, L.J., *Diseño Digital con Lógica Programable*, Editorial Tórculo, Santiago de Compostela, 2004.

[POZA et AL 12] POZA GONZÁLEZ, F., ÁLVAREZ RUIZ DE OJEDA, L.J., *Diseño de sistemas empotrados de 8 bits en FPGAs con Xilinx ISE y Picoblaze* , Vision libros, Madrid, 2012.

Documentación de la asignatura, disponible en las páginas web “http://www.faitic.uvigo.es”.

COMPLEMENTARY BIBLIOGRAPHY OF THE SUBJECT:

DIGITAL SYSTEM DESIGN:

[ÁLVAREZ 13] ÁLVAREZ RUIZ DE OJEDA, L.J., *Diseño Digital con FPGAs*, Vision libros, Madrid, 2013.

[ÁLVAREZ 02] ÁLVAREZ RUIZ DE OJEDA, L. Jacobo, MANDADO PÉREZ, E., VALDÉS PEÑA, M.D., *Dispositivos Lógicos Programables y sus aplicaciones*, Editorial Thomson-Paraninfo, 2002.

[ÁLVAREZ 01] ÁLVAREZ RUIZ DE OJEDA, *Diseño de aplicaciones mediante PLDs y FPGAs*, Editorial Tórculo, Santiago de Compostela, 2001.

[ARTIGAS 02] ARTIGAS MAESTRE, J.I., BARRAGÁN PÉREZ, L.A., ORRITE URUÑUELA, C., URRIZA PARROQUÉ, I., *Electrónica Digital. Aplicaciones y problemas con VHDL*, Prentice-Hall, Madrid, 2002.

[BOLTON 90] BOLTON, M., "*Digital systems design with programmable logic*", Addison-Wesley, 1990.

[LALA 90] LALA, Parag K., "*Digital system design using programmable logic devices*", Prentice Hall, New Jersey, 1990.

[PELLERIN 91] PELLERIN, D., HOLLEY, M., "*Practical design using programmaÂble logic*", Prentice Hall, Londres, 1991.

[SCARPINO 98] SCARPINO, F., *“VHDL and AHDL digital system implementation”*, Prentice Hall, Londres, 1998.

FPGAs:

[ACTEL] Dirección de Internet, *http://www.actel.com*, Actel.

[ALTERA] Dirección de Internet, *http://www.altera.com*, Altera.

[CYPRESS] Dirección de Internet, *http://www.cypress.com*, Cypress.

[CHAN 94] CHAN, Pak K., MOURAD, Samiha, "*Digital design using Field ProgrammaÂble Gate Arrays*", Prentice Hall, New Jersey, 1994.

[JENKINS 94] JENKINS, Jesse H., "*Designing with FPGAs and CPLDs*", Prentice Hall, New Jersey, 1994.

[LATTICE] Dirección de Internet, *http://www.latticesemi.com*, Lattice semiconductors.

[OLDFIELD 95] OLDFIELD, J.V., DORF, R.C., "*Field Programmable Gate Arrays: Reconfigurable logic for rapid prototyping and Implementation of Digital Systems*", John Wiley & Sons, 1995.

[QUICKLOGIC] Dirección de Internet, *http://www.quicklogic.com*, Quicklogic.

[SHARMA 98] SHARMA, A. K., "*ProgrammaÂble logic handbook*", McGraw Hill, Fairfield, 1998.

[XILINX] Dirección de Internet, *http://www.xilinx.com*, Xilinx.

MICROPROCESSORS:

[CHAPMAN 02] “Creating Embedded Microcontrollers (Programmable State Machines)”, Ken Chapman, TechXclusives, Xilinx, 2002.

[CHAPMAN 03] KCPSM3, 8-bit Microcontroller for Spartan-3, Virtex-2 and Virtex-2 Pro (KCPSM3_Manual), Ken Chapman, Xilinx, 2003.

[CHU 08] CHU, PONG P., *“FPGA prototyping by VHDL examples : Xilinx Spartan-3 version”*, John Wiley & Sons, Hoboken (New Jersey), 2008.

[XILINX 10] “PicoBlaze 8-bit Embedded Microcontroller User Guide for Spartan-3, Spartan-6, Virtex-5, and Virtex-6 FPGAs (UG129), Xilinx, 2010.

VHDL:

[IEEE 01] IEEE Standard VHDL Language Reference Manual (IEEE Srd 1076-2001), Institute of Electrical and Electronics Engineers, 2001.

[PÉREZ 02] PÉREZ LÓPEZ, S.A., SOTO CAMPOS, E., FERNÁNDEZ GÓMEZ, S., *Diseño de sistemas digitales con VHDL*, Thomson-Paraninfo, Madrid, 2002.

Recommendations

Subjects that continue the syllabus

Design and Synthesis of Digital Systems/V05G300V01923

Subjects that it is recommended to have taken before

Programming I/V05G300V01205
Digital Electronics/V05G300V01402
Physics: Fundamentals of Electronics/V05G300V01305

Other comments

The students will have previously followed the subject Digital Electronics. It gives the necessary knowledge to understand the topics of this course. It is not necessary to have passed it.

Besides, it is recommended that the students have previously followed the subject Physical: Foundations of Electronics and Programming I. They give the necessary knowledge to understand some topics of this course.

IDENTIFYING DATA				
Radio Frequency Circuits				
Subject	Radio Frequency Circuits			
Code	V05G300V01511			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Isasi de Vicente, Fernando Guillermo			
Lecturers	Isasi de Vicente, Fernando Guillermo			
E-mail	fisasi@uvigo.es			
Web	http://cursos.faitic.uvigo.es/tema1415/claroline/course/index.php			
General description	Main radio system circuits are studied. In this matter main characteristics and structure are treated. The evaluation of this circuits is studied too.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A33	CE24/ST4 The ability to select circuits, subsystems and systems of radiofrequency, microwaves, broadcasting, radio link and radio determination.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.

Learning aims		
Subject competences	Typology	Competences
Student will be able to evaluate radiofrequency circuits and the adequacy to requirements. Also he/she can physically measure key parameters on circuits to evaluate them. In this subject main subsystems of a radiocommunication system will be treated.	know Know How	A4 A6 A8 A9 A33 A34

Contents	
Topic	
Main radiocommunication systems characteristics.	Non linear effects
Use of radiofrequency laboratory equipment.	Use and understanding of laboratory equipment: Spectrum analyzer Network analyzer Signal source
Filtros	Theorical and practical principles of radiofrequency filters.
Study of amplifiers.	Main characteristics Noise in amplifiers

Oscillators	Non linear treatment Oscillators measurement Voltage controlled oscillators (VCO) Phase noise
Mixers	Basic approach Main mixers structures
Frequency synthesizers	Based in PLL. Direct digital synthesis.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	2.5	3.5
Master Session	17	42.5	59.5
Practice in computer rooms	2	3	5
Laboratory practises	16.5	33	49.5
Jobs and projects	1	1	2
Short answer tests	4	24	28
Practical tests, real task execution and / or simulated.	0.5	2	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
Introductory activities	Student will be guided to study of previous required knowledge using various sources in order to adequate subject study. Student is encouraged to make use of tutorship hours in order to solve more difficult topics.
Master Session	Lecture at classroom using blackboard and computer about subject theory
Practice in computer rooms	Learning of some EDA (computer design applications) for design and test of radiocommunication systems.
Laboratory practises	Radiocommunication systems measurements. Use of radiocommunication circuit measurement equipment. Basic knowledge about radiofrequency circuits manufacturing. Team work using official standards and specifications.

Personalized attention

	Description
Laboratory practises	Practices in computer classroom as in the ones of laboratory and the practical proofs will resolve the doubts on the fly and will warn to the student that can be making some mistake. In the case of the works and projects will attend directly students' on the fly.
Practice in computer rooms	Practices in computer classroom as in the ones of laboratory and the practical proofs will resolve the doubts on the fly and will warn to the student that can be making some mistake. In the case of the works and projects will attend directly students' on the fly.
Jobs and projects	Practices in computer classroom as in the ones of laboratory and the practical proofs will resolve the doubts on the fly and will warn to the student that can be making some mistake. In the case of the works and projects will attend directly students' on the fly.
Practical tests, real task execution and / or simulated.	Practices in computer classroom as in the ones of laboratory and the practical proofs will resolve the doubts on the fly and will warn to the student that can be making some mistake. In the case of the works and projects will attend directly students' on the fly.

Assessment

	Description	Qualification
Master Session	Class with blackboard in classroom with occasional support of computer,	0
Laboratory practises	Questions of the professor and evaluation on the fly of the work at laboratory By this way CG4 and CG9 competences will be evaluated.	10
Practice in computer rooms	Some questions to test if student knows the tools explained. By this way CG4 and CG9 competences will be evaluated	5
Jobs and projects	Team project. Evaluation is done to one of the team's student randomly chosen. This examination is oral and student will answer professor's questions. Team's qualification will be fixed by this examination. By this way CG4, CG6, CG8, CG9, CE24/ST4 y CE25/ST5 competences will be evaluated.	20

Short answer tests	Theoretical problems written examination. Five tests for continuous assesment with relative weight of (6%, 10%, 10%,, 12% and 12%) and to the end of the course other similar test with a 50% of total qualification fpr those who don't choose continuous assesment or prefer this option. A student will not be evaluated by continuous assesment if has been done less than three tests. By this way CG4, CE24/ST4 y CE25/ST5 competences will be evaluated.	50
Practical tests, real task execution and / or simulated.	Practices test. Numerical results, neccesary for the practices will be evaluated. By this way CG4, CG6, CG8, CE24/ST4 y CE25/ST5 will be evaluated.	15

Other comments and second call

In final and july examinations if a student has not done practical or project works has to do them with a relative weight of 30% for practical works and 20% for projects. The problems examination's weight is 50%. Project and practical examinations will be done in a schedule agreed with professor. Those who has not passed practical or project works are allowed to take examination of these matters.

For C-type groups a project must be executed by some students. It results will be presented by one or several students randomly chosen.

Practical questions test will consist on problems and/or exercises solving. These problems are founded on theory presented in class and laboratories.
Except in case of continuous assesment, laboratory work is mandatory. A maximum of 20% of missed practices is allowed. Practices are recoverable along the curse agreeing with professor for an adequate time for it.

In july examination continuous assesment's qualifcations will be kept if student prefers so.

Sources of information

Electrónica de comunicaciones, M. Sierra y otros, 1, Madrid 2003

Apuntes de la asignatura, F. Isasi, 1, Vigo 2012

Solid state radio engineering, Kraus, Bostian y Raab, 1, 1980

James W. Nilsson, Susan A. Riedel, Circuitos eléctricos, 7, Madrid, 2005

Recommendations

Subjects that continue the syllabus

Microwave Circuits/V05G300V01611
Wireless Systems and Networks/V05G300V01615

Subjects that it is recommended to have taken before

Physics: Fundamentals of Electronics/V05G300V01305
Signal Transmission and Reception Techniques/V05G300V01404
Electronic Technology/V05G300V01401
Electromagnetic Transmission/V05G300V01303

IDENTIFYING DATA				
Radio Communication Systems				
Subject	Radio Communication Systems			
Code	V05G300V01512			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Rubiños López, José Óscar			
Lecturers	Arias Acuña, Alberto Marcos Rubiños López, José Óscar			
E-mail	oscar@com.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course is devoted to the study of the fundamentals of radio communications systems, including the antennas, the link budget as well as those factors that limit the correct recepction such as noise and interference.			

Competencies	
Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A30	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
A31	CE22/ST2 The ability of applying the basic techniques of telecommunication networks, services and applications for mobile and fixed environments, personal, local or long distance, with different bandwidth, including telephony, radio broadcasting, TV and data, from the point of view of transmission systems.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.

Learning aims		
Subject competences	Typology	Competences
Ability to apply the techniques underlying radio communication systems in fixed and mobile communication services, in local or long-distance links at different bandwidths.	know Know How	A31
Ability for the selection of antennas and equipment to transmit information by electromagnetic waves.	know Know How	A34
Knowledge, understanding and ability to handle and fulfill the specific legislation (technical requirements, law ...) in the field of Telecommunications.	Know How Know be	A2
Ability to solve problems with initiative, decision making, creativity, and to communicate and transmit knowledge and skills.	Know How Know be	A4
Ability to build, exploit and manage radio communication systems.	know Know How	A30

Contents
Topic

1. RADIATION FUNDAMENTALS	1.1 Electromagnetic Fundamentals 1.2 Antenna parameters in transmission 1.3 Antenna parameters in reception 1.4 Types of antennas
2. LINK BUDGET	2.1 Friis transmission equation 2.2 Propagation losses. 2.3 Band frequencies.
3. NOISE	3.1 Thermal noise. 3.2 Noise in antennas. 3.3 Noise factor and noise-equivalent temperature of a receiver.
4. INTERFERENCE	3.1 Concept and types of interference 3.2 Characterization of interference
5. AVAILABILITY	5.1 Concepts of availability, fading and diversity 5.2 Noise-limited Systems 5.3 Interference-limited Systems
6. RADIOWAVE PROPAGATION	6.1 Propagation at very low frequencies 6.2 Surface wave propagation 6.3 Ionospheric propagation 6.4 Tropospheric Propagation

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	14	14	28
Troubleshooting and / or exercises	7	7	14
Laboratory practises	5	10	15
Autonomous practices through ICT	0	8	8
Case studies / analysis of situations	10	40	50
Reports / memories of practice	0	15	15
Troubleshooting and / or exercises	4	8	12
Long answer tests and development	2	6	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	Presentation, by the professor, of the contents of the course (theoretical basis, guidelines for solving exercises/problems or developing a radio communication project).
Troubleshooting and / or exercises	Resolution, by the student, of problems and/or exercises related with the course. The student not only has to get the suitable or correct solutions by the application of the theory previously explained but also has to interpret correctly the results.
Laboratory practises	Application of knowledge to specific situations and acquisition of basic skills and procedures in the related field. They are developed in laboratories with specialized equipment.
Autonomous practices through ICT	Application through ICT of the knowledge and the procedural skills that the student has acquired in the course to specific situations.
Case studies / analysis of situations	Study and analysis of problems based on real events in order to know them, think about them, interpret them, generate hypothesis, constrast data ... and train in the use of different procedures of solution.

Personalized attention

	Description
Master Session	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.
Troubleshooting and / or exercises	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.
Case studies / analysis of situations	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.

Laboratory practises	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.
Autonomous practices through ICT	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.

Assessment

	Description	Qualification
Case studies / analysis of situations	Technique that consists of monitoring the student, who will be assessed from his autonomously solving of the proposed tasks (case studies / analysis of situations). In these proofs, the skills A2, A4 and A34 will be evaluated.	10
Reports / memories of practice	Evaluation of: - the preparation and development of the lab practices - the reports and memories on lab practices In these proofs, the skills A2, A30, A31 and A34 will be evaluated.	10
Troubleshooting and / or exercises	Two examinations in which the student has to solve a number of exercises by applying the acquired knowledge in the time and conditions established by the professor. The student can take them during the course or together with the final examination, depending on the evaluation system chosen. In these proofs, the skills A2, A4 and A31 will be evaluated.	40
Long answer tests and development	Final examination: evaluation of the skills acquired by the student. He/she has to develop, relate, organise and present the knowledge acquired in the course. In these proofs, the skills A2, A4, A31 and A34 will be evaluated.	40

Other comments and second call

According to the guidelines of the degree, the student can choose between two evaluation systems: continuous assessment or only final examination. Previously to the final examination (or at the entrance of the session), the student will decide the evaluation system. Before permorming each task or delivery, the procedure and dates for the review of the qualifications will be published within a reasonable period of time.

1. The continuous assessment includes a series of tasks performed during the course (70%). They are not recoverable, i.e., if a student can not fulfilled them in the time established, the professor is not bound to repeat them. The obtained qualification will be valid only for the current academic course.

The continuous assessment consists of:

a) two examinations (approximately in the weeks 4 and 9);

b) delivery (in the last weeks of the course) of memories of the lab and autonomous-ICT practices;

c) autonomous tasks (case studies / analysis of situations);

d) the mandatory part of the final examination.

2. FINAL EXAMINATION at the end of the semester: the final examination consists of two parts:
- one part is mandatory for all the students,
- the second one is optional for students who had chosen continuous assessment and mandatory for the rest of students. The students who had chosen continous assessment can do this part to improve their marks.

FORMULA OF QUALIFICATION

E1=score obtained in the mandatory part of the final examination (up to 10 points).

E2=score obtained in the other part of the final examination (up to 10 points).

PM=score obtained in the lab practices (attendance, quality of the reports...) (up to 10 points).

PEC=score obtained in both exams (continous assessment) (up to 10 points).

S=score obtained in the autonomous tasks (case studies / analysis of situations) (up to 10 points).

Continuous evaluation: 0.4 * E1 + MAX (0,6 * E2; 0,4 * PEC + 0,1 * PM + 0,1 * S)

No continuous Evaluation: 0,4 * E1 + 0,6 * E2

4. RECOVERY IN the JULY SESSION. Previously to the exam (or at the entrance of the session) the students choose the evaluation system. The qualification formulas are the same.

5. STUDENTS PRESENTED AT THE COURSE. A student is considered "presented" if he/she receives the final exam or both exercises of the continuous assessment.

Sources of information
Marcos Arias Acuña, Oscar Rubiños López, Radiocomunicación, 1ª, Andavira Editora, 2011
José María Hernando Rábanos, Transmisión por Radio, 6ª, Editorial Universitaria Ramón Areces, 2008
John Griffits, Radio Wave Propagation and Antennas. An Introduction, 1st, Prentice Hall, 1985
Robert E. Collin, Antennas and Radiowave Propagation, 1st, Mc Graw Hill, 1985
Thomas A.Milligan, Modern Antenna Design, 2nd, Wiley, 2005
Angel Cardama, L. Jofre, J.M. Rius, S. Balnch, M. Ferrando, Antenas, 2ª, Ediciones UPC, 2002
Constantine A. Balanis, Antenna Theory. Analysis and design, 3rd, Wiley, 2005
ITU-R, Recommendations, ,

The first three references are considered as basic. The others are complementary bibliography for specific topics.

Recommendations

Subjects that continue the syllabus

Spectrum Management/V05G300V01612
Wireless Systems and Networks/V05G300V01615

Subjects that are recommended to be taken simultaneously

Radio Frequency Circuits/V05G300V01511

Subjects that it is recommended to have taken before

Physics: Fields and Waves/V05G300V01202
Signal Transmission and Reception Techniques/V05G300V01404
Electromagnetic Transmission/V05G300V01303

IDENTIFYING DATA				
Multimedia Signal Processing				
Subject	Multimedia Signal Processing			
Code	V05G300V01513			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Docampo Amoedo, Domingo			
Lecturers	Cardenal López, Antonio José Docampo Amoedo, Domingo			
E-mail	ddocampo@uvigo.es			
Web	http://http://faitic.uvigo.es/			
General description	Multimedia signal processing is now a fundamental part of any modern information, communication, learning, and entertainment system. Once the main Digital Signal Processing concepts and bases have been introduced in the second year, this course prepares students for the analysis and processing of deterministic and random signals, before encoding and transmission of multimedia information. In related courses both on this and next academic year, the knowledge acquired shall be applied to voice, audio, image and video signals and systems,. The main goals of the course are: • Analyze digital signal processing schemes. • Design digital filters according to prescribed specifications. • Analyze and specify the basic parameters of communication subsystems from the point of view of signal processing. • Apply statistical filtering in coding, processing and transmission of multimedia information. To help in reaching these goals, the course is divided into four major topics: DFT and Fast Fourier Transform, Fundamentals of statistical signal processing, digital filter characterization and multirate signal processing.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A35	CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques.

Learning aims		
Subject competences	Typology	Competences
Analyze digital signal processing diagrams. Design digital filters from specifications. Analyze and specify the fundamental parameters of the communication subsystems from the point of view of digital signal processing. Statistical analysis and filtering applied to the coding, processing and transmission of multimedia information.	know Know How	A3 A4 A35

Contents	
Topic	
Practice 1 Fourier Analyses through DFT.	Linear Filtering using DFT. Effects of the temporal and frequency sampling. Windowing and spectral resolution
Topic 1 Fourier Transform of discrete signals: DFT.	Formulation and properties of the DFT. Efficient computation of the DFT (FFT). Linear Filtering Methods using DFT. Effects of the time and frequency sampling. Windowing and spectral resolution.

Topic 2 Introduction to Statistical signal processing.	Random signals. Correlation and spectra for stationary signals. Random signals and linear systems. Optimal Linear Filters. Wiener filter. Introduction to adaptive filtering: LMS algorithm. Spectral Estimation.
Practice 2 Adaptive Filtering.	Wiener Filter. LMS.
Topic 3 Filter Design and implementation.	Z transform: a review. Implementation of FIR and IIR filters from difference equations. Block Diagramas. Structures for digital filters. FIR and IIR Design.
Practice 3 Digital Filters Design and implementation.	FIR filters Design. IIR filters Design.Implementation of digital filters.
Topic 4 Multirate signal processing.	Decimation and Interpolation. Spectral interpretation of interpolation and decimatio. FIR Filter Structures Based on Polyphase Decomposition. Filter Banks.
Practice 4 Multirate signal processing.	Decimation and Interpolation. Polyphase Filter Banks.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	12	24	36
Tutored works	7	35	42
Master Session	21	42	63
Long answer tests and development	2	7	9

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

Methodologies

	Description
Laboratory practises	Application of MatLaB commands and functions to digital signal processing practical exercises.
Tutored works	Group work on a project centered in a practical application of signal processing.
Master Session	Presentation of main topics in class. Multimedia material will be made available in faitic before classes take place. Personal study. Support from the instructors through tutorial help.

Personalized attention

	Description
Master Session	The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.
Laboratory practises	The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.
Tutored works	The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.

Assessment

	Description	Qualification
Master Session	Written exam encompassing all the material exposed in the classroom and laboratory (competencies CG3 and CG4).	40
Laboratory practises	Individual drills related with the laboratory content. Will be taken in laboratory time, and will last 30 minutes (competencies CG3 and CG4).	40
Tutored works	Projects to be carried out in groups. Different gradings according to levels of participation (competencie CE25).	20

Other comments and second call

Evaluation

Following the guidelines of the degree, students shall be offered two evaluation systems: continuous evaluation or evaluation at the end of the semester.

- Continuous evaluation.
- Evaluation at the end of the semester.

- Recovery in the month of June-July.

CONTINUOUS EVALUATION

The continuous evaluation of the course will consist in:

- Four 30-minutes drills related with the laboratory work, that will account for 40% of the final grade.
- One project to be carried out in group that will account for 20% of the final grade.
- A written exam encompassing all the material exposedin the classroom and laboratory. Will take place in the dates scheduled by the School. The exam shall help in gauging the level of understanding of the four course topics. The exam will feature exercises and questions to be answered in two hours. Students may bring to the exam books, laboratory and classroom notes, and any other materials downloaded from faitic.The exam will account for 40% of the final grade.

The final qualification of the student will be computed as a weighted sum (40%, 20% and 40%, respectively) of the qualifications of laboratory, group project and final exam. However, in order to pass the course, the grade of the final exam must not lie below 25 out of 100 points.

The contents and weights of each continuous evaluation exercises are the following:

- Laboratory drill 1 (10 %):

Fourier Analysis through DFT: will take place in the fourth week of the course.

- Laboratory drill 2 (10 %)

Adaptive filtering: will take place in the sixth week of the course.

- Laboratory drill 3 (10 %):

Design and implementation of FIR and IIR filters: will take place in the tenth week of the course.

- Laboratory drill 4 (10 %):

Multirate Filter Banks: will take place in the thirteenth week of the course.

- Project: (20%) practical application of concepts mastered in the course. Oral presentations shall take place in the fourteenth week of the course.

EVALUATION AT THE END OF THE SEMESTER

Should a student decide not to be graded through continuous evaluation, she will have a written examination opportunity that will take place the same day of the final exam for all the students. Before taking the exam though, the student shall sign a form in which he states his decision to dispense with continuous evaluation.
This written exam will last three hours and will be composed of 5 exercises encompassing all the material mastered in the classroom, laboratory, and tutorial sessions, under the same conditions specified for the students that take the final exam at the end of the continuous evaluation process.

Grading Periods

First opportunity to pass the course (December)

If the student passes the course in this period, her grade will be final and will be recorded in her academic file.

If the student does not pass the course, a provisional fail shall be posted in his academic file.

Second opportunity to pass the course (June-July)

In June-July only the written exams shall be offered. If a student wants to dispense with continuous evaluation in this period, he will be able to take the final exam reserved for those cases. Before taking the exam though, the student shall sign a form in which heÂ he states his decision to dispense with continuous evaluation.Â

The provisional fails will become definitive should the student not take any of the written exams in this second period.

Sources of information
John G. Proakis, Dimitris G. Manolakis. , Tratamiento Digital de Señales, Prentice Hall, 2007
Sanjit K. Mitra. , Digital Signal Processing: A Computer Based Approach. , Ed. McGraw-Hill , 2001
Alan V. Oppenheim, Ronald W. Schafer, Discrete-Time Signal Processing, Prentice Hall, 1999

Besides, for each topic the student will have available in the multimedia platform faitic all the material used in the presentations and laboratory work.

Recommendations

Subjects that it is recommended to have taken before
Digital Signal Processing/V05G300V01304

IDENTIFYING DATA				
Data Acquisition Systems				
Subject	Data Acquisition Systems			
Code	V05G300V01521			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Río Vázquez, Alfredo del			
Lecturers	Río Vázquez, Alfredo del			
E-mail	ario@uvigo.es			
Web	http://webs.uvigo.es/ario/docencia/sad/sad.htm			
General description	This subject is about acquisition data, including instrumention amplifiers, analog switches, S&H and converters.			

Competencies	
Code	
A52	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
A54	(CE45/SE7): The ability to design interface, data capturing and storage devices, and terminals for services and telecommunication systems.

Learning aims		
Subject competences	Typology	Competences
Knowledge of instrumentation amplifiers, and control about its use.	know Know How	A52 A54
Knowledge of the different types of electronic analogue switches and the control of applications.	know Know How	A52 A54
Knowledge of Sample&Hold circuits and their applications in data acquisition.	know Know How	A52 A54
Knowledge of the operation of different DAC and ADC converters, and the control of their applications.	know Know How	A52 A54
Knowledge about data storage and the control of their applications.	know Know How	A52 A54
Knowledge of the design of data acquisition using the previous elements.	know Know How	A52 A54

Contents	
Topic	
Analogue signals adaption	Analog multiplexers Digitally controlled amplifiers an basic attenuators
Galvanic isolation	Inductive isolation Capacitive isolation Optical isolation
Sample and hold	Sample and hold circuits Anti-alias filters

DACs I	DAC based on a multiplexer and a linear resistive network Digital potentiometers Switching DAC with weighting resistors
DACs II	Unipolar DAC with an R/2R network, in current mode. Unipolar DAC with an R/2R network, in voltage mode.
DACs III	Bipolar DACs. Indirect operation DACs.
ADCs I	Flash ADC. Half-flash ADC (sub-ranging)
ADCs II	Single-slope analogue ADC. Dual-slope analogue ADC. ADC based on successive aproximation register (SAR).
ADCs III	ADC based on a voltage-controlled oscillator (VCO) and a frequency-meter. ADC based on sigma-delta.
ADCs IV	ADC based on switching capacitors. Other applications based on switching capacitors.
Lab work 1	The instrumentation amplifier. Analogue multiplexer.
Lab work 2	Galvanic isolation amplifier. Optical coupler.
Lab work 3	Anti-alias filter. Sample and hold circuits.
Lab work 4	DACs based on R/2R network. Voltage mode. Current mode.
Lab work 5	Dual-slope ADC. Operational in bipolar mode.
Lab work 6	ADC using successive aproximation register (SAR). SAR based on software.

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	4	22.5	26.5
Tutored works	7	20	27
Laboratory practises	12	38	50
Master Session	15	27.5	42.5
Short answer tests	0.5	0	0.5
Troubleshooting and / or exercises	1	0	1
Short answer tests	0.5	0	0.5
Troubleshooting and / or exercises	1	0	1
Practical tests, real task execution and / or simulated.	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
Troubleshooting and / or exercises	The lecturer will solve some exercises related to the subject. Competencies A52 and A54 will be addressed in these sessions.
Tutored works	The lecturer will lead the students in a data acquisition system design. Competencies A52 and A54 will be addressed in these sessions.
Laboratory practises	Simulations and real assembled circuits will be tested. Competencies A52 and A54 will be addressed in these sessions.
Master Session	The lecturer will show some theoretical contents related to the subject. Competencies A52 and A54 will be addressed in these sessions.

Personalized attention

	Description

Master Session	Students are permitted to interrupt the session in order to ask the lecturer for some doubt related to the session.
Troubleshooting and / or exercises	Students are permitted to interrupt the session in order to ask the lecturer for some doubt related to the session.
Tutored works	Students are permitted to interrupt the session in order to ask the lecturer for some doubt related to the session.
Laboratory practises	Students are permitted to interrupt the session in order to ask the lecturer for some doubt related to the session.

Assessment

	Description	Qualification
Tutored works	Every student has to write a document related to the asigned work. Competencies A52 and A54 will be assessed in these works.	10
Short answer tests	First short answer test, in the classroom. Competencies A52 and A54 will be assessed in these tests.	15
Troubleshooting and / or exercises	First exercise test, in the classroom. Competencies A52 and A54 will be assessed in this test.	15
Short answer tests	Second short answer test. Competencies A52 and A54 will be assessed in this test.	15
Troubleshooting and / or exercises	Second exercise test. Competencies A52 and A54 will be assessed in this test.	15
Practical tests, real task execution and / or simulated.	Laboratory-work exam based on simulations and real circuits. Competencies A52 and A54 will be assessed in this test.	30

Other comments and second call

NOTE: The timing of the partial exams might suffer some changes, due to time restrictions. The exact timing will be indicated along the course.

CONTINUOUS EVALUATION OPTION:

The subject is evaluated in a continue way, by mean of two partial exams. These exams treat the theoretical aspects. In addition, there is an exam for the lab-work.

This first partial includes themes from one to five. The second partial exam includes themes from six to ten. The weight of both partials is a 60% from the total mark.

The two partials take place in the classroom, within the class time. These partials are approximately 90 minutes long. The first 30 minutes will be dedicated to an exam with short answers. The rest 60 minutes will be dedicated to an exam with long answers.

Inside each partial, the 90 minutes exam and the 30 minutes exam have the same weight.

In order to pass a partial exam (the first or the second), the student is required to obtain at least a mark of 5 over 10.

The student that passes only one partial will only have to try the other one at the final exam option.

The lab-work is evaluated using a unique exam, in the laboratory. The weight is 30%.

Tutored works are assessed using a report that every student should be done. The weight is 10%.

When a student attends the first partial, he or she accepts to follow the continuous assessment. Students that do not attend to the first partial will be assessed by means of a final exam.

The mark that a student obtains in the lab-work is maintained until July, except if the student does not want. In this case, the student will have to do partials and lab exams in July.

In order to pass the subject, once partials have been passed, the student has to obtain a global mark (GM) of at least 5 points in ten. The global mark is calculated following the next formula:

$GM = 0.6 * TM + 0.3*LM + 0.1*RM$

where

TM = Mean value of the partial marks; LM = lab mark; RM = report mark

The first partial is preview to take place in the sixth week. The second partial will take place in the last week. Â

The lab exam will take place in the lab, the day of the last lab session.

FINAL EXAM OPTION:

The students that do not follow the continuous assessment will be assessed by means of a final exam. The exam will consist of three parts: the first part of the themes 1 to 5, the second part of the themes 6 to 10 and the third part of lab-work in the laboratory.

In order to pass the subject, the student has to obtain a mark of at least 5 points over ten for the first and second parts. In this case, the global mark (GM) is calculated following the next formulae:

GM = 0.6 * TM + 0.4*LM

where:

TM = Average mark of the first and second part of the exam; LM = lab mark

If the student does not obtain a mark of at least 5 in the first part or in the second part, the global mark would be the least mark between 4 or the GM taken from the early formulae.

IMPORTANT:

If a student did not enter the continuous assessment mode but is interested in participate in the final exam, he or she should talk with the professor at least two weeks before the day of the exam. Contact can be by e-mail. This way, the organization of the lab-work exam will be simpler.

RECOVERY EXAM

The recovery exam (June-July) shares the same structure than the final exam.

Sources of information
Paul Horowitz y Winfield Hill, The Art of Electronics, Cambridge Univ. Press., 1989
Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, WCB/McGraw-Hill, 2002
Franco Maloberti, Data Converters, ISBN 978-0-387-32485-2, 2007
Analog Devices Library, hhtp;//www.analog.com/library/analogDialogue/archives/43-09/EDCh%206%20Converter.pdf, Capitulos 6.1,6.2,6.3,

Recommendations

Subjects that continue the syllabus

Analogue Electronics/V05G300V01624

Subjects that are recommended to be taken simultaneously

Analogue Electronics/V05G300V01624

Subjects that it is recommended to have taken before

Electronic Technology/V05G300V01401

Other comments

I recommend the students to search the web for information about this subject. Electronic devices factories show interesting information. Many universities around the world hung interesting notes in the Internet. And many of them for free.

IDENTIFYING DATA				
Electronic Systems for Signal Processing				
Subject	Electronic Systems for Signal Processing			
Code	V05G300V01522			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish Galician			
Department				
Coordinator	Valdés Peña, María Dolores			
Lecturers	Costas Pérez, Lucía Quintáns Graña, Camilo Valdés Peña, María Dolores			
E-mail	mvaldes@uvigo.es			
Web	http://www.faitic.uvigo.es			
General description	This course introduces the basic concepts of digital signal processing systems from the point of view of its hardware implementation. Emphasis is put on FPGAs-based solutions, using professional software design tools and hardware supports. The nature of the course is mainly practical. It enhances the development of collaborative projects whose ultimate goal is the design of electronic signal processing systems.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A48	(CE39/SE1): The ability to construct, exploit and manage the receiving, transporting, representation, processing, storage, manage and presentation multimedia information from the electronic systems point of view.
A54	(CE45/SE7): The ability to design interface, data capturing and storage devices, and terminals for services and telecommunication systems.
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Subject competences	Typology	Competences
Understand the fundamental design principles of the signal processing hardware systems.	know	A48 A54
Ability to decide different design strategies depending on the application.	know	A48 A54
Ability to choice the most suitable hardware architecture for each application.	know	A48 A54
Ability to design basic circuits for audio and image processing.	Know How	A6 A9 A48 A54
Acquire skills in the use of design, simulation and implementation tools of signal processing systems.	Know How	A48 A54 B4
Acquire skills to verify the proper operation of complex hardware systems.	Know How	A48 A54
Acquire skills to combine different software tools and hardware platforms.	Know How	A48 A54

Ability to document hardware design projects.	Know How	A1

Contents

Topic	
Theory: Theme 1. Introduction	- Basic architecture of electronic signal processing systems: signal conditioning, sampling, conversion, and reconstruction.
Theory: Theme 2. Types of signal processing	-Different hardware and software solutions: DSP and FPGAs. -Processing forms: Serial/Parallel, Hardware/Software. -Hardware cost of regular signal processing circuits. Logical resources used. Processing rate.
Theory: Theme 3. Arithmetic in DSP	-Data types. -Data modification: quantification and overflow. -Arithmetic operations and associated circuits. -Associated concepts: critical path, pipeline and latency.
Theory: Theme 4. Siignal conditioning and sampling	- Example of a real system for signal conditioning and sampling using a FPGA-based development board.
Theory: Theme 5. Design and Implementation of Digital Filters	- Implementation of digital filters in FPGA. - Analysis of full parallel and semi-parallel solutions: hardware costs, operation rates.
Theory: Theme 6. Design of image processing systems	- Examples of basic image processing systems. - Analysis of hardware resources required. - Implementation and performance analysis.
Theory: Theme 7. Design of audio processing systems	- Examples of audio processing systems. - Analysis of required hardware resources. - Implementation and performance analysis.
Theory: Theme 8. Design of signal processing systems for communications	- Examples of signal processing systems for communication applications. - Implementation and performance analysis.
Labs: Design of basic signal processing systems.	- Design, implementation and verification of basic signal processing systems described using VHDL: digital filters, communication applications, image processing, audio processing. - Using the ISE design tool from Xilinx and MATLAB from MathWorks.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	12	24	36
Projects	12	60	72
Master Session	14	14	28
Short answer tests	2	4	6
Jobs and projects	2	6	8

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

Methodologies

	Description
Laboratory practises	Basic signal processing systems will be implemented using FPGAs. A6, A9, A48, A54 and B4 competencies will be worked on.

Projects	Working groups of two or three students will be established. Each group will develop two projects along the course. These projects will address the design of signal processing systems of low and medium complexity, respectively. The implementation of the projects will be mainly in laboratory hours (hours type B). Additionally, small groups (Groups Type C) will be available allowing monitoring the projects to be developed in the course. Activities to be developed in groups C: Activity 1. Description, analysis and discussion of the systems designed in the first project of the course. Presentation of results. Duscussion of design alternatives. Activity 2. Analysis and monitoring of the proposed solution for the second project. Activity 3. Demonstration of the behavior of systems designed in the second project. Analysis and discussion of results. A1, A6, A9, A48, A54 and B4 competencies will be worked on.
Master Session	The theoretical content of the course will be presented by the teacher. A6, A48 and A54 competencies will be worked on.

Personalized attention

	Description
Master Session	The teacher will personally attend student’s doubts and queries related to theoretical contents, laboratory practices and projects. Students will have the opportunity to attend to individual or group tutorials, which will be held at the teacher's office following the schedule to be established at the beginning of the course, to be published at the course’s website.
Laboratory practises	The teacher will personally attend student’s doubts and queries related to theoretical contents, laboratory practices and projects. Students will have the opportunity to attend to individual or group tutorials, which will be held at the teacher's office following the schedule to be established at the beginning of the course, to be published at the course’s website.
Projects	The teacher will personally attend student’s doubts and queries related to theoretical contents, laboratory practices and projects. Students will have the opportunity to attend to individual or group tutorials, which will be held at the teacher's office following the schedule to be established at the beginning of the course, to be published at the course’s website.

Assessment

	Description	Qualification
Short answer tests	There will be a short-answer test on the theoretical issues of the course. More information is provided in the "Other Comments" section below. This test will assess competencies A48 and A54.	20
Jobs and projects	There will be two projects during the course. In the first project the student will design a basic signal processing system. The weight of this assessment is 35% of the total grade for the course. The second project will involve the design of a signal processing system of medium complexity and its evaluation will be a 45% of the final grade. More information is provided in the "Other Comments" section that follows. These projects will assess competencies A1, A6, A9, B4, A48 and A54.	80

Other comments and second call

According to the guidelines for the degree programme , two evaluation systems will be offered to students: continuous assessment andÂ a final exam.

1.- Continuous assessment

The evaluation of the course is done through continuous assessment, which consists of a theory test and the delivery of two theoretical-practical works (projects). However, the realization of a final test is also included as an alternative.

The theoretical examination will include the contents of the first three temes of the course and will take place during lecture hours (Type A hours). The weight of this examination will be 2 points out of 10.

The first theoretical-practical work will include themes 1 to 5. It will consist of the design of a basic signal processing sysem. This work will be conducted in laboratory hours (Type B hours) in groups of two or three students. As a result of the work a descriptive report is produced for the designed system. The weight of this assessment is 3.5 points out of 10.

The second theoretical-practical work will include themes 6 to 8. This work will be conducted in laboratory hours (Type B hours) in groups of two or three students. The weight of this assessment is 4.5 points out of 10.

The final grade for the course will be the sum of the three assessments. To pass the course a student must meet the following conditions:

- Get at least 5 out of 10 in the overall evaluation.

- Get at least 40% of the maximum score for each of the evaluation activities.

Students who fail any of the assessments shall be submitted to the corresponding final exam. Similarly, students who want to improve the grade obtained in any of the assessments may be submitted to final exam.

In the case a student fails to obtain at least 40% of the maximum score in any of the assessment activities, but has above the minimum of 5 out of 10 in the overall assessment, the student will be considered suspended and the note 4.5 will appear in the minutes.

It is understood that the student chooses continuous assessment if he/she conducts the first theoretical-practical work, and since then will be considered submitted to this evaluation alternative.

2.- Assessment by final exam.

The final exam will consist of the same evaluative activities covered by continuous assessment. This means that on the date scheduled for the final exam students who have not opted for the continuous assessment should make the theoretical examination of the themes 1 to 3 of the course and deliver the reports of both theoretical and practical work equivalent to that performed by continuous assessment. Such works will be indicated in class week 8. The theoretical and practical work will be discussed in the week following delivery.

As noted above, those students who have opted for continuous assessment and not passed any assessment activities or want to improve their grade may also pass a final exam only with the theme (or themes) to be considered. In this case the grade will be the highest between the final examination and continuous assessment.

3.- Second call (July)

The second call assessment exam will be similar to the final examination described in item 2 above.

Sources of information
U. Meyer-Baese, Digital signal processing with Field Programmable Gate Arrays, 3th ed., 2007
James H. McClellan, Ronald W. Schafer, Mark A. Yoder, Signal processing first, , 2003
John G. Proakis, Dimitris G. Manolakis, Digital signal processing, 4th ed., 2007
XUP, University of Strathclyde and Steepest Ascent, DSP for FPGA Primer, , 2011
John G. Proakis, Tratamiento digital de señales : principios, algoritmos y aplicaciones, 4ª ed., 2007

Recommendations

Subjects that are recommended to be taken simultaneously

Programmable Electronic Circuits/V05G300V01502
Data Acquisition Systems/V05G300V01521

Subjects that it is recommended to have taken before

Digital Electronics/V05G300V01402
Digital Signal Processing/V05G300V01304

IDENTIFYING DATA				
Engineering of Electronic Equipment				
Subject	Engineering of Electronic Equipment			
Code	V05G300V01523			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge Sánchez Real, Francisco Javier			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es/			
General description	This course shows students the basics concepts about RAMS (Reliability, Availability, Maintainability and Safety) of electronic components and electronic systems, as well as techniques to follow for a study of this type or design a system that meets specifications RAMS. the basics concepts about the sources of electromagnetic interference and their minimization are also discussed.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A50	(CE41/SE3):The ability to make the specification, implementation, documenting and tuning of electronic systems and equipment (both instrumentation and control oriented), considering the corresponding technical aspects and the regulations.
A56	(CE47/SE9): The ability to analyze and solve interference and electromagnetic compatibility problems .

Learning aims		
Subject competences	Typology	Competences
Knowledge of the applicable standards in the design of electronic systems	Know How	A2 A6 A50
Ability for the specification of components and electronic systems	Know How	A56
Knowledge and application of techniques to meet EMC standards	Know How	A1 A6 A56
Knowledge of techniques and tools for the design and manufacture of an electronic system based on dependability specifications	Know How	A2
Ability to design, implement and manage a dependability system	Know How	A6 A9
Ability to manage the knowledge of the organization	Know How	A8 A9

Contents

Topic	
Item 1: Introduction	Definitions. Reliability Basics. RAMS Technologies. Statistical functions. Reliability Management.
Item 2: Reliability of electronic components	Definitions. Parameters (Failure rate, MTBF, MTTF). Reliability prediction of electronic components. Regulations.
Item 3: Reliability of electronic systems	Serie systems. Redundant Systems. Reliability allocation. Redundancy optimitation. Srtandards.
Item 4: Maintainability and Availability	Definitions and types of maintenance. Parameters (Repair rate, MTTR). Stocks management. Availability of series and parallel systems. Regulations.
Item 5: Safety	Definitions. Electronic systems for safety applications. Safety level or safety category determination for safety electronic systems. Standards.
Item 6: Reliability tools	Failure mode effects analysis and criticalities (FMECA). Fault Tree (FTA). Markov Models. Standards.
Item 7: Failure Analysis	Determination of causes, modes and failure mechanisms. Semiconductor failure mechanisms.
Item 8: Essays	Types and test plans. Accelerated tests. Standards.
Item 9: Electromagnetic Interferences	Definitions. Fundamentals of electromagnetic interferences. Sources of interference. Minimization elements. Standards.

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	6	12	18
Laboratory practises	8	0	8
Tutored works	0	60	60
Case studies / analysis of situations	7	0	7
Master Session	21	36	57

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

Methodologies

	Description
Troubleshooting and / or exercises	Teaching activities with problems develop, case studies and exercises related to the subject. Also it be used to show existing doubts and also for feedback to teachers. Competencies A1, A2, A6, A8 and A50 are used
Laboratory practises	The students learn how to perform reliability calculations by using specific software for this application. Competencies A8 and A56 are used
Tutored works	Sspecific workbs that are related to the content of the subject and in partnership with a company or outside entity. The student will propose the holding of two jobs one of them in collaboration with AENOR and another in collaboration with a company's environment. Competencies A6, A8, A9 and A56 are used
Case studies / analysis of situations	The groups are conducted with a small number of students and are used for the development of group work and learning methodologies teamwork. Competencies A2 and A50 are used
Master Session	It consist of a presentation by the teacher, of the contents of the subject. Also proceed to solving examples and / or problems that illustrate the problems to be solved adequately. The student may submit all doubts and questions deemed appropriate, during the session. We will promote the more active participation of the student possible. Competencies A6, and A56 are used

Personalized attention

	Description

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

Assessment

	Description	Qualification
Troubleshooting and / or exercises	Deliverables, problems and exercises will be assess. Competencies assessed A1, A2, A6, A8 and A50	40
Tutored works	The tutored works will be evaluated (content, development methodology, conclusions and presentation of results) of the two tutored work. Competencies assessed A6, A8, A9 and A56	60

Other comments and second call

The deliverables of the troubles and exercises are provide for guidance, for weeks 2, 4, 6, 8 and 10.
Following the guidelines for the degree and agreements of the academic committee, the students can choose between continuous assessment or the final exam on the date set by the engineering school.
Students who choose the continuous assessment should inform the instructor during the first two weeks of class.
Continuous assessment involves:

a) The students should do the problems and exercises and it will be delivered to the teacher. Maximun rating 4 ponits (40% of the final grade). The students must obtain a minimum of 2 points. These tasks are not recoverable later. Students do not exceed this minimum will have to do the final exam.

b) The students should do two jobs. One of them in collaboration with AENOR and students of the Faculty of Philology and Translation, and another in collaboration, with a company´s environment. Working in partnership with the company will be held in the months of May, June and July. Maximum rating 6 points (60% of the final grade).

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

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

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

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

Sources of information

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

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

David J. Smith, Reliability, Maintainability and Risk, , Butterworth Heinemann, 2001

Kececioglu, Dimitri, Reliability Engineering Handbook, , Prentice Hall, 1997

Antonio Creus Solé, Fiabilidad y seguridad: Su aplicación en procesos industriales, , Marcombo, S.A., 2005

J. Balcells, F. Daura, R. Esparza e R. Pallás, Interferencias Electromagnéticas en Sistemas Electrónicos, , Marcombo

Recommendations

Subjects that are recommended to be taken simultaneously

Data Acquisition Systems/V05G300V01521

Subjects that it is recommended to have taken before

Mathematics: Calculus II/V05G300V01203
Digital Electronics/V05G300V01402
Physics: Fundamentals of Electronics/V05G300V01305
Electronic Technology/V05G300V01401

IDENTIFYING DATA				
Fundamentals of Acoustics Engineering				
Subject	Fundamentals of Acoustics Engineering			
Code	V05G300V01531			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Torres Guijarro, María Soledad			
Lecturers	Pena Giménez, Antonio Torres Guijarro, María Soledad			
E-mail	marisol@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Concepts covered by the subject: vibratory systems related to the acoustic wave equation, radiation and propagation, mechanisms of acoustic-mechanical-electrical transduction, behaviour and design of speakers and microphones.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A46	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.
B2	To approach a new problem considering first the essential and then the secondary aspects

Learning aims		
Subject competences	Typology	Competences
Results of learning: • Evaluate the different types of microphones from the point of view of their technical specifications and their possible applications. • Describe the acoustic wave radiation phenomenon. • Understand the basic mechanisms of mechanical-acoustic transduction. • Analyze electro-mechanical systems using acoustic analogies based on circuit theory. • Design acoustic systems using speakers, cabinets and horns.	know Know How Know be	A3 A43 B2
Results of learning: • Understand the basic mechanisms of vibration of different elements and understand their relationship with sound production. • Learn the basics of linear acoustics and relate the concepts of pressure, particle velocity, current, power and impedance. • Explain the sound propagation phenomena and analyze the influence of the medium	know Know How Know be	A3 A46 B2

Contents	
Topic	
1. Sound power measurement tests.	Acoustic variables. Sound field. Propagation. Uses of intensity and power. Sound intensity probes. Power measurement standards using acoustic pressure or intensity.
2. Models of radiation sources.	Directivity. Acoustic impedance. Monopole. Dipole. Monopole on infinite baffle. Baffled circular piston. Directivity measurement standards.

3. Vibrating systems.	Damped and forced oscillatory motion. Vibration of strings, bars, membranes and plates. The sound in tubes. Sound sources. Acoustic filters.
4. Specifications and measurement of electroacoustic systems.	Introduction to loudspeakers: baffles and crossovers. Acoustic measurement tests: measurement of speakers. Measurement of noise and nonlinear distortion.
5.Analogies and transduction.	Electro-mechano-acoustic systems. Equivalent circuits. Transduction
6. Speakers, horns and cabinets.	Equivalent model of an infinite baffle loudspeaker. Equivalent model of a cabinet with speaker. Horns.
7. Cabinet design.	
8. Microphones.	A microphone equivalent model. Tank circuits.

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	3	6	9
Practice in computer rooms	11	19	30
Projects	7	45	52
Master Session	19	38	57
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
Troubleshooting and / or exercises	Given a certain situation, students should obtain the reasoned suitable solution, properly choosing the applicable formulas and arriving to a valid solution. This methodology is targeted to competency B2.
Practice in computer rooms	Handle and adjustment of tools of analysis and algorithms, identifying which is appropriate for a given situation. This methodology is targeted to competencies A43 and A46.
Projects	Collaborative work in reduced groups related to lab tests. Role assignments, working in common, planning and report writting. This methodology is targeted to competency A46.
Master Session	Oral speech, promoting the critical discussion of the concepts. Theoretical bases of algorithms and procedures used to solve problems are presented. This methodology is targeted to competencies A3, A43 and A46.

Personalized attention

	Description
Master Session	Tutoring to solve issues related to master sessions or lab practice is implemented: -> Individually or -> in reduced groups (no more than 2-3 students). E-mail confirmation to match the date of the appointment is needed. ---------------- During group projects an individualized tracking of the student is developed. Cross-assessment within the group and self-assessment may be used.
Troubleshooting and / or exercises	Tutoring to solve issues related to master sessions or lab practice is implemented: -> Individually or -> in reduced groups (no more than 2-3 students). E-mail confirmation to match the date of the appointment is needed. ---------------- During group projects an individualized tracking of the student is developed. Cross-assessment within the group and self-assessment may be used.
Practice in computer rooms	Tutoring to solve issues related to master sessions or lab practice is implemented: -> Individually or -> in reduced groups (no more than 2-3 students). E-mail confirmation to match the date of the appointment is needed. ---------------- During group projects an individualized tracking of the student is developed. Cross-assessment within the group and self-assessment may be used.

Projects	Tutoring to solve issues related to master sessions or lab practice is implemented: -> Individually or -> in reduced groups (no more than 2-3 students). E-mail confirmation to match the date of the appointment is needed. ---------------- During group projects an individualized tracking of the student is developed. Cross-assessment within the group and self-assessment may be used.

Assessment

	Description	Qualification
Practice in computer rooms	Assessment of the reports describing the results obtained in the computer classroom. Targeted to assess competencies A43 and A46.	15
Projects	Assessment of the work realised in group along the semester, including the preparation of reports. Targeted to assess competency A46.	35
Short answer tests	Written exam, with brief questions and problems. Targeted to assess competencies A3, B2, A43 and A46.	50

Other comments and second call

Following the guidelines of the studies, two evaluation systems will be offered to the students inscribed on this subject:

continuous evaluation (the preferred method, academic activities are linked to this system) and evaluation at the end of the

semester (not recommended).

*** Students who choose continuous evaluation:**

Students follow the continuous evaluation system if they assign a document that will be delivered and collected durinb weeks 1-3, so the collaborative work can begin. Three tasks are evaluated. The approximate task calendar and the weight of each task in the final grade are listed below.

* Reports / memories of practice (Weight: 15%) collected approximately once a week.
* Written exam (weight: 50%): At the end of the semester, the same day when the final exam is planned.

* Collaborative work in a group C (weight: 35%): during the semester each group develop several reports related to the laboratory tests. These reports must be delivered approximately once per week.

To ensure that all competencies are acquired, it will be necessary to fulfill these two conditions to pass:

1) to obtain a grade equal to or greater than 4 (on a scale of 0 to 10), in the set of activities of each type.

2) to obtain an overall mark, calculated as the sum of the scores of activities weighted correspondingly, equal to or greater than 5 (on a scale of 0 to 10)

*** Students who choose for evaluation at the end of the semester:**

The possibility of a final examination will be provided to students who do not opt for the continuous evaluation. This final exam will cover all the activities of the subject.To ensure that all competencies are acquired, it will be necessary to fulfill these two conditions: to pass the exam

1) to obtain a grade equal to or greater than 4 (on a scale of 0 to 10), in each of the sections in which the test is divided. The sections correspond respectively to the contents covered by:

* Master classes

* Simulation practices

* Measurement tests performed in the laboratory.

2) to obtain an overall grade in the examination equal to or greater than 5 (on a scale of 0 to 10).

RETAKE

Two different situations:

=> Students that are evaluated using continuous evaluation:

Two options to choose (just before the exam begins):

* Perform the short answer test again on the official date assigned by the Center and be evaluate as stated in the above section "Students who choose continuous evaluation".

* be evaluated with the same final exam as stated in the above section “Students who choose for evaluation at the end of the semester”.

=> Students who choose for evaluation at the end of the semester:

A final examination will be provided to students who do not opt for the continuous evaluation. This final exam will be assessed as stated in the above section “Students who choose for evaluation at the end of the semester”.

Sources of information
Lawrence E. Kinsler, Fundamentals of acoustics , , John Wiley & Sons
Basilio Pueo Ortega, Miguel Romá Romero , Electroacústica : altavoces y micrófonos, , Pearson/Prentice Hall
W. Marshall Leach, Jr., Introduction to electroacoustics and audio amplifier design, , Kendall/Hunt
Finn Jacobsen et al., FUNDAMENTALS OF ACOUSTICS AND NOISE CONTROL, , Technical University of Denmark

Besides the literature mentioned the student will have as support material:
- Scripts of theory: this material contains the theoretical basis of what is discussed in more detail in the master sessions.
- Scripts of practices: formulations and problems of each practice session.
- Copy of the artwork used in the master sessions.
- Tasks and proposed problems.

Recommendations

Subjects that continue the syllabus

Room Acoustics/V05G300V01635
Audiovisual Technology/V05G300V01631

Subjects that are recommended to be taken simultaneously

Audio Systems/V05G300V01532

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Physics: Fundamentals of Mechanics and Thermodynamics/V05G300V01102
Fundamentals of Sound and Image/V05G300V01405

IDENTIFYING DATA				
Audio Systems				
Subject	Audio Systems			
Code	V05G300V01532			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Pena Giménez, Antonio			
Lecturers	Docio Fernández, Laura Pena Giménez, Antonio			
E-mail	apena@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The chain of audio systems is presented, from a systemic point of view. Each system is revised: configuration, specifications, quality figures and interaction with other systems.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A44	CE35/SI2 The ability to analyze, specify, carry out and maintain systems, equipments, heads and installations of TV, audio and video for mobile and fixed environments.
A46	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.
B3	The development of discussion ability about technical subjects

Learning aims		
Subject competences	Typology	Competences
Results of learning (SI2.1): ->Understand and discuss levels in audio systems ->Know the differente types of audio amplifier, from a systems point of view. Discuss technical specifications to compare them.	know Know How Know be	A3 A44 B3
Results of learning (SI4.2): -> Select a configuration for taking sound in different scenarios.	know Know How	A3 A46 B3
Results of learning (SI1.2): -> Know and understand the operation of dynamic range processors and its application in a chain of audio systems. -> Apply equalization techniques and other processes. ->Schedule and carry out a mixture of sounds from the technical point of view, showing the knowledge of different tools to achieve an artistic result. -> Discuss the influence of the available parameters of a digital audio format of audio in the final quality. ->Explain several elements and interconnection protocols to allow the transport and synchronization of audio signals. Results of learning (SI1.3): -> Understand the basics of spatial audition and 3-d audio systems. -> Understanf the concept 'quality' in a given audio application	know Know How Know be	A3 A43 B3

Contents	
Topic	
Specifications.	Level meters. Impedances. Specifications.

Dynamic range and processes.	Dynamic range. Compressors and expansors. Filtering. Effects.
Amplifiers.	Types.Characterization.
Mixture of sounds.	Mixing table.. Bases of a mixture. Mixture in studio and live mixing. Mastering.
Sound take.	Types. Selecting a microphone. Configuration.
Sound quality.	Concept of quality. Estimate of quality.
Spatial audio (3-D).	Spatial audition. 3-d audio systems.
Digital audio.	Audio sampling systems. Specifications and sources of noise. Dithering. Synchronization and transport. MIDI.

Planning

	Class hours	Hours outside the classroom	Total hours
Practice in computer rooms	14	10.5	24.5
Outdoor study / field practices	0	7	7
Projects	7	52.5	59.5
Master Session	19	38	57
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
Practice in computer rooms	Handle and adjustment of tools of analysis and algorithms, identifying which is appropriate for a given situation. Related competencies: A3, A43.
Outdoor study / field practices	Visits to places where the concepts discussed are applied (radio studio, recording studio, etc.). Due to availability and funding. Related competencies: A43.
Projects	Collaborative work in reduced groups. A complex design with a regular monitoring agenda. Role assignments, working in common, planning, technical reports and oral presentation. Related competencies: A3, B3, A43, A44.
Master Session	Oral speech, promoting the critical discussion of the concepts. Theoretical bases of algorithms and procedures used to solve problems are presented. Related competencies: A3, B3, A43, A44, A46.

Personalized attention

	Description
Master Session	Tutoring to solve issues related to master sessions or lab practice is implemented: -> Individually or -> in reduced groups (no more than 2-3 students). E-mail confirmation to match the date of the appointment is needed. ---------------- During group projects an individualized tracking of the student is developed. Cross-avaliation within the group and autoavaliation may be used.
Practice in computer rooms	Tutoring to solve issues related to master sessions or lab practice is implemented: -> Individually or -> in reduced groups (no more than 2-3 students). E-mail confirmation to match the date of the appointment is needed. ---------------- During group projects an individualized tracking of the student is developed. Cross-avaliation within the group and autoavaliation may be used.
Projects	Tutoring to solve issues related to master sessions or lab practice is implemented: -> Individually or -> in reduced groups (no more than 2-3 students). E-mail confirmation to match the date of the appointment is needed. ---------------- During group projects an individualized tracking of the student is developed. Cross-avaliation within the group and autoavaliation may be used.

Assessment

	Description	Qualification
Projects	Assessment of a collaborative work, developed along the semester, including a written report and oral presentation. Assessed competencies: A3, B3, A43, A44.	50

Short answer tests	Written test with short questions and problems to solve. Assessed competencies: A3, A43, A44, A46.	50

Other comments and second call

Following the guidelines of the studies, two evaluation systems will be offered to the students inscribed on this subject: continuous evaluation (the preferred method, academic activities are linked to this system) and evaluation at the end of the semester (not recommended).
*** "Students who choose continuous evaluation" conditions:**
A student follows the continuous evaluation system if she/he assigns a document that will be delivered and collected during weeks 1-3, so the collaborative work can begin.
Two tasks are evaluated. The approximate task calendar and the weight of each task in the final grade are listed below.
* Collaborative work in a group C (weight: 50%): during approx. 10 weeks each group develops a project. Some evidences are picked during this period (crossed evaluation, written test, etc.) and a final report must be delivered around week 11-12. An oral presentation, week 14, ends this activity.
* Written exam (weight: 50%): short questions related to group A and B activities, plus additional material. At the end of the semester, the same day when the final exam is planned.
If a student has participated in continuous evaluation and does not pass the course he/she will receive a grade of fail, regardless of he/she takes the written exam or not.
In order to ensure that students acquire a balanced minimum on the subject competences, they will pass the course if they meet these two conditions:
1) get a final mark equal to or greater than 5 (on a ten-points scale)
2) and a score equal to or greater than 4 (on the same scale) in each of the partial marks (written exam and collaborative group, respectively).

*** "Students who choose for evaluation at the end of the semester" conditions:**
The possibility of a final examination will be provided to students who do not opt for the continuous evaluation.
In order to ensure that students acquire a balanced minimum on the subject competences, they will pass the course if they meet both these two conditions:
1) get a final mark equal to or greater than 5 (on a ten-points scale)
2) and a score equal to or greater than 4 (on the same scale) in each of the sections of the exam. These sections, respectively, correspond with:
* contents included in all activities
* project developed in group, including group internals, management, writing of technical reports and oral presentations.

--- RETAKE

Two different situations:
=> Students that are evaluated using continuous evaluation:
Two options to choose (just before the exam begins):
* repeat the written exam included in the continuous evaluation planning an be evaluated under the "Students who choose continuous evaluation" conditions, described above.
* be evaluated with the same final exam of students who choose for evaluation at the end of the semester, under the "Students who choose for evaluation at the end of the semester" evaluation conditions, described above. No other activities are considered.
=> Students who choose for evaluation at the end of the semester:
A final examination will be provided to students who do not opt for the continuous evaluation, and are evaluated under the "Students who choose for evaluation at the end of the semester" conditions, described above. No other activities are considered.

Sources of information

Bruce and Jenny Bartlett, Practical recording techniques, 2005, Focal press
Francis Rumsey and Tim McCormick, Sound and recording, 2009, Focal press
Davis, Gary, The Sound reinforcement handbook , 2nd edition, Milwaukee (Winsconsin) : Hal Leonard Corporation
Philip Giddings, Audio systems: design and installation, 1990, Focal press

In addition to the bibliography mentioned the student will have as a support material:
* Scripts of theory: material that contains the theoretical base of what is included in the master sessions.
* Scripts of the practices: proposed activities and problems of each practical session.
* Copy of the slides.

* Questions and problems proposed.

Recommendations

Subjects that continue the syllabus

Sound Processing/V05G300V01634
Audiovisual Technology/V05G300V01631

Subjects that are recommended to be taken simultaneously

Fundamentals of Acoustics Engineering/V05G300V01531

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Digital Signal Processing/V05G300V01304

IDENTIFYING DATA				
Video and Television				
Subject	Video and Television			
Code	V05G300V01533			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Martín Rodríguez, Fernando			
Lecturers	Fernández Hermida, Xulio Martín Rodríguez, Fernando			
E-mail	fmartin@uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)(*) This subject develops nowadays available video technology: video saving on magnetic and/or optic media, digital television over different transmission media (terrestrial, satellite, cable and IP) and television networks. We assume knowledge of basic image and video formats (JPEG and MPEG) that were studied in the prerequisite FSI (Fundamentos de Son e Imaxe, compulsory in the second year).			

Competencies	
Code	
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A44	CE35/SI2 The ability to analyze, specify, carry out and maintain systems, equipments, heads and installations of TV, audio and video for mobile and fixed environments.

Learning aims		
Subject competences	Typology	Competences
Chossing appropriate saving formats for each need. Choosing appropriate equipment to work with such formats (C1).	Know How	A43 A44
Designing and implementing interactive TV projects (C2).	Know How	A43 A44
Making the necessary calculations for design and implementation of TV networks of all different kinds (C3).	Know How	A5 A6 A43 A44
Writing intra-building video distribution projects and monitoring their installation process. Testing and correcting problems in existing systems (C4).	Know How	A5 A6 A43 A44

Contents	
Topic	
Structure of a video production studio.	General overview. Multimedia matrixes. Capturing formats: SDI, HDMI, analog. Auxiliary equipment: caption machines, measurment and control equipment... Playout system.

Video saving.	Magnetic saving. Optical saving. Domestic formats. Introduction to professional formats.
Televisión Digital.	DVB Standard: Digital Video Broadcasting. DVB transmission media: DVB-T, DVB-S, DVB-C. IPTV (Television over IP). Digital Interactive TV (MHP standard). Fundamentals of 3D TV (Coding and Transmission).
Redes de TV.	TV Broadcasting. Terrestrial networks: emitters, re-emitters, gap-fillers. Cable networks: HFC, FTTB, FTTH. Intra-building networks (residential buildings, hotels, other...).
Lab content 1.	Study of QPSK modulation in DVB-S. Implementation of a simple matlab simulator. Results evaluation.
Lab content 2.	Introduction to terrestrial coverage planning. Development of a small planning application using matlab.
Lab content 3.	Desing of an intra-building TV network for a real example.
Lab content 4.	Assigment about MHP application development.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Practice in computer rooms	12	9	21
Tutored works	7	49.5	56.5
Multiple choice tests	0	1.5	1.5
Reports / memories of practice	0	6	6
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	Professor makes presentation of contents, encouraging critical discussion. Algorithm and procedures teoretical basis are exposed. Related capabilities: A5, A6, A43, A44, C1, C2, C3, C4.
Practice in computer rooms	Small projects are suggested. Students must obtain well founded solutuions, choosing appropriate methods and coming to a valid solution. Related capabilities: A5, A6, A43, A44, C2, C3, C4.
Tutored works	Lab projects are checked in individual or small group interviews. Professor suggests a qualification (the one the presented work derserves). Possible improvement actions are discussed. Related capabilities: A5, A6, A43, A44, C2, C3, C4.

Personalized attention

	Description
Master Session	Doubts can be answered in tutorshio sessions. These tutorships will be performed: * Individually or in small groups (tipically nor more than 2-3 students). * Previous appointment with professor is needed unless indicated otherwise. Appointment will be asked via e-mail and will take place prerrably in the times and place formally booked. In lab hours, professor will assint in any problem that arises at that moment. In monitoring sessions (C groups), works will be presented to professor that will comment them, insisting on the detected weak points and the improvement possibilities.
Practice in computer rooms	Doubts can be answered in tutorshio sessions. These tutorships will be performed: * Individually or in small groups (tipically nor more than 2-3 students). * Previous appointment with professor is needed unless indicated otherwise. Appointment will be asked via e-mail and will take place prerrably in the times and place formally booked. In lab hours, professor will assint in any problem that arises at that moment. In monitoring sessions (C groups), works will be presented to professor that will comment them, insisting on the detected weak points and the improvement possibilities.

Tutored works	Doubts can be answered in tutorshio sessions. These tutorships will be performed: * Individually or in small groups (tipically nor more than 2-3 students). * Previous appointment with professor is needed unless indicated otherwise. Appointment will be asked via e-mail and will take place prerrably in the times and place formally booked. In lab hours, professor will assint in any problem that arises at that moment. In monitoring sessions (C groups), works will be presented to professor that will comment them, insisting on the detected weak points and the improvement possibilities.

Assessment

	Description	Qualification
Tutored works	This consists of small projects exposed in the lab clases (B group). Such works start at B group but are monitored in C group. In such meetings, work state will be analyzed included a qualification (achieved up to the moment). Improvements will be proposed and they could be implemented in B group or via non presential work. Assesed capabilities: A5, A6, A43, A44, C2, C3, C4.	0
Reports / memories of practice	They are the final version of tutored jobs. Reports are submitted at course ending. Altough we show here the complete qualification, this 25% is due to the work performed in this section and also in the section above. Assesed capabilities: A5, A6, A43, A44, C2, C3, C4.	25
Multiple choice tests	Multiple choice tests, performed online via faitic platform. There will be three tests. The first one will be about thr first two themes. The second one about the third theme and the third one about the fourth theme. On finishing each theme, professor will announce the dates to take the online test. Each test will deserve a maximum of 0.5 points of the final qualification. Estimated dates: - Third week (production studios and video saving). - Fifth week (DVB). - Eighth week (TV networks). Assesed capabilities: A5, A6, A43, A44, C1, C2, C3, C4.	15
Long answer tests and development	Final written exam in time and place according to school official scheduling. Assesed capabilities: A5, A6, A43, A44, C1, C2, C3, C4.	60

Other comments and second call

Student can decide wether he wants to be evaluated via final exam or with continuous evaluation (the procedure described above). Student must indicate his decision writing it on the final exam. If he chooses the final exam option (final exam is 100% of the qualification), he will be required to answer extra questions or to solve extra exercises (having extra time available).

In the second call, students will be ask the same question (choosing between continuous evaluation and final exam) but with the following considerations:

- The qualification from test and lab reports is the same of the first call.

- That qualification is only valid within the present academic year.

Sources of information

Ulrich Reimers, DVB: the family of international standards for digital video broadcasting, Berlin : Springer, 2005

Tomás Perales Benito, Radio y Televisión Digitales: Tecnología de los Sistemas DAB, DVB, IBUC y ATSC, Creaciones Copyright, 2005

José Luis Fernández Carnero, Antonio Suárez Perdigón, Televisión y radio analógica y digital : sistemas para la recepción y distribución de las comunicaciones y los servicios en edificios y viviendas, Santiago de Compostela : Televés, 2004

Besides bibliography student will have this material (in spanish):

* Theory text: material that contains the theoretical basis to be developed in the in-person classes.

* Practical jobs guidelines: especifications for each practical job demanded.

* Copy of graphical material to be used in in-person classes.

Recommendations

Subjects that are recommended to be taken simultaneously

Audiovisual Technology/V05G300V01631

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Digital Signal Processing/V05G300V01304

IDENTIFYING DATA				
Operating Systems				
Subject	Operating Systems			
Code	V05G300V01541			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Pazos Arias, José Juan			
Lecturers	Pazos Arias, José Juan Ramos Cabrer, Manuel			
E-mail	jose@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim of this subject is that the student was able to learn the foundations of the current operating systems and to comprise its importance inside the architecture of a computer.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A42	CE33/TEL7 The ability to program network and distributed applications and services.

Learning aims		
Subject competences	Typology	Competences
CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations	know	A3
Knowledge of the main concepts and the principles of design of the operating systems.	know	A3
Ability to identify the components of an operating system, recognise its functions and the interrelationships between them.	know	A3
Knowledge of the lastest advances and tendencies related with operating systems	know	A3
CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.	know Know How Know be	A4
CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.	Know How Know be	A9
TEL7 The ability to program network and distributed applications and services.	know Know How	A42
Acquisition of basic skills for the configuration and the utilisation of operating system services.	know Know How	A42

Contents	
Topic	
Introduction and general perspective of the Operating systems	• Concept of operating system. • Structure of an operating system. • Types of operating systems. • Emulation and virtualization.

Processor management.	• Concept of process and thread. • Strategies of allocation of capacity of computation.
Memory management.	• Strategies of contiguous allocation. • Concepts of fragmentation, protection, compactation, relocation and sharing of memory. • Strategies of non-conriguous allocation: paging, segmentation and hybrid methods. • Virtual memory.
Permanent storage of the information.	• Functions of a file system. Concepts of file and directory. • Interface with the file system. • File sharing. • File Protection. • File system implementation. • Free space management. • Methods for allocation of space to files.
Input/Output (I/O) management.	• I/O Controllers. • I/O Interfaces. • Secondary and tertiary storage. • Disk scheduling. • Management of disk. • Replication and consistency of the information. RAID and RAIN technologies.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	20	46	66
Practice in computer rooms	13	26	39
Workshops	5	30	35
Multiple choice tests	1	0	1
Practical tests, real task execution and / or simulated.	1	0	1
Jobs and projects	2	6	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	Presentation of the ideas, concepts, technics and algorithms of each lesson. This activity develops the CG3 and CG4 competencies.
Practice in computer rooms	The students will resolve under the supervision of the professors practical problems that pose in each session of laboratory. This activity develops the CG4 and CE33/TEL7 competencies.
Workshops	Each group of students will tackle the design and implementation of a software project with half complexity. This task will be realised in successive steps, that will be discussed and validated in each one of the face-to-face sessions. The aim of this methodology of work is to provide a suitable feedback to improve the proposed solutions. This activity develops the CG4 and CG9 competencies.

Personalized attention

	Description
Practice in computer rooms	Personalised attention will be provided through individual and face-to-face meetings in the timetables published at start of the course. In the practices of laboratory and workshops, this attention will be provided by means of the follow-up of the work of each student, monitoring the partial solutions proposed and reorienting them if it was precise.
Workshops	Personalised attention will be provided through individual and face-to-face meetings in the timetables published at start of the course. In the practices of laboratory and workshops, this attention will be provided by means of the follow-up of the work of each student, monitoring the partial solutions proposed and reorienting them if it was precise.

Master Session	Personalised attention will be provided through individual and face-to-face meetings in the timetables published at start of the course. In the practices of laboratory and workshops, this attention will be provided by means of the follow-up of the work of each student, monitoring the partial solutions proposed and reorienting them if it was precise.

Assessment

	Description	Qualification
Multiple choice tests	Proof of theoretical contents exposed in the master classes. In these works, CG3 and CG4 competencies will be evaluated.	60
Practical tests, real task execution and / or simulated.	Validation of the work realised in every laboratory session. In these works, CG4 and CE33/TEL7 competencies will be evaluated.	20
Jobs and projects	In the last face-to-face session of workshop, students will deliver and will expose to their mates the design and the proposed solution for their project. This solution will be exposed to debate for students and professors. In these works, CG4 and CG9 competencies will be evaluated.	20

Other comments and second call

The subject can be surpassed by means of Continuous Evaluation according to the following criteria, having opened the possibility to opt by the No Continuous Evaluation anytime until the beginning of the final examination to celebrate the day fixed to such effect in the official calendar of the EET. All those students that opt by the continuous evaluation will consider presented if they evaluate of the part of the work in Workshops.

Continuous evaluation:

The final note will result of the sum of the corresponding notes to the three following components:

1.Â Â Â Â Four proofs of type Test to evaluate the contents given in the masterclasses. Each proof will take place in one of the master classes , except the last that will realise in one of the sessions of the Workshop.

Punctuation: Up to 1,5 points each proof.

2.Â Â Â Â Six Practical Proofs that will realise when finalising each one of the sessions of laboratory and that will consist in the validation of the results obtained during said session.

Punctuation: Up to 1/3 points each proof.

3.Â Â Â Â Presentation of the Project proposed like work in the sessions of the Workshop.

Punctuation: Up to 2 points.

To pass the subject by Continuous Evaluation will have to give the three following conditions: (i) obtain an equal or upper qualification to 2 points in the group of the tests.; (ii) Upper qualification to 0 points in, at least, four of the six practical proofs; and (iii) to attend all the face-to-face sessions and obtain more than 0 points in the presentation of the project.

No Continuous Evaluation:

By means of an examination on 10 points scheduled in the official calendar of the EET.

Final Call:

It will be governed by the indicated for the No Continuous evaluation.

Sources of information

Basic referemces:

1. "*Operating System Concepts*". Abraham Silberschatz, Greg Gagne y Peter B. Galvin, 8ª edición actualizada. 2011, Wiley.
2. "*Understanding the Linux Kernel*". Daniel P. Bovet y Marco Cesati, 3ª edición. 2005, O'Reilly Media.
3. "*Hello, Android: Introducing Google's Mobile Development Platform*". Ed Burnette, 3ª edición. 2010, Pragmatic Bookshelf.

Complementary references:

1. "*Operating Systems: Internals and Design Principles*". William Stallings, 7ª edición. 2011, Prentice Hall.

2. "*Operating System : A Modern Perspective*". Gary Nut, 3ª edición. 2004, Adison-Wesley Longman, Inc.
3. "*Sistemas Operativos: Una Visión Aplicada*". Jesús Carretero, Felix García, Pedro de Miguel y Fernando Pérez, 2ª edición. 2007, McGraw Hill.
4. "*Multimedia Systems*". Ralf Steinmetz y Klara Nahrstedt, 1ª edición. 2004, Springer.
5. "*Introduction to Grid Computing*". Frederic Magoules , Jie Pan, Kiat-An Tan y Abhinit Kumar, 1ª edición. 2009, CRC Press.
6. "*Cloud Computing: Implementation, Management, and Security*". John Rittinghouse y James Ransome, 1ª edición. 2009, CRC Press.
7. "*Operating Systems: A Design-Oriented Approach*". Charles Crowley, 1ª edición. 1996, McGraw Hill.
8. "*Modern Operating Systems*". Andrew S. Tanenbaum, 3ª edición. 2007, Prentice Hall.
9. "*Linux Kernel Development*". Robert Love, 3ª edición. 2010, Addison-Wesley Professional.
10. "*Professional Linux Kernel Architecture (Wrox Programmer to Programmer)*". Wolfgang Mauerer, 1ª edición. 2008, Wrox.
11. "*Unlocking Android: A Developer's Guide*". Frank Ableson, Charlie Collins y Robi Sen, 1ª edición. 2009, Manning Publications.
12. "*The Busy Coder's Guide to Advanced Android Development*". Mark L .Murphy, 1ª edición. 2011, CommonsWare, LLC.

Recommendations

Subjects that continue the syllabus

Distributed and Concurrent Programming/V05G300V01641
Information Systems/V05G300V01644

Subjects that are recommended to be taken simultaneously

Network Security/V05G300V01543

Subjects that it is recommended to have taken before

Informatics: Computer Architecture/V05G300V01103
Programming I/V05G300V01205
Programming II/V05G300V01302

IDENTIFYING DATA				
Data Networks: Technology and Architecture				
Subject	Data Networks: Technology and Architecture			
Code	V05G300V01542			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Rodríguez Pérez, Miguel			
Lecturers	Rodríguez Pérez, Miguel Rodríguez Rubio, Raúl Fernando			
E-mail	Miguel.Rodriguez@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The objective of this subject is to teach our students the technical basics that govern the modern computer networks, regarding topics like new switching paradigms, new access technologies or data transport with quality of service.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A39	CE30/TEL4 The ability to describe, program, assess and optimize communication protocols and interfaces at different network architecture layers .
A41	CE32/TEL6 The ability to design networks and service architectures.

Learning aims		
Subject competences	Typology	Competences
(*)The ability to apply modern transmission, switching and transport concepts and technologies to design, to operate and to take advantage of heterogeneous networks.	Know How	A1
(*)To identify and to know how to use specific solutions -related to switching, transport and management- to deploy networks for specific purposes.	know	A4
(*)To know and to apply methods and techniques to provide quality of service in networks and telecommunication services, both in open and closed environments.	know Know How	A39 A41
(*)The ability to design, to manipulate and to apply advanced configurations to computer networks, from the point of view of switching, the quality of service, data transportation and the deployment of telematic services.	know Know How	A6 A39 A41
(*)The ability to solve problems inventively, to work in group and to be able to communicate -both in a written and oral fashion- the knowledge, the proceedings and the results related to the management and configuration of computer networks infrastructures.	Know How Know be	A4

Contents	
Topic	
Network virtualization	Tunnels Overlay networks Remote access (VPNs) Mobile IP

IPv6	Introduction Self-configuration Addressing scopes Transition mechanisms
Advanced switching mechanisms	Label switching (MPLS) MPLS applications VPNs with provider support
Access network technologies	xDSL Cable (HFC, DOCSIS) Optical access networks
Optical switching and transmission	SDH/SONET. Protection rings Circuit switching, burst switching and packet swithching

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	20	25	45
Laboratory practises	8	12	20
Tutored works	7	42	49
Presentations / exhibitions	2	4	6
Others	0	5	5
Long answer tests and development	4	15	19
Short answer tests	1	0	1
Reports / memories of practice	0	5	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	The master lectures follow the usual scheme for this way of teaching; although, in some sessions, we will be able to dedicate 5 or 10 minutes of the class to make a simple examination (some brief questions) that will form part of the continuous evaluation. These short tests intend to motivate our students for a daily work. We impart the competencies A6, A39 and A41 in these master sessions.
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. In such practices they will use real network equipment (routers and switches) and/or virtualization software that will allow their instruction and training on their own. The practices that the teachers will pose will be designed to be done within the respective face-to-face sessions at the School; although the student that like this need will be able to reproduce them at home using free software that will allow to virtualize the network hardware used in the laboratory. Also, the professors will be able to propose optional exercises that the student will be able to do as homework; and review individually in tutorial time. The students should adquire comnpetencies A39 and A41 in the lab.
Tutored works	A project with a fairly large magnitude will be posed to be developed as a teamwork during all the semester. This practical work might require in its earliest stage to be set in context doing an additional theoretical study/research. Both works will be supervised by the professors with periodic meetings every 10/15 days (roughly). And finally, they will select some of the best works for their public exhibition before the other groups of the course. The tutored works are related with competencies A1, A4, A39 and A41.
Presentations / exhibitions	Every group must deliver the right documents where the suggested challenge (project teamwork) have to be explained in a detailed way. Also, the students must prepare a public presentation of the team solution to be defended in front of the rest of the class. The students practice competencie A4 in the presentations.
Others	A social network designed for educative purposes will be used to promote debates and other online activities that will imply the participation of our students, either collaborative or competitively. Competencies A6 and A39 are exercised.

Personalized attention

	Description
Master Session	During tuitition 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, or to correct whichever optional homework done out of the class- or collectively -with the supervision of the teamwork that will share among a group of peers.

Laboratory practises	During tuitition 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, or to correct whichever optional homework done out of the class- or collectively -with the supervision of the teamwork that will share among a group of peers.
Tutored works	During tuitition 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, or to correct whichever optional homework done out of the class- or collectively -with the supervision of the teamwork that will share among a group of peers.

Assessment

	Description	Qualification
Laboratory practises	They will be marked as "passed" or "not passed". To pass them, the student must attend all the sessions of this type. If any unexpected event makes one student to miss one session, he must replace it doing an extra practice that the professor will pose dynamically.	0
Tutored works	The practical teamwork (project) that the student will face will determine one of the mid-term marks, Xb, of our continuous evaluation. The quantitative value (between 0-10) will be determined by the correctness of the solution presented by the group, the associated presentation and docs, and the individual implication of the student in the developed work. Competencies A1, A4, A6 and A41 are evaluated.	25
Others	Using a social network will allow to define online activities (like debate forums, blogs, online mental competitions ...) that would be evaluated individually after the systematic observation of the student involvement (Z). This is related to competence A6.	10
Long answer tests and development	There will be two written exams: a mid-term exam in the middle of the semester (Xa1), and a final one (Y). Both tests are theory examinations and will be evaluated individually between 0 and 10. The second one (Y) will weight 40% of the whole mark, and the student must score at least 3/10 to pass the subject. The mid-term test, Xa1, will be involved arithmetically in a special way with the "short-response" questionnaires (Xa2) and the tutored work (teamwork, Xb) to get other 50% of the whole mark. As a result competencies A39 and A41 are evaluated.	52,5
Short answer tests	With some periodicity, and within the master sessions, the professors will be able to incorporate brief tests (short response questionnaries), Xa2. These brief tests, together with the mid-term examination (Xa1), compose the complementary part of the theory but the final examination Y. Competencies A39 and A41 are evaluated.	12.5

Other comments and second call

The assessment of the subject can follow either be based on a *continuous evaluation* or on a single *final examination*. Students will choose the *continuous evaluation* if they take the mid-term written exam (Xa1) at the middle of the semester. The percentages shown in the previous section only reflect the maximum weights that any activity (partial mark) can obtain when following the continuous evaluation strategy, and serve only as illustration. The precise assessment follows:

In *continuous evaluation*, the final mark will be the arithmetic weighted mean among the mark of the final examination (Y, 40%), the score associated to other measurable activities done in the course (Xa1 Xa2 and Xb, 50%) and the one originated through the online activities (Z, 10%). The students must obtain at least 3/10 in both the first two marks, X and Y, as well as a “pass” in the laboratory practices, to pass the subject. The joint partial mark associated to the rest of activities just mentioned, X, will be the geometric mean between the mark of the tutored teamwork (Xb) and the arithmetic mean between the short response tests (Xa2) and the written mid-term exam (Xa1).

X=SQRT [Xb·(0.5·Xa1+0.5·Xa2)]

FINAL MARK= 0.4·X+0.5·Y+0.1·Z

Students that do not opt for the continuous evaluation, must take a final examination that will be made up of three parts: a theory examination, like the final one in the continuous evaluation (Y), an aptitude test in the laboratory, and a practical project that must be developed individually (Xb). The final mark, in this case, will be the geometric mean between the theoretical exam and the project work, provided that the student pass the aptitude test in the lab.

Finally, the extraordinary examination session in July will have the same characteristics than the special final examination just described, but students will be allowed to inherit the partial mark of any activity (Xb or Y) if that has been passed during the same academic year, independently of the assessment modality that the student had followed.

Sources of information

Kurose & Ross, Computer Networks, 6ª, Prentice Hall
Peterson & Davis, Computer Networks, 5ª, Morgan Kauffman
Ina Minei & Julian Lucek, MPLS-Enabled Applications, 2ª, Wiley
Charlie Scott, Paul Wolfe & Mike Erwin, Virtual Private Networks, 2ª, O'Reilly
Christian Huitema, IPv6, 2ª, Prentice Hall
Roderick W. Smith, Broadband Internet connections: a user guide to DSL and cable, , Addison Wesley
Walter Goralski, Tecnologías ADSL y xDSL, , McGraw-Hill
Biswanath Mukherjee, Optical WDM networks, , springer
G. Papadimitriou, C. Papazoglou & A. Pomportsis, Optical Switching, , Wiley

Recommendations

Subjects that are recommended to be taken simultaneously

Network and Switching Theory/V05G300V01642

Subjects that it is recommended to have taken before

Computer Networks/V05G300V01403

IDENTIFYING DATA				
Network Security				
Subject	Network Security			
Code	V05G300V01543			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	1st
Language	Spanish			
Department				
Coordinator	Fernández Masaguer, Francisco			
Lecturers	Fernández Masaguer, Francisco			
E-mail	francisco.fernandez@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this course are studied , in an unified way, the main problems and threats to security in networks and telematic services, and distinct techniques to protect them are presented. First the subject is considered from a general point of view, so that the concepts, services and security techniques studied, can be applied to any type of network, telematic service or information system to secure. This block is formed by chapters 1 to 4. This carries to treat with detail the three central subjects of security: the algorithmic part (encipherment, digital signature and integrity), the authentication problem and the procedures of key management. The aim is to give the student the knowledge and practice to entitle him/her to ease his understanding of the particular techniques that each application can require and to apply them to other scenarios that he(she) have to face. Afterwards the subject is considered in a more particular way, reviewing the problems, techniques and standards of security in some of the communication environments of greater prevalence in actuality. Thus a chapter is devoted to the security to the IP level, central protocol in the Internet architecture, and another chapter to the security in the Web, given the current importance of this way of telematic intercommunitation. The main security problems in electronic commerce using the Web are presented, studiing in particular the operation of Paypal, one of the payment methods more used in the Web. Given also the every time greater utilisation of wireless communications and his particular security problems, one chapter is devoted to the subject. The course is closed with an introduccion to other two subjects of increasing transcendence: botnets, malicious networks and software, and the forensic analysis of information systems.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A37	CE28/TEL2 The ability to apply the techniques that are basis of computer networks, services and applications, such as management, signaling and switching, routing and securing systems (cryptographic protocols, tunneling, firewalls, charging mechanisms, authentication and content protection) traffic engineering (graph theory, queuing theory and teletraffic) rating, reliability and quality of service in both fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.

Learning aims		
Subject competences	Typology	Competences
Knowledge of some of the mathematic theories in which support the security of the cryptographic algorithms and protocols used for the protection of networks and services.	know	A3
Knowledge of the principles and operation of the main encryption, digital signature and hash algorithms used as the base of the security services incorporated in telematic networks and services.	know	A3

Knowledge of the different and more important methods, techniques and protocols of authentication, used to protect networks.	know	A3
Endow to the student of the capacity to analyse the problems of security of an information system, network or telematic service, evaluate the risks associated and implement the appropriate techniques to guarantee a suitable level of security.	know Know How	A4
Ability to apply the security techniques used by the networks, services and telematic applications, such as cryptographic protocols, tunneling, firewalls, Internet payment mechanisms, authentication and protection of contents.	know Know How	A37
Facilitate the handle and knowledge of specifications and normative about security.	know	A6 A37

Contents

Topic	
1 Mathematics foundations of security.	- Notions of Complexity Theory. - Notions of Number Theory.
2. Cypher, digital signature and hash algorithms	- Encrytion. Shannon principles. Stream and block cyphers. DES and AES algorithms Cypher modes of operation - Integrity and hash algorithms. - Public key cryptosystems. RSA, ElGamal and DSA.
3. Certification and Public Key Infrastructures.	- Security problems of asimetric cryptography. Certification and certificate formats. - Trust models. Flat trust model and PGP. Third partiy trust model and certification authorities. - Certificate Infrastructures. Certification path and revocación of certificates.
4. Authentication and key agreement protocols.	- Authentication methods. - Threats to an authentication protocol. Countermeasures. - Requirements of a key agreement protocol. Diffie-Hellman protocol. - Authentication in simmetric cryptosistems. Cases of study: GSM and Kerberos. - Authentication in asimetric cryptosistems. Cases of study: X509 and SSL. - Passwords based protocols: SRP.
5. Security at the network layer	- Threats in the network layer. - IP Security Architecture. - IPsec Protocol. IPsec tunnels. IPsec and NAT. - Key manegement protocols: IKE, ISAKMP and OAKLEY.
6. Security in the Web and electronic commerce.	- Problems of security in the Web. - Protocols: SSL and TLS. - Certification in the Web. - Principles of electronic commerce and payment protocols. PayPal system.
7. Wireless security and AAA protocols.	- Threats to security in wireless environments. - Wireless Application Protocol (WAP). WTLS. Protocols WEP, WPA, WPA2 (802.11i). - AAA Protocols: RADIUS and DIAMETER.
8. Systems Security.	- Firewalls and systems against intrusions. - Malicious software and networks. Botnets. - Forensic analysis of systems.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	19	38	57
Troubleshooting and / or exercises	2	0	2
Autonomous troubleshooting and / or exercises	0	10	10
Tutored works	6	28	34
Laboratory practises	11	22	33
Long answer tests and development	2	10	12
Practical tests, real task execution and / or simulated.	1	0	1
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
Master Session	Exhibition by means of powerpoint presentations and blackboard of the theoric contents of the course. They will develop the theoretical subjects of the matter that do not remain covered by the others methodologies employed. With this methodology, student will adquire part of A3 y A37 competences.
Troubleshooting and / or exercises	Some problems and exercises of the bulletin will be solved, so that they can serve as a guide for the autonomuous resolution by the group of the rest of exercises or questions. The solution to similar problems will be given also to students to ease the reaization of the bulletin. This methodology, is aimed to A4 competence.
Autonomous troubleshooting and / or exercises	The group will solve in an autonomous form the exercises, cuestions or problems of the bulletin not solved in the face-to-face hours. The diverse solutions that arise when tackling each problem, will be put in common to agree the best form of solution. The doubts arisen will be agreed and will be exposed to the tutor in normal tutor time. This methodology is aimed to A4 competence.
Tutored works	Several theoretical and practical works to develop will be explained to the students, between which each group will have to choose one. In the C class type, will expose to each group the aims of the work, hardware and software tools to use, form to tackle it and will realise a follow-up to each group. This methodology, is aimed to adquire part of A4,A6 and A37 competences.
Laboratory practises	The student will developed some practices in the laboratory, focused to mature and carry to practice the theoretical concepts , as to improve his ability for the engineering of secure networks and services. This methodology, is aimed to A6 and A37 competences.

Personalized attention	
	Description
Master Session	The student can interact with the teacher in normal tutorial time to: 1. Follow the work or project selected, before and during his development, to validate its orientation, organization and aims, descriptive part and absence of errors. 2. Solve any type of doubt concerning the orientation, understandings, errors and realization of laboratory practices. 3. Doubts that appears to the student on his realization of the bulletin exercises and questions and about the theoretical contents of the course.
Laboratory practises	The student can interact with the teacher in normal tutorial time to: 1. Follow the work or project selected, before and during his development, to validate its orientation, organization and aims, descriptive part and absence of errors. 2. Solve any type of doubt concerning the orientation, understandings, errors and realization of laboratory practices. 3. Doubts that appears to the student on his realization of the bulletin exercises and questions and about the theoretical contents of the course.
Troubleshooting and / or exercises	The student can interact with the teacher in normal tutorial time to: 1. Follow the work or project selected, before and during his development, to validate its orientation, organization and aims, descriptive part and absence of errors. 2. Solve any type of doubt concerning the orientation, understandings, errors and realization of laboratory practices. 3. Doubts that appears to the student on his realization of the bulletin exercises and questions and about the theoretical contents of the course.

Tutored works	The student can interact with the teacher in normal tutorial time to: 1. Follow the work or project selected, before and during his development, to validate its orientation, organization and aims, descriptive part and absence of errors. 2. Solve any type of doubt concerning the orientation, understandings, errors and realization of laboratory practices. 3. Doubts that appears to the student on his realization of the bulletin exercises and questions and about the theoretical contents of the course.
Autonomous troubleshooting and / or exercises	The student can interact with the teacher in normal tutorial time to: 1. Follow the work or project selected, before and during his development, to validate its orientation, organization and aims, descriptive part and absence of errors. 2. Solve any type of doubt concerning the orientation, understandings, errors and realization of laboratory practices. 3. Doubts that appears to the student on his realization of the bulletin exercises and questions and about the theoretical contents of the course.

Assessment

	Description	Qualification
Autonomous troubleshooting and / or exercises	Assessment of the two bulletins of problems/exercises. The group will have to deliver bulletin 1 before week 10 and bulletin 2 before week 15. With this test part of A3, A4 and A37 competences will be evaluated.	10
Long answer tests and development	Final exam of the course. This exam will consist of about 8 to 10 exercises/problems/questions on the contents given in the course. With this test part of A3, A4 and A37 competences will be evaluated.	50
Practical tests, real task execution and / or simulated.	Proof of group in which the professor will value laboratory practices, reviewing his operation with all group members present. This proof will be realised in week 15. With this test, A6 and another part of A37 competences will be evaluated.	20
Jobs and projects	Assessment of the tutee project or work realised by the group (type C). The group will do a demonstration to the teacher of the project or work realised and results obtained. The group must deliver the work before week 15. All the members of the group have to be present at the moment of presentation. With this test part of A4, A6 and A37 competences will be evaluated.	20

Other comments and second call

- CHOICE OFÂ CONTINUOUS EVALUATION .

- The students that opt by continuousÂ evaluation (EC) mustÂ communicate it explicitly to the teacher before week 4 of the course. This communication must be made by electronic mail.
- ANNOUNCEMENT OF END OF FOUR-MONTH PERIOD.

- TheÂ Â continuousÂ evaluation (EC) is formed by the exercises to realise of autonomous form, by the tutee work or proyect and by the laboratory practices, representing in total 50% of the course, as indicated in the assesment.Â
  The students that do not choose EC will do a final exam by 80% of the final note, together with the laboratory Â that will complete the other 20%.
  The final exam will be the same for all the students, that is, for both EC and not EC students. In the case of EC students this exam will count by 50% of the note, whereas for not EC students will count by 80% of the note.
- ANNOUNCEMENT OF JULY

- In the first case, that is for the students than continue by Â EC in July, the note of the bulletin, laboratory practices and tutee work is saved from the January announcement. However, the student has the option to improve any of them until his corresponding maximum note. Â
- In the second case, not EC students in July, will do a final examination by 80% of the note, and laboratory practices by 20%.

- ADDITIONAL NOTES.

  - **Minimal cualification for theory evaluation (long answer tests and development).** Â Independently of if continuous or not continuous evaluation, and independently Â of the announcement, it will be necessary to get a minumun of 3,33 points over 10 in the theoretical evaluation (long answer tests and development), for the approval of the course.

- It will be considered Â to the student as "no presented" if he/she has not followed continous evaluation and has not presented to the final examination.
- The ratings obtained in the laboratory and group works Â will be valid only during the academic course in that they realise.Â

Sources of information
F. Fernandez Masaguer, Seguridad en Redes y Sistemas de Informacion, 1ª ed., Publicacion digital, 2013
R.Perlman, C. Kaufman, M.Speciner, Network Security: Private communications on a public world, 2ª ed., Prentice-Hall, 2003
Joseph Migga Kizza, Guide to Computer Network Security, 2ª ed., Springer,2013
Douglas R. Stinson, Cryptography. Theory and Practice., 3ª ed., Chapman & Hall/CRC, 2006
Benjamin M. Lail, Broadband Network & Device Security, 1ª ed., RSA Press, 2002

Recommendations

Subjects that are recommended to be taken simultaneously

Architectures and Services/V05G300V01645
Internet Services/V05G300V01501

Subjects that it is recommended to have taken before

Mathematics: Linear Algebra/V05G300V01104
Computer Networks/V05G300V01403

IDENTIFYING DATA				
Microwave Circuits				
Subject	Microwave Circuits			
Code	V05G300V01611			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish English			
Department				
Coordinator	Fernández Barciela, Mónica			
Lecturers	Fernández Barciela, Mónica Rodríguez Rodríguez, José Luis			
E-mail	monica.barciela@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject provides the student with the basic tools to analyze components and analog subsystems (active and passive) that operate in the band of the microwaves, as well as to evaluate his specifications and performance. The microwave subsystems are part, among others, of the modern communications systems transceivers (cellular telephony, wireless networks, satellite communications, and so on), thus the importance for the student to get some knowledge and background about these components. On the other hand, this subject complements the knowledge the student has, due to previous subjects, in electronics for communications, since when working in the microwave range, we need to use different tools for an accurate circuit analysis and design.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A32	CE23/ST3 The ability to analyze the components and their specifications for guided and non-guided communications systems
A33	CE24/ST4 The ability to select circuits, subsystems and systems of radiofrequency, microwaves, broadcasting, radio link and radio determination.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.

Learning aims		
Subject competences	Typology	Competences
To learn how to analyze microwave active and passive circuits and components, and to evaluate their specifications and performance. The student will learn how to use S-parameters, electronic instrumentation for measurements in the microwave range and circuit simulators for that purpose.	Know How	A3 A4 A5 A32
To learn how to solve exercises, how to perform measurements, how to elaborate and present reports, how to work in a technical team and to transfer knowledge in the field. To learn how to handle technical documentation and scientific bibliography, both in English.	Know How	A5 A9 A33 A34

To learn how to select, analyze and apply semiconductor active devices in circuits for microwave communications subsystems.	Know How	A3 A4 A32 A33 A34
To learn how to analyze and select microwave circuits for optical transmitters and receivers.	Know How	A3 A4 A32 A34
To learn how to evaluate and select microwave subsystems. To propose solutions for applications at the different frequency bands for guided (coaxial cable, waveguide...) and wireless transmissions.	Know How	A4 A5 A33 A34

Contents

Topic	
1.Introduction to microwave circuits.	A. Technologies for high frequency bands. B. Applications. C. Microwave Subsystems. Solutions for applications in the different frequency bands for wave guided and wireless transmissions.
2. Basic concepts.	A. Transmission Lines Theory. Travelling waves, characteristic impedance and reflection coefficient. Smith Chart. B. Coaxial cable and planar transmission lines.
3. S-parameters.	A. Definition and properties. B. Flow charts. C. Power and Gain. D. Stability.
4. Impedance Matching.	Basic matching networks (discreet and distributed).
5. Microwave passive components.	Filters, couplers, phase shifters and resonators.
6. Microwave active devices for integrated circuits.	A. Semiconductors for microwave integrated circuits. B. Diodes c. Transistors
7. Circuits for microwave transceivers.	A. Linear microwave amplifiers. B. Circuits for optical receivers and transmitters.
8. Analysis of microwave active and passive components, and circuits with a commercial simulator.	
9. Measurements on microwave devices and circuits.	Microwave measurement systems for linear device characterization.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	4	6	10
Practice in computer rooms	8	12	20
Tutored works	6	12	18
Master Session	19	38	57
Troubleshooting and / or exercises	4	32	36
Reports / memories of practice	1	8	9

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

Methodologies

	Description

Laboratory practises	With the aid of different microwave measurement instruments/ components, there will be analyzed passive and active microwave devices / circuits in microstrip technology. It will be defined and evaluated different figures of merit and other tools that will be used in the experimental characterization of these components. An introduction to Vector Network Analyzers with be provided to the student. Their use and calibration procedure will be described. The student work during these laboratory practises will be evaluated: 1. In continuous assessment: by means of a set of short questions to be delivered in writing at the end of some of the practises, and in all or some of the three short examinations involving exercises resolution. 2. In the evaluation in only a final examination: by means of a set of questions related to the work performed in the experimental practices. These practises are designed to help in adquiring competencies A5, A32, A33 and A34.
Practice in computer rooms	With the aid of a commercial microwave circuits simulator, there will be analyzed different passive components (matching networks, filters, couplers, etc.) and active semiconductor devices (diodes and transistors), and simple amplifier circuits, in agreement with Chapter 8. There will be defined and evaluated diverse figures of merit and other tools that will be in used in the analysis of these components. The evaluation of the student work in these computed aided practises will be performed: 1. In continuous assessment: by means of short questions to be delivered in writing, at the end of some of the practices, and in all or some of the three short examinations involving exercises resolution. 2. In the evaluation in only a final examination: by means of questions related to the work performed during these practices. These practises are designed to help in adquiring competencies A4, A32, A33 and A34.
Tutored works	The student, as part of a team, will study and develop a theoretical topic or a certain practical design, which later will be evaluated by means of a writing report and an oral presentation. These works are designed to help in adquiring competencies A3, A32, A33.
Master Session	It will be given in a classroom with the aid of a slate board and a video projector. Most of the concepts in the Chapters will be described in detail and explained. There will be also described several exercises resolutions. These sessions are designed to help in adquiring competencies A3, A32, A33.

Personalized attention

	Description
Laboratory practises	During the scheduled experimental and computer practices and team work meetings, 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.
Practice in computer rooms	During the scheduled experimental and computer practices and team work meetings, 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.
Tutored works	During the scheduled experimental and computer practices and team work meetings, 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.

Assessment

	Description	Qualification
Laboratory practises	In the case of continuous assessment, during the designated time for experimental practices the student will answer in writing to some proposed questions. Besides, in any of the three short examinations, the work performed in the available time for practices may be evaluated. In the case a unique evaluation in a final examination, the work performed in the available time for practices may be evaluated. Competencies evaluated are A5, A32, A33 and A34.	10
Practice in computer rooms	In the case of continuous assessment, during the designated time for practices the student will answer in writing to some proposed questions. Besides, in any of the three short examinations, the work performed in the available time for practices may be evaluated. In the case a unique evaluation in a final examination, the work performed in the available time for practices may be evaluated. Competencies evaluated are A4, A32, A33 and A34.	10
Troubleshooting and / or exercises	There will be three short examinations, each will contain exercises resolution. Moreover, they may contain a set of short questions related to the magisterial classes or the practices, both experimental or computer aided. Competencies evaluated are A3, A4, A32, A33 and A34.	70

Reports / memories of practice	It will be evaluated both the written report and the oral presentation of the team work performed. Competencies evaluated are A4, A5, A9, A32 and A34.	10

Other comments and second call

A) If the student selects continuous assessment:

1. His/her presence in all scheduled experimental and computer aided practices will be mandatory, as well as his/her presence in all scheduled team meetings. In order that his/her work as part of the team is evaluated, the corresponding written report and oral presentation will be mandatory, personally or as part of the team (to be decided by the lecturer). The maximum mark the student might obtain in the evaluation of all the scheduled practices and team work is 30 % of the total available mark for the subject.

2. The rest of the work in the subject will be evaluated by mean of three short examinations that will contain mainly exercises resolution, but that also may contain short questions. These three short examinations as a whole add up to 70 % of the total subject qualification.

The first short examination will take place around the 6th week, and the second around the 10 th week, term period. Both examinations may last 1 hour, and each corresponds to 15% of the total mark in the subject. Before the second short examination, the student must make know to the lecturer his decision about the type of evaluation he prefers: continuous assessment, or being evaluated only in a final examination. The third short examination will take place with the final examination performed for those students who do not follow continuous assessment. This short examination is also mandatory for those students following continuous assessment and it corresponds to a 40 % of the total subject qualification. To pass the subject, the student must obtain in this third short exam a mark equal or higher to the 30% of the total exam qualification. Otherwise, the marks he obtained in the computer and lab practises, and team C work will not be considered (added) to compute his/her final subject qualification.

B) In the case of the students who does not choose continuous assessment, the final (long version) and only examination corresponds to 100% of the subject qualification. In this examination it will be evaluated exercises resolution (in their extended version), answers to short questions related to the subject theoretical part, and the experimental and computer/simulator aided practices.

The second summons (July):

In July the students who have previously failed will have to perform a similar final examination than in option B, with similar characteristics as the ones described previously. In particular, the students who followed continuous assesment and want to preserve the qualifications obtained in the practices (both experimental and computer aided) and in the team work (that will add as a whole up to 30 % of the total subject qualification) will solve a reduced version of the final examination described in previous paragraph (which will corresponds in this case to 70 % of the total qualification).

Sources of information

R.E. Collin, Foundations for Microwave Engineering , 2, Wiley-IEEE Press

D.M. Pozar, Microwave Engineering, 3, Addison-Wesley Pub. Co

P.A. Rizzi, Microwave Engineering, Passive Circuits, 1, Prentice-Hall

S. Y. Liao, Microwave Devices and Circuits, 3, Prentice-Hall

J.M. Miranda y otros, Ingeniería de Microondas, 1, Prentice-Hall

Guillermo González, Microwave Transistor Amplifiers: Analysis and Design, 1, Prentice-Hall

Enrique Sánchez, Introducción a los dispositivos y circuitos semiconductores de microondas, 1, Pearson Educacion

Notes / viewfolds of the content of the magisterial classes.

Guides of the experimental and computer aided practices.

Recommended books.

Internet.

Recommendations

Subjects that are recommended to be taken simultaneously

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Physics: Fundamentals of Electronics/V05G300V01305
Electronic Technology/V05G300V01401
Electromagnetic Transmission/V05G300V01303

IDENTIFYING DATA				
Spectrum Management				
Subject	Spectrum Management			
Code	V05G300V01612			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	García Sánchez, Manuel			
Lecturers	García Sánchez, Manuel			
E-mail	manuel.garciasanchez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The management of the radioelectric spectrum, understood this like a natural resource, limited and scarce, pursues the most efficient use of the spectrum by means of the application of effective processes, to facilitate the implementation of communication systems and to guarantee minimum interference. To acomplish this objectives, engineering tools, planning, management and technical survey and certification are needed. Besides in this matter study of the SMATV systems and Structured Wiring are included.			

Competencies	
Code	
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A30	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.

Learning aims		
Subject competences	Typology	Competences
Know and comprise the mechanisms of exploitation and management of the radioelectric spectrum. Capacity for the management of the radioelectric specrum and allocation of frequencies. Capacity for the design of radioelectrric stations.	Know How	A30 A34
Knowledges for the realisation of measures of surveillance of the radioelectric spectrum. Capacity for the certification of radioelecrric stations according to the national rules. Capacity for checkingof the exposition limits to the electromagnetic fields. Knowledge of the laws, regulations and relative norms to the management of the radioelecric spectrum. Capacity of realisation of a work in group and its oral and written presentation.	Know How	A5 A6 A7 A8 A9

Contents	
Topic	
Introduction	Introduction to the matter. General concepts.

Spectrum management	National and international regulatory bodies International management and coordination National management The Telecommunications Law National telecommunication Plans CNAF
Spectrum engineering	Specifications of telecommunication equipmnet. Radio wave propagation. Coverage. Interferences. Re-use distance. Techniques to share the spectrum.
Modulations	Definitions The radio channel Objective of the modulation Types Analog Modulations: AM, FM Digital Modulations Wideband Modulations
Frequency planning	Trellis method List method Other methods Examples
Technical surveillance	The specrrum analyzer The wideband sounder measurement procedures for radioelectric base station certification
SMATV	Introduction Rules Design Examples
Structured wiring.	Introduction Rules Design Examples

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	1	2	3
Tutored works	3	45	48
Practice in computer rooms	6	6	12
Outdoor study / field practices	11	11	22
Others	2	25	27
Master Session	19	19	38

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

Methodologies

	Description
Laboratory practises	Activities of application of the acquired knowledge to particular situations. Acquisition of basic skills related with the matter. Specific measurement equipment as Spectrum Analysers , Field level sounders, etc, will be used.
Tutored works	The student, alone or in a small group with other students, elaborates a report on a given subject. This includes the search of the information, reading, writting, etc
Practice in computer rooms	Activities of application of the acquired knowledge to particular situations. Acquisition of basic skills related with the matter using computer programs.
Outdoor study / field practices	Field activities. Activities of application of the acquired knowledge to particular situations. Acquisition of basic skills related with the matter. Specific measurement equipment as Spectrum Analysers , Field level sounders, etc, will be used.
Others	Written exam on the contents of the matter.
Master Session	Master lecture given by the teacher.

Personalized attention

	Description
Master Session	The students will be able to resolve the doubts and questions of these types of teaching during the realisation of the activities, attending to scheduled meetings with the , or by means of email
Laboratory practises	The students will be able to resolve the doubts and questions of these types of teaching during the realisation of the activities, attending to scheduled meetings with the , or by means of email
Tutored works	The students will be able to resolve the doubts and questions of these types of teaching during the realisation of the activities, attending to scheduled meetings with the , or by means of email
Practice in computer rooms	The students will be able to resolve the doubts and questions of these types of teaching during the realisation of the activities, attending to scheduled meetings with the , or by means of email
Outdoor study / field practices	The students will be able to resolve the doubts and questions of these types of teaching during the realisation of the activities, attending to scheduled meetings with the , or by means of email

Assessment

	Description	Qualification
Laboratory practises	Realisation of measures on a panel of distribution of TV signal. Competences ST1 and ST5 will be evaluated.	2.5
Tutored works	Realisation of reports and presentations about issues related to spectrum management, that will be presented in class to evaluate the compentencie CG9.3 "Capacity to communicate, so much by writing as of oral form, knowledges, procedures, results and ideas related with the telecommunications and the electronics."	15
Practice in computer rooms	The coverage area of an AM station will be calculated. It will be evaluated with the memory of the practice. Competences CG6, CG9, ST1 and ST5 will be evaluated.	5
Outdoor study / field practices	Basic use of the spectrum analyser. Measure of the bandwidth of a FM signal. Measure of TDT signals. Installation of a parabolic antenna. Phase 1 and phase 2 measurements. Execution of the practice or test when finalising the practice. Competences CG5, CG7, ST1 and ST5 will be evaluated.	27.5
Others	Written exams of the contents of the matter. Competences CG6, CG7, CG8, ST1 and ST5 will be evaluated.	50

Other comments and second call

1)Following the guidelines of the degree we offer to the studentsÂ two schemes of evaluation in the ordinary announcement, at the end of the semester: continuous assessment and final assessment. The students will have to opt by one of the two schemes before the delivery of the report of the first practice. To be able to opt to the continuous evaluation the student has to complete and deliver in term the exercises that will be proposed in the classes of theory.

a)Continuous assessment. The continuous assessment will be based on the report of the PC practice and the tests of the other seven practices. The work *will be assessed by means of the presentationÂ in class. The last task of the continuous evaluation is a written exam. These tasks are not recoverable and only are valid for the current course.

b)Final evaluation. The students that do not opt to her continuous assessment will have to complete two written exams, one related toÂ the theoretical contents (50%) and the other to the practical contents (50%) in the official date of examination.

2) Extraordinary announcement (July). The students that haveÂ previously opted by continuous assesment will be able to opt between repeating the written examinations (50% of the mark) or examine again of all the matter (100% of the mark) by means two written exams, one related toÂ the theoretical contents (50%) and the other to the practical contents (50%). They will communicate the option they choose before the official date of the examination. The rest of the students will examine of all the matter (100% of the mark) by means two written exams, one related toÂ the theoretical contents (50%) and the other to the practical contents (50%).

Sources of information

Internacional Telecomunication Union, ITU-R recommendations, ,

Internacional Telecomunication Union, Radiocomunication Rules, ,

Internacional Telecomunication Union, National Spectrum management Manual, 2005,

Gretel-COIT, La evolución de la gestión del espectro radioeléctrico, 2007,

Recommendations

Subjects that it is recommended to have taken before

Signal Transmission and Reception Techniques/V05G300V01404
Electromagnetic Transmission/V05G300V01303
Radio Communication Systems/V05G300V01512

IDENTIFYING DATA

Principles of Digital Communications

Subject	Principles of Digital Communications			
Code	V05G300V01613			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language				
Department				
Coordinator	González Prelcic, Nuria			
Lecturers	Comesaña Alfaro, Pedro González Prelcic, Nuria Márquez Flórez, Óscar Willian			
E-mail	nuria@gts.tsc.uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)Os obxectivos básicos da materia son os seguintes: - Aplicar criterios de optimización para a realización de esquemas de estimación e sincronización en receptores dixitáis de comunicacións. - Diferenciar os bloques e as funcionalidades dun sistema de transmisión de datos completo. - Utilizar o procesado dixital de sinais para transmitir e recibir formas de onda analóxicas - Aplicar os mecanismos básicos de redución do impacto de ruído nun sistema de comunicacións.			

Competencies

Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A35	CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques.
B2	To approach a new problem considering first the essential and then the secondary aspects

Learning aims

Subject competences	Typology	Competences
CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations	know Know be	A3
CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.	Know How Know be	A4
CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques.	Know How	B2
CG11: To approach a new problem considering first the essential and then the secondary aspects	Know How	A35

Contents

Topic	
1. Introduction to digital communications.	- The software radio concept. - Elements of a digital receiver. - Quality objectives in a digital receiver
2. Timing recovery	- Introduction to the problem. - Decision directed timing recovery. - Timing recovery via Ouput Power maximization.

3. Carrier recovery.	- Phase estimation with known frequency. - The Phase Locked Loop. - The Costas Loop. - Decision directed phase tracking. - Frequency tracking.
4. Equalization	- Equivalent discrete time channel. - Least Squares (LS) equalization. - Adaptation algorithms: trained, decision directed, blind.
(*)5. Codificación de canle.	(*)- Medida da información. Entropía. - Capacidade de canle. - Codificación de canle. Ganancia de codificación.
5. Coding	- Entropy. - Channel capacity. - Channel coding. Coding gain.

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	4	12	16
Laboratory practises	12	36	48
Projects	7	35	42
Master Session	17	25	42
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
Troubleshooting and / or exercises	Some of the proposed problems for each topic will be solved in class.
Laboratory practises	The concepts presented in class will be further illustrated and developed by means of Matlab-based simulation and signal processing tools
Projects	Development of a complete PAM and QAM modem in Matlab. Work in small groups.
Master Session	Presentation and discussion of the fundamental theory

Personalized attention

	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.
Laboratory practises	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.
Projects	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
Laboratory practises	Three short tests will be given during the semester	30
Projects	The project will be evaluated at the end of the semester.	30
Long answer tests and development	Final exam.	40

Other comments and second call

For those students thatÂ opt by continuous evaluation the final note will obtain eat:

*Npuntuables+*Nproyecto+*Nexamen

Being *Npuntuables the note accumulated in the scored short exercises, until a maximum of 3 points; *Nproyecto the note of the practical project until a maximum of 3 points, and *Nexamen the note of the final examination until a maximum of 4 points. To approve the *asignatura a student has to have a minimum of 4 points over 10 in the exam; but it reaches this minimum the final note of the student will be the obtained in the examination, although it have opted by continuous evaluation.

For the students that do not opt by continuous evaluation, the final note will be the obtained in the final examination.

The final examination will beÂ the same for the two types of evaluation; only it will change his weight in the final note according to the student opt or no by continuous evaluation.

The Â student has to decide, after the realisation ofÂ the second race, if it opts byÂ continuous evaluation or no, communicating it to the professor Â inside the termÂ that *estableza. The students that opted by the continuous evaluationÂ and did not approve the matter will receive the qualification of "suspense" *independentemente that they present to the final examination or no.

TheÂ note of the scored conserves for the announcement of Julio, but no for back courses. InÂ the examination of the announcement of Julio the students that opt by continuous evaluation will be able to choose if they wish to keep the note obtainedÂ in Â the races and project, or be evaluated only by the final examination with a weight of 100%.

Sources of information
C. R. Johnson Jr y W. A. Sethares, Telecommunication breakdown: Concepts of communication transmitted via software-defined radio, , Pearson-Prentice Hall (2004)
J.R. Barry, E. A. Lee y D. G. Messerschmitt, Digital communication, , 3rd edition, Kluwer Academic Publishers (2004).
A. Artés Rodríguez, F. Pérez González y otros,, Comunicaciones Digitales, , Pearson Educación (2007)

Recommendations

Subjects that it is recommended to have taken before

Signal Transmission and Reception Techniques/V05G300V01404
Multimedia Signal Processing/V05G300V01513

IDENTIFYING DATA				
Optical Telecommunication Infrastructures				
Subject	Optical Telecommunication Infrastructures			
Code	V05G300V01614			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish English			
Department				
Coordinator	Curty Alonso, Marcos			
Lecturers	Curty Alonso, Marcos Fraile Peláez, Francisco Javier			
E-mail	mcurty@com.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Firstly, we explain the physical foundations of the optical fibre technology. This includes concepts of electromagnetism in dielectric dispersive materials that may be nonlinear, the theory of the optical reception and noise, and the theory of the optical sources and optical modulators. Then, we describe the different transmission systems that use fibre, and we present optical networks. Special emphasis is made on the analysis and design of these optical systems.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A30	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.

Learning aims		
Subject competences	Typology	Competences
1. To understand the origin and reasons for the use of optical transmission systems.	know	A3
2. To learn the physical foundations of the optical transmission systems and optical information processes. In particular, those concepts that deviate most from the classical technics such as, for instance, the optical generation and photonic detection.	know	A3
3. To know the basic theory of optical devices and optical subsystems like, for example, LEDs and lasers, photodetectors, modulators, fibre amplifiers and optical filters.	know	A3 A5
4. To be able to specify the type of optical fibres and other necessary optoelectronical components that are needed for a certain optical link. Also, to understand their physical and technological limitations.	Know How	A3 A5 A34
5. To be able to develop models for optical links and to evaluate the impact that the different transmission subsystems and transmission formats have on their performance.	Know How	A3 A5 A34
6. To know the foundations, topologies and switching technologies of optical networks, as well as those of the current proposals of FTTH	know	A3 A30

Contents
Topic

1. Introduction to optical communications	1.1. Reasons for the optical transmission 1.2. Digital transmission in multimode fibres
2. Electromagnetism in dielectrics	2.1. Maxwell equations in dielectrics 2.1. Wave equations in dielectrics 2.3. Refraction index and losses 2.4. Dispersion
3. Monochromatic propagation in flat guides	3.1. Solution to the wave equation in flat guides 3.2. Guided modes: TE and TM 3.3. Modal power 3.4. Normalised parameters
4. Monochromatic propagation in step index fibres	4.1. Solution to the wave equation in step index fibres 4.2. Guided modes 4.3. Modal power 4.4. Weakly guiding fibres 4.5. Losses; transmission windows
5. Propagation of pulses in single-mode fibres	5.1. Pulse distortion in optical fibres 5.2. Propagation of gaussian pulses in single-mode fibres 5.3. Propagation of analog signals in single-mode fibres 5.4. Dispersion minimisation in single-mode fibres
6. Detection of the luminous radiation	6.1. Light detection in semiconductors 6.2. p-i-n photodiodes and APDs 6.3. Photonic noise 6.4. Quantum efficiency and equivalent noise power
7. Sources and optical amplifiers	7.1. Photonic emission: basic concepts 7.2. Light emitting diodes (LEDs) 7.3. Semiconductor lasers (LDs) 7.4. External modulation of the laser 7.5. Doped fibre and semiconductor optical amplifiers
8. Digital systems based on intensity modulation	8.1. Basic concepts of digital transmission in fibre 8.2. Digital receiver: a simplified model 8.3. The Photonic (or quantum) limit 8.4. Interference and equalisation in a digital receiver 8.5. The effect of noise
9. Analog systems based on intensity modulation	9.1. Characteristics of the analog transmission, SCM systems 9.2. Signal-noise ratio 9.3. Distortion 9.4. Frequency planning 9.5. Design considerations
10. Introduction to WDM and to optical networks	10.1. Introduction 10.2. WDM systems 10.3. Optical networks 10.4. Basic topologies of optical networks 10.5. FTTH
Laboratory exercise 1. Measuring the numerical aperture of a multimode fibre	Here we will measure the numerical aperture of a multimode fibre
Laboratory exercise 2. Acousto-optic modulator (AOM)	Here we will built a free-space optical link that uses an AOM together with an He-Ne laser.
Laboratory exercise 3. Optical amplifier	Here we will characterise an erbium doped fibre amplifier (EDFA)
Laboratory exercise 4. Fusion splicing.	Fusion splicing of multimode step-index fibre.
Laboratory exercise 5. Digital link based on graded index fibres	Here we will characterise a LED and a FP laser. Also, we will analyse the effects that losses and noise have on a digital link based on graded index fibres
Laboratory exercise 6. Spectral characteristics of optical sources and observation of the chirp	Characterisation of several optical sources with an optical spectrum analyser and observation of the chirp
Laboratory exercise 7. WDM systems	Here we will characterise the performance of WDM systems working at 1310/1550nm

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Master Session	18	27	45
Troubleshooting and / or exercises	0	12	12

Laboratory practises	12	9	21
Projects	6	39	45
Presentations / exhibitions	1	3	4
Short answer tests	2	8	10
Long answer tests and development	2	10	12

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

Methodologies	
	Description
Introductory activities	Presentation of the subject: program, bibliography, educational methodology and assessment system.
Master Session	The professor introduces the main contents of each chapter to the students. Note, however, that these lectures do not cover all the contents of each subject. For that reason, the students have to review the supplementary notes provided in class. It is also expected that the students review the concepts introduced in the classroom and expand on their contents using the guide of each chapter, together with the recommended bibliography, as a reference.
Troubleshooting and / or exercises	The students have to solve problems and/or exercises given by the professor. These exercises are related to the contents presented in the class and can be solved in groups. The exercises have to be handed in to the professor on a given deadline.
Laboratory practises	The lectures include some exercises in the lab involving different optical devices and optical communication systems. The students have to read the lab notes provided by the professor before the lab starts. At the beginning of each exercise the professor might request that the students summarise the main concepts related to the exercise. Any doubt can be solved using the office hours of the professor.
Projects	The students will have to complete several small projects proposed by the professor. These projects require the correct planning, design and realisation of a series of activities and are performed in groups of students. Each project has to be turned over on a given deadline.
Presentations / exhibitions	The students will give a small presentation of the completed projects in front of the professor and possibly other students.

Personalized attention	
	Description
Master Session	The students can use the office hours of the professor to solve doubts related to the subject. The timetable of these office hours will be available at the beginning of the semester and is published on the website of the course. These office hours can be employed to solve doubts related to: 1. The concepts presented in class or included in the syllabus of the course. 2. The exercises performed in the lab. 3. The problems and/or exercises proposed for homework, as well as any other possible problems and/or exercises related to the study of the course. 4. The contents and development of the different projects.
Troubleshooting and / or exercises	The students can use the office hours of the professor to solve doubts related to the subject. The timetable of these office hours will be available at the beginning of the semester and is published on the website of the course. These office hours can be employed to solve doubts related to: 1. The concepts presented in class or included in the syllabus of the course. 2. The exercises performed in the lab. 3. The problems and/or exercises proposed for homework, as well as any other possible problems and/or exercises related to the study of the course. 4. The contents and development of the different projects.

Laboratory practises	The students can use the office hours of the professor to solve doubts related to the subject. The timetable of these office hours will be available at the beginning of the semester and is published on the website of the course. These office hours can be employed to solve doubts related to: 1. The concepts presented in class or included in the syllabus of the course. 2. The exercises performed in the lab. 3. The problems and/or exercises proposed for homework, as well as any other possible problems and/or exercises related to the study of the course. 4. The contents and development of the different projects.
Projects	The students can use the office hours of the professor to solve doubts related to the subject. The timetable of these office hours will be available at the beginning of the semester and is published on the website of the course. These office hours can be employed to solve doubts related to: 1. The concepts presented in class or included in the syllabus of the course. 2. The exercises performed in the lab. 3. The problems and/or exercises proposed for homework, as well as any other possible problems and/or exercises related to the study of the course. 4. The contents and development of the different projects.

Assessment

	Description	Qualification
Troubleshooting and / or exercises	The students will have to solve a series of problems and/or exercises proposed by the professor. The exercises must be completed within a certain timeframe and follow the conditions established by the professor. With this methodology we basically evaluate all the specific learning aims of the subject	8
Projects	The students will have to deliver a report for each of the realised projects. Also, the students shall give a presentation of the results obtained within a certain timeframe and follow the conditions established by the professor. With this methodology we basically evaluate the learning aims A3, A5 and A34	25
Short answer tests	Before the lab starts, the students will perform a test (8% of the final mark) about the contents of the the lab notes. Likewise, when finalising the lab, the students will perform a test (20% of the final mark) about the lab exercises. With this methodology we basically evaluate the learning aims A3 and A5	27
Long answer tests and development	At the end of the semester, the students will perform a final test that covers all the contents of the course. With this methodology we basically evaluate all the specific learning aims of the subject	40

Other comments and second call

Following the guidelines of the degree, we will offer to the students two possible assessment systems: continuous evaluation or final evaluation at the end of the semester.

Each student has to decide on one of these two options by the third week of the semester.

Continuous evaluation:

The continuous evaluation comprises a series of tasks that the student has to realise along the semester (60%), together with a long answer test (40%) that he/she performs at the end of the semester. These tasks include the resolution of several problems and/or exercises (8%), the completion of two short answer tests about the lab (27%), and the realisation of several projects (25%). In particular, there are two bulletins of exercises (which are given to the students during the sixth and the ninth week of the course). These exercises have to solved in groups and should be delivered to the professor during the ninth and twelfth weeks of the course, respectively. The two short answer tests about the lab are scheduled for weeks eight and sixteen of the course. Finally, the projects have to be presented on the twelfth, fourteenth and sixteenth weeks, respectively, of the course. All these tasks may not be retaken at another point in time. That is to say, if a student cannot fulfill them within the time stipulated by the professor, there is no possibility to fulfil them afterwards. Also, they are only valid for the present academic year.

Those students who decide to opt for a continuous evaluation will have to fulfill these conditions in order to pass the course: (a) perform at least 6 out of the 7 lab exercises; (b) obtain, at least, 10 points out of 25 in the projects; (c) obtain, at least, 16 points out of 40 in the long answer test; and (d) obtain a minimum of 50 points in total (i.e., taking all the activities into account). The final mark of those students who do not fulfill these minimum requirements will be calculated as follows. It will be the minimum between: (i) the total number of points obtained by the student in all the activities of the course, and (ii) 40 points. That is to say, the maximum mark obtainable for these students is 40 points.

The choice of a continuous evaluation necessarily implies that the student is counted as present at the final evaluation, independently of whether or not the student has performed the long answer test.

Evaluation at the end of the semester:

In addition to the system of continuous evaluation described above, the student can opt for a final examination only. This final evaluation covers all the contents of the subject. The professor may demand the student to deliver some additional tasks, which will be notified by the seventh week of the course. These tasks have to be delivered on the day of the final examination. To pass the course the student will have to obtain, at least, 50 points out of 100 in the final exam together with the additional tasks.

Evaluation in July:

Those students who opted for a continuous evaluation and fulfill the requirements of (a) and (b) above, will be able, if they so wish, to keep the mark obtained in the tasks performed during the continuous evaluation (60%). In such a case, they will only take a long answer test (40%). To pass the course, these students will have to obtain, at least, 16 points out of 40 in the long answer test, and obtain a minimum of 50 points in total.

Alternatively, these students can also opt for a final examination only, which covers all the contents of the course. In this case, the students will have to inform the professor one month prior to the final exam. Otherwise, it will be understood that the student opts for continuous evaluation.

The rest of students (i.e., those that opted for a system of continuous evaluation and do not fulfil the requirements of (a) and (b) above, and those students that opted for a final exam only) will be evaluated by a final exam only, which covers all the contents of the course.

In the case of choosing a final exam only, the professor may demand the student to deliver some additional tasks, which will be notified by the seventh week of the course. These tasks have to be delivered at the day of the final examination. To pass the course the student will have to obtain, at least, 50 points out of 100 in the final exam together with the additional tasks.

Sources of information

There is no single book that covers all the contents of this subject. The bibliography below is only recommended. The class notes and the additional material given during the course constitutes the exact guide for this subject.

Additional bibliography:

1.**Â** J. Capmany, F. J. Fraile Peláez and J. Martí, Fundamentos de Comunicaciones Ópticas. Ed. Síntesis, Madrid (2001), 2nd Edition. (See also http://www.com.uvigo.es/~jfraile/erratas.pdf)

2. G. P. Agrawal, Fiber-Optic Communication Systems. Wiley-Interscience (2002), 3rd Edition.

3. J. Capmany, F. J. Fraile Peláez and J. Martí, Dispositivos de Comunicaciones Ópticas. Ed. Síntesis, Madrid (1999).

4. G. Keiser, Optical Fiber Communications. McGraw-Hill (1991), 2nd Edition.

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204
Electromagnetic Transmission/V05G300V01303

IDENTIFYING DATA				
Wireless Systems and Networks				
Subject	Wireless Systems and Networks			
Code	V05G300V01615			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Pérez Fontán, Fernando			
Lecturers	Pérez Fontán, Fernando			
E-mail	fpfontan@tsc.uvigo.es			
Web	http://http://faitic.uvigo.es/			
General description	(*)(*) A general overview of current wireless communications systems will be provided including standards and dimensioning issues.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A30	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
A31	CE22/ST2 The ability of applying the basic techniques of telecommunication networks, services and applications for mobile and fixed environments, personal, local or long distance, with different bandwidth, including telephony, radio broadcasting, TV and data, from the point of view of transmission systems.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.

Learning aims		
Subject competences	Typology	Competences
(*) To build, operate and manage telecommunication networks, services, processes and applications from the a transmission systems point of view	Know How	A1 A30
(*) To apply techniques based on telecommunications networks, services and applications for fixed, mobile, personal, local or long range scenarios with different bandwidths, including telephony, broadcasting and data from a transmission systems point of view. - Cellular and wireless network specifications. - Provide access solutions to communications systems. - Develop roll-out models which minimize the social and environemntal impact of the radio communication networks, understanding the ethic and moral resposabilities involved in such work.	Know How	A4 A31

(*) Selection of antennas, equipment and transmission systems, guided and radiated wave propagation, spectrum management and frequency assignment. - To apply previously acquired knowledge on wave propagation for the planning of radio networks. - To specify the various elements (antennas, transmitters and receivers) which make up a global system.	Know How	A7 A34

Contents

Topic	
Theory 1. Introduction to radiocommunications	Basic concepts Current situation Wireless LANs Personal networks.
Theory 2. Cellular systems	Fundamental concepts The radio propagation channel Multiple access techniques Interferencr Traffic theory Network sizing up Countermeasures Medium access control. Security and access control. Network management. Mobility management. Quality of service.
Theory 3. Review of cellular and wirelss lan standards and other proposals	2nd generation systems Evolution of 2G systems 3rd generation systems Beyond 3G WLAN systems Other systems and proposals Cognitive access Femtocells.
Lab 1. Statistical analysis of simulated and/or measured time-series	Analysis of simulated and/or experimental time-series
Lab 2. Introduction to multipath effects	Reproducing multipath fading Doppler effect Narrow and wideband channel
Lab 3. Introduction of blockage/shdowing effects	Simulation of the shadowing effect Call handover Interference

Planning

	Class hours	Hours outside the classroom	Total hours
Tutored works	7	14	21
Troubleshooting and / or exercises	6	18	24
Practice in computer rooms	14	28	42
Master Session	13	26	39
Short answer tests	1	0	1
Reports / memories of practice	0	8	8
Troubleshooting and / or exercises	1	0	1
Jobs and projects	0	14	14

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

Methodologies

	Description
Tutored works	Simulation work to be carried out in Matlab language will be proposed to C class gropus where they will go deeper into specific issues discussed in less detail in the theoretical classes.
Troubleshooting and / or exercises	The theoretical treatment of the various topics studied in theoretical classes will be complemented by performing numerical calculations relative to radio network dimensioning
Practice in computer rooms	In laboratory sessions (type B) various Matlab simulations will be proposed to the students in order to study specific topics which are more suitably aproached this way.

Master Session	In classroom lectures the more theoretical issues will be presented

Personalized attention

	Description
Master Session	The student can individually ask for clarifications on the various topics relative to this lecture (theory, problems, lab and turored work) during tutoring hours
Tutored works	The student can individually ask for clarifications on the various topics relative to this lecture (theory, problems, lab and turored work) during tutoring hours
Troubleshooting and / or exercises	The student can individually ask for clarifications on the various topics relative to this lecture (theory, problems, lab and turored work) during tutoring hours
Practice in computer rooms	The student can individually ask for clarifications on the various topics relative to this lecture (theory, problems, lab and turored work) during tutoring hours

Assessment

	Description	Qualification
Short answer tests	Adequate kowledge of the theoretical materials of the lecture will be assessed by means of short response questions during the final exam.	25
Reports / memories of practice	For each lab assignment, the studens in pairs, will present a written report and will respong to oral questions on the work carried out.	25
Troubleshooting and / or exercises	In the final exam, there will be a part containing various short numerical problems.	25
Jobs and projects	The evaluation of supervised group work (C classes) will be carried out through an oral presentation, a report and oral questions during the presentation.	25

Other comments and second call

If possible all skills pertaining to this subject will be evaluated in all the various tests and exercises proposed: short answer tests, lab reports, problem solving and projects

For those who choose to take the final examan (alternatively to continuous assessment), this will have a weight of 100% of the final grades and will cover all issues dealt with in the theoretical lectures, the problem solving lectures, tutored group work and laboratory.

Above the precedure for carrying out the continouos assesment was presented. The final grades will be the result of four equal weight parts, namely

- a theoretical test consisting of short questions (25%) to take place during the final exam,

- a problem solving test consisting of short numerical calculations (25%) to take place during the final exam,

- the completion of the laboratory work and corresponding reports (25%) and

- the completion of the proposed tutored group work, its corresponding report and oral presentation (25%)

The grades for the lab. work and group work will only be valid during the current school year.

Those students who choose the continuous assessment option shall inform the professor of this during the first few weeks of the school term. The continuous assessment option entails the completion of all activities proposed: lab works and group work, and taking all tests comprising the continuous assessment route. Those students not fulfilling the above will be assessed with the final exam only.

A student will be atributed the "no presentado" grade if he or she has not followed the full continuous assessment route and has not taken the final exam.

For the retake call (July), the grades obtained in the lab work and group work parts will be kept for those students following the continous assessment route and will only be required to take the theory and problems part of the new final exam. However, he or she can also opt for taking the full final exam.

Sources of information

José María Hernando Rábanos, Comunicaciones Móviles. 2ª ed., Ed. Centro de Estudios Ramón Areces, S.A., 2004

Fernando Pérez Fontán, Sigfredo Pagel Lindow, Introducción a las. Comunicaciones Móviles, Servicio de Publicaciones. Universidad de Vigo, 1997

José María Hernando Rábanos, Comunicaciones Móviles de Tercera Generación, Telefónica Móviles, 2000

Simon R. Saunders, Antennas and Propagation for Wireless Communications Systems, Wiley, 1999

José María Hernando Rábanos, Fernando Pérez Fontán, Introduction to Mobile Communications Engineering, Artech House, 1999

F.Pérez-Fontán and P.Mariño Espiñeira, Modeling of the wireless propagation channel. A simulation approach with Matlab, Wiley, 2008

Ramón Agustí Comés, LTE: nuevas tendencias en comunicaciones móviles , Fundación Vodafone, 2010

Recommendations

Subjects that it is recommended to have taken before

Physics: Fields and Waves/V05G300V01202
Mathematics: Probability and Statistics/V05G300V01204
Fundamentals of Sound and Image/V05G300V01405
Signal Transmission and Reception Techniques/V05G300V01404
Electromagnetic Transmission/V05G300V01303
Radio Frequency Circuits/V05G300V01511
Radio Communication Systems/V05G300V01512

IDENTIFYING DATA				
Electronic Instrumentation and Sensors				
Subject	Electronic Instrumentation and Sensors			
Code	V05G300V01621			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish Galician			
Department				
Coordinator	Mariño Espiñeira, Perfecto			
Lecturers	Costas Pérez, Lucía Mariño Espiñeira, Perfecto Pastoriza Santos, Vicente			
E-mail	pmarino@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main purpose of the subject is to provide the theoretical and practical skills for the design and characterization of electronic instrumentation systems, and the range of sensors which provide analogical and digital signal in the input stage of said instrumentation systems. Course outline: + Analysis of sensor parameters. + Basic concepts about the physical principles of the sensors. + The most important application of sensors in electronic instrumentation. + Electronic instrumentation architectures, from the simplest point to point systems to the most complex distributed systems. International standards for electronic instrumentation are presented. + Design of programmable instrumentation: GPIB, VXI and PXI buses. + Classification of architectures for electronic instrumentation. Introduction of wired and wireless field buses. The main goal of the laboratory sessions (practical work) is to enable the students to acquire sufficient understanding and knowledge to: +Analyze the parameters and main features of the sensors integrated in the electronic instrumentation systems. + Know the applications of each group of sensors. + Manage specific software tools to design (virtual) instruments that allow store, display and analyze recorded data. + Use specific software tools to work with buses of instrumentation programmable. The documentation of the course will be in Spanish. It will be taught and assessed in Spanish.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A55	(CE46/SE8): The ability to specify and use electronic instrumentation and measurement systems.

Learning aims		
Subject competences	Typology	Competences
Comprehension and command of basic concepts about the physical principles of the sensors.	know	A3 A55
Comprehension and command of basic concepts about the features and operating modes of the sensors.	know	A3 A55

Comprehension and command of the signal conditioning settings in sensors and application examples, which form the input stage of the electronic instrumentation systems.	Know How	A4 A5 A55
Comprehension and command of basic concepts about the architectures for programmable instrumentation and the standards on programmable instrumentation.	know	A3 A55
The knowledge of development tools for programmable instrumentation systems	Know How	A4 A5
To ability to use development tools to design programmable instrumentation systems connected to wired or wireless field bus.	Know How	A4 A5

Contents

Topic	
Unit 1: Introduction to sensors.	Energy conversions. Concepts of sensor, transducer and actuator. Dynamic and static features. Other features. Selection of sensors. Conditioning. Application examples on ICT.
Unit 2: Temperature resistive sensors. Strain gauges.	Temperature resistive sensors: General features. Types. Conditioning . Application examples. Strain gauges: Basic principles. General features. Types of using. Conditioning . Application examples.
Unit 3: Photoresistive and Optoelectronic. Other resistive sensors.	Photoresistive and Optoelectronic: Basic principles. General features. Encoders. Conditioning. Application examples. Other resistive sensors: Gas sensors. Magnetoresistors. Potentiometers. Basic principles. General features. Conditioning . Application examples.
Unit 4: Capacitive sensors. Inductive and magnetic sensors.	Capacitive sensors: Introduction. Measurements principles. Features. Conditioning . Proximity sensors. Application examples . Inductive and magnetic sensors: Introduction. Basic principles. Variable transformer types. Features. Conditioning. Hall effect sensors. Application examples.
Unit 5: Pyrometric sensors and Infrared thermography. Thermocouples. Other sensors.	Pyrometric sensors and infrared thermography: Basic principles . General features . Conditioning. Application examples. Thermocouples: Basic principles. General features. Calibration scales. Conditioning. Application examples Other sensors: Pyroelectric. Ultrasounds. Magnetostrictive. Radar level detection. Biosensors. Chemical sensors. High energy and nuclear sensors.
Unit 6: Programmable instrumentation.	Historical events in electronic instrumentation: Evolution of instrumentation. Instrumentation systems. Definitions. Current needs and future trends. Programmable instrumentation. Switched instrumentation. Hybrid systems on instrumentation. GPIB bus: General features. Configurations and equipment. Standards IEEE 488.1/488.2. Transference procedures. Standard HS488. Command groups. Basic functions. Integrated circuits. Controllers on cards. SCPI Standard. Design environments for ATE systems.
Unit 7: Standard multiprocessor buses.	Systems on cards. Applications of standard buses. Classification. Types of connectors and cards. Multiprocessor systems. Common memory multiprocessor systems. Multiplexing. Bus arbiters. Arbiter techniques. Asynchronous bus concept. Addressing. Data transfer. Interrupts. Electrical design of high speed buses. ECL and TTL signals. Backplane features. Drivers, receivers and transceivers. International standards.
Unit 8: The VME bus.	Introduction . Functional modules. Subbuses and signals. Data transfer. Types of arbitration. System controller. The interrupt chain. Commercial products.
Unit 9: Standards on programmable instrumentation.	Introduction to VXI and PXI buses. Subbuses and signals. Configurations. Types of devices. Products and systems of development. PCI Express and the switched instrumentation. Ethernet and its LXI version for instrumentation. The AXIEe for high features.
Unit 10: Field bus architectures for sensors.	General features. Classification. Practical examples: PROFIBUS and CAN. Intelligent Transportation Systems (ITS). Embedded buses for automotive applications: LIN, MOST, FLEXRAY, JSAE 1939 and others. Standard IEEE 1451 for intelligent sensors. Development tools.
Unit 11:Wireless networks for sensors.	The ISM bands. Basic features of wireless networks. Multiplexing and modulation. The SDR concept. Standards for WLAN and WPAN. IEEE standards 802.15.1/4/3. Wireless sensor networks (WSNs). Other commercial networks.

Practice 1: Introduction to the LabVIEW Application Development Environment	Introduction to LabVIEW environment by means of basic examples of programming.
Practice 2: Temperature sensors. NTC thermistor.	Signal conditioning and virtual instrument development for measurement
Practice 3: Optoelectronic sensors. PIN photodiode.	Spectral response analysis.
Practice 4: Capacitive sensors. Accelerometer.	Signal analysis and post-processing, and virtual instrument developing for tilt measurement.
Practice 5: Programmable Instrumentation I.	Frequency response test of two RC circuits via the programmable control of the laboratory instrumentation. The programmable control will realise through a USB connection from the PC to each instrument.
Practice 6: Programmable Instrumentation II.	To develop an application that verify the frequency response of a RC circuit by means of the programmable control of some of the instruments situated in a VXI chassis. The programmable control of each instrument from the PC will realise through a LAN connection and using a GPIB -Ethernet gateway .

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	2	4
Master Session	16	23	39
Laboratory practises	14	12	26
Tutored works	7	28	35
Multiple choice tests	3	43	46

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

Methodologies

	Description
Introductory activities	Subject presentation. Presentation of laboratory sessions, instrumentation and software resources to be used. In these sessions, the skills A3, A4, A5, and A55 will be worked.
Master Session	The lecturer will explain in the classroom the main contents of the subject. The students have to manage the proposed bibliography to carry out a self-study process in a way that leads to acquire the knowledge and the skills related to the subject. The lecturer will answer the students' questions in the classroom or at the office. In these sessions, the skills A3, A4, A5, and A55 will be worked.
Laboratory practises	Activities designed to apply the main concepts and definitions of the subject. The student will be asked to acquire the basic skills to manage the laboratory instrumentation, software tools and components in order to construct and test electronic circuits. The student has to develop and demonstrate autonomous learning and collaborative skills. He/she is supposed to be able to manage bibliography and recently acquired knowledge. Possible questions can be answered in the laboratory sessions or at the lecturer's office. In these practises, the skills A3, A4, A5, and A55 will be worked.
Tutored works	The students have to manage basic concepts to search and select information in order to get a deeper understanding in some specific fields related to the subject. This is a group activity. The lecturer will propose in the classroom the topic of this group task and monitor the student's work in personalized attention sessions. In these sessions, the skills A3, A4, A5, and A55 will be worked.

Personalized attention

	Description

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

Assessment

	Description	Qualification
Laboratory practises	The lecturers will check the level of compliance of the students with the goals related to the laboratory skills. They will consider the work of the students carried out before the laboratory session to prepare the proposed tasks and the work in the laboratory. Marks for each session (LSM: Laboratory Session Mark) will be assigned in a 10 points scale. Final mark of laboratory, FML, will be assessed in a 10 points scale. In these practices, the skills A3, A4, A5, and A55 will be assessed.	35
Tutored works	The lecturers will consider the results, the analysis and the quality of the final report, and the classroom presentation. Marks will be assigned in a 10 points scale. In these works, the skills A3, A4, A5, and A55 will be evaluated.	15
Multiple choice tests	The lecturers will check the level of compliance of the students with the goals related to the theory skills. Marks for each test will be assessed in a 10 points scale. Final mark of theory, FMT, will be assessed in a 10 points scale. In these tests, the skills A3, A4, A5, and A55 will be evaluated.	50

Other comments and second call

1. Continuous assessment

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

When the students perform a short answer test or attend at least two laboratory sessions, ***they will be assessed by continuous assessment***.

The subject comprises three different parts: theory (50 %), laboratory (35%) and tutored work (15%). Once a task has been assessed, the students can not do/repeat the task at a later date. The marks are valid only for the current academic course.

1.a Theory

Two theory exams are scheduled. The first exam (SAT1) will be performed after unit 5, in the usual weekly scheduling of the theoretical classes. The second exam (SAT2) will be performed during the examination period in the date specified in the academic calendar.The students cannot do the exams at a later date.

Each theory exam will be comprised short answer tests and long answer development. Marks for each exam will be assessed in a 10 points scale. The student who miss a exam will be assessed with a mark of 0 for that exam. The final mark of theory (FMT) is calculated as the arithmetic mean of the individual marks:

FMT = (SAT1 + SAT2)/2

The minimum mark required to pass this part is of 5 for each test (SATi>=5). If the minimum mark in the first test is not achieved (SAT1 less than 5), the students can repeat this part in the same date of the second exam.

1.b Laboratory

Seven laboratory sessions are scheduled. Each session lasts approximately 120 minutes and the students will work in pairs. This part also will be assessed by continuous assessment. Each session will be only evaluated according to the developed work at the schedule date. The lecturers will consider the work of the students carried out before the laboratory session to prepare the proposed tasks, the work in the laboratory to deal with them as well as the student’s behavior. Marks for each laboratory session (LSM) will be assessed in a 10 points scale. A mark of 0 will be obtained for missing sessions. The final mark of laboratory (FML) is calculated as the arithmetic mean of the individual laboratory session marks:

FML = (LSM1 + LSM2 + LSM3 + LSM4+ LSM5 + LSM6 + LSM7)/7

In order to pass the laboratory part the students can not miss more than two laboratory sessions and the minimum mark requiredÂ is of 5 (FML>=5).

1.c Tutored work

In the first session of C hours, lecturers will present the objectives and the schedule of the work. They also assign a specific work to each group. After that, the most important part of the workload will be developed at home.

In order to assess the work, the lecturer will consider the results, their analysis, the quality of the written report and the classroom presentation. Mark for the classroom presentation (CPM) and the written report (WRM) will be assessed in a 10 points scale. The final mark of this part, tutored work mark (TWM), is calculated as the following weighted average:

TWM = 0,3*CPM + 0,7*WRM

The minimum mark required to pass this part is of 5 (TWM>=5). The students are only allowed to miss one tutored work session.

1.d Final mark of the subject

The weighted points from all assessed parts are added together to calculate the final mark (FM). The following weightings will be applied: 50% theory (FMT), 35% laboratory (FML) and 15% tutored work (TWM). In order to pass the subject, students will be require to pass the theory, laboratory and group project parts. In this case the final mark (FM) will be:

FM = (0.5·FMT + 0.3·FML + 0.15 TWM)

However, when the students do not pass all parts (FMT, or FML, or TWM less than 5) or do not reach the minimum mark of 5 required to pass each short answer test or miss more than 2 laboratory sessions or miss more than 1 tutored work sessions, the final mark will be the minimum value among them:

FM = min{ FMT, ·FML, TWM }

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

2. Final Exam

The students who prefer a different educational policy can attend an exam on a scheduled date. This exam will comprise three parts (similar to the activities completed by the continuously assessed students): theory exam, laboratory exam and tutored work.

The theory exam will be comprised two exams (SAT) each one with short answer tests and long answer development. Marks for each test will be assessed in a 10 points scale. will be assessed in a 10 points scale. The final mark of theory (FMT) is calculated as the arithmetic mean of the individual marks:

FMT = (SAT1 + SAT2)/2

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

The laboratory exam will be assessed in a 10 points scale. The minimum mark required to pass this part is of 5 (FMT>=5).

The tutored workt will be assessed in a 10 points scale. The project will be assigned following the procedure described in advance by the lecturer. The student will prepare a written report to be handed in just before the exam. The final project must be presented within one week of delivery of reports. In order to assess the work, the lecturer will consider the results, their analysis,Â the quality of the written report and the presentation. Mark for the classroom presentation (CPM) and the written report (WRM) will be assessed in a 10 points scale. The final mark of this part, tutored work mark (TWM), is calculated as the following weighted average:

TWM = 0,3*CPM + 0,7*WRM

The minimum mark required to pass this part is of 4 (TWM>=5).

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

FM = (0.5·FMT + 0.35·FML + 0.15 TWM)

However, when the students do not reach the minimum mark required (FMT, or FML, or TWM less than 5), the final mark will be the minimum value among them:

FM = min{ FMT, ·FML, TWM }

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

3. Second opportunity to pass the subject

The assessment policy in this call will follow the scheme described in the previous section. Dates will be specified in the academic calendar. This exam consist on a theory exam, a laboratory exam and a tutored workt. In order to attend the laboratory exam and to assign the tutored work, the students have to contact to the lecturer according to an established procedure. The procedure will be published in advance.

The marks obtained in the previous continuous assessment or final exam are kept for those parts in which the student has not attended. The final mark will be calculated as it has described in section 2.

Sources of information
Black, J. (editor), The system engineering handbook: a guide to building VME bus and VXI bus Systems, , Academic Press, 1992
Mariño, P., Las comunicaciones en la empresa: normas, redes y servicios, 2ª Ed., RAMA, 2002
Norton, H., Sensores y analizadores, , Gustavo Gili, 1984
Pérez García, M.A., Álvarez Antón, J.C., Campo Rodríguez, J.C., Ferrero Martín, F.J., y Grillo Orteg, Instrumentación Electrónica, , Thomson, 2004
del Río Fernández, J., Shariat-Panahi, S., Sarriá Gandul, S., y Lázaro, A.M., LabVIEW: Programación para Sistemas de Instrumentación, , Editorial Garceta, 2011

Recommendations

Subjects that are recommended to be taken simultaneously

Programmable Electronic Circuits/V05G300V01502
Analogue Electronics/V05G300V01624
Data Acquisition Systems/V05G300V01521

Subjects that it is recommended to have taken before

Digital Electronics/V05G300V01402
Electronic Technology/V05G300V01401

IDENTIFYING DATA				
Microelectronics Design				
Subject	Microelectronics Design			
Code	V05G300V01622			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Rodríguez Andina, Juan José			
Lecturers	Rodríguez Andina, Juan José Rodríguez Pardo, María Loreto			
E-mail	jjrdguez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main purposes of this course are for the students: 1) To get acquainted with integrated circuits (ICs) and micro-electro-mechanical systems (MEMs) fabrication technologies. 2) To get acquainted with CMOS fabrication processes for ICs and MEMs. 3) To analyze the physical structure of passive components and active devices in CMOS technology. 4) To get acquainted with the basic aspects of MEMs design. 5) To work with CAD tools for the design.of CMOS ICs			

Competencies	
Code	
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A51	(CE42/SE4): The ability to apply electronics as support technology in other fields and activities and not only in information and communication technologies.
A52	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Subject competences	Typology	Competences
To know and understand integrated circuits (ICs) and micro-electro-mechanical systems (MEMs) fabrication technologies.	know	A51
To know and understand CMOS fabrication processes for ICs and MEMs, as well as the corresponding design methodologies and the steps in the development of an IC.	know Know How	A52
To know and be capable of analizing the physical structure of resistors, capacitors, and transistors in CMOS technology.	Know How	A52
To know and understand the basic aspects of MEMs design and their basic structures	know	A51
To be capable of working with CAD tools for the design of CMOS ICs	Know How Know be	A9 B4

Contents	
Topic	
Chapter 1: Introduction (1h)	Course introduction. Purposes and planning of the course. Basic concepts in the design of integrated circuits (ICs) and micro-electro-mechanical systems (MEMs).
Chapter 2: Fabrication steps for ICs and MEMs (2h)	Introduction to ICs and MEMs fabrication. Planar technology. Micromachining and micromolding technologies. CMOS IC fabrication steps. Structure of MOS transistors. Fabrication example: CMOS inverter. Layout. MEMs fabrication steps: bulk micromachining, surface micromachining, and LIGA.

Chapter 3. ICs and MEMs fabrication processes (3h)	Silicon wafers. Epitaxial layers. Dielectric layers. Oxidation. Deposition. Semiconductor layers. Dopant diffusion. Ion implantation. Photolithography. Etching. Metalization.
Chapter 4. CMOS process parameters (3h).	MOS transistors: analytical model. Higher-order effects. Spice model. Technology file. Parameters of a sample CMOS process.
Chapter 5. Physical structure of basic elements (2h)	Specification of the physical structure of a MOS transistor. Specification of the physical structure of a resistor. Specification of the physical structure of a capacitor. Types of physical specifications. Influence of physical design in the behavior of a device. Design rules. Design methodologies and tools.
Chapter 6. Resistor layout strategies (1h)	Lateral diffusion. Effective geometric dimensions. Influence of the terminals. Long resistors. Unit resistors. Stacked resistors. Neighborhood effects. Dummies. Interdigited and common centroid structures.
Chapter 7. Capacitor layout strategies (1h)	Oxide thickness gradient, lateral diffusion, and neighborhood effects. Area and perimeter unit capacitances.
Chapter 8. Transistor layout strategies (2h)	Transistor with high aspect ratio. Stacked transistors. Interdigited structures.
Chapter 9. Physical design case studies (3h)	Basic current mirror. Self-biased differential amplifier.
Lab assignment 1. Introduction to IC design tools (3h)	Basic layout elements. Design Rule Check (DRC). Extraction. Basic layout elements from libraries.
Lab assignment 2. MOS transistors (3h)	Layout of pMOS and nMOS transistors. Transistors from libraries. Snake, stacked, and interdigited structures. Dummy definition layers.
Lab assignment 3. Passive components (2h)	Layouts of resistors and capacitors. Resistors and capacitors from libraries. Linear, snake, stacked and interdigited structures.
Lab assignment 4. CMOS inverter (1h)	Schematic and layout of a CMOS inverter. Layout Versus Schematic (LVS). Layout extraction. Post-layout simulation.
Lab assignment 5. Current mirror (2h)	Schematic and layout of a basic curent mirror with resistive load and ideal input current source. LVS. Layout extraction.
Lab assignment 6. Differential amplifier (2h)	Schematic and layout of a self-biased pMOS differential amplifier. LVS. Layout extraction.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	18	45	63
Practice in computer rooms	13	19.5	32.5
Projects	6	27	33
Presentations / exhibitions	1	2.5	3.5
Short answer tests	1	3.5	4.5
Troubleshooting and / or exercises	2	7	9
Practical tests, real task execution and / or simulated.	1	3.5	4.5

*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	The professor will present the relevant concepts of the course. Before each lecture, students must carry out a preparatory analysis of the topics to be addressed, aiming at their active participation. Practical examples and case studies will be developed and analyzed. Attendance will be recorded. Competencias A51 and A52 will be addressed in these sessions
Practice in computer rooms	Students will work in groups of two people, using IC CAD tools. All relevant steps in the physical design of an IC will be practically studied. Attendance will be recorded, and performance of each group in each lab assignment will be evaluated. Competencies A52 and B4 will be addressed in these sessions
Projects	Students will work in small teams (C-type groups) in the physical design and characterization of a circuit consisting of active devices and passive components, under the close guidance of professors. Attendance will be recorded. The activities to be developed by each team are: - Analysis of possible solutions and design alternatives. - Critical analysis of the design process developed. - Demonstration of the circuits designed in the project. - Preparation of a report where results are presented, analyzed, and discussed. Competencies A9, A52, and B4 will be addressed in these sessions.

Presentations / exhibitions	Each group of students will publicly present their project to professors and the other students in the group. Anyone in the audience will be allowed to ask questions about the project. Competencies A9 and A52 will be addressed in these sessions.

Personalized attention	
	Description
Master Session	Professors will personally assist students with doubts and questions they may have about either theoretical contents or lab assignments, as well as in the development of the projects and the preparation of the public presentations. Office hours will be scheduled for both individual and group sessions.
Practice in computer rooms	Professors will personally assist students with doubts and questions they may have about either theoretical contents or lab assignments, as well as in the development of the projects and the preparation of the public presentations. Office hours will be scheduled for both individual and group sessions.
Projects	Professors will personally assist students with doubts and questions they may have about either theoretical contents or lab assignments, as well as in the development of the projects and the preparation of the public presentations. Office hours will be scheduled for both individual and group sessions.
Presentations / exhibitions	Professors will personally assist students with doubts and questions they may have about either theoretical contents or lab assignments, as well as in the development of the projects and the preparation of the public presentations. Office hours will be scheduled for both individual and group sessions.

Assessment		
	Description	Qualification
Projects	Each group of students must deliver a detailed written report about the project they developed. Contributions from each team member must be clearly stated and identified. The methodology used for task distribution and coordination within the group must also be clearly explained. Evaluation will be based on: - Analysis of design alternatives - Design correctness - Layout compaction - Use of adequate layout strategies to minimize the effect of process variations and to assure good matching wherever required. - Formal issues: structure, clarity, conciseness, and completeness of the report. Use of suitable figures and discussion of significant data. Reports are due two days before the public presentation of the work. To pass the course, the group the student belongs to must achieve in the report a mark of 5 or higher in a 0-10 scale. Competencies A9, A52, and B4 will be assessed in these projects	15
Presentations / exhibitions	Each student must provide an individual 5-minute public presentation of the part of the project he/she carried out (including planning / coordination tasks, if applicable). Presentations will be scheduled in the last (1-hour) classroom session of the corresponding group. At the end of each presentation, the student must give suitable replies to questions from the audience, which will consist of professors and the other students in the group, who must attend the whole session. Evaluation will be based on the content, formal issues, and deliverance of the presentation, as well as on the way the student replies to que questions from the audience. Students asking relevant questions will get additional score for them. To pass the course, the student must achieve in his/her presentation (plus additional score if applicable) a mark of 5 or higher in a 0-10 scale. Competencies A9 and A52 will be assessed in these presentations	15

Short answer tests	An intermediate continuous evaluation written short answer 1-hour test will be held during one of the classroom sessions. This test is the last chance for students to decide whether or not they opt for continuous evaluation. All students completing the test implicitly choose to follow continuous evaluation. The remaining students have to explicitly declare their choice. The lack of declaration from a student means he/she will not follow continuous evaluation. Another test (covering the same course contents, and with the same duration and evaluation criteria) will be held in the date of the final exam. It is compulsory for students not in continuous evaluation. Students in continuous evaluation can also voluntarily complete it. In that case, the score they will receive in this part of the course evaluation will be the one achieved in this second test. To pass the course, students must achieve in this part a mark or 4 or higher in a 0-10 scale. Competencies A51 and A52 will be assessed in these tests	20
Troubleshooting and / or exercises	A 2-hour written test where students have to solve a design problem will be held in the date of the final exam. It is compulsory for all students, being or not in continuous evaluation. To pass the course, students must achieve in this part a mark or 4 or higher in a 0-10 scale. Competency A52 will be assessed in this test	30
Practical tests, real task execution and / or simulated.	A continuous evaluation 1-hour lab test using an IC CAD tool will be held in the last scheduled lab session. Another similar test will be held in the date of the final exam. It is compulsory for students not in continuous evaluation. Students in continuous evaluation can also voluntarily complete it. In that case, the score they will receive in this part of the course evaluation will be the one achieved in this second test. To pass the course, students must achieve in this part a mark or 4 or higher in a 0-10 scale. Competencies A52 and B4 will be assessed in these tests	20

Other comments and second call

In order to pass the course, students must achieve a global mark of 5 or higher in a 0-10 scale. The global mark will be obtained as the weighted summation of the scores obtained in the different parts of the course. A minimum score is required in each of these parts. For students not achieving the minimum score in any of the parts, the global mark will be the lower value between 4 and the weighted summation of scores.

Students not in continuous evaluation will be evaluated as follows:
- The final written short answer test will account for 20% of the global mark.
- The final written design problem test will account for 30% of the global mark.
- The final lab test will account for 20% of the global mark.
- They must develop a project, and deliver the corresponding report and public presentation (in the same sessions and with the same criteria as students in continuous evaluation). Reports are due two days before the public presentation. The report and the public presentation will account for 15% of the global mark each.

Minimum scores in the different parts for students not in continuous evaluation are the same as for students in continuous evaluation.

Students not passing the course in the first call will have the opportunity to attend a second call. Requirements to pass the course will be the same as in the first call. In the second call, students must complete the two written tests and the lab test. No new projects and presentations will be allowed except for students not having achieved the minimum required scores on them. Project reports are due seven days before the date of the test.

Sources of information

José Antonio Rubio Solà, Diseño de circuitos y sistemas integrados, , Universidad Politécnica de Cataluña (2003)

Stephen A. Campbell, Fabrication Engineering at the Micro-and Nanoscale, 3ª, Oxford University Press (2008)

J. Franca, Y. Tsividis (eds.), Design of analog VLSI circuits for telecommunications and signal processing, , Prentice Hall (1994)

Recommendations

Subjects that are recommended to be taken simultaneously

Subjects that it is recommended to have taken before

Digital Electronics/V05G300V01402
Physics: Fundamentals of Electronics/V05G300V01305
Electronic Technology/V05G300V01401

Other comments

All conclusions achieved both in the written tests and in the projects must be adequately justified. Non-trivial concepts cannot be assumed but they have to be explained. The methodologies used by the student will be taken into account in the computation of his/her marks. No auxiliary resources, including but not limited to documentation, can be used in the written tests.

IDENTIFYING DATA				
Electronic Systems for Digital Communications				
Subject	Electronic Systems for Digital Communications			
Code	V05G300V01623			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Machado Domínguez, Fernando			
Lecturers	Machado Domínguez, Fernando Pastoriza Santos, Vicente Poza González, Francisco			
E-mail	fmachado@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The overall objective of this course is to provide the theoretical and practical skills for the analysis and design of electronic systems for digital communications. To achieve this, several wire and wireless communication standards will be reviewed and the basic architectures of digital communication systems, the design of the electronic circuits that compose these systems and their functionality will be studied.			

Competencies	
Code	
A49	(CE40/SE2): The ability to select electronic circuits and devices specialized in transmission, forwarding or routing, and terminals for fixed and mobile environments.

Learning aims		
Subject competences	Typology	Competences
Knowledge of transmission-reception principles and general considerations on the transmission-reception circuits (transceivers).	know	A49
Knowledge of the basic digital communication systems architecture and the functional design of these systems.	know	A49
Ability to design different basic subcircuits that compose the transmision-reception circuits of a digital communication system.	Know How	A49
Ability to select circuits and electronic devices specialised for fixed and mobile digital communications.	Know How	A49

Contents	
Topic	
Unit 1. Introduction	Introduction and review of the basic concepts of transmission-reception and general considerations on the transmission-reception circuits. Basic architecture of digital communications systems. Different hardware and software implementations: ASIC, DSP and FPGA.
Unit 2. Wired communication systems	Introduction to serial communication systems. Transmission media, signals and bit encoding. Transceiver circuits. Medium access methods.
Unit 3. Asynchronous serial communication systems	Asynchronous serial communication protocols. Standards and practical implementations.
Unit 4. Synchronous serial communication systems	Synchronous serial communication protocols. Standards and practical implementations.
Unit 5. High-speed synchronous serial communication systems	High-speed synchronous serial communication protocols. Differential technologies. Standards and practical implementations.
Unit 6. Radio frequency identification systems. Near-field communications	RFID technology. Near-field communications. Standards and practical implementations.
Unit 7. Wireless communication systems	Wiireless communication protocols. Wiireless networks characteristics and configurations.

Unit 8. Short range wireless communication systems	Wireless communication protocols of short range and low consumption. WPAN Networks. Characteristics and analysis of the wireless sensors networks. Standards and practical implementations.

Laboratory	
Block 1. Wired asynchronous serial communication circuits	Design, implementation and test of an asynchronous serial communication circuit. Transceivers.
Block 2. Wired synchronous serial communication circuits	Design, implementation and test of a synchronous serial communication circuit. Clock recovery.
Block 3. Wireless communication circuits	Design, implementation and test of a wireless communication circuit. Using and configuring communication modules.
Block 4. Project: Design and implementation of a digital communications system	Design, implementation and test of a digital communication system. Applying theoretical and practical concepts.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	4	6
Master Session	12	12	24
Troubleshooting and / or exercises	4	4	8
Laboratory practises	8	20	28
Integrated methodologies	6	24	30
Others	5	12	17
Short answer tests	3	28	31
Reports / memories of practice	1	2	3
Jobs and projects	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
Introductory activities	Subject presentation. Presentation of laboratory sessions, instrumentation and software resources to be used.
Master Session	The lecturer will explain in the classroom the main contents of the subject. The students have to manage the proposed bibliography to carry out a self-study process in a way that leads to acquire the knowledge and the skills related to the subject. The lecturer will answer the students’ questions in the classroom or in the office. In these sessions the students will develop the skil A49 ("know").
Troubleshooting and / or exercises	Activities designed to apply the main concepts of the subject to solve problems and exercices. The lecturer will explain a set of problems and the students have to solve diferent take-home sets of problems. The lecturer will answer the students’ questions in the classroom or in the office. In these sessions the students will develop the skil A49 ("know").
Laboratory practises	Activities designed to apply the main concepts and definitions of the subject. The student will be asked to acquire the basic skills to manage the laboratory instrumentation, software tools and components in order to construct and test electronic circuits. The student has to develop and demonstrate autonomous learning and collaborative skills. Possible questions can be answered in the laboratory sessions or in the lecturer’s office. In these sessions the students will develop the skil A49 ("know how").
Integrated methodologies	Project-based learning: students have to develop a group activity that goes on over a period of time and address a specific problem. They have to design, schedule and carry out a set of tasks to achieve a solution. The assessment will be based on the quality of the proposed solution, the depth of content understanding demonstrated and the final presentation. The sessions will be performed in the laboratory. In these sessions the students will develop the skil A49 ("know how").
Others	Small-group activities. The lecturer will answer the students’ questions and also give instructions to guide the project development process. The students will study and discuss possible solutions and design alternatives, identify key elements and analyze results. In these sessions the students will develop the skil A49 ("know how").

Personalized attention

	Description
Master Session	The lecturer will answer the students’ questions and also give instructions to guide the studying and learning process. The students can go to the lecturer’s office. The timetable will be available on the subject website at the beginning of the term.

Troubleshooting and / or exercises	The lecturer will answer the students' questions and also give instructions to guide the studying and learning process. The students can go to the lecturer's office. The timetable will be available on the subject website at the beginning of the term.
Laboratory practises	The lecturer will answer the students' questions and also give instructions to guide the studying and learning process. The students can go to the lecturer's office. The timetable will be available on the subject website at the beginning of the term.
Integrated methodologies	The lecturer will answer the students' questions and also give instructions to guide the studying and learning process. The students can go to the lecturer's office. The timetable will be available on the subject website at the beginning of the term.

Assessment

	Description	Qualification
Laboratory practises	The lecturers will check the level of compliance of the students with the goals related to the laboratory skills. Marks for each session will be assessed in a 10 points scale. Final mark of laboratory, FML, will be assessed in a 10 points scale. The skil A49 will be evaluated in these laboratory practices.	20
Short answer tests	The lecturers will check the level of compliance of the students with the goals related to the theory skills. Marks for each test will be assessed in a 10 points scale. Final mark of theory, FMT, will be assessed in a 10 points scale. The skils A23 and A24 will be evaluated in these tests.	30
Jobs and projects	The lecturers will consider the results and the quality of the analysis performed in the developed project. Group project mark (GPM) will be assessed in a 10 points scale. The skil A49 will be evaluated in these projects.	50

Other comments and second call

1. Continuous assessment

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

When the students perform a short answer test or attend at least two laboratory sessions, ***they will be assessed by continuous assessment***.

The subject comprises three different parts: theory (30 %), laboratory (20%) and group project (50%). Once a task has been assessed, the students can not do/repeat the task at a later date. The marks are valid only for the current academic course.

1.a Theory

Two short answer tests (SAT) are scheduled. The first test (SAT1) will be performed after unit 5, in the usual weekly scheduling of the theoretical classes. The second test (SAT2) will be performed during the examination period in the date specified in the academic calendar. Marks for each test will be assessed in a 10 points scale. The minimum mark required to pass this part is of 4 (SATi>=4). The final mark of theory (FMT) is calculated as the arithmetic mean of the individual marks:

FMT = (SAT1 + SAT2)/2

The students cannot do the tests at a later date. The student who miss a test will be assessed with a mark of 0 for that test.

If the minimun mark in the first test is not achieved (SAT1 less than 4), the students can repeat this part in the same date of the second test.

1.b Laboratory

Four laboratory sessions are scheduled. Each session lasts approximately 120 minutes and the students will work in pairs. This part also will be assessed by continuous assessment. Each session will be only evaluated according to the developed work at the schedule date. The lecturers will consider the work of the students carried out before the laboratory session to prepare the proposed tasks, the work in the laboratory to deal with them as well as the student's behavior. Marks for each laboratory session (LSM) will be assessed in a 10 points scale. A mark of 0 will be obtained for missing sessions. In order to pass the laboratory part the students can not miss more than one laboratory sessions. The final mark of laboratory (FML) is calculated as the arithmetic mean of the individual laboratory session marks:

FML = (LSM1 + LSM2 + LSM3 + LSM4)/4

1.c Group project

In the first session lecturers will present the objectives and the schedule of the project. They also assign a specific project to each group. After that, the most important part of the workload will be developed in the laboratory. Six hours of B laboratory sessions and six hours of C laboratory sessions. In order to assess the project, the lecturer will consider the results, their analysis and presentation, and the quality of the written report. The group project mark (GPM)Â will be assessed in a 10 points scale. The students are only allowed to miss one project session.Â The minimum mark required to pass this part is of 4 (GPM>=4).

1.d Final mark of the subject

The weighted points from all assessed parts are added together to calculate the final mark (FM). The following weightings will be applied: 30% theory (FMT), 20% laboratory (FML) and 50% group project (GPM). In order to pass the subject, students will be require to pass the theory, laboratory and group project parts. In this case the final mark (FM) will be:

FM = (0.3·FMT + 0.2·FML + 0.5 GPM)

However, when the students do not pass both parts (FMT or GPM less than 4) or do not reach the minimum mark of 4 required to pass each short answer test or miss more than 1 laboratory sessions or miss more than 1 project sessions, the final mark will be:

FM = (0.3·FMT + 0.2·FML + 0.5 GPM)·3.5/7

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

2. Final Exam

The students who prefer a different educational policy can attend an exam on a scheduled date. This exam will comprise three parts (similar to the activities completed by the continuously assessed students): theory exam, laboratory exam and project.

The theory exam will be assessed in a 10 points scale. The minimum mark required to pass this part is of 4 (FMT>=4).

The laboratory exam will be assessed in a 10 points scale. The minimum mark required to pass this part is of 4 (FML>=4).

The project will be assessed in a 10 points scale. The project will be assigned following the procedure described in advance by the lecturer. The student will prepare a written report to be handed in just before the exam. The final project must be presented within one week of delivery of reports. The minimum mark required to pass this part is of 4 (GPM>=4).

In order to pass the subject, students will be required to pass each part (FMT>=4, FML>=4 and GPM>=4). In this case the final mark (FM) will be:

FM = (0.3·FMT + 0.2·FML + 0.5 GPM)

However, when the students do not reach the minimum mark of 4 required (FMT or FML or GPM less than 4), the final mark will be:

FM = (0.3·FMT + 0.2·FML + 0.5 GPM)·3.5/7

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

3. Second opportunity to pass the subject

The assessment policy in this call will follow the scheme described in the previous section. Dates will be specified in the academic calendar. This exam consist on a theory exam, a laboratory exam and a project. In order to attend the laboratory exam and to assign the proyect, the students have to contact to the lecturer according to an established procedure. The procedure will be published in advance.

The marks obtained in the previous continuous assessment or final exam are kept for those parts in which the student has not attended. The final mark will be calculated as it has described in section 2.

Sources of information
F. Machado, V. Pastoriza, F. Poza, Sistemas Electrónicos para Comunicaciones Digitales, Curso 2013/2014, Plataforma TEMA
B. Sklar, Digital communications. Fundamentals and applications, 2ª Ed., Prentice-Hall
P. Mariño, Las comunicaciones en la empresa. Normas, redes y servicios, 2ª Ed., Ra-Ma
S. Mackay, E. Wright, D. Reynders, J. Park., Practical industrial data networks : design, installation and troubleshooting, 1ª Ed., Newnes-Eslsevier
R. Faludi, Building wireless sensor networks, 2011, O'Reilly
H. Lehpamer, RFID design principles, 2012, Artech House

Recommendations

Subjects that are recommended to be taken simultaneously

Data Acquisition Systems/V05G300V01521

Subjects that it is recommended to have taken before

Data Communication/V05G300V01301
Digital Electronics/V05G300V01402
Signal Transmission and Reception Techniques/V05G300V01404
Analogue Electronics/V05G300V01624

IDENTIFYING DATA				
Analogue Electronics				
Subject	Analogue Electronics			
Code	V05G300V01624			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Río Vázquez, Alfredo del			
Lecturers	Río Vázquez, Alfredo del			
E-mail	ario@uvigo.es			
Web	http://webs.uvigo.es/ario/docencia/eangrado/eangrado.htm			
General description	This subject studies the feedback concept, and its applications to amplifiers. The opamps and their applications are also studied.			

Competencies	
Code	
A51	(CE42/SE4): The ability to apply electronics as support technology in other fields and activities and not only in information and communication technologies.
A52	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
A53	(CE44/SE6): The ability to understand and use feedback theory and electronic control systems.

Learning aims		
Subject competences	Typology	Competences
Knowledge of the techniques for feed-back amplifiers and oscillators.	know Know How	A52 A53
Knowledge of the internal structures of the operational amplifiers and their structures.	know Know How	A52 A53
Knowledge of the design of circuits based on operational amplifiers.	know Know How	A52 A53
Knowledge of the design of power-supplies.	know Know How	A51 A52 A53

Contents	
Topic	
Feedback amplifiers I	Feedback concept. Sample and mix networks. Feedback topologies. Feedback law.
Feedback amplifiers II	Negative and positive feedback. Parameters for the study of feedback. Benefits and draws of feedback. Effect on the uniform of gain. Effect on the harmonic distortion. Effect on the input and output impedances.
Feedback amplifiers III	Methods for the analysis: Simple or using matrix. Topology identifying. Amplifier without feedback, but with the load effect of the feedback network. The gain of the feedback amplifier. The input and the output impedances of the feedback amplifier.

Feedback amplifiers IV	Effect of the feedback on the frequency response. Bandwidth and stability. The effect of poles on the amplifier (one pole, two poles and three poles). Gain and phase margins. Nyquist criteria. Root places. Compensation methods.
Sine waveform oscillators	Barkhausen criteria. Design of a sinusoidal oscillator. RC oscillator. LC oscillator. Oscillator based on quartz crystals.
Operational amplifiers I	Internal structure of an operational amplifier. Current mirrors. Active loads. Voltage references. Technologies for the operational amplifiers: bipolars, bifet, cmos.
Operational amplifiers II	Analysis of the operational amplifier in the non inverting mode, using feedback. Voltage follower. Converters I-V and V-I. Integrator. Derivator. Applications.
Operational amplifiers III	Half-wave inverter rectifier . Full-wave inverter rectifier. Relaxation oscillator. Generator of triangle waves. Sinusoid oscillators based on the operational amplifier.
Power amplifiers	Output stages in class A, B and A-B. Full amplifier in class B. Full amplifier in class A-B. Introduction to the class-D amplifiers.
Regulated power supplies	Linear regulated power supplies. Protection to over current. Low drop-out (LDO).
Lab work 1	The effect of the feedback on a two-stage amplifier .
Lab work 2	Linear applications. Voltage-to-current converter. Integrator.
Lab work 3	Half-wave inverter rectifier. Full-wave inverter rectifier. Peack detector. Slope detector.
Lab work 4	Operational-based relaxation oscillator. Operational-based sinusoidal oscillator.
Lab work 5	Power amplifiers. Class B. Class A-B.
Lab work 6	Design of an active load. Design of a voltaje regulated supply.

Planning

	Class hours	Hours outside the classroom	Total hours
Tutored works	7	20	27
Laboratory practises	12	38	50
Master Session	15	27.5	42.5
Troubleshooting and / or exercises	4	22.5	26.5
Short answer tests	0.5	0	0.5
Troubleshooting and / or exercises	1	0	1
Short answer tests	0.5	0	0.5
Troubleshooting and / or exercises	1	0	1

Practical tests, real task execution and / or simulated.	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
Tutored works	The lecturer will lead the students in order to design an amplifier. Competencies A51, A52 and A53 will be addressed in these sessions.
Laboratory practises	Simulations and real assembled circuits will be tested. Competencies A51, A52 and A53 will be addressed in these sessions.
Master Session	The lecturer will show some theoretical contents related to the subject. Competencies A51, A52 and A53 will be addressed in these sessions.
Troubleshooting and / or exercises	The lecturer will solve some exercises related to the subject. Competencies A51, A52 and A53 will be addressed in these sessions.

Personalized attention	
	Description
Troubleshooting and / or exercises	Students are permitted to interrupt the session in order to ask the lecturer for some doubt related to the session.
Tutored works	Students are permitted to interrupt the session in order to ask the lecturer for some doubt related to the session.
Laboratory practises	Students are permitted to interrupt the session in order to ask the lecturer for some doubt related to the session.
Master Session	Students are permitted to interrupt the session in order to ask the lecturer for some doubt related to the session.

Assessment		
	Description	Qualification
Tutored works	Every student has to create a document about the assigned work. Competencies A51, A52 and A53 will be assessed in these works.	10
Short answer tests	First short answer test in the classroom. Competencies A51, A52 and A53 will be assessed in these tests.	15
Troubleshooting and / or exercises	First exercise test in the classroom. Competencies A51, A52 and A53 will be assessed in this test.	15
Short answer tests	Second short answer test. Competencies A51, A52 and A53 will be assessed in this test.	15
Troubleshooting and / or exercises	Second exercise test. Competencies A51, A52 and A53 will be assessed in this test.	15
Practical tests, real task execution and / or simulated.	Laboratory-work exam based on simulations and real circuits. Competencies A51, A52 and A53 will be assessed in this test.	30

Other comments and second call

NOTE: The timing of the partial exams might suffer some changes, due to time restrictions. The exact timing will be indicated along the course.

CONTINUOUS EVALUATION OPTION:

The subject is evaluated in a continue way, by mean of two partial exams. These exams treat the theoretical aspects. In addition, there is an exam for the lab-work.

This first partial includes themes from one to five. The second partial exam includes themes from six to ten. The weight of both partials is a 60% from the total mark.

The two partials take place in the classroom, within the class time. These partials are approximately 90 minutes long. The first 30 minutes will be dedicated to an exam with short answers. The rest 60 minutes will be dedicated to an exam with long answers.

Inside each partial, the 90 minutes exam and the 30 minutes exam have the same weight.

In order to pass a partial exam (the first or the second), the student is required to obtain at least a mark of 5 over 10.

The student that passes only one partial will only have to try the other one at the final exam option.

The lab-work is evaluated using a unique exam, in the laboratory. The weight is 30%.

Tutored works are assessed using a report that every student should be done. The weight is 10%.

When a student attends the first partial, he or she accepts to follow the continuous assessment. Students that do not attend to the first partial will be assessed by means of a final exam.

The mark that a student obtains in the lab-work is maintained until July, except if the student does not want. In this case, the student will have to do partials and lab exams in July.

In order to pass the subject, once partials have been passed, the student has to obtain a global mark (GM) of at least 5 points in ten. The global mark is calculated following the next formula:

GM = 0.6 * TM + 0.3*LM + 0.1*RM

where

TM = Mean value of the partial marks; LM = lab mark; RM = report mark

The first partial is preview to take place in the sixth week. The second partial will take place in the last week.

The lab exam will take place in the lab, the day of the last lab session.

FINAL EXAM OPTION:

The students that do not follow the continuous assessment will be assessed by means of a final exam. The exam will consist of three parts: the first part of the themes 1 to 5, the second part of the themes 6 to 10 and the third part of lab-work in the laboratory.

In order to pass the subject, the student has to obtain a mark of at least 5 points over ten for the first and second parts. In this case, the global mark (GM) is calculated following the next formulae:

GM = 0.6 * TM + 0.4*LM

where:

TM = Average mark of the first and second part of the exam; LM = lab mark

If the student does not obtain a mark of at least 5 in the first part or in the second part, the global mark would be the least mark between 4 or the GM taken from the early formulae.

IMPORTANT:

If a student did not enter the continuous assessment mode but is interested in participate in the final exam, he or she should talk with the professor at least two weeks before the day of the exam. Contact can be by e-mail. This help in the organization of the lab work exam.

RECOVERY EXAM

The recovery exam (June-July) shares the same structure than the final exam.

Sources of information
Sergio Franco, Design with operational amplifiers and analog integrated circuits, third edition, McGraw-Hill
Paul Horowitz y Winfield Hill, The Art of Electronics, , Cambridge Univ. Press

Recommendations

Subjects that are recommended to be taken simultaneously

Data Acquisition Systems/V05G300V01521

Subjects that it is recommended to have taken before

Electronic Technology/V05G300V01401

Other comments

I recommend the students to search the web for information about this subject. Electronic devices factories show interesting information. Many universities around the world hung interesting notes in the Internet. And many of them for free.

IDENTIFYING DATA				
Power Electronics				
Subject	Power Electronics			
Code	V05G300V01625			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Galician			
Department				
Coordinator	Doval Gandoy, Jesús			
Lecturers	Doval Gandoy, Jesús Vidal González, Ana			
E-mail	jdoval@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main goal of this subject is to provide students with the knowledge about the basics of power electronics. Contents include power semiconductor devices, AC-DC converters, DC-DC converters, DC-AC converters and basic concepts about the control of these power converters.			

Competencies	
Code	
A52	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
A53	(CE44/SE6): The ability to understand and use feedback theory and electronic control systems.

Learning aims		
Subject competences	Typology	Competences
Knowledge of the operation of the basic topologies of electronic converters used in conversion of electrical energy.	know	A52
Capacity to design basic circuits used in power electronic converters.	Know How	A52 A53

Contents	
Topic	
Chapter 1: Introduction to power electronics	Introduction, overview of power electronics,l applications.
Chapter 2: Power electronic devices	Diode, MOSFET, IGBT. Switching, drivers, thermal analysis, association of devices, electrical protection.
Chapter 3: Basics of three phase electrical systems	Definition of electrical power under sinusoidal and non-sinusoidal conditions. Power factor, balanced and unbalanced three phase systems, sequence of phases, definition of power three phase systems.
Chapter 4: Magnetics in power electronics	Basics, inductors, transformers, magnetic materials.
Chapter 5: AC to DC power conversion	Three phase rectifiers. Non-controlled rectifiers, controlled rectifiers. Resistive load, inductive load, capacitive filter. Input AC Introduction to the power factor correction.
Chapter 6: DC to AC power conversion	Basics of DC to AC power conversion. Single phase and three phase inverters. Square wave inverters, PWM inverters. Modulation techniques.
Chapter 7: DC to DC power conversion	Basic DC to DC converter topologies. Converters without isolation and with isolation. Control in DC to DC power converters.
Laboratory exercise 1. Power electronic semiconductor devices.	MOSFET transistor, switching characteristics. Current and voltage characteristics.
Laboratory exercise 2. AC to DC power conversion	Non-controlled three phase rectifier, controlled three phase rectifier. Input/ output current and voltage.
Laboratory exercise 3. DC to AC power conversion	DC to AC converter. Input/ output current and voltage.

Laboratory exercise 4. DC to DC power conversion	Non-isolated and isolated DC to DC converter. Input/ output current and voltage.

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practises	9	18	27
Integrated methodologies	7	21	28
Master Session	21	42	63
Troubleshooting and / or exercises	5	27	32

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

Methodologies	
	Description
Laboratory practises	Practical application of the theoretical concepts. Competencies A52 and A53 will be worked.
Integrated methodologies	Proposal of problems and/or exercises related with the subject contents. Students have to obtain the correct solutions. The professor will support and will help students to solve the problems. Competencies A52 and A53 will be worked.
Master Session	Presentation by the professor of the contents on the subject, guidelines for the work to develop by the student. Competencies A52 and A53 will be worked.

Personalized attention	
	Description
Master Session	The professor will assist students about their doubts and queries related to the study of theoretical concepts, problems or laboratory exercises. Students will have opportunity to attend personal tutorials in the professor’s office, in the hours established for this purpose at the beginning of the academic year.
Laboratory practises	The professor will assist students about their doubts and queries related to the study of theoretical concepts, problems or laboratory exercises. Students will have opportunity to attend personal tutorials in the professor’s office, in the hours established for this purpose at the beginning of the academic year.
Integrated methodologies	The professor will assist students about their doubts and queries related to the study of theoretical concepts, problems or laboratory exercises. Students will have opportunity to attend personal tutorials in the professor’s office, in the hours established for this purpose at the beginning of the academic year.

Assessment		
	Description	Qualification
Troubleshooting and / or exercises	Each exam is composed by exercises and problems related to the theoretical concepts and laboratory practices. The number of exams and examination rules are detailed in "Other comments"	100

Other comments and second call

In this subject there are two ways to evaluate to the students: continuous evaluation or evaluation by final examination.

1. Continuous evaluation.

Consists in the execution of weekly tasks and the realisation of tests of partial evaluation.

1.1 Weekly tasks: weekly, the professor will commission to the students the execution of tasks and the delivery of the report of execution. To be able to approve the subject by continuous evaluation is compulsory to realise and deliver the reports in the term fixed by the professor. These tasks will evaluate the competencies A52 and A53. Students will be able to obtain until 10% of the final qualification

1.2 Tests of partial evaluation: students will realise three written tests of partial evaluation. The partial tests are not recoverable, that is, if a student can not attend the test, professors do not have obligation to repeat them. The qualifications of the partial tests will be valid only for the current academic year. It is understood that students choose continuous evaluation if they attend any of the partial tests. Their qualification will be the one of continuous evaluation. These tests will evaluate the competencies A52 and A53.

1st partial test: it will be held during the last 50 minutes of the first laboratory session. Students will be evaluated of the contents taught to date of the test. Students will be able to obtain in this test until 25% of the final qualification. This test will be held about week 7.

2nd partial test: it will be held during the last 50 minutes of the first laboratory session. Students will be evaluated of the contents taught to date of the test. Students will be able to obtain in this test until 25% of the final qualification. This test will be held about week 11.

3rd partial test: it will be held during 60 minutesÂ in the date and classroom of the final examination.. Students will be evaluated of the contents taught to date of the test. Students will be able to obtain in this test until 40% of the final qualification. This test will be held on a date chosen by the Dean of the Faculty (date final examination).

2. Evaluation by final examination

The final examination evaluates students that did not participate in the continuous evaluation. Consists of theoretical questions, problems and exercises. Students attending final examination, who did not submit the reports of partial tasks, have the obligation to deliver a report including all the partial tasks proposed along the course. This test will be held during 2 hours on a date chosen by the Dean of the Faculty. This final examination will evaluate the competitions A52 and A53.

3. Extraordinary examination (June-July)

Consists of theoretical questions, problems and exercises. Students attending final examination, who did not submit the reports of partial tasks, have the obligation to deliver a report including all the partial tasks proposed along the course. This test will be held during 2 hours on a date chosen by the Dean of the Faculty. This final examination will evaluate the competitions A52 and A53.

Sources of information
Rashid, M. H. , Electrónica de potencia: circuitos, dispositivos y aplicaciones, Pearson Education, 2004
Hart, D. W., Electrónica de potencia, Prentice-Hall, 2001
Mohan, N., Power electronics : converters, applications, and design , John Wiley & Sons, 2003
Barrado, A., Problemas de electrónica de potencia, Pearson Prentice Hall, 2007

Recommendations

Subjects that are recommended to be taken simultaneously

Programmable Electronic Circuits/V05G300V01502

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Physics: Fundamentals of Mechanics and Thermodynamics/V05G300V01102
Digital Electronics/V05G300V01402
Physics: Fundamentals of Electronics/V05G300V01305
Electronic Technology/V05G300V01401

IDENTIFYING DATA				
Audiovisual Technology				
Subject	Audiovisual Technology			
Code	V05G300V01631			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish Galician			
Department				
Coordinator	Fernández Hermida, Xulio			
Lecturers	Fernández Hermida, Xulio Torres Guijarro, María Soledad			
E-mail	xuliofh@gmail.com			
Web	http://faitic.uvigo.es			
General description	In this subject the student will learn to design audiovisual systems,with respect to sound take and sound reinforcement, image take and visual coating, synchronisation, wiring, connections and supply. Indoor and outdoor applications of audiovisual networks, as well as distinct multimedia platforms, will be analysed.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A45	CE36/SI3 The capacity to implement projects at places and installations for the production and recording of audio and video signals.
A47	CE38/SI5 The ability to create, modify, manage, broadcast and distribute multimedia contents taking into account the use and accessibility criteria to audiovisual, broadcasting and interactive services.
B3	The development of discussion ability about technical subjects

Learning aims		
Subject competences	Typology	Competences
IF3.2 Capacity to prepare projects of venues and installations used for the production and recording of signals of audio and video: systems of audio-video and integration of the same. Learning aims: - Design a system of sound take and sound reinforcement given a certain enclosure, comparing different subsystems and elements. - Design a system of image take and visual coating given a certain enclosure, comparing different subsystems and elements - Design the wiring and connections of an audiovisual network for his control and supply - Create atmospheres addressing acoustic and visual appearances - Analyse different indoor and outdoor applications of Audiovisual Networks.	know Know How Know be	A1 A6 A45 B3
IF5.2 Capacity to administer, disseminate and distribute multimedia contents, attending to usabilidad and accessibility criteria of the audiovisual, diffusion and interactive services: sound. Llearning aims: - Apply and analyse distinct multimedia systems: videoconference, streaming, audiovisual databases, synchronisation, metadata processing, exchange of multimedia contents.	know Know How Know be	A1 A6 A47 B3

IF5.4 Capacity to administer, disseminate and distribute multimedia contents, attending to usabilidad and accessibility criteria of the audiovisual, diffusion and interactive services: image. Learning aims: - Apply and analyse distinct multimedia systems: videoconference, streaming, audiovisual databases, synchronisation, metadata processing, exchange of multimedia contents.	know Know How Know be	A1 A6 A47 B3
IF5.5 Capacity to administer, disseminate and distribute multimedia contents, attending to usabilidad and accessibility criteria of the audiovisual, diffusion and interactive services: combination of sound and image. Learning aims: - Apply and analyse distinct multimedia systems: videoconference, streaming, audiovisual databases, synchronisation, metadata processing, exchange of multimedia contents. - Understand which elements have an influence on audiovisual quality.	know Know How Know be	A1 A6 A47 B3

Contents	
Topic	
Sound reinforcement	Sizing and distribution in the processes of take and presentation of sound
Visual overlay	Design of systems of visual take and presentation indoor and outdoor. Sizing and distribution of the visual coverage, in the processes of take and presentation
Connections and supply	Design of the wiring and connecting of an audiovisual network and his supply. Audiovisual networks, indoor and outdoor applications.
Synchronisation and control	Synchronisation of audio and video signals in an audiovisual network. Control systems. Audiovisual quality: sound/image interaction. Ambient creation addressing visual and acoustic issues
Multimedia systems	Videoconference, streaming, audiovisual databases, synchronisation, metadata procesing, exchange of multimedia contents

Planning			
	Class hours	Hours outside the classroom	Total hours
Practice in computer rooms	12	0	12
Projects	7	57	64
Master Session	21	42	63
Short answer tests	2	0	2
Reports / memories of practice	0	9	9

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

Methodologies	
	Description
Practice in computer rooms	Use and adjustment of analysis tools and algorithms, identifying which should be used in each situation posed. This methodology is targeted to competency A45.
Projects	Collaborative work in reduced groups on a complex design that applies several topics covered in the subject. The work is periodically followed-up and it fosters working in group, role sharing, information sharing, planning and public defending of results. This methodology is targeted to competencies A1, A6, A45, A47 and B3.
Master Session	Presentation by the teacher of the contents of the subject, fostering the critical discussion of the concepts. The theoretical grounds of algorithms and procedures used to resolve problems are given. This methodology is targeted to competencies A1, A6, A45, A47 and B3.

Personalized attention	
	Description

Master Session	Students will have the opportunity to solve doubts in personalised attention sessions. These sessions will take place: - Individually or in reduced groups (typically with a maximum of 2-3 students). - Unless otherwise stated, with previous appointment with the corresponding teacher. The appointment should be required and agreed by e-mail, preferably in the timetable and place officially assigned. - The group of students developing a project will attend periodic follow-up meetings.
Practice in computer rooms	Students will have the opportunity to solve doubts in personalised attention sessions. These sessions will take place: - Individually or in reduced groups (typically with a maximum of 2-3 students). - Unless otherwise stated, with previous appointment with the corresponding teacher. The appointment should be required and agreed by e-mail, preferably in the timetable and place officially assigned. - The group of students developing a project will attend periodic follow-up meetings.
Projects	Students will have the opportunity to solve doubts in personalised attention sessions. These sessions will take place: - Individually or in reduced groups (typically with a maximum of 2-3 students). - Unless otherwise stated, with previous appointment with the corresponding teacher. The appointment should be required and agreed by e-mail, preferably in the timetable and place officially assigned. - The group of students developing a project will attend periodic follow-up meetings.

Assessment

	Description	Qualification
Projects	Assessment of a project, developed through the four-month period, including the preparation and public presentation of a report. This methodology is targeted to assess competencies A1, A6, A45, A47 and B3.	40
Short answer tests	Assessment of a written exam, with brief questions and problems. This methodology is targeted to assess competencies A1, A6, A45, A47 and B3.	50
Reports / memories of practice	Assessment of a written inform that describes the work of several weeks in the computer classroom. This methodology is targeted to assess competency A45.	10

Other comments and second call

Following the study programme guidelines, the student can choose between two assessment methods: CONTINUOUS ASSESMENT, that is the recommended method linked to the educational activities and NON CONTINUOUS ASSESSMENT, only recommended for those students which can not follow the first method.

CONTINUOUS ASSESSMENT

The continuous assessment consists of the tests detailed in the following. The student opts by the continuous assessment method once she/he signs the document of commitment that will be available at week 1-3, so that she/he can begin the work in the corresponding group. Once signed, it is assumed that the student has taken the examination session and will be given the mark resulting of the application of the criterion detailed in the following, regardless of wheter she/he takes the final exam or not.

Types and assessment of activities:

Reports of the practical sessions (Weight: 10%): will be assessed around weeks 6 and 11.

Projects (Weight 40%): will be assessed around week 12

Proof of short answer (Weight: 50%): it coincides with the final exam date. It includes all the contents of the subject.

The final note corresponds to the sum of the marks obtained in all the activities weighted by the corresponding percentages. The student should obtain, at least, a grade of 4 points over ten in each type activity, and a final grade of 5 points to pass the subject.

NON CONTINUOUS ASSESSMENT

If the student does not sign the document of commitment, she/he will be evaluated through a final examination in the official date assigned by the Centre. This exam will consist of two parts, of equal weight in the final mark: a written part that may include all the topics of the subjet, and an oral part relative to additional work. This additional work should be presented previously to the teacher. The student may take part in the continuous assessment activities of the practical sessions, but they will not be assessed in her/his case. The additional work to deliver will be specified in week 6 of term, and will have to be delivered to the teacher a week before the final exam.

The student should obtain, at least, a grade of 4 points over ten in each type activity, and a final grade of 5 points to pass the subject.

Extraordinary examination session:

The student will be assessed through a final exam in the official date assigned by the school. This exam will consist of two parts, of equal weight in the final mark: a written part that may include all the topics of the subjet, and an oral part relative to additional work. This additional work should be presented previously to the teacher. The additional work to deliver will be specified in the revision of the ordinary exam, and will have to be delivered to the teacher three days before the extraordinay exam.

The student should obtain, at least, a grade of 4 points over ten in each type activity, and a final grade of 5 points to pass the subject.

Sources of information

John Eargle, Chris Foreman, Audio Engineering for Sound Reinforcement, , Hal Leonard, 2002

Gary Davis and Ralph Jones, Sound Reinforcement Handbook , , Hal Leonard, 1989

Philip Giddings, Audio Systems Design and Installation, , Focal Press, 1990

Hilary Wyatt y Tim Amyes, Postproducción de Audio para TV y Cine, , Escuela de Cine y Video de Andoain, 2005

Rüdiger Ganslandt, Harald Hofmann, Handbook of Lighting Design, , ERCO Edition

In addition to the bibliography mentioned the student will be provided of:

* Outline of the practices: formulation of each practical session

* Copy of the graphic material used in the classroom

Recommendations

Subjects that are recommended to be taken simultaneously

Room Acoustics/V05G300V01635
Imaging Systems/V05G300V01633

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Audio Systems/V05G300V01532
Video and Television/V05G300V01533

IDENTIFYING DATA				
Fundamentals of Image Processing				
Subject	Fundamentals of Image Processing			
Code	V05G300V01632			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish Galician			
Department				
Coordinator	Martín Herrero, Julio			
Lecturers	Martín Herrero, Julio			
E-mail	julio@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Introduces to the student the basics of digital image processing			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A47	CE38/SI5 The ability to create, modify, manage, broadcast and distribute multimedia contents taking into account the use and accessibility criteria to audiovisual, broadcasting and interactive services.
B1	The ability for critical reading of scientific papers and docs.

Learning aims		
Subject competences	Typology	Competences
Understand the nature and organisation of digital images	know	A43
Learn to process digital images	know	A47
Learn how to program a computer to process a digital image	Know How	A3
Understand how the fundamental technics of image processing work	know	A4
Apply fundamental processing technics to solve specific problems with images or groups of images	know	A4
Capacity to do critical reading of scientific documents	Know How	B1

Contents	
Topic	
Basic preprocessing.	Histogram. Brightness and contrast.
Global and local operators.	Linear and nonlinear filters.
Binary and greyscale mathematical morphology.	Erosion. Dilatation. Opening. Closing.
Geometrical transformations. Image transforms.	Affine transformations.
Image compression.	JPEG. JPEG 2000.
Image restoration.	Linear and nonlinear filters.

Planning			
	Class hours	Hours outside the classroom	Total hours

Practice in computer rooms	12	23.5	35.5
Tutored works	7	43	50
Master Session	21	41.5	62.5
Practical tests, real task execution and / or simulated.	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
Practice in computer rooms	Handling and tuning analytic tools and algorithms, identifying which ones to use in different scenarios. All learning aims are addressed.
Tutored works	Groupwork developing the contents dealt with in the classroom, with personalised attention. All learning aims are addressed.
Master Session	Pleanry talks by the teacher on central topics, promoting critical discussion of concepts. All learning aims are addressed.

Personalized attention

	Description
Practice in computer rooms	Tutoring meetings will be used to solve doubts. These meetings will be: * Individually or in small groups. * Except where otherwise indicated, by previous appointment with the teacher. Appointments can be requested verbally or by email, preferably at the times and location reserved officially.
Tutored works	Tutoring meetings will be used to solve doubts. These meetings will be: * Individually or in small groups. * Except where otherwise indicated, by previous appointment with the teacher. Appointments can be requested verbally or by email, preferably at the times and location reserved officially.

Assessment

	Description	Qualification
Practice in computer rooms	Personalised monitoring of the student's work in the laboratory, with feedback. All teaching aims specified in the corresponding section of this guide are evaluated.	50
Tutored works	Assessment of the work done, itscontent and its presentation. All teaching aims specified in the corresponding section of this guide are evaluated.	50
Practical tests, real task execution and / or simulated.	Real programming and problem solving. All teaching aims specified in the corresponding section of this guide are evaluated.	0

Other comments and second call

The assistance to class under continuous evaluation is compulsory, unless exceptional circumstances concur. Continuous evaluation is used for assessment, based in the work of the student in the classroom and at home. There is a final exam in the official date marked by the Board of School in May, for those students that have not passed the continuous evaluation. This final exam will be marked between 0 and 10 points. It covers all the subjects seen during the semester. To approve, the student has to obtain, at least, five points. Students wishing to improve their continuous evaluation marks can also attend the final exam: in this case the mark of this exam will be the final mark. The students that have passed the continuous evaluation and are satisfied with their mark do not need to attend the final exam. Along the semester the students will receive feedback on their progress, and the final mark of continuous evaluation will be communicated to the students well before the final exam. The delivery of the personal work the last week of class will imply the official participation in continuous evaluation.

The extraordinary evaluation of July will be an extraordinary final exam, for those students that have not passed neither the continuous evaluation neither the final exam in May. The final mark will be the mark of the extraordinary final exam in both cases. This extraordinary final exam will be marked between 0 and 10 points, and covers all the subjects. To approve, the student has to obtain, at least, five points.

Note that there are two final exams, but both correspond to a single and the same call ("convocatoria").

Sources of information

Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 3ª, Prentice Hall

Robert Laganière, OpenCV 2 Computer Vision Application Programming Cookbook, 2011, Packt Publishing
Jasmin Blanchette, Mark Summerfield, C++ GUI Programming with Qt 4, 2008, Prentice Hall

Recommendations

Subjects that continue the syllabus

Image Processing and Analysis/V05G300V01931

Subjects that are recommended to be taken simultaneously

Imaging Systems/V05G300V01633

Subjects that it is recommended to have taken before

Programming I/V05G300V01205
Fundamentals of Sound and Image/V05G300V01405
Digital Signal Processing/V05G300V01304

IDENTIFYING DATA				
Imaging Systems				
Subject	Imaging Systems			
Code	V05G300V01633			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Martín Rodríguez, Fernando			
Lecturers	Docio Fernández, Laura Martín Rodríguez, Fernando			
E-mail	fmartin@uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this course we study several families of image systems, including computer vision, remote sensing and medical imaging.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A75	(CE66/OP9) The ability for selection of circuits, subsystems and systems of remote sensing.
B1	The ability for critical reading of scientific papers and docs.

Learning aims		
Subject competences	Typology	Competences
Know and know how to choose image acquisition/generation systems that are most widely used in photography/video studios, computerl vision, medical diagnostic and remote sensing (C1).	know Know How	A3 A43 A75 B1
Understand the principles of operation of such systems. Know the influence of capture foundations in the obtained results for especific examples (C2).	know Know How	A3 A43 A75 B1
Knowledge and understanding about the capabilities and limitations of such systems (C3).	know Know How	A3 A43 A75 B1
Knowledge about the most common applications of such systems (C4).	know Know How	A43 A75 B1

Contents	
Topic	
Image acquisition using cameras.	Camera concept, principles of operation, camera types. Monochrome cameras, color (Bayer and triple CCD). Field and linear cameras. Frame grabbers, multi-camera systems (mono/stereo). Capture Parameters: shutter speed, aperture and sensitivity (ISO). Influence in obtained results. Illumination systems (studio lighting, color temperature, hard and soft light, LED, Laser, fluorescent).

Medical imaging and non destructive testing (NDT).	Generation of ultrasonography, X-ray, computerized axial tomography, nuclear magnetic resonance and positron emission tomography. Processing of images and/or signals aimed to obtain diagnostic quality images.
Aerial, satellite and proxy remote sensing systems.	Acquisition, processing and applications of panchromatic images, single-band, multispectral and hiperspectral, active and passive in UV/VIS/SWIR/NIR/FIR/Thermal/GHz, Radar and Lidar. Geometrical correction, registration and geo-referenciation.

Planning

	Class hours	Hours outside the classroom	Total hours
Practice in computer rooms	12	23.5	35.5
Tutored works	7	35	42
Master Session	21	41.5	62.5
Reports / memories of practice	0	8	8
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
Practice in computer rooms	After theoretical classes, the lecturer defines some practical exercises to be started just at the moment and to be continued later via autonomous work. Related capabilities: A3, A43, A75, B1, C1, C2, C3, C4.
Tutored works	It consists of supervision of small projects initiated in computer lab classes. This initial works are enhanced though reading and analysis of related technical documentation and defining new objectives that will be implemented by students. Related capabilities: A3, A43, A75, B1, C1, C2, C3, C4.
Master Session	Presentation by the teacher of subject contents, encouraging the critical discussion of the concepts. Related capabilities: A3, A43, A75, C1, C2, C4.

Personalized attention

	Description
Practice in computer rooms	Students will have the opportunity to solve doubts in personalised attention sessions. These sessions will take place: - Individually or in reduced groups (typically with a maximum of 2-3 students). - Unless otherwise stated, with previous appointment with the corresponding teacher. The appointment should be required and agreed by e-mail, preferably in the timetable and place officially assigned.
Tutored works	Students will have the opportunity to solve doubts in personalised attention sessions. These sessions will take place: - Individually or in reduced groups (typically with a maximum of 2-3 students). - Unless otherwise stated, with previous appointment with the corresponding teacher. The appointment should be required and agreed by e-mail, preferably in the timetable and place officially assigned.

Assessment

	Description	Qualification
Practice in computer rooms	They are the beginning of the tutored works. They do not have a grade percentage assigned because they will be implicitly assesed through the submited final reports. Related capabilities: A3, A43, A75, B1, C1, C2, C3, C4.	0
Tutored works	Works that continue the exercises started in computer class. They do not have a grade percentage assigned because they will be implicitly assesed through the submited final reports. Related capabilities: A3, A43, A75, B1, C1, C2, C3, C4.	0
Long answer tests and development	Examination of all contents seen in the subject. This exam will be taken by those students that have not delivered any practical work and, therefore, do not use the procedure of continuous evaluation. It will take place in the classroom and date approved by the school board. The examination will include all the studied issues in theoretical classes and also the works proposed this year (the lecturers could to ask questions about additional bibliography recommended and/or the methods that recommend for practical works implementation). Related capabilities: A3, A43, A75, B1, C1, C2, C3, C4.	100

Reports / memories of practice	They are the final result of the tutored works. For each work (or small project), the lecturers will establish a "soft" deadline. This means that if it is delivered within the first deadline, the author wins the right to submit a second version (improvement). The second version will have to be delivered in the 10 days following the publication of the first version marks. Structure of the improved report will have to be: first, the former text foloowed by an annex that describes the new enhancements. If works are noit delivered in the first proposed date, students will still be able to deliver it. ALWAYS before the end of class period. When a student delivers a practical work is choosing the option of continuous evaluation. This means that his final grade will be the average of his works. Depending on the works proposed, the lecturers will be able to decide the weight in the final grade for each. Related capabilities: A3, A43, A75, B1, C1, C2, C3, C4.	100

Other comments and second call

Extraordinary assesment in July consist of a single exam for those students that have not passed neither the continuous evaluation nor the final exam in May. The final grade in this subject will be that one derived from the July exam in both cases. This extraordinary final examination will be graded between 0 and 10 points, and it will include all topics in the subject (including the practical works, as in the may exam). To passs, the student has to achieve, at least, five points.

Notice that there are not two calls, but there is only one. Although there are two final examinations.

Sources of information

Arnulf Oppelt, Imaging Systems for Medical Diagnostics, 2ª, Wiley-VCH, 2005

John Robert Schott, Remote Sensing: The Image Chain Approach, 1ª, Oxford University Press, 2007

Oleg S. Pianykh, Digital Imaging and Communications in Medicine (DICOM), 2ª, Springer, 2012

Michael Vollmer and Klaus-Peter Möllmann, Infrared Thermal Imaging: Fundamentals, Research and Applications, 1ª, Wiley-VCH, 2010

Erik Reinhard et al., Color Imaging: Fundamentals and Applications, 1ª, A K Peters, 2008

In addition to this bibliography, the lecturers will provide (through theÂ faitic platform) the following material:

- Scripts for theoretical Â classes (slides).

- Requirements documentation for the tutored works.

- In the tutored works, lecturers could provide bibliography: tutorials, papers... They will be made available through faitic either directly (inÂ PDF format) or throughÂ Internet links.

Recommendations

Subjects that continue the syllabus

Image Processing and Analysis/V05G300V01931
Audiovisual Production/V05G300V01935

Subjects that are recommended to be taken simultaneously

Fundamentals of Image Processing/V05G300V01632

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405

IDENTIFYING DATA				
Sound Processing				
Subject	Sound Processing			
Code	V05G300V01634			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Rodríguez Banga, Eduardo			
Lecturers	Cardenal López, Antonio José Rodríguez Banga, Eduardo			
E-mail	erbanga@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course describes the main techniques of the sound processing, with special emphasis on real applications. Students are shown s the basic principles of these techniques and how the same principles may give rise to different algorithms or systems depending on the type of signal to process (speech or audio, for instance). This course also makes an introduction to the principles of underwater acoustic and ultrasounds as well as their applications.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A46	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.
A47	CE38/SI5 The ability to create, modify, manage, broadcast and distribute multimedia contents taking into account the use and accessibility criteria to audiovisual, broadcasting and interactive services.

Learning aims		
Subject competences	Typology	Competences
CG4.1 The ability to solve problems with initiative and make creative decisions	know	A4
CG4.2 Ability to communicate and transmit knowledge and skills	know	A4
CG6 Ease for handling specifications, regulations and norms of forced fulfillment.	know	A6
IF1.2 Ability to build, exploit and manage telecommunications services and applications, under the perspective of audiovisual services and multimedia information: analog and digital processing, coding, transport, parameterization and storage of the sound.	Know How	A43
IF4.4 Ability to develop projects in acoustic engineering: underwater acoustic systems.	Know How	A46
IF5.1 Ability to generate and encode multimedia contents, attending to the usability and accessibility criteria of the audiovisual services, and related aspects of broadcasting and interaction: sound.	Know How	A47

Contents	
Topic	
Voice production and perception	Voice generation. Physiology. General characteristics of a speech signal. Perception. Auditive physiology. Hearing aids.
Analysis of speech and audio signals	Short term analysis. Time and spectral parameters. Linear Prediction Techniques. Psychoacoustic models.

Speech coding	Waveform coding. Parametric coding. Standards. Other related applications: speech recognition and synthesis.
Audio Coding	Main characteristics of an audio signal. Time-frequency analysis : filterbanks and transforms. Transform coding. Standards. Related applications: music synthesis and effects.
Underwater acoustics and ultrasounds	Propagation of acoustic waves in water. Applications. Ultrasounds. Applications

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Practice in computer rooms	12	9	21
Tutored works	7	57	64
Short answer tests	2	0	2

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

Methodologies

	Description
Master Session	The teacher makes a presentation of some relevant contents of the subject. Some concepts may be illustrated by means of computer simulation. Students are encouraged to make questions and discuss some proposed problems and exercises. The main objective of these sessions is to provide the students with the theoretical background so that they can develop the subject competences, especially IF1.2, IF4.4 and IF5.1.
Practice in computer rooms	Students will carry out computer simulations using Matlab, which will help them to better understand the concepts introduced in the theory sessions and to discover new ones. In addition to deepen competences IF1.2, IF4.4 and IF5.1, the student will develop competences CG4.1, CG4.2 and CG6.
Tutored works	The students will be grouped into teams which will develop one or several tasks proposed by the teacher. The number of students in a team will be established taking into account the number of students enrolled and the complexity of the proposed tasks. Each team work will be supervised by the teacher who, in addition to evaluate the team work, may establish procedures for self and cross evaluation. In addition to deepen some other aspects of competences IF1.2, IF4.4 and/or IF5.1, the student will further develop competences CG4.1, CG4.2 and CG6

Personalized attention

	Description
Practice in computer rooms	The teacher will establish mechanisms to determine the degree of understanding of the main concepts by the students. At the regular team meetings the teacher will track the work of each student. If deemed appropriate, the teacher may establish additional mechanisms such as, for instance, self-evaluation and assessment of the student work from their team mates.
Tutored works	The teacher will establish mechanisms to determine the degree of understanding of the main concepts by the students. At the regular team meetings the teacher will track the work of each student. If deemed appropriate, the teacher may establish additional mechanisms such as, for instance, self-evaluation and assessment of the student work from their team mates.

Assessment

	Description	Qualification
Tutored works	The evaluation of a team work will be done through the collection of evidences and/or tests during its developement, at personal and group levels, a final report and a presentation and/or test about the work. A final report will be delivered to the teacher around the 14th week of the teaching period. The precise date will be established at the beginning of this period. In order to pass this course a minimum score will be required in the tutored work as explained in the section “Other comments and second call” Tutored work will be evaluated according to the student's competence level in CG4.1, CG4.2 and CG6, besides some other aspects of competences IF1.2, IF4.4 and/or IF5.1.	50

Short answer tests	Final exam with several questions referred to the contents of the subject. In order to pass this course a minimum score will be required in the final exam as explained in the section “Other comments and second call”. The exam is mainly focused on the evaluation of competences IF1.2, IF4.4 and IF5.1, although it will also cover some aspects of competences CG4.1, CG4.2 and CG6 (ability to solve problems, transmit knowledge, etc.).	50

Other comments and second call

The previously proposed evaluation method will apply to students who follow the recommended continuous evaluation (C.E.) procedure.In order to not handicap his potentia lteam mates,the student will have a brief period to decide whether or not follows the C.E. procedure (as an orientation,the first two weeks of the semester). Students attending only the final exam may obtain the maximum grade in the subject. However, these students will have to answer some additional questions related to the proposed team works in order to demonstrate that they have acquired the same skills that students following C.E.

The second call will consist of a final exam, but students who followed C.E. may choose to keep the grade obtained in the team work instead of answering the additional questions related to these works.

The assessment of the subject competences is jointly covered by the tutored work and the final exam. Although no competence is exclusive of these two parts, we could consider that competences CG4.1, CG4.2 and CG6 have a heavier weight in the tutored work than in the final exam.

In order to ensure that students acquire at least a balanced minimum on the subject competences, they will pass the course if they get a final mark equal to or greater than 5 (on a ten-points scale) and a score equal to or greater than 4 (on the same scale) in both the tutored work and the final exam. Just in case a student has no grade on the tutored work, or chooses to leave it out at the second call in July, the score obtained in the group of questions related to the tutored work will be considered the grade on the tutored work and the score on the remaining questions will be the final-exam grade. The final mark will be calculated as the sum of the previous scores (tutored work and final exam) achieving a 4, and dividing this sum by two.

Sources of information

Andreas Spanias, Ted Painter and Venkatraman Attii, Audio Signal Processing and Coding, Wiley-Interscience, 2007. ISBN: 978-0471791478

Wai C. Chu, Speech Coding Algorithms: Foundation and Evolution of Standardized Coders, John Wiley & Sons, 2003. ISBN: 978-0471373124

X. Lurton, An Introduction to Underwater Acoustics. Principles and Applications, Springer , 2nd edition, 2010. 978-3540784807

Douglas O'Shaughnessy, Speech Communications. Human and Machine, Wiley-IEEE Press, Se2nd edition. 1999. ISBN: 978-0780334496.

Dutoit, T. and Marqués F. , Applied signal processing : a matlab-based proof of concept, Springer, 2009. ISBN: 978-0-387-74534-3

Kuttruff, H., Acoustics. An introduction, Taylor & Francis, 2007.ISBN: 978-0415386807

D. Ensminger and F. B. Stulen, Eds., Ultrasonics. Data, Equations, and Their Practical Uses, CRC Press, 2009. ISBN: 978-0824758301

Recommendations

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Digital Signal Processing/V05G300V01304

Other comments

It is assumed that the student has some basic skills in Matlab.

IDENTIFYING DATA				
Room Acoustics				
Subject	Room Acoustics			
Code	V05G300V01635			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Sobreira Seoane, Manuel Ángel			
Lecturers	Cardenal López, Antonio José Sobreira Seoane, Manuel Ángel			
E-mail	msobre@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Architectural acoustics, develops the fundamental theoretical principles of the architectural acoustics, in the fields of room acoustics and acoustic isolation. The aims of the subject are: provide a sufficient theoretical background that allow the understanding of the behaviour of the sound filed in rooms; define the parameters that allow to evaluate the acoustic quality of rooms; develop the techniques of design that allow to optimise the acoustic behaviour of rooms; detail the parameters that allow to evaluate the acoustic isolation in buildings and introduce the problematic of the calculation of the acoustic insulation in the buildings and building elements.			

Competencies	
Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A45	CE36/SI3 The capacity to implement projects at places and installations for the production and recording of audio and video signals.
A46	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.

Learning aims		
Subject competences	Typology	Competences
CG2: The knowledge, comprehension and ability to apply the needed legislation related to the subject of Room Acoustics CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work related to the field of Room Acoustics.	know Know How	A2 A5
CE36/SI 3 The capacity to implement projects at places and installations for the production and recording of audio and video signals. CE37/SI 4.1 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms. CE 37/SI 4.2 The ability to carry out acoustic loudspeaker installations, specification, analysis and selection of electro acoustical transducers and measurements.	Know How	A45 A46

Contents	
Topic	
Introduction	Basic concepts in acoustics. Acoustic power, sound pressure, sound intensity. Levels and decibels.
Statistital theory in acoustics.	Average sound pressure in rooms. Reverberation time: Sabine and Eyring equations.
Absorbents and Acoustic Diffusers.	Porous absorbing materials. Membrane and Helmhotz resonators. Acoustic diffusers.

Wave theory in rooms.	Three dimensional wave equation.Resonant frequencies and resonant modes in rooms. Modal density. Frequency response of rooms. The influence of dimension relations and frequency response.
Geometrical theory.	Method of the virtual image. Reflections in flat surfaces. The acoustic behaviour of curved surfaces
Acoustic design of rooms.	Descriptors of room acoustics. Echoes in rooms. Focalization effects in rooms. Acoustic behaviour of audience: seat dip. Geometrical design of rooms. Design of conference rooms and classrooms. Recording studios: LEDE and Non-Environment design techniques.
Acoustic insulation.	Introduction to the acoustic insulation. Acoustic isolation of single panels. Insulation of double walls. Introduction to the flanking transmission evaluation in buildings. Noise control in buildings.

Planning

	Class hours	Hours outside the classroom	Total hours
Tutored works	7	28	35
Practice in computer rooms	12	9	21
Previous studies / activities	0	15	15
Master Session	19	38	57
Troubleshooting and / or exercises	2	10	12
Short answer tests	2	8	10

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

Methodologies

	Description
Tutored works	Learning aim A45 and A46 are covered through the development of practical tutored works and measurements. The students will have to develop and write a report on three small projects: 1. Design and building Helmholtz and membrane resonators. 2. Design and acoustic measurements on scale models. 3. Software to calculate acoustic reflectors and diffusers
Practice in computer rooms	During practical sessions, the student will learn the use use of software to measure and analyse the impulse response of rooms. (Learning aim A5)
Previous studies / activities	The students must study and prepare with the sources of information given before the lectures and the practical sessions. (Learning aim related to the knowledge of regulations related to room acoustics-Learning aim A2).
Master Session	Lectures will be given, developing the main theoretical concepts of the subject.

Personalized attention

	Description
Master Session	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Tutored works	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Practice in computer rooms	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Troubleshooting and / or exercises	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Short answer tests	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Assessment

	Description	Qualification
Tutored works	Tutored practical project, with the delivery of a final report. The learning aims containing the develompent of the ability to develop projects are assesed through this practical tutored works (SI 3.1, SI 4.1 and SI 4.2.)	35
Practice in computer rooms	Practical tasks, solved in a computer lab with specific acoustic software. Assesment of the practical aspects related to the learning aims CG2 y CG5.	15
Troubleshooting and / or exercises	Written examination, solving calculation problems. Evaluation of the learning aim CG5, mainly in those aspects related to "know how to carry calculations out" in the field of room acoustics.	25
Short answer tests	Short answers related to the theoretical content of the subject. Evaluation of the competence CG2 in the aspects related to knowledge of regulations in the matter of room acoustics.	25

Other comments and second call

Following the guidelines of the degree, two systems of evaluation are offered: continuous assessment (recommended) and a final examination. Evaluation with only a final examination will be only allowed in situations in which it is imposible to follow the system recommended.

CONTINUOUS ASSESSMENT:Â

The continuous assessment will be based in the evaluation of practical task, projects and two tests. Once a student has signed a document of agreement with the process of continuous assessment, the final degree will be obtained by the application of the criteria described bellow, even though a student could miss some of the tasks or tests envolved in the process.

The final grade with be obtained from the weighted sum of the grade obtained in the following tasks with the given weights:

1. Tutored works: The students will deliver three reports on tutored works during the weeks 5th, 9th and 14th. The total weight of tutored works on the final grade is 35 %.
2. Reports of practical tasks (Weight: 15 %).
3. Short answer tests : A short answer tests is scheduled around the 6th week. (25 % of the final grade)
4. A second examination, containing problems and exercises is scheduled on the official scheduled date at the end of the semester.(25 % of the final grade)

FINAL EXAMINATION:

A final examination is available for those students that for some reason could not follow the continuous evaluation assessment process. In this case there is date scheduled and officially published for final examination. The final examination will consist in two short answer tests, and some additional questions related with the practical tasks and projects.

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if the final grade obtained is equal or greater than 5.

SECOND CALL:

There is scheduled date in july for a final examination retake, for those students that either dropped out during the semester or failed. Prior the examination, a student can choose to follow the continuous assessment or the final examination. In the former selection, the grades obtained in the projects and practical tasks will be taken into account and the student will only answer to the short answer tests. If the later, (final examination), the student will have also to answer a full examination as described before.

Sources of information

Higini Arau, ABC de la acústica arquitectónica , , Barcelona : CEAC, D.L. 1999

Phillip R. Newell, Recording Studio Design, 3, Focal Press

Lothar Cremer, Principles and applications of room acoustics, , London ; New York : Applied Science, cop. 1982

Recommendations

Subjects that continue the syllabus

Advanced Acoustics/V05G300V01933
Noise Measurement Techniques and Regulations/V05G300V01934

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Fundamentals of Acoustics Engineering/V05G300V01531

IDENTIFYING DATA				
Distributed and Concurrent Programming				
Subject	Distributed and Concurrent Programming			
Code	V05G300V01641			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	García Duque, Jorge			
Lecturers	García Duque, Jorge Pazos Arias, José Juan			
E-mail	jgd@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main goal of this subject is to provide the foundations of the synchronisation and communication among processes in centralised and distributed systems.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A42	CE33/TEL7 The ability to program network and distributed applications and services.

Learning aims		
Subject competences	Typology	Competences
The ability to program network and distributed applications and services.	know Know How	A42
The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations	know	A3
The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.	know Know How Know be	A4
The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.	Know How Know be	A9

Contents	
Topic	
Introduction to Concurrent Programming	Concepts of concurrence, parallelism and multitasking. Interleaving of atomic instructions. Precedence graphs.
The critical section problem	The definition of the problem. Busy waiting. Starvation Deadlock. Dekker´s algorithm. Peterson´s algorithm

Concurrent Programming Constructs	Semaphores. The problem of the producer-consumer. The problem of the philosophers. Monitors. Variables of Condition. The problem of the readers-writers.
Deadlock	Introduction and definition of deadlock. Necessary conditions. Deadlock prevention. Deadlock avoidance. Detection and Recovery
Communication among processes	Message Passing. Remote Procedure Call (RPC).
Distributed Programming	Introduction to Distributed Systems. Distributed mutual exclusion Ricart-Agrawala Algorithm. Token ring Algorithms. Consensus: Crash Failures. Byzantine Failures.

Planning

	Class hours	Hours outside the classroom	Total hours
Workshops	5	30	35
Practice in computer rooms	13	26	39
Master Session	20	46	66
Multiple choice tests	1	0	1
Practical tests, real task execution and / or simulated.	1	0	1
Jobs and projects	2	6	8

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

Methodologies

	Description
Workshops	Each group of students will tackle the design and implementation of a software project with half complexity. This task will be realised in successive steps, that will be discussed and validated in the face-to-face sessions. The aim of this methodology is to provide a suitable feedback to improve the proposed solutions. This methodology deals with skills CG4 and CG9
Practice in computer rooms	The students will resolve practical problems under supervision of teachers This methodology deals with skill CE33/TEL7
Master Session	Presentation of the ideas, concepts, technics and algorithms of each lesson. This methodology deals with skill CG3

Personalized attention

	Description
Master Session	Personalised attention will be dispensed through individual and face-to-face meetings scheduled at the beginingt of the course. For practices and workshops, the personal attention will be articulated by means of the follow-up of the job of each student, monitoring the partial proposed solutions and reorienting them if it was necessary.
Workshops	Personalised attention will be dispensed through individual and face-to-face meetings scheduled at the beginingt of the course. For practices and workshops, the personal attention will be articulated by means of the follow-up of the job of each student, monitoring the partial proposed solutions and reorienting them if it was necessary.
Practice in computer rooms	Personalised attention will be dispensed through individual and face-to-face meetings scheduled at the beginingt of the course. For practices and workshops, the personal attention will be articulated by means of the follow-up of the job of each student, monitoring the partial proposed solutions and reorienting them if it was necessary.

Assessment

	Description	Qualification
Multiple choice tests	Proof of theoretical contents exposed in the master classes. These tests evaluate skill CG3	60
Practical tests, real task execution and / or simulated.	Validation of the work realised in every laboratory session. These exercises evaluate skills CE33/TEL7	20
Jobs and projects	In the last face-to-face session of workshop, students will deliver and will expose to their mates the design and the proposed solution for their project. This solution will be exposed to debate for students and professors This project evaluates skills CG4 and CG9	20

Other comments and second call

The subject can be surpassed by means of Continuous Evaluation according to the following criteria, having opened the possibility to opt by the No Continuous Evaluation anytime until the beginning of the final examination to celebrate the day fixed to such effect in the official calendar of the EET. All those students that opt by the continuous evaluation will consider presented if they evaluate of the part of the work in Workshops.

Continuous evaluation:

The final note will result of the sum of the corresponding notes to the three following components:

1.Â Â Â Â Four proofs of type Test to evaluate the contents given in the masterclasses. Each proof will take place in one of the master classes , except the last that will realise in one of the sessions of the Workshop.

Punctuation: Up to 1,5 points each proof.

2.Â Â Â Â Six Practical Proofs that will realise when finalising each one of the sessions of laboratory and that will consist in the validation of the results obtained during said session.

Punctuation: Up to 1/3 points each proof.

3.Â Â Â Â Presentation of the Project proposed like work in the sessions of the Workshop.

Punctuation: Up to 2 points.

To pass the subject by Continuous Evaluation will have to give the three following conditions: (i) obtain an equal or upper qualification to 2 points in the group of the tests.; (ii) Upper qualification to 0 points in, at least, four of the six practical proofs; and (iii) to attend all the face-to-face sessions and obtain more than 0 points in the presentation of the project.

No Continuous Evaluation:

By means of an examination on 10 points scheduled in the official calendar of the EET.

Final Call:

It will be governed by the indicated for the No Continuous evaluation.

Sources of information

M. Ben-Ari, Principles of Concurrent And Distributed Programming, Second Edition, Addison Wesley 2006

George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems Concepts and Design, Fifth Edition, Addison Wesley 2011

William Stallings, Operating Systems: Internals and Design Principles, 6/E, Seventh Edition, Prentice Hall 2011

Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating system concepts, Eight Edition, Wiley, cop. 2011

Lea, Douglas, Programación concurrente en Java : principios y patrones de diseño , Second Edition, Addison Wesley, 2001

Recommendations

Subjects that are recommended to be taken simultaneously

Architectures and Services/V05G300V01645
Information Systems/V05G300V01644

Subjects that it is recommended to have taken before

Informatics: Computer Architecture/V05G300V01103
Programming I/V05G300V01205
Programming II/V05G300V01302
Operating Systems/V05G300V01541

IDENTIFYING DATA				
Network and Switching Theory				
Subject	Network and Switching Theory			
Code	V05G300V01642			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Suárez González, Andrés			
Lecturers	Fernández Veiga, Manuel Suárez González, Andrés			
E-mail	asuarez@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The objective pursued with this course is that students acquire mastery of the basic methods of analysis for predicting the performance of networks, services and telecommunication systems, in terms of the amount of traffic they carry, the physical structure of the system and the way it is interconnected, the capacity of its constituent network elements and the algorithms used in them.			

Competencies	
Code	
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A37	CE28/TEL2 The ability to apply the techniques that are basis of computer networks, services and applications, such as management, signaling and switching, routing and securing systems (cryptographic protocols, tunneling, firewalls, charging mechanisms, authentication and content protection) traffic engineering (graph theory, queuing theory and teletraffic) rating, reliability and quality of service in both fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.
A40	CE31/TEL5 The ability to follow the technological progress of transmission, switching and processing to improve computer networks and services.

Learning aims		
Subject competences	Typology	Competences
Ability to apply mathematical methods of queueing theory to the analysis and design of telecommunication networks and systems.	know Know How	A5 A37 A40
Ability to understand the basic compromises in designing telecommunication networks and systems in function of the parameters of traffic.	know Know How	A5 A37 A40
Ability to use methods of discrete mathematics to resolve problems of routing and interconnection of networks, reliability, quality of service and distribution of contents in wired and wireless networks, fixed and mobile networks, access and transport networks.	know Know How	A5 A37 A40
Mastery of the necessary basic concepts to resolve problems of resource optimization in networks.	know Know How	A37 A40

Contents	
Topic	
Queuing Theory	One-server systems. Finite queue systems. Systems with congestion: models of Erlang and Engset. Reversibility. Networks of queues with product solution. Applications: design of link capacity; design of buffer size; congestion in cellular networks; analysis of systems with priorities; provision of ARQ; provision of multiaccess networks.

Graph theory	Graph traversal and connectivity. Minimum cut, maximum flow. Tree coverage and expansion. Minimum cost trees. Graph coloring. Results and uses. Regular and irregular random graphs: small world networks, scale-free networks. Applications: Network topology design, the web graph, message broadcasting in wired networks and ad hoc networks.
Network Optimization	Utility Maximization. NUM decomposition problems. Applications.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Practice in computer rooms	10	15	25
Projects	7	42	49
Long answer tests and development	2	3	5
Long answer tests and development	2	6	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	It will present a systematic theoretical approach to the subject, highlighting the objectives, key concepts and relationships between different topics. Students should assimilate knowledge to enable them in the CG5, CE31/TEL5 and CE28/TEL2 competencies.
Practice in computer rooms	Guided practice where it is intended to study problems by both by applying analytical techniques and by using software tools, providing a training in the use of the latter. So students should acquire practical training in the CE28/TEL2 competency.
Projects	Group work focused on studying and solving a real problem using the techniques studied in theory and the software tool seen in practice. So students should gain practical experience that will enable them on the CE31/TEL5 competency.

Personalized attention

	Description
Master Session	The student may consult individually in the tutoring hours all doubts that arise in the study of both the theoretical content and the use of the software tools of the practices.
Practice in computer rooms	The student may consult individually in the tutoring hours all doubts that arise in the study of both the theoretical content and the use of the software tools of the practices.
Projects	The student may consult individually in the tutoring hours all doubts that arise in the study of both the theoretical content and the use of the software tools of the practices.

Assessment

	Description	Qualification
Projects	Group work, presentation and defense of the resolution of a typical real-world problem by applying both theoretical knowledge as using, where appropriate, the software tools used in practical classes.	20
Long answer tests and development	Partial test developed over the first two themes, around the eighth week of class.	30
Long answer tests and development	Final test done on the total of the subject.	50

Other comments and second call

It is left to the discretion of the students two alternative evaluation methods in the subject: continuous assessment and one-time evaluation.

To pass the course both continuous assessment and one-time evaluation, the alumniÂ must and pass the correctness test of the proposed practices for hours B of the subject. This ensures a minimum on the CE28/TEL2 competency.

Also the selection of continuous assessment involves conduct a non-scoring short test (15 minutes) of previous and basic knowledge on the second week at hour A. In addition to this short test, continuous assessment will consist on the group development of two projects (each project half the note), a partial test on the first two topics, and the completion of a written exam at the end of the quarter about the total content of the subject. The statements in the specification of the projects will be proposed before ending the respective classes about those topics. To be qualifying, the projects have to be delivered within a period not shorter than 7 calendar days after the relevant class C of discussion with the teacher about the progress of it, the teacher will qualify within 7 calendar days after delivery. The rating of the projects and partial test is effective only in the course they are proposed, including the second opportunity at the end of the academic year. In any case, the minimum score on the continuous assessment evaluation (once the requirements of the second paragraph and beginning of this one are met) is given by the result in the final test: score = max (0.2 x projects + 0.3 x partial + 0.5 x final, final). Passing partial and final test requires a minimum in the CG5 and CE31/TEL5 competencies while assessing the degree of training in the three of them including the CE28/TEL2 competency. The evaluation of projects is an additional measure of the degree of assimilation of the CE31/TEL5 competency.

The one-time assessment will consist of a written examination on the contents of the subject. The final grade (once the requirement of the second paragraph is met) will be the score obtained in the exam. Passing this test requires a minimum in the CG5 and CE31/TEL5 competencies while assessing the degree of training in the three of them including the CE28/TEL2 competency.

All students who have attended the partial test or attend the final exam will be subjected to a final qualification. The evaluation mode (continuous or one-time) will be chosen in the act of examination, exercise whose wording is different for each type of evaluation. Those who fail the course at the first opportunity at the quarter end have a second at the end of the academic year, similar to the first call: The evaluation mode (continuous or one-time) will be chosen in the act of examination, exercise whose statement will be different for each type of evaluation.

Sources of information
Pazos Arias, J.J., Suárez González, A., Díaz Redondo, R.P., Teoría de colas y simulación de eventos discretos, 2003, Prentice Hall
Villy B. Iversen , TELETRAFFIC ENGINEERING and NETWORK PLANNING , 2011, web
M.J. Newman, Networks, 2012, Oxford Univ. Press

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204
Data Communication/V05G300V01301
Computer Networks/V05G300V01403

IDENTIFYING DATA

Multimedia Networks

Subject	Multimedia Networks			
Code	V05G300V01643			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Herrería Alonso, Sergio			
Lecturers	Herrería Alonso, Sergio López García, Cándido Antonio			
E-mail	sha@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject presents the main specific technological solutions for the distribution of audiovisual contents over telecommunication networks.			

Competencies

Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A39	CE30/TEL4 The ability to describe, program, assess and optimize communication protocols and interfaces at different network architecture layers .
A42	CE33/TEL7 The ability to program network and distributed applications and services.

Learning aims

Subject competences	Typology	Competences
The comprehension of basic concepts in digital encoding of audio and video.	know	A3
The knowledge of the main standards in the field of digital encoding of audio and video.	know	A6
The knowledge and comprehension of the main problems raised in the transmission of audiovisual contents.	know	A3
The knowledge of the main protocols used for the transmission of audiovisual contents.	know	A6 A39
The knowledge and comprehension of the main mechanisms used to provide quality of service in Internet.	know	A3
The ability to analyze and develop VoIP networks.	know Know How	A39 A42
The knowledge of the basic characteristics of cellular networks.	know	A3

Contents

Topic	
Digital encoding of audio and video	a) Digital audio (PCM). Audio compression b) Digital video. Intraframe and interframes compression
Multimedia applications	a) Classes. Quality of service (QoS) requirements b) Impact of delay and packet losses c) Content distribution: multicast, CDNs... d) IP Telephony: architecture, softphones, softswitches...
Multimedia protocols	a) RTP/RTCP b) SIP c) H.323 d) RTSP

Providing quality of service in Internet	a) Monitoring and policing mechanisms b) Scheduling and resource allocation c) Differentiated Services (DiffServ) d) Integrated Services (IntServ). RSVP
Cellular networks	a) Architecture b) Signalling c) Mobility management

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	20	40	60
Practice in computer rooms	12	18	30
Tutored works	6	24	30
Troubleshooting and / or exercises	1	5	6
Jobs and projects	1	5	6
Troubleshooting and / or exercises	2	16	18

*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	Exhibition of the ideas, concepts and techniques of each topic of the course. In these sessions, students must acquire competences A3, A6 and A39.
Practice in computer rooms	Practical learning of basic tools for the distribution of multimedia contents on computer networks. In these sessions, students must acquire competences A39 and A42.
Tutored works	Configuration, under the supervision of professors, of a basic IP PBX. This work should help to acquire competence A42.

Personalized attention

	Description
Master Session	It will be dispensed individually attention during the hours of tutoring. No appointment is necessary.

Assessment

	Description	Qualification
Troubleshooting and / or exercises	Partial exam covering some of the contents of the subject. Questions and problems of conceptual, logical, analytical or applied character. One hour long written exercise. Competences A3, A6 and A39 are evaluated.	20
Jobs and projects	Evaluation of the features and performance of the IP PBX configured by the student during the course. Competence A42 is evaluated.	20
Troubleshooting and / or exercises	Final exam covering all the contents of the subject. Questions and problems of conceptual, logical, analytical or applied character. Two hour long written exercise. Competences A3, A6 and A39 are evaluated.	60

Other comments and second call

Two different systems of evaluation will be offered to the students: continuous evaluation and evaluation at the end of the course.

Students opting for continuous evaluation must take two intermediate tasks: a short exam around week 5 of the course (20% of the final mark) and a project consisting of the configuration of a basic IP PBX around week 13 of the course (20% of the final mark), together with a final written exam at the end of the course (60% of the final mark). Both intermediate tasks are not recoverable and will be only valid for the current course.

Students can also opt for being evaluated by means of just a final written exam at the end of the course. The final mark of the subject will be, in this case, just the mark obtained in this exam.

It will be considered that a student opts for continuous evaluation if he takes the short exam or the project proposed. The final exam can contain some additional questions for those students that have opted by the evaluation at the end of the course.

If plagiarism is detected in any of the tasks proposed (exams or project), the involved students will be failed with a final mark of 0.

Those students that have not passed the subject in first call will have to take an extra written exam in July. Those students that opted for continuous evaluation will be able to choose between evaluation by means of just the final exam or keep continuous evaluation, in which case they would keep the marks obtained in the intermediate tasks (short exam and project) and only would have to take the final exam as the last task. Students will be able to indicate which of these two options choose at the final exam.

Sources of information
J.F. Kurose, K.W. Ross, Computer networking: a top-down approach, 6ª ed., 2012
Kun I. Park, QoS in packet networks, 1ª ed., 2010
Mario Marchese, QoS over heterogeneous networks, 1ª ed., 2007
M. Barreiros, P. Lundqvist, QoS-enabled networks: tools and foundations, 1ª ed., 2011
Ted Wallingford, Switching to VoIP, 1ª ed., 2005
L. Madsen, J. Van Meggelen, R. Bryant, Asterisk : the definitive guide, 1ª ed., 2011
S. Wintermeyer, S. Bosch, Practical Asterisk 1.4 and 1.6, 1ª ed., 2010
Alan B. Johnston, SIP: Understanding the Session Initiation Protocol, 3ª ed., 2009

Recommendations

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Computer Networks/V05G300V01403

IDENTIFYING DATA				
Information Systems				
Subject	Information Systems			
Code	V05G300V01644			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Ramos Cabrer, Manuel			
Lecturers	Pazos Arias, José Juan Ramos Cabrer, Manuel			
E-mail	mramos@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim of this subject is to introduce to the student in the main technologies to process and store the information, like central element of the telematic services			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A36	CE27/TEL1The ability to construct, operate and manage telecommunication networks, services, processes and applications considered as systems to receive, transport, represent, process, store, manage and present multimedia information from the computer services point of view.
A38	CE29/TEL3 The ability to build, operate and manage computer services using planning, sizing and analytical tools

Learning aims		
Subject competences	Typology	Competences
TEL1 The ability to construct, operate and manage telecommunication networks, services, processes and applications considered as systems to receive, transport, represent, process, store, manage and present multimedia information from the computer services point of view.	know Know How	A36
Know the main mechanisms of search, recovery and presentation of the information.	know Know How	A36
Know the concept of metainformation and his main applications in the new telematic services.	know Know How	A36
TEL3 The ability to build, operate and manage computer services using planning, sizing and analytical tools	know Know How	A38
CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations	know Know How	A3
CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.	Know How Know be	A4
CG6: The aptitude to manage mandatory specifications, procedures and laws.	Know How	A6
CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.	Know How Know be	A9

Contents	
Topic	
Introduction and general perspective of the Systems of Information.	- Concepts of system of information and database. - Types of systems of information. - Concept of Managing System of Databases. - Models of databases. - The process of design of a database.
Design of Relational Databases: Conceptual Model.	- Aims of the conceptual design. - Conceptual models of databases. - The E-A model.
Design of Relational Databases: Logical Model.	- Concept of the logical design. - Logical models of databases. - The relational model. - Relational algebra. - Relational calculus. - Normalisation of databases.
Database Management Systems.	- Physical storage of the data. - Organisation of data in files. - Indexes and associations. - Management of the integrity of the data. - Consistency. - Concepts related with the security. - Optimisation of queries.
Other information systems.	- No relational databases. - Semistructured information Processing. - No-structured information Processing. - Meta-information and infomration semantics: - Semantic information processing. - Semantic web and ontologies.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	20	46	66
Practice in computer rooms	13	26	39
Workshops	5	30	35
Multiple choice tests	1	0	1
Practical tests, real task execution and / or simulated.	1	0	1
Jobs and projects	2	6	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	Presentation of the ideas, concepts, technics and algorithms of each lesson. This activity develops CG3, CG4 and CG6 competencies.
Practice in computer rooms	The students will resolve practical problems under supervision of teachers. This activity develops CG4, CE29/TEL3 and CE27/TEL1 competencies.
Workshops	Each group of students will tackle the design and implementation of a software project with half complexity. This task will be realised in successive steps, that will be discussed and validated in the face-to-face sessions. The aim of this methodology is to provide a suitable feedback to improve the proposed solutions. his activity developsCG9, CE27/TEL1 and CG4 competencies.

Personalized attention	
	Description
Workshops	Personalised attention will be dispensed through individual and face-to-face meetings scheduled at the beginingt of the course. For practices and workshops, the personal attention will be articulated by means of the follow-up of the job of each student, monitoring the partial proposed solutions and reorienting them if it was necessary.

Practice in computer rooms	Personalised attention will be dispensed through individual and face-to-face meetings scheduled at the beginingt of the course. For practices and workshops, the personal attention will be articulated by means of the follow-up of the job of each student, monitoring the partial proposed solutions and reorienting them if it was necessary.
Master Session	Personalised attention will be dispensed through individual and face-to-face meetings scheduled at the beginingt of the course. For practices and workshops, the personal attention will be articulated by means of the follow-up of the job of each student, monitoring the partial proposed solutions and reorienting them if it was necessary.

Assessment

	Description	Qualification
Multiple choice tests	Proof of theoretical contents exposed in the master classes. In these proofs CG3, CG4 and CG6 competencies will be evaluated.	60
Practical tests, real task execution and / or simulated.	Validation of the work realised in every laboratory session. In these proofs CG4, CE27/TEL1 and CE29/TEL3 competencies will be evaluated.	20
Jobs and projects	In the last face-to-face session of workshop, students will deliver and will expose to their mates the design and the proposed solution for their project. This solution will be exposed to debate for students and professors. In these proofs CG4, CE27/TEL1 and CG9 competencies will be evaluated.	20

Other comments and second call

The subject can be surpassed by means of Continuous Evaluation according to the following criteria, having opened the possibility to opt by the No Continuous Evaluation anytime until the beginning of the final examination to celebrate the day fixed to such effect in the official calendar of the EET. All those students that opt by the continuous evaluation will consider presented if they evaluate of the part of the work in Workshops.

Continuous evaluation:

The final note will result of the sum of the corresponding notes to the three following components:

1.Â Â Â Â Four proofs of type Test to evaluate the contents given in the masterclasses. Each proof will take place in one of the master classes , except the last that will realise in one of the sessions of the Workshop.

Punctuation: Up to 1,5 points each proof.

2.Â Â Â Â Six Practical Proofs that will realise when finalising each one of the sessions of laboratory and that will consist in the validation of the results obtained during said session.

Punctuation: Up to 1/3 points each proof.

3.Â Â Â Â Presentation of the Project proposed like work in the sessions of the Workshop.

Punctuation: Up to 2 points.

To pass the subject by Continuous Evaluation will have to give the three following conditions: (i) obtain an equal or upper qualification to 2 points in the group of the tests.; (ii) Upper qualification to 0 points in, at least, four of the six practical proofs; and (iii) to attend all the face-to-face sessions and obtain more than 0 points in the presentation of the project.

No Continuous Evaluation:

By means of an examination on 10 points scheduled in the official calendar of the EET.

Final Call:

It will be governed by the indicated for the No Continuous evaluation.

Sources of information

Basic resources:

[1]Â Â Â *Â “*Database *System *Concepts”.* Abraham *Silberschatz, Henry *Korth and *S. *Sudarshan. 6ª edition. 2010, *McGraw-*Hill.

[2]Â Â Â *Â “SQL *Cookbook”.* Anthony *Molinaro. 1º edition. 2005, O'Reilly Half.
[3]Â Â Â *“*Murach'*s *Java *Servlets *and *JSP”.* Andrea *Steelman and Joel *Murach. 2ª edition. 2008, Mike *Murach & *Associates.

Additional references

[1]Â Â Â *“*Fundamentals *of *Database *Systems”.* *Ramez *Elmasri And *Shamkant *Navathe. 6ª edition. 2010, Addison Wesley.
[2]Â Â Â *Â “*Database *Systems: *The Complete *Book”.* Hector Garcia-Molina, Jeffrey D. *Ullman And Jennifer *Widom. 2ª edition. 2008, *Prentice *Hall
[3]Â Â Â *“To *First *Course *in *Database *Systems”.* Jeffrey D. *Ullman And Jennifer *Widom. 3ª edition. 2007, *Prentince *Hall.
[4]Â Â Â *“*An *Introduction *to *Database *Systems”.* Chris *J. Give you. 8ª edition. Â 2003, Addison Wesley.
[5]Â Â Â *“*Database *Design *and *Relational *Theory: Normal *Forms *and *All *That Jazz”.* Chris *J. Give you. 1ª edition.Â 2012, O'Reilly Half.
[6]Â Â Â *“*Beginning *Database *Design: *From *Novice *to *Professional”.* Clare *Churcher. 1ª edition. 2007, *Apress.
[7]Â Â Â *“*Professional Apache *Tomcat 6”.* *Vivek *Chopra, *Sing *Li and Jeff *Genender . 1ª edition. 2007, *Wrox.
[8]Â Â Â Â “**Beginning SQL *Joes 2 *Pros: *The SQL *Hands-*On *Guide *for *Beginners”.* Rick To *Morelan. 1ª edition. 2009, *BookSurge *Publishing.
[9]Â Â Â *Â “*Beginning *JSP , *JSF *and *Tomcat Web *Development: *From *Novice *to *Professional”.* Giulio *Zambon and Michael *Sekler. 1ª edition. 2007, *Apress.
[10] *“*Core Web *programming”.* *Volumenes 1 and 2. *Marty *Hall And Larry Brown. 2ª edition. 2001, *Prentice *Hall.
[11] *“*Beginning *JavaServer *Pages”.* *Vivek *Chopra, Jon *Eaves, *Rupert Jones and *Sing *Li. 1ª edition.Â 2005, *Wrox.
[12] *“*Professional *JSP”.*Simon Brown, Robert *Burdick, Jayson *Falkner and others. 2ª edition. 2001, *Wrox.

Recommendations

Subjects that are recommended to be taken simultaneously

Architectures and Services/V05G300V01645
Distributed and Concurrent Programming/V05G300V01641

Subjects that it is recommended to have taken before

Programming II/V05G300V01302
Internet Services/V05G300V01501
Operating Systems/V05G300V01541

IDENTIFYING DATA				
Architectures and Services				
Subject	Architectures and Services			
Code	V05G300V01645			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	3rd	2nd
Language	Spanish			
Department				
Coordinator	Fernández Vilas, Ana			
Lecturers	Díaz Redondo, Rebeca Pilar Fernández Vilas, Ana			
E-mail	avilas@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course focuses on the architectonic solutions for the design of distributed systems. More specifically, the course is oriented to sscenarios based on services (service-oriented architectures) and the deploymen SOA solutions by means of Web Services Technologies (WS-*). Taking the WS-* stack as our techonologcal layout, the course lokks through the description, discovery and invocation of services in an SOA. Finally, The course introduces models for services composition in SOA (again using Web Services as deployment technology).			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A38	CE29/TEL3 The ability to build, operate and manage computer services using planning, sizing and analytical tools
A41	CE32/TEL6 The ability to design networks and service architectures.

Learning aims		
Subject competences	Typology	Competences
The ability to build, operate and manage computer services using planning, sizing and analytical tools	Know How	A38
The ability to design networks and service architectures	Know How	A41
The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations	Know How Know be	A3
The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.	Know How Know be	A4
The aptitude to manage mandatory specifications, procedures and laws.	Know How	A6

Contents	
Topic	
Introduction	• Distributed Systems. • Client-server Model: RPC. • Message Middlewares. • Web Services and SaaS. • SOA : Roles, operations, layers.
Web Services	• Simple SOA with REST. • API Styles for Web Services. • RPC, messages and resources APIs. • Stack of Web Services technologies.

Technological Basis	• Review of XML. • SOAP Protocol & Messages. • WSDL: Description of Services. • Services Discovery.
Designing Services	• Design of Web Services. • Web Service LifeCycle. • Implementation Axis/TomCat.
Composing Services	• Model of composition • Orchestration and choreography • Orchestration with WS-BPEL • Description of choreography: WS-CDL

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	19	38	57
Practice in computer rooms	8	8	16
Troubleshooting and / or exercises	3	6	9
Workshops	2	6	8
Projects	2	28	30
Presentations / exhibitions	2	8	10
Practical tests, real task execution and / or simulated.	4	8	12
Long answer tests and development	2	6	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	Classes that will combine the exhibition of the concepts and small exercises. These will be resolved by the teachervor by the students individually and/or in groups. The aim is to boost the debate in the class and reinforce the acquisition of skills. COMPETENCES: A3, A41, A38
Practice in computer rooms	During all the course, the lab sessions will be devoted to the development of small prototypes that allow to materialise the fundamental concepts of the course. COMPETENCES: A4, A6
Troubleshooting and / or exercises	In the laboratory or in the classroom, the professor will pose small challenges that will be resolved collectively so that the students can discuss abouth the underlying concepts and the different options. COMPETENCES: A3, A4.
Workshops	The workshops will be devoted to the discussion of real cases and to the follow-up of the project of the course. COMPETENCES: A4, A6
Projects	The students, in groups, will develop a software system whose requirements will be established in the 9th week of the teaching period. The follow-up of the project will be carried out during the workshops. COMPETENCES: A38, A41
Presentations / exhibitions	Each workhroup will justify in a oral presentation the adopted solution for the course project. The presentation will take place the last week of the teaching period. COMPETENCES: A4

Personalized attention

	Description
Projects	During the second part of the course, the students (organised in groups) will tackle the design and implementation of a telematic system using the architectonic and technological principles of Web Services. Each group will be continuously guided (weekly) about the adopted solution (workshops of the course).
Workshops	During the second part of the course, the students (organised in groups) will tackle the design and implementation of a telematic system using the architectonic and technological principles of Web Services. Each group will be continuously guided (weekly) about the adopted solution (workshops of the course).

Assessment

	Description	Qualification

Presentations / exhibitions	Each workgroup will justify in an oral presentation the solution adopted in his project. The presentation will take place the last week of the teaching period with the professors of the course. COMPETENCES: A4	10
Projects	Each workgroup will deliver the course project during the penultimate week of the teaching period. The delivery will consist of the design, implementation and documentation. After delivering the project, a practical test will be performed (last week of the course) on the project implemented by each of the groups . COMPETENCES: A4, A5, A41	20
Practical tests, real task execution and / or simulated.	This test will take place the last week of the teaching period. Individually, each student will solve an exercise that show his/her skills in using the main technologies of the course in some practical context. COMPETENCES: A5, A38	20
Long answer tests and development	Individual writing test will take place in the date indicated in the official calendar of exams. Books, class notes and other matrial will not be allowed during the exam. COMPETENCES: A38, A41, A3.	50

Other comments and second call

The student can follow up an assesment model of continuous evaluation or can do a final exam.Â

CONTINUOUS EVALUATION

The CONTINUOUS EVALUATION consists in the assesment activities mentioned previously. The student can choose to follow upÂ continuous evaluation in week 7, after the first two assessments of the course. After that, workgroups are created in order to tackle the collaborative development the course project. From this moment, the final mark never will be "not taken" (incomplete).

The maximum mark for the activities in continuous evaluation is the following:

1. Individual writing test: Official calendar (Maximum 5 points).
2. Intermediate Test I: Practical Test (Maximun 1 point).
3. Intermediate Test II: Practical Test (Maximun 1 point).
4. Project:Â Â Design, implementation and deployment (Maximum 3 points) .

The student passes the course if he/she obtains at least 2 points in "Individual Wirting Test"(1); a minimumÂ of two points in the other sections (2, 3 , and 4);Â and a total score (sum of theÂ assessmentÂ activities) equal or upper to 5 points. The maximum score is 10 points.

FINAL EXAM

The evaluation by means of a FINAL EXAM will consist of the following parts (Tests will not be recoverable):

1. Writing Test: Maximum of 5 points. A minimum punctuation of 2,5 points will be required.
2. Individual Project: Delivered during the last week of teaching. It will include design, implementation and documentation. TheÂ maximumÂ score is 2 points.
3. Practical test: In the lab. The maximumÂ scoreÂ is 3 points but a minimum of 1.5 points is required.

In any case, the course is considered passed if the student receives the minimum qualifications in both the written and the practical Â test and a total score (resulting from the sum of those obtained in sections 1, 2 and 3) equal or greater than 5Â

EXAMINATION AT THE END OF THE COURSE

For the examination ath the END OF THE COURSE, all the students will are assesed in the modality of final exam as it has described previously.

Sources of information

BASIC BIBLIOGRAPHY

- “Web Services & SOA: Principles and Technology”. Michael Papazoglou. Pearson Education, 2012 . ISBN-10:Â 0273732161
- “Building Web Services with Java: Making Sense of XML, SOAP, WSDL, and UDDI “.By Steve Graham, Doug Davis, Simeon Simeonov, Glen Daniels, Peter Brittenham, Yuichi Nakamura, Paul Fremantle, Dieter Koenig, Claudia Zentner. Sams, 2004.Â ISBN-10: 0-7686-6348-2.
- “Service-Orientâ€‹ed Architecture: A Field Guide to Integrating XML and Web Services”. Thomas Erl. Prentice Hall, 2004.

*ISBN-10: 0131428985.

COMPLEMENTARY BIBLIOGRAPHY

- “Understanding Web Services: XML, WSDL, SOAP, and UDDI.” Eric Newcomer. Addison-Wesley Professional; 1 edition, 2002. ISBN-10: 0201750813.
- “SOA Using Java Web Services. Mark D. Hansen. Prentice Hall, 2007. ISBN-10: 0130449687.
- “Distributed Systems: Concepts and Design (5th Edition)“. George F. Coulouris. Addison Wesley, 2011. ISBN-10: 0132143011.
- “Web Services: A Technical Introduction.” Harvey M. Deitel, Paul J. Deitel, B. DuWaldt, L. K. Trees. Prentice Hall, 2002.Â ISBN-10: 0130461350.
- “Service Design Patterns: Fundamental Design Solutions for SOAP/WSDL and RESTful Web Services”. Robert Daigneau. Addison-Wesley Professional; 1 edition,Â 2011. ISBN-10: 032154420X.
- “SOA in Practice: The Art of Distributed System Design (Theory in Practice)”. Nicolai M. Josuttis. O'Reilly Half; 1 edition , 2007. ISBN-10: 0596529554.
- “Principles of Transaction Processing, Second Edition”. Eric Newcomer. Morgan Kaufman; 2 edition , 2009. ISBN-10: 1558606238.
- “Service Oriented Architecture with Java: Using SOA and Web Services to build powerful Java applications”. Binildas To. Christudas. Packt Publishing, 2008) . ISBN-10: 1847193218.
- “Applied SOA: Service-Orientâ€‹ed Architecture and Design Strategies”. Michael Rosen .Wiley; 1 edition , 2008. ISBN-10: 0470223650.
- “SOA Principles of Service Design”. Thomas Erl. Prentice Hall; 1 edition, 2007. ISBN-10: 0132344823.
- Service-Orientâ€‹ed Architecture (SOA): Concepts, Technology, and Design”. Thomas Erl. Prentice Hall, 2005. ISBN-10: 0131858580
- “Programming the World Wide Web (6th Edition)”. Robert W. Sebesta . Â Addison Wesley; 6 edition, 2010. ISBN-10: 0132130815.
- Internet & World Wide Web: How to Program (4th Edition)". P.J. Deitel. Prentice Hall; 4 edition, 2007). ISBN-10: 0131752421.

Recommendations

Subjects that are recommended to be taken simultaneously

Distributed and Concurrent Programming/V05G300V01641
Information Systems/V05G300V01644

Subjects that it is recommended to have taken before

Internet Services/V05G300V01501

IDENTIFYING DATA				
Technology Management				
Subject	Technology Management			
Code	V05G300V01801			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	2nd
Language	Spanish Galician			
Department				
Coordinator	González Castaño, Francisco Javier			
Lecturers	Díaz Redondo, Rebeca Pilar Fernández Hermida, Xulio Fernández Vilas, Ana González Castaño, Francisco Javier			
E-mail	javier@det.uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	This course provides skills in design, management and leadership of technological projects. This includes detection of needs, technological surveys, team creativity techniques, project management, property definition and protection, and entrepreneurship strategies.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A63	(CE54/PY1) The ability to elaborate the proposal of technical projects according to the specified requirements in a public competitive bidding.
A64	(CE55/PY2) The ability for technical direction of telecommunication project.
A65	(CE56/PY3) The ability to manage telecommunication project human resources and economic.
A66	(CE57/PY4) The ability to elaborate technical reports and for the follow up of a telecommunication project.
B2	To approach a new problem considering first the essential and then the secondary aspects
B4	The ability to use software tools that support problem solving in engineering
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Subject competences	Typology	Competences
Interpreting needs as technological problems	Know How	A4 B2
Identifying and handling relevant sources for technological surveys	Know How	A66 B5

Techniques to boost team creativity	Know How	A4 A9 A65
Design and management of large-scale technological projects	know Know How	A1 A5 A63 A64 A65 A66
Choosing and using project management tools	Know How	B4
Management of R&D human resources	know	A4 A8 A9 A64 A65
Legal aspects	know	A2 A4 A6 A7 A8
First steps towards the creation of a start-up	know	A2 A4 A6 A8

Contents	
Topic	
Identifying and interpreting needs	- Gathering requisites - Translating needs into technical objectives - Technological perspective. Hype cycles - Sources and methods for technical surveys
Creativity techniques	- Research, development and innovation - Team methods to boost creativity - Is my idea original? Formulating and evaluating it
Project design and management	- Definition of technical goals - Translating goals into tasks - Planning the project - Project resources - Human team. R&D profiles - Budget - Tracking project evolution
Business models	- Product proposal - Risk analysis - Customer survey - Business plan
Entrepreneurship	- From the idea to the business plan - Looking for capital - Technological partnerships - First steps towards the creation of an enterprise
Legal aspects	- Types of property: Intellectual and industrial - Technological actives vs. legal property. Models, patents. Licenses - Spanish case/international case. Europe and the US. Internationalization hints - CIN/352/2009 regulation
(*)-	(*)-

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	22	26	48

Projects	4	20	24
Troubleshooting and / or exercises	2	12	14
Practice in computer rooms	28	36	64

*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	Oral presentation of the main concepts of the course by the professors, supported by multimedia. Lectures by experts
Projects	Personal project (individual or in groups) to be presented during class hours A of the last week
Troubleshooting and / or exercises	Brief individual assignments on the topics of the master sessions
Practice in computer rooms	Práctice on aspects of specification of requisites, creativity and project design and tracking using computer tools

Personalized attention	
	Description
Projects	- The professors will publish a timetable to attend the students individually at their offices - Course documentation (slides employed in the classroom, homework, questionnaires of practical assignments, documentation for the seminars, recommended lectures) will be available through the TEMA platform (http://faitic.uvigo.es)
Troubleshooting and / or exercises	- The professors will publish a timetable to attend the students individually at their offices - Course documentation (slides employed in the classroom, homework, questionnaires of practical assignments, documentation for the seminars, recommended lectures) will be available through the TEMA platform (http://faitic.uvigo.es)

Assessment		
	Description	Qualification
Master Session	Exam	25
Practice in computer rooms	Evaluation of partial results+exam	40
Projects	Individual defense (commitee)	30
Troubleshooting and / or exercises	Correction by the professors	5

Other comments and second call

The exam will take place in the official date. It will consist of two parts, with the same weight in the final score: a written part covering the whole course content and an oral part on the project of the current course. The project assignment must be handed to the professors three days before the exam date.

Competencies considered in the assessment process:

Exam: all

Evaluation of partial results in lab practice & problems: A4, A9, B2, B4, B5

Project: A4, A9, A63, B2, B4, B5

Note: in case problems will not be proposed, their weight in the assessment process will be transferred to the project.

Sources of information

- V. Chiesa (2001), R&D Strategy and Organisation, Imperial College Press
- R. Florida,Â J. Goodnight,Â Managing for Creativity, Harvard Business Review
- M. Michalko, Thinkertoys: A Handbook of Creative-Thinking Techniques (2nd edition,Â ISBN-10: 1580087736 | ISBN-13: 978-1580087735)
- A. Osterwalder, Y. Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers (ISBN: 978-2-8399-0580-0)

Recommendations

IDENTIFYING DATA				
Projects Lab				
Subject	Projects Lab			
Code	V05G300V01802			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	12	Mandatory	4th	2nd
Language	Spanish			
Department				
Coordinator	Mosquera Nartallo, Carlos			
Lecturers	Alba Castro, José Luis Álvarez Sabucedo, Luis Modesto Caeiro Rodríguez, Manuel Díaz Otero, Francisco Javier Docio Fernández, Laura Eguizábal Gándara, Luis Eduardo Fariña Rodríguez, José Fernández Manin, Generosa Fernández Vilas, Ana García Mateo, Carmen González Castaño, Francisco Javier Isasi de Vicente, Fernando Guillermo Lorenzo Rodríguez, María Edita de Machado Domínguez, Fernando Mosquera Nartallo, Carlos Prol Rodríguez, Miguel Rodríguez Rodríguez, José Luis Sánchez Real, Francisco Javier Santos Gago, Juan Manuel Valdés Peña, María Dolores			
E-mail	mosquera@gts.uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	Interdisiciplinary projects must be addressed by a group of students who must represent at least two of the four technologies of the Telecommunication Technologies Engineering Degree. The teams are supervised by two faculty members from different Departments to enrich and facilitate the cross-fertilization between different areas of work. The work developed by the different teams will be defended at the end of the course as part of the evaluation process.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A63	(CE54/PY1) The ability to elaborate the proposal of technical projects according to the specified requirements in a public competitive bidding.
A64	(CE55/PY2) The ability for technical direction of telecommunication project.
A65	(CE56/PY3) The ability to manage telecommunication project human resources and economic.
A66	(CE57/PY4) The ability to elaborate technical reports and for the follow up of a telecommunication project.
B2	To approach a new problem considering first the essential and then the secondary aspects

B3	The development of discussion ability about technical subjects

Learning aims		
Subject competences	Typology	Competences
The ability to develop projects in the field of Telecommunication Engineering	Know How	A1
The skills to handle technical specifications and standards	Know How	A6
The capacity to evaluate the potential social impact of the developed solutions	Know be	A7
Familiarity with project management and planning	Know How	A8
Skills to work as a member of an interdisciplinary team	Know be	A9
Oral and written presentation skills in the field of Telecommunication Engineering	Know How	A9
Ability to get into a new problem gradually	Know How	B2
Discussion skills on technical problems	Know be	B3
Skills to anticipate technical challenges and issues in Engineering projects.	Know How	A63
Skills to take responsabilities on technical tasks	Know be	A64
Skills to manage human and financial resources	Know How	A65
Skills to monitor the evolution of a telecommunications project	Know How	A66

Contents
Topic
1. Team work
2. Technical writing
3. Public speaking

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	0	2
Classroom work	4	4	8
Projects	14	244	258
Presentations / exhibitions	8	24	32
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	Some practical hints on skills such as oral and written presentation, and team working.
Classroom work	Partial review of the different projects evolution, with short presentations and discussions.
Projects	This is the core of the course: the team of students must address a project initially proposed by two faculty members. During the duration of the course the team members must work in close cooperation to achieve the objectives of the project; the supervision is such that a weekly one hour meeting willl take place with one or both advisors. All members of the team must be able to defend its project at the end of the course in both oral and poster sessions.
Presentations / exhibitions	Every team must defend its project in a final oral presentation and a poster session. The oral presentation can be made by one or more members of the team, and must include evidences to show proof of the work developed and achieved results. At the end of the presentation all members must be available for Q&A. The poster session requires the presence of all members of the team. An executive summary of the work must be available to the evaluation committee three days in advance.

Personalized attention	
	Description
Projects	The two advisors will hold a one hour weekly meeting with the students. In addition, they will be available during their regular office hours for additional support.

Assessment		
	Description	Qualification

Presentations / exhibitions	A portion of the final grade will be based on the committee evaluation during the LPRO DAYS. The attendance to these days will be mandatory for all students. They must submit an executive summary of the project at least three days in advance to help assess their work. The members of the evaluation committe will be the instructors of the Type-A ECTS, as long as they are not involved in the supervision of any project. Otherwise, additional assistance for the evaluation of those conflicting projects will be requested from other instructors from the course. Competences A1, A7, A9 and B3 will be evaluated here. Although the grade is expected to be similar for the entire group as a general principle, exceptions might apply. Thus, especially underperforming students not contributing to the team effort can get a different grade. Similarly, students contributing well above the average of the group can get a higher grade.	35
Projects	A portion of the final grade will be based on: 1. Advisors recommendations. For an adequate tracking of the project development, advisors will request different pieces of evidence, both oral and/or written, including partial and/or final reports. Each pair of advisors must submit a justified recommendation to the committee as to the team work methodology and the performance of the team members in the accomplishment of the project goals. Competences A1, A6, A7, A8, B2, B3, A63, A64, A65, A66 will be evaluated here. 2. Group mates. A peer review among the team members will be also requested as additional evidence for competence A9.	65

Other comments and second call

Final presentations are allowed in Galician, Spanish or English.

Those teams not getting the minimum grade to pass the course will have some additional weeks till the allocated date in the second call to present their work again. If the performance of a given student is graded differently from his/her team-mates, and this leads to failing the course, then he/she will need to show a comprehensive domain of the project developed by his/her team in the second call, together with sufficient additional contributions of his/her own.

Sources of information

The advisors of each project will detail the recommended sources of information

Recommendations

Subjects that are recommended to be taken simultaneously

Technology Management/V05G300V01801

Other comments

Attendance to the different activities of the course is mandatory.
Final presentations are allowed in Galician, Spanish or English.
Those teams (or members of the teams) not getting the minimum grade to pass the course will have some additional weeks till the allocated date in the
second call to present their work again. If the performance of a given student is graded differently from his/her team-mates, and this leads to failing the course, then he/she will need to show a comprehensive domain of the project developed by his/her team in the second call, together with sufficient additional contributions of his/her own.

IDENTIFYING DATA				
Remote Sensing				
Subject	Remote Sensing			
Code	V05G300V01911			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	English			
Department				
Coordinator	Cuiñas Gómez, Íñigo			
Lecturers	Cuiñas Gómez, Íñigo			
E-mail	inhigo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Remote Sensing is the topic devoted to all systems that allow the collection of data about object or surface characteristics without physical contact. This topic presents the basic principles of Remote Sensing, both in visible and infrared spectrum, and in microwaves. Special care will be put on active and passive sensors, with a deep explaination of RADAR and optic-electronic systems. The topic involves technological elements and signal processing, with a focus on the applications.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A74	(CE65/OP8)Applying conceptual, theoretical and practical tools of telecommunications in the development and applications of radar and remote sensing systems.
A75	(CE66/OP9) The ability for selection of circuits, subsystems and systems of remote sensing.

Learning aims		
Subject competences	Typology	Competences
Analyze and specify radar systems, subsystems and radar signal	know Know How	A3 A74
Analyze and specify passive sensors	know Know How	A3 A75
Develop image forming algorithms.	Know How Know be	A9 A74 A75
Suggest solutions based on microwave remote sensing, infrared remote sensing and remote sensing in the visible spectrum	know Know be	A4 A7 A9

Contents
Topic

Introduction to Remote Sensing	Panoramic of the meaning and application of the distance observation of earth, sea and air, doing upsetting in the different points of view between our usual perception of the Earth and his appearance when it is observed from a satellite or another airlifted platform. Besides, it exposes the historical evolution of the Remote Sensing and his implication in the human life, standing out the appearances of the space exploration and the distinct programs that have gone conforming it. The contents given in group A have an autonomous activity associated, called "The Earth from the air/space".
Fundamental concepts	In this subject three fundamental concepts are explained: the spectral signature, the classification and the compositions of colour. All this, after an introduction to the multispectral sensors.
Sensors	Explanation of the concept of sensor, introduction to the distinct types of sensors, the concept of resolution and calibration. Afterwards, it devotes at least a session of two hours to the passive sensors (optical-electronic, thermal and radiometers of microwaves) and another session to the active sensors (RADAR and LIDAR). This exhibition includes the foundations and operation, its characteristics, advantages and inconvenient and applications. The contents given in group A have several practices of laboratory (group B) associated, those called "Sensors calibration", "Passive Sensors: infrared", and "RADAR Fundamentals". Besides, there will be an autonomous activity, "Microwave active RADAR".
Processing, interpretation and formation of images	The subject results a summary of the distinct techniques of processing applied for the interpretation and classification of images taken from satellites. It employs an image example to which go applying the distinct processed explained, for a better understanding of the applications of each technique. Besides, the subject occupies of the formation of images of big regions of the surface of the Earth from images of areas more reduced, by means of the use of mosaics. It exposes the process of the mosaic both from satellite and airborne images. All the contents are given in laboratory (group B), for four sessions of 2 hour each. Besides, the works developed in group C support the contents of this subject.
Geographic Information Systems (GIS)	It treats to introduce the foundations and applications of the GIS, orienting all the exhibition to the support in the decisions process related with geographic locations. The second part of the session devotes to deepen in the knowledge of applications of GIS by means of the study of practical cases.
Terrestrial exploration	In this subject present some examples of applications of the Remote Sensing in diverse fields: studies of the floor, agriculture, mining, geology. The own actuality in the moment of teaching can determine the applications in which more upsetting is done. The contents given in group A have associated the work developed by students in groups C.
Meteorology and Oceanography	In this subject the applications that more satellites have occupied along the history of the Remote Sensing are exposed: the meteorology and the oceanography. In Meteorology, it indicates which types of sensors employ , analyses the distinct parameters of interest, the characteristics regarding resolution and the results of climatic studies along all the planet. Regarding Oceanography, the subject indicates the observed parameters, the sensors, and it also presents images that show the results of the observations both directly and after the application of distinct processed.
Space exploration	The aim of the subject is to present a panoramic of the space exploration. Beginning with the sensors employed along the years of history of the humanity in the space, the subject shows the main knowledges that we have obtained from the distinct bodies of the solar system and it exposes how they arrived to this knowledge (missions, peculiarities of the ships and sensors employed, etc.).

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	17.2	25.8	43
Laboratory practises	4	8	12
Practice in computer rooms	10	15	25
Tutored works	5	45	50
Presentations / exhibitions	2	4	6
Autonomous practices through ICT	0	2	2
Introductory activities	1	1.2	2.2
Short answer tests	2.8	0	2.8
Systematic observation	0	2	2
Jobs and projects	0	5	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	Exhibition by the professor of the contents of the topic "Remote Sensing": foundations, theoretical bases, applications, etc. Reserves for the sessions of group A. This methodology works on competences A74, A75, and A3
Laboratory practises	Activities of application of the knowledges to concrete situations and of acquisition of basic skills and procedures related with the matter object of study. They are developed in laboratories with the suitable equipment. They are two face-to-face sessions of 2 hours each one: one centred in calibration of sensors (using LEGO Mindstorm), and another in thermography by infrared (learning to handle termographic cameras). Both are developed in groups B. This methodology works on competences A74, A75, and A4
Practice in computer rooms	Activities of application of the knowledges to concrete situations and of acquisition of basic skills and procedures related with the matter object of study. They are developed in laboratories with computers. They are five sessions of two hours each one: 1. Foundations of RADAR, by means of a game of computer designed specifically, "RADAR Technology". 2. Processing and Interpretation of satellite images, with a program for processing LandSat images (it takes four sessions). This methodology works on competences A74, A75, A9, and A4
Tutored works	The student, in groups, prepares a document on an application of the Remote Sensing in the daily life. For this, the students will begin with a research of news on a subject that are propose to each group, related to the actuality, in which the remote sensing appear like a basic tool (for example, the research of corpses buried by a murderous, the follow-up of some floods, the study of the outlines of the continental plate under the ocean). The groups will begin for locating actual related news. From them, they will treat to identify the technologies, sensors, processing techniques, employee. They will have to look for technical and scientific information on these and, finally, elaborate a report and a presentation. The interaction with the professors will be face-to-face along five meetings of one hour each, and through forums during the research of information, and by email for the exchange of ideas. This methodology works on competences A4, A7, and A9
Presentations / exhibitions	Exhibition by part of the students in front of the professor and the rest of students of the work realised in small groups (C). These works will be presented as an activity of group A. This methodology works on competence A9
Autonomous practices through ICT	Activities to be autonomously developed, with software provided by means of FaiTIC platform: 1. "Earth from air/space", to learn about points of view. 2. "Microwave active RADAR", to learn on RADAR imaging. This methodology works on competences A74 and A75

Introductory activities	Activities directed to take contact and gather information on the students, as well as to present the topic. For this activity reserves a face-to-face hour of group A, in which the professor presents the topic, explain the practices of laboratory and computer, and what expects of the works in group C. This methodology works on competences A74, A75, and A4

Personalized attention

	Description
Introductory activities	Time that each professor has reserved to attend and resolve doubts of the students.
Master Session	Time that each professor has reserved to attend and resolve doubts of the students.
Laboratory practises	Time that each professor has reserved to attend and resolve doubts of the students.
Practice in computer rooms	Time that each professor has reserved to attend and resolve doubts of the students.
Tutored works	Time that each professor has reserved to attend and resolve doubts of the students.
Presentations / exhibitions	Time that each professor has reserved to attend and resolve doubts of the students.
Autonomous practices through ICT	Time that each professor has reserved to attend and resolve doubts of the students.

Assessment

	Description	Qualification
Master Session	Proofs of short answer: there will be four proofs, the weeks 3, 6, 8 and 10, of 5-10 minutes of length, that allows the student to pass part of the matters. In these short proofs the skils A74, A75, A3 and A7 will be evaluated.	40
Laboratory practises	Systematic observation: During the practices of laboratory and computer, the obtaining of results and the demonstration to having comprised the procedure to arrive to them will be evaluated: 1. "Sensors calibration": 5% 2. "Infrared thermography": 10% In these practices the skils A75, A4 and A9 will be evaluated.	15
Practice in computer rooms	Systematic observation: During the practices of laboratory and computer, the obtaining of results and the demonstration to having comprised the procedure to arrive to them will be evaluated: 1. "Foundations of RADAR": 7% 2. "Image Processing": 13% In these practices the skils A74 and A4 will be evaluated.	20
Tutored works	The realisation of the works in groups will be evaluated in two parts: the own dynamics of the works and the presentations. The work itself will receive 15% of the mark In these works the skils A75, A7 and A9 will be evaluated.	15
Presentations / exhibitions	Presentations of the works by part of the groups In the presentation of the works the skil A9 will be evaluated.	5
Autonomous practices through ICT	Students will give the lecturer their autonomous work results: 1. "The Earth from the air/space": 3% 2. "Active RADAR of microwaves": 2% In these practices the skils A74 and A4 will be evaluated.	5
Short answer tests	The final examination, in case to have to do it, will consist of 10 questions of short answer, with questions related with the classes of theory, of laboratory and the presentations of the works, and will cost by 100% of the note of the topic.	0

Other comments and second call

All proofs will be performed in English.

The proofs of continuous evaluation allow the student to obtain a final qualification based only in his path along the course, and consist in:

1. Four proofs of short answer, with 10% of the total note each one, adding 40%.

2. Proofs of systematic observation in the practices of laboratory and computer, that add another 40%

3. Evaluation of the tutored works (15%) and of the presentation of the same (5%)

The tasks of continuous evaluation are not recoverable, and they are only valid for the current course. A student is supposed that has opted by continuous evaluation when he has done two of the proofs of short answer and he has attended two practices of laboratory. A student that opts by the continuous evaluation is considered to be presented to the topic, independently that he attends or not the final examination.

If a student, having presented to continuous evaluation, opts for presenting to the final examination, the final mark of the topic will be the average of both.

According to the regulations of the University of Vigo, the student that wish has to be able to opt to 100% of the final note by means of an only final examination. The final examination is that he realises in the official dates marked in Board of School in the months of December or January (or July, in the case extraordinary exam), and to those that have to attend those students that have not opted by continuous evaluation and wish to approve the topic. The final examination will consist of ten brief questions related with the contents of the classes of classroom, of laboratory, and the presentations of the works.

The extraordinary examination will have a similar structure to the final examination.

Sources of information

Emilio Chuvieco Salinero, Teledetección ambiental, Ariel, 2010

Nicholas M. Short, Sr., The Remote Sensing Tutorial, Code 935, Goddard Space Flight Center, 1998

, Exploring the Moon, NASA,

Águeda Arquero Hidalgo, Consuelo Gonzalo Martín, Estíbaliz Martínez Izquierdo, Teledetección: Una aproximación desde la superficie al satélite, Fundación General de la UPM, 2003

, Fundamentals of Remote Sensing, Canadian Centre for Remote Sensing, 1998

Gerald C. Holst, Common Sense Approach to Thermal Imaging, SPIE Optical Engineering Press, 2000

Gary Jedlovec, Advances in Geoscience and Remote Sensing, In-Teh, 2009

Iñigo Cuiñas, Verónica Santalla, Ana V. Alejos, María Vera-Isasa, Edita de Lorenzo, Manuel G. Sánche, Playing LEGO Mindstorms® while Learning Remote Sensing, International Journal of Engineering Education, vol. 27, no. 3, pp. 571-579, 2011

Iñigo Cuiñas, Verónica Santalla, Pablo Torío, Aprender jugando: fundamentos de Termografía en asignaturas de Teledetección, Jornada de Innovación Educativa 2012, 2012

Recommendations

Subjects that are recommended to be taken simultaneously

Satellite Navigation and Communication Systems/V05G300V01912

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Signal Transmission and Reception Techniques/V05G300V01404
Electromagnetic Transmission/V05G300V01303
Microwave Circuits/V05G300V01611
Radio Frequency Circuits/V05G300V01511
Spectrum Management/V05G300V01612
Optical Telecommunication Infrastructures/V05G300V01614
Principles of Digital Communications/V05G300V01613
Wireless Systems and Networks/V05G300V01615
Radio Communication Systems/V05G300V01512

Other comments

The topic is going to be taught in English.
All the documents will be in English.

IDENTIFYING DATA				
Satellite Navigation and Communication Systems				
Subject	Satellite Navigation and Communication Systems			
Code	V05G300V01912			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	English			
Department				
Coordinator	Mosquera Nartallo, Carlos			
Lecturers	Aguado Agelet, Fernando Antonio García Sánchez, Manuel Mosquera Nartallo, Carlos			
E-mail	mosquera@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The contents of this course cover the basics of satellite navigation and satellite communication systems: GPS and Galileo, the different segments of satellite communication systems, and an introduction to the planning and development standards. 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	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A76	(CE67/OP10) Applying conceptual, theoretical and practical tools of telecommunications in the development and applications of navigation and satellite communications systems.
A77	(CE68/OP11) The ability for selection of navigation and satellite communications systems and subsystems.

Learning aims		
Subject competences	Typology	Competences
To know the planning and development standards of satellite systems.	know	A2 A3 A76 A77
To know the different alternatives of communication and navigation satellite systems, their different segments (space, ground and user) and the type of orbits.	know	A3 A4 A76 A77
To know the more usual systems and services for satellite communications, including their technological capabilities and limitations.	know	A3 A76 A77
To know and apply satellite navigation systems: GPS, Galileo, and other systems.	know Know How	A2 A3 A4 A76 A77

Contents

Topic	
Introduction	- System definition - Standards - Regulations - Allocated frequency bands
Elements of a System	- Ground Segment - Space Segment - Launch Segment - User Segment
Architecture of the Communication Subsystems	Subsystems: - Antennas - Payload: transponders
Introduction to Satellite Communications	- Main elements in a communications payload - Signal propagation impairments - Link budget - Multibeam satellites
Satellite Communication Services	- Fixed Satellite Services (FSS) - Broadcast Satellite Services (BSS) - Mobile Satellite Services (MSS)
Introduction to Navigation Systems (GNSS)	- GPS, Galileo, Glonass, and other systems.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Practice in computer rooms	13	39	52
Laboratory practises	4	8	12
Tutored works	3	9	12
Short answer tests	1	10	11

*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.
Practice in computer rooms	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.
Laboratory practises	Every student will apply in a practical way the different theoretical knowledge in a specific context.
Tutored works	The student will work in groups, with the support of the university lecturers, to apply, extend and personalize the contents covered in the theoretical and laboratory hours.

Personalized attention

	Description

Assessment

	Description	Qualification
Practice in computer rooms	The students will perform laboratory practice where they will work with concepts studied in the theoretical classes. In these laboratory practices the capabilities A76, A77, A3 and A4 will be evaluated.	40
Tutored works	The evaluation of the group work will be taken into account as well as the understanding, maturity, importance and originality of the work and interaction between the group. In these tutored works the capabilities A76, A77, A3 and A4 will be evaluated.	5
Laboratory practises	Each student will perform field practices. The evaluation will be performed by means of a report for a total weight of 10% of the final mark. In these field practices, the capabilities A76, A77, A3 and A4 will be evaluated.	10
Short answer tests	A final test to evaluate the contents presented in the master sessions. The test will be individual with time limit. In this short answers test, the capabilities A76, A77, A2, A3 and A4 will be evaluated.	45

Other comments and second call

At the beginning of the term, the student will choose the assessment methodology: final exam or continuous evaluation.

Both, documentation and presentations of this subject will be exclusively in English.

English shall be used for writing the reports to evaluate the laboratory practices and the tutored works.

The students may use either English, Spanish or Galego to respond the short answer test.

The subject will be evaluated through one of the following mechanisms:

Final exam:

- The exam will include questions and/or numerical problems related with the contents presented in master sessions, laboratory practices and tutored works. It will be necessary to obtain 5 points over 10 to pass the exam.

***Continuous* evaluation** (the students who choose the continuous evaluation method will not be allowed to attend the final exam in the first call). The subject will be assessed throughout the entire term:

- **Laboratory practices**: each student will have to perform different tasks with a total weight of 40% of the final mark.
- **Tutored works:** each student will participate in different tutored works proposed during the lecture period. This part will be evaluated by written reports. These reports will have a total weight of 5% of the final mark.
- **Outdoor study/field practices:** each student will perform field practices. A report must be turned in to get a maximum score of 10% of the final grade.
- **Short answer test**: This exam will be the final assessment of the continuous evaluation, and it will have a total weight of 45% of the final mark.

Make-up exam (second exam): the student will have to take an exam which will include questions and/or numerical problems related with the contents presented in the master sessions, the laboratory practices and the tutored works (100% of the final mark). Optionally, they could take a partial exam on the contents of the master session (45% of the final mark).

All the different grades are only valid for the current course, and will expire after the second call in case someone needs to take the course again.

Sources of information

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

Maral and Bousquet, Satellite Communications Systems: Systems, Techniques and Technology., Wiley, 2010

, http://www.ecss.nl, ,

Teresa M. Braun, Satellite Communications, Payload and System, Wiley, 2012

E. Lutz, M. Werner, A. Jahn, Satellite Systems for Personal and Broadband Communications, Springer, 2000

Organización de Aviación Civil Internacional, Telecomunicaciones aeronáuticas : Anexo 10 al Convenio sobre aviación civil internacional. Volumen III, Sistemas de telecomunicaciones / Organizacion de Aviación Civil Internacional , ,

Elliott D. Kaplan, Christopher J. Hegarty, editors, Understanding GPS : principles and applications, Artech House, 2006

Bernhard Hofmann-Wellenhof, Herbert Lichtenegger, Elmar Wasle, GNSS - global navigation satellite systems : GPS, GLONASS, Galileo, and more , Springer , 2007

, http://www.trimble.com/gps_tutorial/, ,

, http://www.insidegnss.com/magazine, ,

, http://igs.bkg.bund.de/, ,

, http://waas.stanford.edu/index.html, ,

Recommendations

Subjects that are recommended to be taken simultaneously

Remote Sensing/V05G300V01911

Subjects that it is recommended to have taken before

Signal Transmission and Reception Techniques/V05G300V01404
Electromagnetic Transmission/V05G300V01303
Radio Communication Systems/V05G300V01512

IDENTIFYING DATA				
Real Time Digital Processing				
Subject	Real Time Digital Processing			
Code	V05G300V01913			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish			
Department				
Coordinator	Cardenal López, Antonio José			
Lecturers	Cardenal López, Antonio José			
E-mail	cardenal@gts.uvigo.es			
Web				
General description	This course is designed to provide the student with basic knowledge about the design and implementation of real-time digital signal processing (DSP) algorithms. The main objective for the student is to obtain knowledge about the different platforms available for this purpose in scenarios with real-time restrictions, and to learn the practical issues related with the implementation of DSP algorithms in such platforms. Knowledge acquired on lectures will be reinforced by laboratory practices. For this purpose a Digital Signal Processor development board, will be employed. The course will be taught in Spanish, but all teaching materials will be in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A78	(CE69/OP12) The ability to implement digital signals processing schemes in programming devices.
A79	(CE70/OP13) The ability to interact digitally with radio signals.

Learning aims		
Subject competences	Typology	Competences
Know the architectures for applications in real time. Develop applications in real time on selected architectures. Adapt the knowledges of digital signal processing to real time tasks. Propose digital solutions for its integration in radio transceptors.	know Know How	A3 A4 A78 A79

Contents	
Topic	
Topic 1 Elementary concepts	Definition of real-time processing. Real-time restrictions for digital signal processing. Overview of hardware platforms for real time digital signal processing.
Topic 2 Time-domain algorithms.	Signal generation. Advanced structures for IIR filters. Finite-precision effects.
Topic 3 Frequency-domain Algorithms	Fast Fourier Transform (FFT). Discrete Cosine Transform. Goertzel algorithm
Topic 4 Introduction to Digital Signal Processors.	DSP architecture. Arithmetic-logic unit. Address-Generation Unit. Program flow control. Performance measures.
Topic 5 High level programming for DSP	Development systems structure. Fixed point programming techniques. Optimising high level code.
Practice 1: Introduction to the development system	Compiling, runing and debugging programs on the DSP development system.
Practice 2: Signal generator	Generation of a sinusoidal signal using several approaches.
Practice 3: IIR filters (I)	IIR filters implementation using transposed and cascade structures.

Practice 4: IIR filters (II)	IIR filter programming using fixed-point arithmetic.
Practice 5: Frequency domain processing.	Using the DSP libraries for FFT computation. Frequency domain filtering.
Practice 6: Software defined radio.	Programming of basic algorithms for programmable transmiters and receptors.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Tutored works	7	35	42
Laboratory practises	12	24	36
Long answer tests and development	2	7	9

*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 in class. Multimedia material will be made available in faitic before classes take place. Personal study. Support from the instructors through tutorial help.
Tutored works	Group work on a project centered in a practical application using the DSP development board employed in the laboratory.
Laboratory practises	Practical exercises on a DSP development board. Matlab will be used for designing filters, and for simulation purpose if necessary.

Personalized attention	
	Description
Laboratory practises	The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.
Master Session	The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.
Tutored works	The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.

Assessment		
	Description	Qualification
Laboratory practises	Evaluation of practical exercices using the DSP development board. (Comptencies A2, A4, A78, A79)	50
Tutored works	Group work centred in a practical application of real-time signal processing, using the DSP development board.(Competencies A2, A4, A78)	30
Long answer tests and development	Written exam encompassing all the material exposed in the classroom and laboratory. (Competencies A2, A4, A78,)	20

Other comments and second call

Evaluation

Following the own guidelines of the degreeÂ students shall be offered two evaluation systems: continuous evaluation orÂ evaluation at the end of the semester.

CONTINUOUS EVALUATION

The continuous evaluation of the course will consist in:

- 5 practices developed on the DSP development board.These practices will account for 50% of the final grade.
- 1 project to be carried out in Â group, that will account for 30% of the final grade.
- A written exam encompassing all the material Â exposed in the classroom and in the laboratory. It will take place inÂ the

dates scheduled by the school. It will account for Â 20% of the final grade.

The final qualification of the student will be computed as a weighted sumÂ (50%, 30% and 20%, respectively) of theÂ qualifications of laboratory, group project and final exam.Â

The contents and the weight of each continuous evaluation exercise are the following:

- Signal generation (10%)
- IIR filter programming (10%)
- Programming IIR filters with fixed point arithmetic. (10%)
- Frequency domain processing Â (10%)
- Software defined radio Â (10%)
- Project: (30%)Â

EVALUATION AT THE END OF THE SEMESTER

Should a student decide not to be graded through continuous evaluation, he will have a written examination opportunityÂ that will take place the same day of the final exam for all the students. The exam will cover all the material mastered in theÂ classroom and the laboratory. Students should communicate their intention to renounce to be graded through continuous evaluation at least a week before the date of the final exam.

Students who do not pass the course at the end of the semester have an oportunity to retest on the end of the academic year.Â Previously to the exam, students will be asked to choose to be evaluated by continuous evaluation system or only by the final exam. In the former case, they will have the opportunity to improve the continous evaluation grade by means of redoing and improving selected practices.

Sources of information
Sen M. Kuo, Bob H. Lee, Real-Time Digital Signal Processing,: Implementations, Application and Experiments with the TMS320C55X, John Wiley & Sons, 2001
Sanjit K. Mitra, Digital Signal Processing: A Computer Based Approach, McGraw-Hill, 2001
Alan V. Oppenheim, Ronald W. Schafer, Discrete-Time Signal Processing, Prentice Hall , 1999

Recommendations

Subjects that it is recommended to have taken before

Digital Signal Processing/V05G300V01304
Multimedia Signal Processing/V05G300V01513

IDENTIFYING DATA				
Digital Communications				
Subject	Digital Communications			
Code	V05G300V01914			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	English			
Department				
Coordinator	Pérez González, Fernando			
Lecturers	Mosquera Nartallo, Carlos Pérez González, Fernando			
E-mail	fperez@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course presents the modulations that are used in practically all modern communication standards. Teaching and exams are in English.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A80	(CE71/OP14) The ability to analyze the physical layer in modern digital communications systems.
B3	The development of discussion ability about technical subjects

Learning aims		
Subject competences	Typology	Competences
Acquire the intuition and needed math skills to understand the role played by diversity in improving the provision of communication systems.	know	A4 A9 A80 B3
Develop the capability of analyzing the physical layer of current telecommunication systems.	know Know How	A4 A9 A80 B3
Handle the necessary tools to understand the different aspects of the physical layer of communications system a system and put them to practice when it comes to simulating, designing or dimensioning.	Know How	A4 A9 A80 B3
Strengthen the capacity to follow a technical class in English.	know Know be	A9 B3

Contents	
Topic	
Subject 1: Multicarrier modulations	1.Introduction. 2 Analog and digital OFDM modulations 3 Diagram of an OFDM transmitter. 4 Effect of the channel on the received signal. 5 Diagram of an OFDM receiver. 6 OFDM seen as a block process.

Subject 2: Equalization, coding and synchronization in multicarrier modulations.	1. Pilot carriers. 2 ZF and MMSE equalization. 3 Zero-padding methods. 4 Coded OFDM (COFDM). 5 Carrier synchronization algorithms. 6 Timing recovery algorithms. 7 Channel state information estimation.
Subject 3: Applications	1 Digital Radio/TV standards. 2 OFDM wireless communications standards. 3 OFDM wire communications standards.
Subject 4: Advanced digital communications.	1 MIMO ystems. 2 Advanced coding: turbo and LDPC codes. 3 Spread-spectrum systems. 4 Generalized multicarrier systems.

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	6	6	12
Laboratory practises	12	24	36
Master Session	21	40	61
Short answer tests	2	10	12
Reports / memories of practice	0	14	14
Jobs and projects	1	14	15

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

Methodologies

	Description
Troubleshooting and / or exercises	Each subject will be complemented with exercises. Previous work by the students on the exercises will be required. Competences: CG4, CG9, CE71, B3
Laboratory practises	Lab practices will consist in the demodulation of Digital Radio Mondiale (DRM) signals. This will allow students to practically implement some of the concepts seen in the lectures: OFDM, demodulations, synch recovery,... Competences: CG4, CG9, CE71
Master Session	The course is structured in four main subjects that revolve around the concept of multicarrier modulations. Each subject will be taught through lectures in the classroom. Competences: CG4, CG9, CE71

Personalized attention

	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.
Troubleshooting and / or exercises	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.
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.
Jobs and projects	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

Short answer tests	Final exam with short questions on the contents of the subject, that will include also some questions on the projects. Competences: CG4, CG9, CE71, B3.	20
Reports / memories of practice	Deliverables for the lab project. 50% of the final grade corresponds to tasks associated to a lab project. Along the course there will be six milestones, corresponding to each of the stages for the Matlab implementation of a simplified OFDM receiver. The weight given to each of these tasks is the following: Task 1 (Demodulation to baseband): 5% Task 2 (Mode detection and temporal allignment): 5% Task 3 (Frequency error correction): 10% Task 4 (Frame synchronization): 10% Task 5 (Channel estimation and equalization - I): 10% Task 6 (Channel estimation and equalization - II): 10% Competences: CG4, CG9, CE71, B3.	50

Jobs and projects	Projects on any of the digital communication standards that employ the techniques presented in the classroom. Possible topics include: - Digital radio (DAB, DAB+, DRM) - Digital terrestrial television (DVB-T, DVB-H, DVB-T2) - LAN and MAN wireless networks. - ADSL and VDSL - Comunicaciones over PLC and multimedia over coax (MoCA) - LTE The project must focus on those aspects of the standards that are related to the subjects covered by the lectures and should consider the following issues: - Historical aspects: previous standards solving similar problems. - Technical aspects: details about the employed modulation, bandwidth, channel coding, etc. - Applications of the standard. - Deployment degree at national and international levels. Competences: CG4, CG9, CE71, B3.	30

Other comments and second call

In those cases in where the student decides not to carry out the continuous evaluation tasks, the final score will be solely based on the exam with short 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

Ye Li, G.L. Stuber, Orthogonal Frequency Division Multiplexing for Wireless Communications, Springer-Verlag, 2006

J.R. Barry, E.A. Lee, D.G. Messerschmitt, Digital Communication, Kluwer, 2004

M. Engels, Ed, Wireless OFDM Systems. How to make them work?, Springer-Verlag, 2002

Antonio Artés, Fernando Pérez González, Carlos Mosquera et al. , Comunicaciones Digitales, Pearson, 2007

Recommendations

Subjects that it is recommended to have taken before

Principles of Digital Communications/V05G300V01613

IDENTIFYING DATA				
Fundamentals of Bioengineering				
Subject	Fundamentals of Bioengineering			
Code	V05G300V01915			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	English			
Department				
Coordinator	Hermida Domínguez, Ramón Carmelo			
Lecturers	Hermida Domínguez, Ramón Carmelo			
E-mail	rhermida@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course provides an introduction to several aspects of biomedical engineering, including basic concepts of human physiology, description of most common systems and biomedical signals, and a brief introduction to several electromedical systems. This course will be tough and evaluated in English. All the documentation for this course will be in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A81	(CE72/OP15) The knowledge of biomedical engineering elements and techniques and their application in solving therapy, monitoring and diagnostic problems.
B1	The ability for critical reading of scientific papers and docs.

Learning aims		
Subject competences	Typology	Competences
Know the systemic structure of the human physiology.	know	A3 A81 B1
Identify biomedical signals and learn their utility in the clinical environment.	know Know How	A3 A4 A9 A81 B1
Adapt the adquired knowledge to propose solutions for the design of systems for diagnosis, monitorization and therapy.	Know How	A3 A4 A9 A81 B1
Strengthen the capacity to follow a technical class in English.	know Know be	A9 B1

Contents	
Topic	
1. Introduction to biomedical engineering.	Physiology and anatomy of the circulatory system. Measurements in the cardiovascular system. Nervous and endocrine systems. Introduction to chronobiology.

2. Biomedical signals and systems.	Linear least-square estimation. Model comparison and analysis of variance. Techniques for model construction. Introduction to rhythmometry.
3. Diagnosis, monitorization, and therapy.	Criteria for the diagnosis of vascular risk. Ambulatory blood pressure monitoring. Treatment of hypertension: Current approaches. Chronotherapy for cardiovascular risk reduction. Early identification and prevention of complications in pregnancy.
4. Electromedical systems.	Diagnosis by X rays. Nuclear medicine. Ultrasounds. Nuclear magnetic resonance. Biotelemetry. Telemedicine.

Planning

	Class hours	Hours outside the classroom	Total hours
Tutored works	2	35	37
Presentations / exhibitions	7	9	16
Troubleshooting and / or exercises	10	15	25
Master Session	21	42	63
Short answer tests	2	7	9

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

Methodologies

	Description
Tutored works	The student, in groups, prepares a document on an application of Biomedical Engineering.
Presentations / exhibitions	Exhibition by the students in front of the professor and the rest of students of the work realized in small groups.
Troubleshooting and / or exercises	Some topics will be complemented with problem resolution.
Master Session	Exposición por parte del profesor de los conceptos principales de cada tema. Trabajo personal posterior del estudiante preparando o repasando los conceptos vistos en el aula.

Personalized attention

	Description
Master Session	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Tutored works	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Troubleshooting and / or exercises	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.

Assessment

	Description	Qualification
Tutored works	Composition, in small groups, of a monographic document related to one of the electromedical systems in bioengineering (nuclear medicine, ultrasounds, magnetic resonance, biotelemetry, telemedicine). In these works the skills A9, A81 and B1 will be evaluated.	30
Presentations / exhibitions	Exhibition by the students of the tutored work, and discussion of the findings with the professor and other students. In these presentations the skills A9, A81 and B1 will be evaluated.	10
Troubleshooting and / or exercises	Short questions on the problems solved in the practices in relation to the contents of the master sessions. In these short questions the skills A3, A4 and A81 will be evaluated.	30

Short answer tests	The final exam will consist on small questions and problems in relation to the master sessions, laboratory practices, and presentation of the tutored works. In this exam the skills A3, A4 and A81 will be evaluated.	30

Other comments and second call

Following the guidelines of the studies, two evaluation systems will be offered to the students inscribed on this course: continuous evaluation and evaluation at the end of the semester. Students should communicate their intention to renounce to be graded through continuous evaluation before the third week of class.

The continuous evaluation will be based on the grades obtained in the tutored works and their exposition, the laboratory practices and the final test. The grades obtained throughout the continuous evaluation will only be valid for the current academic year.

The possibility of a final examination, with theory and problems, will be provided to students who do not opt for the continuous evaluation. This exam will be rated between 0 and 10, and this will be the final grade obtained.

The second chance of examination at the end of the academic year will have a similar structure to the final examination of those students who do not choose the continuous evaluation.

Sources of information

Guyton AC. Textbook of Medical Physiology. 11th edition, W.B. Saunders Company, Philadelphia, 2005.

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Webster JG. Medical Instrumentation. Application and Design. Third edition. Wiley, 1997.

Â

Enderle J, Blanchard S, Bronzino J. Introduction to Biomedical Engineering. Academic Press, San Diego, 2000.

Â

Weisberg S. Applied Linear Regression. 2ª Ed., J Wiley & Sons, New York, 324 pp., 1985.

Â

Peña D. Estadística Modelos y Métodos: Tomo I Fundamentos. 2ª Ed., Alianza Universidad Textos, Madrid, 402 pp., 1989.

Â

Cook RD, Weisberg S. Residuals and Influence in Regression. Chapman Hall, London, 1982.

Â

Drapper NR, Smith H. Applied Regression Analysis. 2ª Ed., John Wiley & Sons, New York, 1981.

Â

Mojón A, Fernández JR, Hermida RC. Chronolab. An interactive software package for chronobiologic time series analysis written for the Macintosh™ computer. Chronobiol Int. 1992;9(6):403-412.

Â

Portaluppi F, Tiseo R, Smolensky MH, Hermida RC, Ayala DE, Fabbian F. Circadian rhythms and cardiovascular health. *Sleep Med Rev.* 2012;16:151-166.

Â

Hermida RC, Smolensky MH, Ayala DE, et al. 2013 ambulatory blood pressure monitoring recommendations for the diagnosis of adult hypertension, assessment of cardiovascular and other hypertension-associated risk, and attainment of therapeutic goals. Joint recommendations from the International Society for Chronobiology (ISC), American Association of Medical Chronobiology and Chronotherapeutics (AAMCC), Spanish Society of Applied Chronobiology, Chronotherapy, and Vascular Risk (SECAC), Spanish Society of Atherosclerosis (SEA), and Romanian Society of Internal Medicine (RSIM). *Chronobiol Int.* 2013;30(3):355-410.

Â

Smolensky MH, Siegel RA, Haus E, Hermida RC, Portaluppi F. Biological rhythm, drug delivery, and chronotherapeutics. In: Siepmann J, Siegel RA, Rathbone MJ, eds.Fundamentals and Applications of Controlled Release Drug Delivery (Chapter 13). Advances in Delivery Science and Technology (MJ Rathbone, ed.). New York: Springer. 2012:359-443. doi 10.1007/978-1-4614-0881-9_13.

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204

IDENTIFYING DATA				
Designing Applications with Microcontrollers				
Subject	Designing Applications with Microcontrollers			
Code	V05G300V01921			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish Galician			
Department				
Coordinator	Costas Pérez, Lucía			
Lecturers	Costas Pérez, Lucía Río Vázquez, Alfredo del			
E-mail	lcostas@uvigo.es			
Web	http://cursos.faitic.uvigo.es/tema1415/claroline/course/index.php			
General description	Design and development of microcontroller-based applications, including design methodologies to develop real time applications, peripheral components configuration and connectivity. The scope of these contents will be adapted to the academic level reached by the students.			

Competencies	
Code	
A67	(CE58/OP1) The ability to design hardware and software systems based on microcontrollers.
A68	(CE59/OP2) The ability to use software tools for microcontrollers simulation.

Learning aims		
Subject competences	Typology	Competences
Ability to know in deep the design methodologies of microcontroller-based electronic systems.	know Know How	A67
Ability to configure peripheral components and to connect them to the microcontroller.	know Know How	A67
Ability to know in deep the software design of the microcontroller-based electronic systems.	know Know How	A67 A68
Ability to design microcontroller-based instrumentation systems and the connection between several microcontrollers.	know Know How	A67 A68
Ability to know and to use design methodologies of microcontroller-based real time applications.	know Know How	A67 A68

Contents	
Topic	
Introduction. Previous topics review.	Introduction. Previous topics review. PIC18F45K20. Internal Structure. Arithmetic and Logic Unit. Control Unit. Program memory. Data memory. Peripherals. Watch Dog Timer (WDT).
Instruction set. Addressing modes.	Introduction: Instruction Set. Transfer Instructions. Arithmetic Instructions. Logic Instructions. Jumps. Addressing Modes.
Input/Output.	Introduction. I/O Structure. Ports (A B C D E). Configuration Registers. Parallel Slave Port. Signal Coupling.
Timers.	Introduction. Timers/Counters: TMR0/TMR1/TMR2/TMR3.
Excepctions and interrupts.	Introduction. Excepctions. Interrupts. Interrupt Response. Registers.
Analog interface.	Introduction. ADC. ADC Operation. Analog Comparator Module.
Compare Mode.	Introduction. Capture Mode. Compare Mode. PWM. ECCP1: Enhanced Mode.
Power-Managed modes.	Introduction. Different Modes. Switching between modes.
MSSP: Master Synchronous Serial Port SPI. I2C	Introduction. Registers. SPI Mode. I2C Mode.

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practises	12	38	50
Master Session	12	33	45
Troubleshooting and / or exercises	5	15	20
Tutored works	7	22	29
Short answer tests	2	0	2
Short answer tests	2	0	2
Practical tests, real task execution and / or simulated.	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
Laboratory practises	The students will perform simulations and electronic circuits.
Master Session	The lecturer will explain in the classroom the subject contens.
Troubleshooting and / or exercises	The lecturer will solve exercices related to the subject contebts.
Tutored works	The students have to develop a project. The lecturers will help and monitor them.

Personalized attention	
	Description
Tutored works	The lecturers will be available to help students in order to deal with the contents of the subject, the laboratory practices as well as the monitored work. The students can go to the lecturer's desk (individually or in a group). The timetable will be available on the subject website at the beginning of the term.
Laboratory practises	The lecturers will be available to help students in order to deal with the contents of the subject, the laboratory practices as well as the monitored work. The students can go to the lecturer's desk (individually or in a group). The timetable will be available on the subject website at the beginning of the term.
Master Session	The lecturers will be available to help students in order to deal with the contents of the subject, the laboratory practices as well as the monitored work. The students can go to the lecturer's desk (individually or in a group). The timetable will be available on the subject website at the beginning of the term.
Troubleshooting and / or exercises	The lecturers will be available to help students in order to deal with the contents of the subject, the laboratory practices as well as the monitored work. The students can go to the lecturer's desk (individually or in a group). The timetable will be available on the subject website at the beginning of the term.

Assessment		
	Description	Qualification
Tutored works	The students will be asked to elaborate a report related to the project they have to carry out. The lecturer will also assess the student's work developed during the laboratory sessions. Competencies A67 and A68 are assessed.	20
Short answer tests	Exam to evaluate the knowledge acquired by the student after the first part of the subject. It is carried out in a classroom sesión. Competency A67 is assessed.	25
Practical tests, real task execution and / or simulated.	Laboratory exam. The student has to deal with some real and/or simulated tasks and answer several questions. Competencies A67 and A68 are assessed.	30
Short answer tests	Exam to evaluate the knowledge acquired by the student related to the second part of the subject. It is carried out in a classroom session. Competency A67 is assessed.	25

Other comments and second call

CONTINUOUS ASSESSMENT:

A continuous assessment learning scheme will be offered to the students:

- Two partial exams will be held related to the theory (A sessions).

- The laboratory work will be assessed by means of an exam (B sessions).

- The student has to elaborate a report describing the monitored project (C sessions).

The first partial exam will take place in the classroom after the first six sessions approximately. It will last ninety minutes. If the student passes this part, he/she is not required to retake it. In this case, after finishing the term, he/she has to take only the second partial exam. The date will be specified in the academic calendar.

In partial exams, a minimum score (5 out of 10) is required in order to get a pass.

The laboratory exam will take place at the laboratory during the last session.

In order to assess the monitored project, the lecturer will consider the quality of the final report, the work in the laboratory and the student’s behavior.

The final mark (FM) is calculated as the weighted average of the three individual marks. The formula will apply a weight of 50% to the theory mark (TM), a 30% to the laboratory mark (LM) and a 20 % to the project mark (PM):

FM = 0,5*TM + 0,3*LM + 0,2*PM

The minimum passing score required in order to get a pass in the subject is 5.

When a student takes the first partial exam, it is considered that he/she choose the continuous assessment scheme and he/she will be assessed in June.

FINAL EXAM:

Students who refuse the continuous assessment scheme will be assessed by means of a final exam to evaluate the theory. The exam will be the same for them as for the students who fail the first partial exam.

The assessment of the laboratory for these students will be carried out by means of a laboratory exam. The date will be fixed within the examination period. In this case, the final mark (FM) is calculated as the weighted average of the two individual marks. The formula will apply a weight of 50% to the theory mark (TM) and a 50% to the laboratory mark (LM):

FM = 0,5*TM + 0,5*LM

The minimum passing score required in order to get a pass in the subject is 5.

IMPORTANT REMARK:

Students who refuse the continuous assessment scheme have to contact the lecturer at least two weeks before the exam date. It is necessary to organize the laboratory exams.

FINAL EXAM (JULY):

The assessment policy in July follows the scheme described in the previous section (FINAL EXAM).

Sources of information

F. E. Valdés Pérez, R. Pallás Areni, Microcontroladores. Fundamentos y Aplicaciones con PIC., Marcombo,

http://ww1.microchip.com/downloads/en/DeviceDoc/41303F.pdf, PIC18FXXK20 Data Sheet, ,

http://ww1.microchip.com/downloads/en/DeviceDoc/52116A.pdf, PICkit™ 3 In-Circuit Debugger/Programmer User’s Guide, ,

http://ww1.microchip.com/downloads/en/DeviceDoc/41370C.pdf, PICkit™ 3 Debug Express PIC18F45K20 – MPLAB® C Lessons, ,

Recommendations

Subjects that it is recommended to have taken before

IDENTIFYING DATA				
Optoelectronic Devices				
Subject	Optoelectronic Devices			
Code	V05G300V01922			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish English			
Department				
Coordinator	Moure Rodríguez, María José			
Lecturers	Cao Paz, Ana María Moure Rodríguez, María José			
E-mail	mjmoure@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject deals with the optoelectronic properties of semiconductors and their application in electronic devices for detection, emission, amplification and conversion of optical/electrical signals. Devices include light-emitting diodes, lasers diodes, photodiodes, phototransistors and solar cells. The contents of the course and the laboratory activities coverage the basic operating principles, design considerations, driving circuits and applications of optoelectronic devices. The subject will enable students to apply the physics of optoelectronic devices in optical sensors design and fiber optic communications. Emphasis will also be place on understanding the data sheets of optoelectronic components and their applications to different technologies. Finally integrated optoelectronics, display and image sensor technologies are introduced.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A69	(CE60/OP3) The ability to design circuits based on optoelectronics devices used in telecommunication systems.
A70	(CE61/OP4) The ability to acquire, condition and process the information obtained from optoelectronic sensors.
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Subject competences	Typology	Competences
The knowledge of the operating principles of the different optoelectronic devices. The ability to design basic control circuits for photoemitters. The ability to design basic control circuits for photodetection. The knowledge of the architecture and operating mode of displays. The knowledge of the architecture and characteristics of image sensors	Know How	A69
The knowledge of the different optoelectronic sensors and their applications. The ability to acquire, condition and process the information obtained from optoelectronic sensors	Know How	A70
The ability to select de optimal optoelectronic devices for each application. The ability to integrate optoelectronic devices and sensors in information processing systems	Know How	A1
The ability to analyze the data sheets and to compare different optoelectronic devices or sensors. The ability to design optical systems following the standards applicable to communications, reliability or environmental protection	know	A6
The ability to use computer-aided design tools for the design of electronic systems based on optoelectronic devices	Know How	B4

Contents	
Topic	
Unit 1: Introduction	Fundamentals and classification of optoelectronic devices. Radiometric and photometric units and their relationships.

Unit 2: Light Emitting Diodes	Principles of LED operation. Types of LEDs and properties. Parameters and characteristics. Driving circuits. Basic applications.
Unit 3: Optoelectronic Detectors	Light Dependent Resistors: principles of LDR operation, properties, parameters, driving circuits and applications. Photodiodes: principles of photoconductive detectors, types, parameters, driving circuits and applications. Phototransistor: principles of phototransistor operation, types, parameters, driving circuits and applications. Photodetector comparison.
Unit 4: Solar Cells	Photovoltaic detectors: principles and properties. Manufacture and performance of solar cells, parameters and characteristics. Applications.
Unit 5: Laser Diodes	Principles of Laser operation. Types of lasers. Laser diode operation. Driving circuits and applications.
Unit 6: Image Sensors	Principles of CCD and CMOS operation. Parameters and characteristics. Color detection. Applications.
Unit 7: Optical Sensors	Principles of optical sensing. Internal design, types, parameters and applications of: optocouplers, optical encoders, object sensors, code-bar readers, humidity sensors, color detection, distance sensors, anemometers, temperature sensors and biomedical sensors.
Unit 8: Display Technologies	Principles of Liquid Crytal Display operation. Principles of LED and Organic LED displays. Introduction to plasma, electroluminescence and digital light processor technologies.
Unit 9: Introduction to Fiber Optics	Fiber Optic fundamentals. Classification of fibers. Fiber optic emitters and detectors. Principles of fiber optic communications. Principles of fiber optic sensors.
Laboratory Practices	1. Basic optoelectronic circuits. LEDs and LDRs. Laboratory measurements. 2. Optical detectors. Circuits based on photodiodes. 3. Analog optical modulation. Optical detectors based on photodiodes and phototransistors. 4. Digital communications based on fiber optic. 5. Optoelectronic sensors for object sensing. 6. Optical circuits for color measurement. 7. Basic drive circuit for laser diodes.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	15	30	45
Case studies / analysis of situations	4	8	12
Projects	6	30	36
Presentations / exhibitions	1	3	4
Laboratory practises	14	9	23
Multiple choice tests	2	24	26
Reports / memories of practice	0	4	4

*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 professor explains the theoretical contents of the course, encouraging critical discussion and the student involvement. Reading assignments for each session will be previously available via FaiTIC, and students are expected to come to the theoretical class having completed the assigned reading.
Case studies / analysis of situations	The study and analysis of actual technological solutions completes the theoretical presentations. This activity includes the study of different alternatives, commercial devices or systems, cost and power estimation, environmental impact and performance analysis.
Projects	This activity focuses on applying the techniques described in the lecture classes and the skills developed at laboratory to a mini-project implementation. These sessions are developed in a laboratory with skilled equipment. Students should obtain well founded solutions, choosing appropriate methods and devices. These projects are planned and tutored in small size groups.
Presentations / exhibitions	The project developed by the students must be oral presented by the authors.
Laboratory practises	During laboratory sessions the student learns the design, hardware implementation, verification and measurement of basic optoelectronics circuits. All the sessions are guided and supervised by the professor.

Personalized attention	
	Description
Master Session	Students have the opportunity to solve doubts in personalized attention sessions. The appointment with the corresponding professor should be required and agreed by e-mail, preferably in the timetable and place officially assigned. Besides, the group of students developing a project will attend periodic follow-up meetings
Laboratory practises	Students have the opportunity to solve doubts in personalized attention sessions. The appointment with the corresponding professor should be required and agreed by e-mail, preferably in the timetable and place officially assigned. Besides, the group of students developing a project will attend periodic follow-up meetings
Projects	Students have the opportunity to solve doubts in personalized attention sessions. The appointment with the corresponding professor should be required and agreed by e-mail, preferably in the timetable and place officially assigned. Besides, the group of students developing a project will attend periodic follow-up meetings

Assessment		
	Description	Qualification
Projects	The students should present a tutored project which deserves the 40% of the final qualification. The progress of this job will be supervised from continuous assessment but the final work should be oral presented by the authors. This project will assess competencies A69, A70, A1, A6 and B4.	40
Reports / memories of practice	The assistance to the laboratory practices is mandatory: at least the student should complete 6 of the 7 sessions. The implementation of the circuits described in the practice guidelines and the reports submitted at the end on each session will deserve the 30% of the final qualification. This reports will assess competencies A69, A70, A1 and A6.	30
Multiple choice tests	A multiple choice test, performed preferably online via the FaiTic platform. This test covers all of the contents taught in the theoretical classes. The estimated date will be the 11th week, after the completion of the theoretical classes. This test will deserve the 30% of the final qualification. This test will assess competencies A69, A70 and A1.	30

Other comments and second call

1. Continuous assessment

The course can be passed with full marks from continuous assessment, with no need to sit the final exam. Students who assist to more than 2 laboratory sessions may not be listed as "Not Present".

The weighting and content of each continuous assessment part are as follows:

1.1 Test (NTest):

- It covers all of the contents taught in the theoretical classes.
- The estimated date will be the 11th week of the course.
- The student pass this part if he/she gets a mark greater than or equal to 5.

1.2 Laboratory practices (NPrac):

- The student should complete 6 of the 7 sessions in order to pass this part.
- The student should correctly implement the circuits described in the guidelines of the practice and submit a report corresponding to each laboratory session. The qualification of each practice depends on these achievements.
- It can be developed individually or by groups of 2 students.
- The student will pass this part if he/she gets an average greater than or equal to 5. The weighting of each practice is the same to obtain the NPrac mark.

1.3 Project (NPro):

- It can be developed individually or by groups of 2 students.
- It should be oral presented by the authors.
- The student will pass this part if he/she gets a mark greater than or equal to 5.

1.4 Final qualification of continuous assessment (Final_ca)

The final qualification (Final_ca) of continuous assessment is obtained as follows:

Final_ca: = (NTest*0.3 + NPrac*0.3 + NPro*0.4) if NTest is greater than or equal to 5 and NPrac is greater than or equal to 5 and NPro is greater than or equal to 5;

Final_ca = min [(NTest*0.3 + NPrac*0.3 + NPro*0.4), 4] in other case;

The student who fails one or more of the parts of continuous assessment has another opportunity to pass any part in the Final exam:

- He/she can repeat the test and this mark replaces the previous one (NTest).
- He/she student can improve his/her Laboratory mark (NPrac) by means of an exam. This exam consists of several problems related to the contents of laboratory practices.
- He/shet can complete and present his/her project before the date of the final exam.

2. Final exam and qualification

There is a final exam at the end of each quadmester.

- In the final exam, all content is evaluated. It usually consists of several questions and problems and lasts about 2.5 hours. The pass mark for this exam is 5 out of 10 and deserves 60% of the final qualification (NEx).
- In order to pass the subject the students should present a project with the same objectives and complexity of the project developed in continuous assessment. This project deserves 40% of the final qualification (NPro) and should be presented before the date of the final exam.

The final qualification (Final_ex) is obtained as follows:

Final_ex = (NEx*0.6 + NPro*0.4) if NEx is greater than or equal to 5 and NPro is greater than or equal to 5;

Final_ex = min [(NEx*0.6 + NPro*0.4) , 4] in other case;

3. Other comments

- The grades obtained from the continuous assessment and final exams are only valid for the current academic year.
- The use of books, notes or electronic devices such as phones or computers is not permitted in any test or exam. Mobile phones must be turned off and out of reach of the student.

Sources of information
S.O. Kasap, Optoelectronics and Photonics, Pearson, 2013
Vaughn D. Martin, Optoelectronics, PROMPT Publications, 1997
John Wilson, John Hawkes, Optoelectronics. An introduction, Prentice-Hall,
Francis T.S. Yu, Xiangyang Yang, Introduction to optical Engineering, Cambribge University Press, 1997
Endel Uiga, Optoelectronics, Prentice-Hall, 1995
J.E. Midwinter, Y.L. Guo, Optoelectronics and Lightwave Technology, Wiley, 1992
Gerald C. Holst, CCD Arrays, Cameras and Displays, Optical Engineering Press, 1998
Josephn J. Carr, Electro-Optics. Electronic Circuit Guidebook, Prompt Publications, 1997
Ed. W. Göpel, J. Hesse, J.N. Zemel, Sensors. A comprehensive Survey, , 1992
A. Goetzberger, J. Knobloch, B. Voss, Crystalline Silicon Solar Cells, Wiley, 1998
J. Watson, Optoelectrónica, Limusa, 1993
S. Desmond Smith, Optoelectronic Devices, Prentice Hall, 1995
Albert J.P. Theuwissen, Solid-state Imaging with Charge-Coupled Devices, Kluwer, 1995
R.C. Lasky, U.L. Österberg, D.P. Stigliani, Optoelectronics for Data Communication, ,
David Wood, Optoelectronic Semiconductors Devices, Prentice Hall, 1995
David R. Goff, Fiber Optic Reference Guide. A Practical Guide to the Technology, Focal Press, 1999
Eric Udd, Fiber Optic Sensors. An Introduction for Engineers and Scientists, John Wiley&Sons, 1991
R.M. Marston, Circuitos de optoelectrónica, CEAC, 2000
Kasap, Ruda, Boucher, Cambridge Illustrated Handbook of Optoelectronics and Photonics, Cambridge University Press, 2009

In addition to the bibliography above, the student have access to the following support material:

- Notes of the course which cover the contents of theoretical sessions.
- Documentation for laboratory which includes the guidelines of the practices and the data sheets of optoelectronic devices or sensors.

The language used for this support material is the English and this material is available via the FaiTIC platform (http://faitic.uvigo.es)

Recommendations

Subjects that it is recommended to have taken before

Physics: Fundamentals of Electronics/V05G300V01305
Electronic Technology/V05G300V01401

IDENTIFYING DATA				
Design and Synthesis of Digital Systems				
Subject	Design and Synthesis of Digital Systems			
Code	V05G300V01923			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	English			
Department				
Coordinator	Álvarez Ruíz de Ojeda, Luís Jacobo			
Lecturers	Álvarez Ruíz de Ojeda, Luís Jacobo			
E-mail	jalvarez@uvigo.es			
Web	http://www.faitic.uvigo.es			
General description	This course will be taught and assessed in English. The course documentation is in English. The main learning goals of this course are: • Introduction to VHDL for synthesis. • Design and synthesis of synchronous digital systems. • Development, synthesis and verification of programmable digital circuits, using VHDL for its application in the field of the Telecommunications.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A71	(CE62/OP5) The ability to design and synthesize complex digital systems by hardware description language.
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Subject competences	Typology	Competences
To be able to distinguish the differences between the use of Hardware Description Languages for simulation and for synthesis.	know	A71
To deepen the understanding of synchronous digital design techniques using VHDL for synthesis.	know	A71
To acquire skills at designing complex synchronous digital systems using VHDL.	know	A1 A9
To use the hardware and software tools available for the design of digital systems by means of VHDL and for their implementation on programmable digital circuits.	Know How	A1 A9 B4

Contents	
Topic	
LESSON 1 THEORY (2 h.). INTRODUCTION TO COMPLEX DIGITAL SYSTEM DESIGN AND SYNTHESIS.	1.1.- Introduction. 1.2.- Types of digital integrated circuits. Microprocessors. DSPs. ASICs. FPGAs. 1.2.1.- Comparative analysis. 1.3.- Field Programmable Gate Arrays (FPGAs). 1.4.- Complex application specific digital system design by means of FPGAs. 1.4.1.- Sequential processing systems. Operational unit. Control Unit. 1.4.2.- Continuous processing systems.

LESSON 2 THEORY (2 h.). ADVANCED DIGITAL SYSTEM DESIGN.	2.1.- Introduction. 2.2.- General rules for the design of digital systems. 2.2.1.- Hierarchical design. 2.2.2.- Technology independent design. 2.2.3.- Design timing. 2.2.4.- Design for reuse. 2.2.5.- Design for verificability. 2.2.6.- Design documentation. 2.3.- Intellectual Property (IP) cores.
LESSON 3 THEORY (2 h.). INTRODUCTION TO SYNTHESIS OF DIGITAL SYSTEMS DESCRIBED IN VHDL.	3.1.- Introduction. 3.2.- Definition of synthesis. Basic concepts on synthesis. 3.3.- Conversion of a VHDL description to real hardware. Differences between the original VHDL model and the result of the synthesis / implementation. Timing simulation model. 3.4.- Recommendations for the description in VHDL synthesisable of distinct types of circuits. 3.5.- Examples of synthesisable models of commonly used circuits.
LESSON 4 THEORY (6 h.). VHDL FOR SYNTHESIS. RESTRICTIONS.	4.1.- Introduction. 4.2.- IEEE standard for synthesis. 4.3.- Time sentences (“After”, “Wait”). 4.4.- Loops (“Loop”). Loops “generate”. 4.5.- ‘Real’ data type. Type conversion. 4.6.- Complex arithmetical operations. Division (“/”). 4.7.- Complex mathematical functions. (“Without”, “Cos”, “Log”). 4.8.- Two-dimensional matrices. (“Array”). 4.9.- Exercises of non- synthesisable models and equivalent synthesisable circuits.
LESSON 5 THEORY (2 h.). ARITHMETICAL CIRCUITS DESIGN IN VHDL.	5.1.- Introduction. 5.2.- Representation of binary numbers with decimal part. Fixed point. Floating point. 5.3.- Design of fixed point applications. 5.4.- Design of floating point applications. 5.5.- Implementation of arithmetical circuits in FPGAs.
LESSON 6 THEORY (4 h.). VHDL ADVANCED SENTENCES.	6.1.- Introduction. 6.2.- Libraries and packages. 6.3.- Access to files. 6.3.1.- Memory initialisation. 6.3.2.- Testbench stimuli. 6.4.- ‘Generic’ data type. Parameterisable circuits. 6.5.- Subprograms. 6.5.1.- Functions. 6.5.2.- Procedures. 6.6.- Conditional compilation.
LESSON 7 THEORY (1 h.). VERIFICATION OF COMPLEX DIGITAL SYSTEMS.	7.1.- Introduction. 7.2.- Verification through simulation. 7.2.1.- Signals. Delay models. Definition of ‘driver’. 7.2.2.- Design analysis and simulation. Simulation cycle. Delta delay. 7.2.3.- Recommendations for VHDL simulation. Examples. Testbench design. 7.2.4.- Differences between functional and timing simulation. 7.3.- Verification through timing analysis. 7.4.- Verification through test in a development board. 7.5.- Exercises.
LESSON 1 LABORATORY (4 h. TYPE B). PRACTICAL TUTORIAL OF DIGITAL SYSTEM DESIGN AND SYNTHESIS.	1.1.- Introduction. 1.2.- Basic digital system design in synthesisable VHDL. 1.3.- Testbench design in VHDL. 1.4.- Implementation of digital systems in FPGAs. 1.5.- Testing digital systems.
LESSON 2 LABORATORY (2 h. TYPE B). DIGITAL SYSTEM DEBUGGING. VIRTUAL LOGICAL ANALYSERS.	2.1.- Introduction. 2.2.- Xilinx virtual logical analyser. ‘Chipscope core’. 2.3.- Parameters of the Xilinx virtual logical analyser. 2.4.- Implementation of the Xilinx virtual logical analyser. 2.5.- Analysis of a digital system by means of the Xilinx virtual logical analyser.

LESSON 3 LABORATORY. (15 h. = 8 H. TYPE B + 7 h. TYPE C). DESIGN OF A MEDIUM-COMPLEXITY DIGITAL SYSTEM IN SYNTHESISABLE VHDL.	3.1.- Introduction. Task explanation. (2 h. TYPE B) 3.2.- Project based learning. Discussions on the most suitable approach. (6 h. TYPE C) 3.2.- Design of a medium-complexity digital system in synthesisable VHDL. (6 h. TYPE B) 3.3.- Oral presentation. (1 h. TYPE C)

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	4	8	12
Integrated methodologies	15	31.5	46.5
Laboratory practises	6	7.5	13.5
Integrated methodologies	14	51	65
Presentations / exhibitions	1	8	9
Introductory activities	2	2	4

*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	Conventional lectures. Through this methodology the outcome CE62/OP5 is developed.
Integrated methodologies	Problem based learning (PBL): Problem solving. Design of non- synthesisable models and synthesisable circuits in VHDL. To solve them, the student has to previously develop certain outcomes. Through this methodology the outcomes CG9, CG13 and CE62/OP5 are developed.
Laboratory practises	VHDL design of digital circuits and circuit implementation in FPGAs. Through this methodology the outcomes CG9, CG13 and CE62/OP5 are developed.
Integrated methodologies	Project based learning. The students must design a digital system in VHDL to solve a problem. In order to that, the students must plan, design and implement the necessary steps. The project development will be implemented in laboratory hours (type B). Besides, in type C hours there will be discussions and one-to-one interaction with the teacher. Activities to develop in the groups C: Analysis and debate about the project approach and different alternatives. Analysis and follow-up of the proposed solution. Design implementation. Analysis and debate of results. Oral presentations of the project results. Through this methodology the outcomes CG1, CG9, CG13 and CE62/OP5 are developed.
Presentations / exhibitions	Presentations/exhibitions: Exhibition of the results of the project developed. Through this methodology the outcomes CG1 and CG9 are developed.
Introductory activities	Introduction to the subject key topics both theoretical and practical. Through this methodology the outcomes CG13 and CE62/OP5 are developed.

Personalized attention

	Description
Integrated methodologies	In class the teacher will assist the students. Besides, the students will have the opportunity to consult with the teacher in office hours which will be published in the faculty website.
Laboratory practises	In class the teacher will assist the students. Besides, the students will have the opportunity to consult with the teacher in office hours which will be published in the faculty website.
Integrated methodologies	In class the teacher will assist the students. Besides, the students will have the opportunity to consult with the teacher in office hours which will be published in the faculty website.

Assessment

	Description	Qualification

Integrated methodologies	Resolution of theoretical problems and exercises. The majority of them will be focused on the design of non-synthesisable models and synthesisable circuits in VHDL. The problems will be based on the theoretical topcis. It will be necessary to teach to the professor the operation of each one of the models and circuits. The correct application of the theoretical concepts to the problems will be assessed, based on the published criteria. It will be necessary to deliver the documentation requested by the professor for each one of the exercises. Through this methodology the outcomes CG9, CG13 and CE62/OP5 are assessed.	50
Integrated methodologies	Laboratory Project. Design of a medium-complexity synthesisable digital system in VHDL. It will be necessary to deliver the design source files. The assessment will be based on the operation of the digital system and the correct application of the theoretical concepts, according to the published criteria. Through this methodology the outcomes CG1, CG9, CG13 and CE62/OP5 are assessed.	40
Presentations / exhibitions	It will be necessary to do an oral presentation of 15 minutes as a maximum about the work, according to the index supplied by the teacher. Through this methodology the outcomes CG1 and CG9 are assessed.	10

Other comments and second call

The total mark will be the sum of the marks obtained in the different tasks of the subject.

The global mark of the theoretical problems has to be equal or greater than 5 over 10 in order to pass the subject.

The mark of the Laboratory Project has to be equal or greater than 5 over 10 in order to pass the subject.

All the students, both those who follow the subject continuously and those who want to be assessed in the final exam at the end of the term or at the end of the year (second opportunity), will have to do the tasks described in the previous section.

The students that do not attend classes regularly will also have to do the same tasks as the students who attend classes.

The final mark will be expressed in numerical form ranging from 0 to 10, according to the valid regulation (Royal decree 1125/2003 of 5 September; BOE 18 September).

Following the guidelines of the degree the students will be offered two assessment systems: continuous assessment and final assessment at the end of the term.

CONTINUOUS ASSESSMENT:
The students are considered to have chosen the continuous assessment when they have done 2 laboratory practices and/or 2 reports of theoretical exercises.
The students that have chosen continuous assessment, but do not pass the course, will have to do the final assessment at the end of the year.
The students that pass the course by means of continuous assessment will not be allowed to repeat any task in the final assessment in order to improve the mark.
The different tasks should be delivered in the date specified by the teacher, otherwise they will not be assessed for the continuous assessment.
The students will develop the theoretical exercises, the laboratory practices and the laboratory projects in groups of two students during the continuous assessment.
The students who want to be assessed in the continuous assessment can only miss two sessions as a maximum.. If they miss more than 2 sessions, it will be compulsory to do an additional individual task or an examination.

FINAL ASSESSMENT:
The students that opt for the final assessment will have to do all the theoretical and practical tasks and the project individually.
The tasks for the final assessment have to be delivered before the official date of the examination set by the faculty.

In case the students pass the theoretical exercises (TE) and the Laboratory Project (LP), that is, the mark of each part >= 5, the final mark (FM) will be the weighted sum of the marks of each part of the subject:

FM = 0'50 * TE + 0'40 * LP + 0'10 * OP

In case the students do not pass any of the two main parts of the subject, the theoretical exercises (TE) or the Laboratory Project (LP), that is, the mark of any task < 5, the final mark (FM) will be:
FM = Minimum [4'5; (FM = 0'50 * TE + 0'40 * LP + 0'10 * OP)]

Where:
TE = Global mark of the theoretical exercises and problems.
LP = Laboratory Project.
OP = Oral presentation.

ASSESSMENT CRITERIA.

1) Theoretical exercises and problems.
Each one of the theoretical exercises and problems proposed in the theoretical sessions will be marked from 0 to 10. Its influence in the total mark of the subject will be weighted in function of the number of exercises assigned.
There will be eight reports of exercises.
The majority of the exercises will consist in the design of non-synthesisable models and synthesisable circuits in VHDL.

The assessment criteria are the following:
1. Correct design (CORR).
a. Behavioural model adequate to the project specifications.
b. Synchronous design.
c. Reusable design.

2. Functionality (FUNC). For each one of the exercises, the behavioural circuit model has to work perfectly to obtain the maximum mark. If the circuit is synthesisable, the temporary simulation of the resultant circuit also has to work perfectly.
a. Behavioural simulation.
b. Synthesis.
c. Timing simulation.

3. Project documentation (DOC).
a. Design source files.
b.Enough comments in the VHDL files to explain the sentences used.
It will be necessary to deliver the required source files.
The total mark will be the sum of the marks of each one of the exercise reports divided by the number of reports:
TE = (Report 1 + … + Report 8) / 8

2) Laboratory Project.
This project consists in the design of a synthesisable digital system of medium complexity in VHDL.

The assessment criteria are the following:

1. Correct design (CORR).
a. System entirely synthesisable.
b. Suitable hierarchy arrangement.
c. Design totally synchronous.
d. Technology independent design.
e. Reusable design.

2. Analysis of the design and the implementation in FPGAs (ANA).
a. Analysis of the FPGA logical resources used and their justification.
b. Analysis of the internal system delays.
c. Analysis of the chosen implementation options.
d. Optimal utilisation of the FPGA logical resources.
e. Achievement of an optimal processing speed.
f. ‘Chipscope’ Verification.

3. Functionality (FUNC). For each circuit, the behavioral simulation, the timing simulation and the board test should work perfectly to obtain the maximum mark.
a. Individual circuits.
b. Complete system.

4. Documentation (DOC).
a. Design source files.
b. Enough comments in the VHDL files to explain the sentences used.
For the Laboratory Project (LP), it will be necessary to do an oral presentation.

3) Oral Presentation.
The assessment criteria are the following:
1. Clear structure and presentation order.
2. Clear explanations.
3. Enough explanations to understand the project.
4. Suitable figures.
5. Relevant data.

Sources of information

BASIC BOOKS OF THE SUBJECT:
[CHU 06] CHU, PONG P., “RTL Hardware Design Using VHDL: Coding for Efficiency, Portability, and Scalability”, John Wiley & Sons Inc, 2006.

[ÁLVAREZ 13] ÁLVAREZ RUIZ DE OJEDA, L.J., Digital Design with FPGAs, Vision books, Madrid, 2013.

COMPLEMENTARY BIBLIOGRAPHY OF THE SUBJECT:

Course documentation, available on the following website “http://www.faitic.uvigo.es”.

DESIGN OF DIGITAL SYSTEMS:

[ÁLVAREZ 04] ÁLVAREZ RUIZ DE OJEDA, Digital Design with Programmable Logic, Publisher Tórculo, Santiago de Compostela, 2004.

[ÁLVAREZ 02] ÁLVAREZ RUIZ DE OJEDA, L. Jacobo, COMMANDED PÉREZ, And., VALDÉS CRAG, M.D., Programmable Logical Devices and his applications, Publisher Thomson-Paraninfo, 2002.

[ÁLVAREZ 01] ÁLVAREZ RUIZ DE OJEDA, Design of applications by means of PLDs and FPGAs, Publisher Tórculo, Santiago de Compostela, 2001.

[ARTIGAS 02] ARTIGAS MAESTRE, J.I., BARRAGÁN PÉREZ, L.To., ORRITE URUÑUELA, C., URRIZA PARROQUÉ, I., Digital Electronics. Applications and problems with VHDL, Prentice-Hall, Madrid, 2002.

[BOLTON 90] BOLTON, M., "Digital systems design with programmable logic", Addison-Wesley, 1990.

[LALA 90] LALA, Parag K., "Digital system design using programmable logic devices", Prentice Hall, New Jersey, 1990.

[PELLERIN 91] PELLERIN, D., HOLLEY, M., "Practical design using programmable logic", Prentice Hall, London, 1991.

[SCARPINO 98] SCARPINO, F., “VHDL and AHDL digital system implementation”, Prentice Hall, London, 1998.

FPGAs:

[CHAN 94] CHAN, Pak K., MOURAD, Samiha, "Digital design using Field Programmable Gate Arrays", Prentice Hall, New Jersey, 1994.

[JENKINS 94] JENKINS, Jesse H., "Designing with FPGAs and CPLDs", Prentice Hall, New Jersey, 1994.

[OLDFIELD 95] OLDFIELD, J.V., DORF, R.C., "Field Programmable Gate Arrays: Reconfigurable logic for rapid prototyping and Implementation of Digital Systems", John Wiley & Sons, 1995.

[SHARMA 98] SHARMA, To. K., "Programmable logic handbook", McGraw Hill, Fairfield, 1998.

[XILINX] Direction of Internet, http://www.xilinx.com, Xilinx.

VHDL:

[ASHENDEN 08] ASHENDEN, PETER J., “The Designer's Guide to VHDL”, 3rd edition, Morgan Kaufmann Publishers, 2008.

[ASHENDEN 98] ASHENDEN, PETER J., “The VHDL Cookbook”, University of Adelaide,1998.

[BHASKER 98] BHASKER, “To VHDL Synthesis First”, 2nd edition, Star Galaxy Pub, 1998.

[CHU 08] CHU, PONG P., “FPGA Prototyping by VHDL Examples”, John Wiley & Sons Inc, 2008.

[IEEE 01] Standard IEEE VHDL Language Reference Manual (IEEE Srd 1076-2001), Institute of Electrical and Electronics Engineers, 2001.

[PÉREZ 02] PÉREZ LÓPEZ, S.A., SOTO CAMPOS, E., FERNÁNDEZ GÓMEZ, S., Design of digital systems with VHDL, Thomson-Paraninfo, Madrid, 2002.

[PERRY 02] PERRY, DOUGLAS L., “VHDL: Programming by example”, 4th edition, McGraw-Hill, 2002.

Recommendations

Subjects that it is recommended to have taken before

Digital Electronics/V05G300V01402
Programmable Electronic Circuits/V05G300V01502

Other comments

The students will have previously followed the subjects Digital Electronics and Programmable Electronic Circuits. They give the necessary knowledge to understand the topics of this course.
It is not necessary to have passed them.
The students of the specialisation “Electronic Systems”, should have previously followed the subject Electronic Systems of Processed of Signal, but is not indispensable.

IDENTIFYING DATA				
Advanced Electronic Sensors				
Subject	Advanced Electronic Sensors			
Code	V05G300V01924			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish			
Department				
Coordinator	Mariño Espiñeira, Perfecto			
Lecturers	Costas Pérez, Lucía Mariño Espiñeira, Perfecto Pastoriza Santos, Vicente			
E-mail	pmarino@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main purpose of this subject is to train students in order that they become well-qualified to understand the physical principles and current techniques employed in the most recent electronic sensors technology. Course outline: + Optical fiber sensors. + Laser sensors. + Microelectromechanical sensors (MEMS). + Image sensors. + Integrated sensors. + Intelligent sensors. + Acoustic wave sensors. + Biosensores. The main goal of the laboratory sessions (practical work) is to enable the students to acquire sufficient understanding and knowledge to: Analyze the parameters and main features of the sensors. Know the applications of each group of sensors. Manage specific software tools developed to design (virtual) instruments that allow store, display and analyze recorded data. The documentation of the course will be in English. It will be taught and assessed in Spanish.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A72	(CE63/OP6) The ability to design and use optoelectronic sensors, micromechanical sensors (MEMS) and acoustic wave sensors.

Learning aims		
Subject competences	Typology	Competences
Knowledge of the modes of operation and applications of fiber optic sensors.	know	A3 A72
Knowledge of the modes of operation and applications of microelectromechanical sensors.	know	A3 A72
Knowledge of the modes of operation and applications of acoustic wave sensors.	know	A3 A72
Ability to select and work with next generation electronic sensors.	Know How	A4 A72

Ability to work in groups and to develop communications skills in order to elaborate and present technical reports related to the subject.	Know How	A9 A72

Contents	
Topic	
Unit 1: Fiber Optic Sensors I.	Introduction. Classification. FOS types. Basic structure. Extrinsic, intrinsic and evanescent wave sensors. Applications. Interferometric FOS. Applications.
Unit 2: Fiber Optic Sensors II.	Multisensory FOS systems. Distributed and multiplexed FOS. OTDR reflectometry. OFDR reflectrometry. Fiber Bragg grating. Applications. Intelligent systems. Laser vibrometry and interferometry. Applications.
Unit 3: Integrated Optical Sensors.	Introduction. Classification of optical integrated waveguides. Materials. Devices. Interferometry in IO. Active integrated optic devices; detectors and sources. Sensors. Biosensors. OF-IO Coupling. Applications.
Unit 4: Microelectromechanical Sensors (MEMS).	Microelectronic technologies. MEMS fabrication processes. MEMS materials. MEMS Sensors. Micromachined free space integrated micro optics. CMOS Microsensors. Applications.
Unit 5: Image Sensors and Displays I.	Introduction. Display specifications. Display classification. Illumination technologies. Image capture technology: CCD and CMOS. Night vision technology: PMTs y IR cameras.
Unit 6: Image Sensors and Displays II.	Introduction to pyrometry. Operating principle General features. Disappearing filament pyrometer. Conditioning. Bolometric detector. Quantum detectors. Radiometers. IR cameras. Applications.
Unit 7: Acoustic Wave Sensors (AWS).	Classification. Materials features. Comparative study of AWS sensors. Applications. FPW microsensor. FPW integrated systems. Coatings for AWS. Pattern recognition in “electronic nose”.
Unit 8: Intelligent Sensors.	Definition. Classification. Architectures. Multisensorial systems. International standars. Applications.
Unit 9: Virtual Reality Sensors.	Introduction. Tactile response systems. RV features. Architectures. Neuronal processes. Mechanoreceptors. Projective field. Visual tactile synesthesia. Visual immersion systems. UAV (Unmanned Aerial Vehicle) systems.
Unit 10: Sensor Technology in Particle Physics.	Introduction. Specific instrumentation standars: CAMAC, FASTBUS and SCI. The standard model. Features of the standard model. Beta decay. Evolution of particle accelerators. Particle Detectors in accelerators. Nuclear medicine applications.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	2	3
Master Session	17	17	34
Tutored works	3	26	29
Laboratory practises	12	30	42
Integrated methodologies	7	25	32
Practical tests, real task execution and / or simulated.	2	8	10

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

Methodologies	
	Description
Introductory activities	Subject presentation. Presentation of laboratory sessions, instrumentation and software resources to be used. In these sesions, the skills A3, A4, A72, and A9 will be worked.
Master Session	The lecturer will explain in the classroom the main contents of the subject. The students have to manage the proposed bibliography to carry out a self-study process in a way that leads to acquire the knowledge and the skills related to the subject. The lecturer will answer the students’ questions in the classroom or at the office. In these sesions, the skills A3, A4, A72, and A9 will be worked.
Tutored works	The students have to manage basic concepts to search and select information in order to get a deeper understanding in some specific fields related to the subject. The lecturer will propose in the classroom the topic of this individual task and monitor the student’s work in personalized attention sessions. In these sesions, the skills A3, A4, A72, and A9 will be worked.

Laboratory practises	Activities designed to apply the main concepts and definitions of the subject. The student will be asked to acquire the basic skills to manage the laboratory instrumentation, software tools and components in order to construct and test electronic circuits. The student has to develop and demonstrate autonomous learning and collaborative skills. He/she is supposed to be able to manage bibliography and recently acquired knowledge. Possible questions can be answered in the laboratory sessions or at the lecturer’s office. In these sesions, the skills A3, A4, A72, and A9 will be worked.
Integrated methodologies	Project-based learning: students have to develop a group activity that goes on over a period of time and address a specific problem. They have to design, schedule and carry out a set of tasks to achieve a solution. The assessment will be based on the quality of the proposed solution, the depth of content understanding demonstrated and the final presentation. The sessions will be performed in the laboratory. In these sesions, the skills A3, A4, A72, and A9 will be worked.

Personalized attention

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

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

Assessment

	Description	Qualification
Laboratory practises	The lecturers will check the level of compliance of the students with the goals related to the laboratory skills. They will consider the work of the students carried out before the laboratory session to prepare the proposed tasks and the work in the laboratory. Marks for each session (LSM: Laboratory Session Mark) will be assigned in a 10 points scale. In these practices, the skills A3, A4, A72, and A9 will be assessed.	30
Tutored works	The lecturers will consider the results, the presentation, the analysis and the quality of the final report. Marks will be assigned in a 10 points scale. In these works, the skills A3, A4, A72, and A9 will be evaluated.	50
Practical tests, real task execution and / or simulated.	The lecturers will consider the results and the quality of their analysis. Marks will be (GPM: Group Project Mark) assigned in a 10 points scale. In these tasks, the skills A3, A4, A72, and A9 will be evaluated.	20

Other comments and second call

1. *Continuous assessment*

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

When the students go to the lectures regularly (less than 10% unjustified absence) or miss at most one laboratory session, they will be assessed by continuous assessment.

The subject comprises three different parts: theory (50 %), laboratory (30%) and group project (20%). Once a task has been assessed, the students cannot do/repeat the task at a later date. The marks are valid only for the current academic course.

1.a Theory

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

The final mark of this part will be:

FMT (Final Mark of Theory) = TWM (Tutored Work Mark)

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

1.b Laboratory

Six laboratory sessions are scheduled. Each session lasts approximately 120 minutes and the students will work in pairs. This part also will be assessed by continuous assessment.

Each session will be only evaluated according to the developed work at the schedule date. The lecturers will consider the work of the students carried out before the laboratory session to prepare the proposed tasks, the work in the laboratory to deal with them as well as the student’s behavior. Marks for each session will be (LSM: Laboratory Session Mark) assigned in a 10 points scale. A mark of 0 will be obtained for missing sessions.

The final mark of this part is calculated as the arithmetic mean of the six individual marks:

FML (Final Mark of Laboratory) = Sum(LSMi)/6; i = 1, 2, …, 6

Attendance at the laboratory classes is compulsory. If the student miss more than one laboratory session without a valid documented reason (medical, bereavement or other) he/she will be assigned a grade of 0 for that laboratory class.

1.c Group project

In the first session lecturers will present the objectives and the schedule of the project. They also assign a specific project to each group. After that, the most important part of the workload will be developed in the laboratory. Two hours of B laboratory sessions and six hours of C laboratory sessions.

In order to assess the project, the lecturer will consider the results and the quality of their analysis. Marks will be (GPM: Group Project Mark) assigned in a 10 points scale.

The students are only allowed to miss one project session without a valid documented reason.

1.d Final mark of the subject

In order to past the subject, students will be required:

+ to obtain FMT >=5, and

+ no more than one missed laboratory session, and

+ no more than one missed group project session.

The weighted *points* from all assessed parts are added together to calculate the final *mark (FM)*. The following weightings will be applied: 50% theory, 30% laboratory and 20% group project.

FM = 0,50·FMT + 0,30·FML + 0,20·GPM

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

However, when:

+ FMT < 5, or

+ more than one missed laboratory session, or

+ or more than one missed group project session,

the final mark (FM) will be the minimum value among them.

FM = min{ FMT, FML, GPM }

2. Final Exam

If a student prefers a different educational policy he/she can take an exam on a scheduled *date*. The date will be specified in the academic calendar. This exam will comprise four parts (similar to the activities completed by the continuously assessed students):

+ an **exam** if they didn't go to the lectures regularly (more than 10% unjustified absence).

+ a **task monitored by a tutor**, (tutored work)

+ a **practical exam carried out in the laboratory** if they have missed more than one laboratory session.

+ a previously assigned **project**.

The tutored work and the project will be assigned following the procedure described in advance by the lecturer. The student will prepare a writing report to be handed in just before the exam.

2.a Theory

2.a.1 Theory Exam

In order to pass the theory, the student cannot miss more than 10 % of the lectures without a valid documented reason (medical, bereavement or other). Otherwise, he/she will have to attend to an exam (with short or long answer questions). Marks will be (EM: Exam Mark) assigned in a 10 points scale.

2.a.2 Tutored Work

To evaluate the tutored work the lecturer will consider the results, the presentation, the analysis and the quality of the final report. Marks will be (TWM: Tutored Work Mark) assigned in a 10 points scale.

2.a.3 Theory Final Mark

The final mark of theory (FMT) will be:

FMT = TWM (Tutored Work Mark) if the student don't miss more than 10 % of the lectures**.**

FMT = EM (Exam Mark) if the student miss more than 10 % of the lectures and MTM >= 5.

FMT = 0 in any other case.

2.b Laboratory

In order to pass the laboratory part, the student cannot miss more than one laboratory session lectures without a valid documented reason (medical, bereavement or other**). Otherwise,**he/she will have to attend to a practical exam carried out in the laboratory. In this exam the student will be asked to deal with some of the electronic circuits developed in the laboratory sessions as well as some short answer questions related to these sessions. Marks will be (LEM: Laboratory Exam Mark) assigned in a 10 points scale.

The final mark of laboratory (FML) will be:

FML = the arithmetic mean of the laboratory session marks (LSM) when the student didn't miss more than one laboratory session, that is:

FML = Sum(LSMi)/6 i = 1, 2, …, 6

FML = LEM (Laboratory Exam Mark) when the student missed more than one laboratory session.

LFM = 0 in any other case.

2.c Project

In order to assess the project, the lecturer will consider the results and the quality of their analysis. Marks will be (GPM: Group Project Mark) assigned in a 10 points scale.

2.d Final mark

In order to pass the subject, it is mandatory:

+ FMT >= 5, and

+ no more than one missed laboratory session or FML >= 5, and

+ no more than one missed group project session or GPM >= 5.

The final mark will be the weighted average of the marks obtained by the student in the different parts. The final mark (FM) will apply a weight of 50% to the final theory mark (FMT), a 30% to the laboratory final mark (FML) and a 20 % to the group project mark (GPM).

FM = 0,50·FMT + 0,30·FML + 0,20·GPM

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

However, when:

+ FMT < 5, or

+ FML < 5 and the student missed more than one laboratory session, or

+ GPM < 5 and the student missed more than one group project session,

the final mark will be the minimum value among them.

FM = min{ FMT, FML, GPM }

3. Second opportunity to pass the subject.

The assessment policy in this call will follow the scheme described in the previous section. Dates will be specified in the academic calendar. The lecturer will assign the tutored work and the project to the student. The student has to contact to the lecturer according to an established procedure. The procedure will be published in advance.

Marks obtained in the previous continuous assessment or final exam are kept if the student have got a pass in some parts. Moreover, students cannot take an exam, develop a project or a tutored work task if they have got a pass previously.

The final mark will be the weighted average of the marks obtained by the student as it has described in section 2.

Sources of information
Pérez García, M.A., Álvarez Antón, J.C., Campo Rodríguez, J.C., Ferrero Martín F.C., y Grillo Ortega, Instrumentación Electrónica, 2ª, Thomson, 2004
Pallás Areny, R., Sensores y Acondicionadores de Señal, 4ª, Marcombo, 2003
Norton, H.N., Sensores y analizadores, , Gustavo Gili, D.L., 1984.
Fraile Mora, J., García Gutiérrez, P., y Fraile Ardanuy, J., Instrumentación aplicada a la ingeniería, 3ª, Editorial Garceta, 2013
Martín Fernández, A., Instrumentación electrónica. Transductores y acondicionadores de señal y sistemas de adquisición de datos, , Dpto. De publicaciones de la E.U.I.T.T. de Madrid,
del Río Fernández, J., Shariat-Panahi, S., Sarriá Gandul, S., y Lázaro, A.M., LabVIEW: Programación para Sistemas de Instrumentación, 1ª, Editorial Garceta, 2011

Recommendations

Subjects that it is recommended to have taken before
Analogue Electronics/V05G300V01624 Electronic Instrumentation and Sensors/V05G300V01621 Data Acquisition Systems/V05G300V01521

IDENTIFYING DATA				
Industrial Communications				
Subject	Industrial Communications			
Code	V05G300V01925			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish			
Department				
Coordinator	Domínguez Gómez, Miguel Ángel			
Lecturers	Domínguez Gómez, Miguel Ángel Poza González, Francisco			
E-mail	mdgomez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	There are more electronic units of control in the systems used in diverse areas of the engineering (industrial control, automotion, domotic, aircrafts, ships, etc.). These units must be connected between them of an efficient way and in real time to transmit all the necessary information. The use of industrial communications networks has had a very big peak in the last years and the knowledge of the different fieldbus protocols existing in the market is of big interest for the engineering. This subject intends that the student know the different protocols of communications that exist in various areas of application and acquires the capacity to choose the most adapted solution for a determinate problem. In accordance with the exposed, will treat the following contents: * Introduction to industrial communications systems * Introduction to fieldbuses * Standards * General Characteristics * Applications * Study of the most used protocols * Tools of design and analysis			

Competencies	
Code	
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A73	(CE64/OP7) Comprehension and command of basic concepts of industrial communication networks of field buses.
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Subject competences	Typology	Competences
Understanding and control of the industrial communications systems.	know	A73
Understanding and control of the basic concepts of industrial communications networks (fieldbuses).	know	A73
Understanding and control of fieldbuses applications and the most important protocols.	know	A73
Capacity to choose the better solution for a determinate problem of communication.	know	A6 A73
Capacity to design simple industrial communication systems.	Know How	A6 B5
Basic knowledges of software tools for analysis and design.	Know How	A6 B5
Capacity of use and configurate communication hardware modules.	Know How	A6 B5

Contents
Topic

Theme 1: Communication networks	OSI and TCP/IP models. Local Area Networks (LAN). Wide Area Networks (WAN). Wireless and mobile communication systems. Interconnection resources. Hierarchy.
Theme 2: Fieldbuses	Origin. Main characteristic. standardization. Applications.
Theme 3: CAN/LIN	History. Applications. Main characteristic. Physical layer. Data link layer. Media access control. Frames format. Coding of frames. Errors management.
Theme 4: Domotic fieldbuses: KNX	Basic concepts (domotic, inmotic, digital home). Physical levels of transmission. Main protocols used in domotic. KNX (Generalities, main characteristic, topology, telegram).
Theme 5: P-NET	Physical layer. Data link layer. Frames format. Media access control. Transmission of frames.
Theme 6: PROFIBUS	Physical layer. Topology. Data link layer. Media access control. Transmission methods. Timers. Structure of the frames.
Theme 7: WorldFIP	Physical layer. Data link layer. Variables and messages. Media access control. Frames format. Timers. Bus arbitrator. Producers/Consumers entities.
Theme 8: Industrial Ethernet	Main characteristic. Solutions based in Ethernet IEC 61784-2.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	4	8	12
Master Session	12	36	48
Tutored works	9	40	49
Laboratory practises	12	24	36
Short answer tests	5	0	5

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

Methodologies

	Description
Introductory activities	Presentation of the course. Presentation of the laboratory practices and the instrumentation and software to use.
Master Session	Exhibition by professor of the contents. Personal homework of the student reviewing the concepts seen in the classroom and preparing the topics using the proposed bibliography. Identification of doubts that require to be resolved in personalised attention.
Tutored works	A work about a specific protocol will be assigned to the students, individually or in group. This work will have to be exposed and argued in class.
Laboratory practises	Activities of application of the theoretical knowledges purchased. It will learn to handle specific software of design, simulation and analysis of industrial communication networks. They will program simple hardware modules of some protocol studied in theory. Personal work of the student preparing the practices using the available documentation and reviewing the related theoretical concepts. Preparation and analysis of results. Identification of doubts that require to be resolved in personalised attention.

Personalized attention

	Description
Master Session	The students will have occasion of personalised attention in the office of the professor in the schedule that the professors will establish for this purpose at the beginning of the course and that will publish in the web page of the subject. The doubts arisen to the students about the contents of the subject will be resolved and they will be oriented on how study. The doubts arisen to the students about the development of the laboratory practices, the handle of the software of design, simulation and analysis and the specifications and operation of the hardware modules will be resolved too. The doubts arisen to the students about the work they have to do and present in the last weeks of classes will be resolved.

Tutored works	The students will have occasion of personalised attention in the office of the professor in the schedule that the professors will establish for this purpose at the beginning of the course and that will publish in the web page of the subject. The doubts arisen to the students about the contents of the subject will be resolved and they will be oriented on how study. The doubts arisen to the students about the development of the laboratory practices, the handle of the software of design, simulation and analysis and the specifications and operation of the hardware modules will be resolved too. The doubts arisen to the students about the work they have to do and present in the last weeks of classes will be resolved.
Laboratory practises	The students will have occasion of personalised attention in the office of the professor in the schedule that the professors will establish for this purpose at the beginning of the course and that will publish in the web page of the subject. The doubts arisen to the students about the contents of the subject will be resolved and they will be oriented on how study. The doubts arisen to the students about the development of the laboratory practices, the handle of the software of design, simulation and analysis and the specifications and operation of the hardware modules will be resolved too. The doubts arisen to the students about the work they have to do and present in the last weeks of classes will be resolved.

Assessment

	Description	Qualification
Tutored works	Work that have to do the students and present in class. It will evaluate the work and the quality of the implementation and presentation. The skills A6 and B5 will be evaluated in these works.	50
Laboratory practises	The work of the student in the laboratory will be evaluated, as well as the memories that should be deliver of the practices. The skills A6, A73 and B5 will be evaluated in these practises.	20
Short answer tests	Exams that will be realised in the classroom after a set of exposed subjects to evaluate the knowledges acquired by the student. The skill A73 will be evaluated in these tests.	30

Other comments and second call

1. Continuous evaluation

Following the own guidelines of the degree and the agreements of the academic commission,Â a system of continuous evaluation will be offered to the students.

1.a Proofs of short answer

There will be 3 proofs of short answer (type test and/or questions) properly programmed along the course. These proofs will be valued from 0 up to 10 and the final mark will be the average (NPRC):

NPRC = (NPRC1 + NPRC2 + NPRC3)/3

The proofs are not recoverable,that is to say, that if a student cannot attend the day in that they are programmed, the professor has no obligation to repeat them. The mark of the proofs that were missed will be of 0.

1.b Personalized works

A work will be assigned to the students,Â individually or by groups (depending of the number of students) in the first weeks of the course. This work should be delivered and presented in the last weeks of the course. The presentation of the works will be properly programmed by the professors. The implemented work and its presentation will be valued with a final mark (NT) from 0 up to 10.

The student that does not deliver the work or does not present it in the indicated day will have a mark of 0.

1.c Laboratory practices

Each practice will be valued from 0 up to 10 taking into account the work made in the laboratory. The final mark of laboratory (NPL) will be the average of the qualifications obtained in the practices:

NPL = (NPL1 + NPL2 + ... + NPLn)/n

The practices are not recoverable, that is to say, that if a student cannot attend the day in that they are programmed, the professor has no obligation to repeat them. The mark of the practices that were missed will be of 0.

1.d Final mark

The final mark (NF) will be:

NF = 0,3*NPRC + 0,5*NT + 0,2*NPL

2. Final exam

The students that do not pass by continuous evaluation (final qualification less than 5), will be able to present to a final exam.

The final exam will be in the dates provided for the School and will consist in a proof of short answer (type test and/or questions) (NPRC), the delivery and presentation of a work that the professors will have assigned to the student and the delivery of a laboratory work (NPL) previously assigned to the student by the professors. Each one of these parts will be valued from 0 up to 10. The students will be able to present to all these parts or which they consider appropriate. They will conserve the mark of the continuous evaluation in the parts that do not present.

The calculation of the final mark will be as it was explained in the section 1.d.

3. On the announcement of recovery (July)

The announcement of recovery (July) will have the same format that the final exam and will be in the dates provided for the School.

The students that present to this announcement can do it to all the parts or only which they consider appropriate. They will conserve the mark of the ordinary announcement (continuous evaluation or final exam) in the parts that do not present .

The calculation of the final mark will be as it was explained in the section 1.d. The final mark will be the best of the obtained by the student in the ordinary announcement and the recovery one.

4. Validity of the qualifications

The qualifications of the student will be valid only for the academic course in which they were obtained.

Sources of information
Oliva N. y otros, Redes de comunicaciones industriales, 1ª, UNED, 2013
Castro M.A. y otros, Comunicaciones industriales: principios básicos, 1ª, UNED, 2007
Castro, M.A. y otros, Comunicaciones industriales: sistemas distribuidos y aplicaciones, 1ª, UNED, 2007

Documentation elaborated by the professors (slides, papers,...) available in FaiTIC. This documentation is in English.

Recommendations

Other comments

It is recommended to have passed all the subjects of the Electronic Systems module

IDENTIFYING DATA				
Image Processing and Analysis				
Subject	Image Processing and Analysis			
Code	V05G300V01931			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course follows "Fundamentals of Image Processing" (3rd year). The student will acquire knowledge and skills on high-level techniques to analyze and extract relevant information from images of different application field in computer vision, medical imaging and multimedia resources. The course is lectured and assessed in english. The documentation is also in english.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A82	(CE73/OP16) The ability to construct, exploit and manage artificial vision, medical imaging, and multimedia data base systems.
B1	The ability for critical reading of scientific papers and docs.
B3	The development of discussion ability about technical subjects

Learning aims		
Subject competences	Typology	Competences
Know how to solve problems with initiative, for decision making, creativity, and to communicate and transmit knowledge, skills and abilities, understanding the ethic and professional responsibility on the activity of a telecommunications engineer. Know how to build, exploit and manage machine vision systems, medical image systems and Multimedia DataBases.	know Know How Know be	A4 A82 B1 B3

Contents	
Topic	
Analysis of image.	Segmentation based in colour, textures, shapes and models. Extraction of descriptive and invariant characteristics. Examples in actual problems.
Description and classification of objects.	Clustering. Image descriptors. Classical and probabilistic decisors. Classification. Examples in actual problems.
Aplications	RGB image processing. Medical image processing. Real-time video processing

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	10	10	20
Tutored works	24	82	106
Presentations / exhibitions	3	6	9
Introductory activities	3	0	3

Multiple choice tests	2	0	2
Reports / memories of practice	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	Each 3-hour class will include one hour of explanation of subject contents, encouraging critical discussion and assimilation through computer programming and visualization.
Tutored works	Each 3-hour session will include 2 hours of "hands-on" working to assimilate the explained concepts through problem-based learning (PBL). Every Problem/Task will take 4 or 5 weeks of the subject during which the student will have to discover, alone or with the professor guidance, what he needs to solve the problem effectively.
Presentations / exhibitions	The third and last task will be presented in front of the class mates. The students from the same group will have to split the presentation, so both of them explain one part of the work.
Introductory activities	In the first class of the course, concepts learned in FPI and the programming tools for the course will be reviewed: C/C++, QT, OpenCV

Personalized attention	
	Description
Introductory activities	Personalized attention will be carried out during the 3-hour sessions in the lab, guiding and advising each student to make the most of his time for solving the practical problem at hand. Plus, the student can make use of the counseling hours whenever he needs them.
Master Session	Personalized attention will be carried out during the 3-hour sessions in the lab, guiding and advising each student to make the most of his time for solving the practical problem at hand. Plus, the student can make use of the counseling hours whenever he needs them.
Tutored works	Personalized attention will be carried out during the 3-hour sessions in the lab, guiding and advising each student to make the most of his time for solving the practical problem at hand. Plus, the student can make use of the counseling hours whenever he needs them.
Presentations / exhibitions	Personalized attention will be carried out during the 3-hour sessions in the lab, guiding and advising each student to make the most of his time for solving the practical problem at hand. Plus, the student can make use of the counseling hours whenever he needs them.

Assessment		
	Description	Qualification
Multiple choice tests	These tests are linked to the delivery of each guided task and are meant to score each student individually. This tests help to assess competence A82.	15
Reports / memories of practice	The score of the guided task includes: the follow-up of each student, the techniques used, the results achieved and the presentation of them. This tasks help to assess competence A82, A4, B1 and B3	85

Other comments and second call

Attendance is compulsory in continuous assessment, unless special circumstances are alleged. Continuous Â assessment will be based on the student lab work and guided tasks related to contents of the subject. There will be an official final exam scheduled by the "Junta de Escuela" that the students that didn't pass the continuous assessment will have to take if they want to pass the course. Â This final exam will be scored from 0 to 10 points and includes all the topics explained during the course and also concepts and techniques explained for the guided tasks. To pass this exam the student has to score, at least, 5 points. The students that are eager to improve their continuous assessment score can also take the final exam. In this case the final score of the course will be the maximum score of the final exam and continuous assessment. Â Throughout the semester the students will be receiving feedback about his performance on the continuous assessment, along with the scores obtained in the tests and guided tasks. Delivering any of the guided tasks or sitting any test will automatically mean that the student is following the course in the continuous assessment mode. That means that he will appear as "presented" in the records of the subject even if the final exam is not taken.Â

The continuous assessment contains the next milestones:

Guided task 1: linked to the image analysis topic (25%). 20% for the computer work and 5% for the test.

Guided task 2: linked both to the image analysis and classification topics (25%). 10% for the computer work and 5% for the test.

Guided task 3: linked to all topics (35%). 30% for the computer work an 5% for the test.

Public presentation of the 3rd guided task Â (15%).

The extraordinary final exam will only be held for students who failed the course both in continuous assesment mode or final exam. The score of the subject will be the score of this exam. The examÂ will be scored between 0 and 10. To pass the subject, at least 5 points are needed.

Sources of information
Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 3ª (2008), Prentice Hall
Robert Laganière, OpenCV 2 Computer Vision Application Programming Cookbook, 2011, Packt Publishing
Jasmin Blanchette, Mark Summerfield, C++ GUI Programming with Qt 4, 2008, Prentice Hall
Richard O. Duda, Peter E. Hart, David G. Stork, Pattern Classification, 2ª (2001), John Wiley & sons

OpenCV book can be freely dowload from hereÂ

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204
Programming I/V05G300V01205
Fundamentals of Sound and Image/V05G300V01405
Digital Signal Processing/V05G300V01304
Fundamentals of Image Processing/V05G300V01632
Imaging Systems/V05G300V01633

IDENTIFYING DATA				
Multimedia Technology and Computer Graphics				
Subject	Multimedia Technology and Computer Graphics			
Code	V05G300V01932			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish Galician English			
Department				
Coordinator	Fernández Hermida, Xulio			
Lecturers	Fernández Hermida, Xulio			
E-mail	xuliofh@gmail.com			
Web	http://faitic.uvigo.es			
General description	Subject mainly based in projects to be done between the classroom and out of it. It consist of works to be done in groups of 2, 3 or 4 studets. It is necessassry to do a presentation and defence of the work in front of the rest of the classmates. It tackles fundamentally the 3D design, the construction of multimedia dynamic web pages and the construction of games.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A83	(CE74/OP17) The ability to construct, exploit and manage image and synthetic video generation systems and interactive multimedia applications.

Learning aims		
Subject competences	Typology	Competences
CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations	know	A3
CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.	Know How	A9
(CE74/OP17) The ability to construct, exploit and manage image and synthetic video generation systems and interactive multimedia applications.	Know How	A83

Contents	
Topic	
Synthesis of image by computer	Description of the underlying mathematics to the charts by computer. Description of the philosophy of the electronics associated to the cards of graphic processing in the computers
3D Modelling	Getting familiar with software programs for 3D design. Understanding of the differences between different applications and the implications that these differences suppose in what can be done with the designs realised in each program. (Blender, Sketchup, Solid Works, etc.). Texture mapping and material mapping: UV mapping. Formats of files for virtual surroundings and games.

3D Animation	Simple animation of rigid objects (rotation, traslation, scale). Illumination of scenes and obtaining of videos of these scenes. Realistic animation (a ball bouncing) Foundations of the animation with skeletons (animation of complex objects; walk of a person, etc.)
Virtual Reality, Enhanced Reality	Description of applications of virtual reality and enhanced reality. Limitations in the sensorization necessary for applications of virtual reality and enhanced reality.
Video games	Multisubject knowledge in the construction of a video game. Hardware platforms for video games. Software platforms for the creation of video games. Business Model in companies of video games. (Play Station, Xbox, Laptops, Smartphones. Apple store, etc.) Study of different graphic engines for video games (free and non free)

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	4	4	8
Practice in computer rooms	26	26	52
Tutored works	7	69	76
Presentations / exhibitions	4	8	12
Short answer tests	1	1	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	Only some classes in which the teacher shows concepts and/or explains knowledges interesting to learn and that are not easy to turn into works that can be done by the students.
Practice in computer rooms	Are the main part of the course. In these practices the students use the programs and applications with which, in parallel, they are realising the tutored works that are the main element of learning. The tutored works also give place to the presentations and to the main part of the evaluation.
Tutored works	Are only two or three works along the four month curse. They are to be done in groups of 2 to 4 students, in the classroom of practices and out of the classroom. Some presentations are to be done in class in front of the other classmates. They are the fundamental element of the course.
Presentations / exhibitions	To present the work is an important learning object in this subject. Through the shared work done in the classroom while they manage the tutored projects and afterwards the public presentation of the tutored work that has been done, we do the fundamental part of the evaluation. (evaluation that is to be done by the own students).

Personalized attention

	Description
Presentations / exhibitions	Taking advantage of that this is a subject with not too many students, the professor will do an individual follow-up of each student trying to be slope at all times of what his follow-up of the subject is and what his feeling is concerning what it is being done in classes. As a part of the work of the tutored works is being done in the informatic classrooms, these classes are the fundamental point of interaction between the professor and each student. The professor moves around the classroom helping to the groups in the realisation of the projects. If, in any point, all the studens need help, the teacher will do the explanation as in a masterclass. If the help is individual or for several ones, it will be given to the specific students wich need it.
Practice in computer rooms	Taking advantage of that this is a subject with not too many students, the professor will do an individual follow-up of each student trying to be slope at all times of what his follow-up of the subject is and what his feeling is concerning what it is being done in classes. As a part of the work of the tutored works is being done in the informatic classrooms, these classes are the fundamental point of interaction between the professor and each student. The professor moves around the classroom helping to the groups in the realisation of the projects. If, in any point, all the studens need help, the teacher will do the explanation as in a masterclass. If the help is individual or for several ones, it will be given to the specific students wich need it.

Tutored works	Taking advantage of that this is a subject with not too many students, the professor will do an individual follow-up of each student trying to be slope at all times of what his follow-up of the subject is and what his feeling is concerning what it is being done in classes. As a part of the work of the tutored works is being done in the informatic classrooms, these classes are the fundamental point of interaction between the professor and each student. The professor moves around the classroom helping to the groups in the realisation of the projects. If, in any point, all the studens need help, the teacher will do the explanation as in a masterclass. If the help is individual or for several ones, it will be given to the specific students wich need it.

Assessment

	Description	Qualification
Presentations / exhibitions	We will evaluate the quality of the work realized and also the quality of the presentation. In order this assessment to be done by the own students (self and crossed assessments) we give them a Rúbric where details on how to assess the different aspects. This probe evaluates the competence A9	30
Tutored works	These works are done with the supervision of the professor. But also with the 'crossed supervision' of the own students during the times of simultaneous work in the practical classes. Works usually are very good because the students are very motivated with them. The works done in the practical classes are 'the guiding thread' of all the subject. This probe evaluates the competence A83 (CE74/OP17)	60
Short answer tests	This is a test where questions fundamentally go over materials explained in the magistral classes. It also includes questions about basic conceps learnt in the development of the projects. This test could be different for those students that do not follow the Continuous Assessment. This probe evaluates the competence A3 (CG3)	10

Other comments and second call

Learning is thoght to be automatic for the students who do a continuous following of the classes works and lessons. (It's similar to learning a different language being introduced in a conversation group in that language: It's enough to be there and participate).
We will use some tools to realize some works. We will explain our mates what we are going to do, how we will do it, and finally what we do. With this dynamics we learn to use the tools at the same time that we do a project. We see how our classmates use the tools and how they realize their projects. We can help others and be helped by others. We enjoy doing and learn to value our work also the work of our mates.
And ... well. Finally it's necessary to put a note. But the note has little importance. If we learn, and enjoy, the fundamental profit has already been collected.

Those that did not take advantage of the previous, worry for the note. For them, and for those that did not show the minimum knowledges, we create a Second opportunity and a No Continuous Evaluation in the ending of the academic course.

Sources of information

D. Roland Hess, Animating with Blender, Focal Press,

Blender Is the program of Free Software that will be used as the base for the 3D Design and the 3D Animation.

Recommendations

Subjects that are recommended to be taken simultaneously

Image Processing and Analysis/V05G300V01931
Audiovisual Production/V05G300V01935

Subjects that it is recommended to have taken before

Fundamentals of Image Processing/V05G300V01632
Imaging Systems/V05G300V01633
Audiovisual Technology/V05G300V01631
Video and Television/V05G300V01533

Other comments

This subject is thought to be done by the method of EVALUATION CONTINUA and with assistance to all the classes. The learning process is being done day to day out and class to class. If it is done this way, the evaluation loses leadership because the fact of the learning is real and very clear for all: professor and students.

By imperative of educational organisation it is necessary to enable the option of EVALUACIÓN NO CONTINUA. I understand that this is a badly recommended way for the students wishing to take advantage of what they have paid and wishing to LEARN.

In any case, in the method of evaluación no contínua, we will try to give the possibility to the student to undoubtedly demonstrate that they know all what the students that assisted to class learnt during the development of the course.

The students that opt by the evaluación no contínua will equally have to do the works that the other students have done by evaluación contínua. They have to do a presentation of the work done, and answer to the questions that the professor can do in order the student to show that they dominate the tools that have had to use for these works.
They will do also a written examination in which they will answer to questions of the subjects given in the masterclasses and of any subject developed during the course.
The material used in the classes, projects, etc. will be located in FAITIC where it will be going put simultaneously with the development of the classes.

IDENTIFYING DATA				
Advanced Acoustics				
Subject	Advanced Acoustics			
Code	V05G300V01933			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish English			
Department				
Coordinator	Sobreira Seoane, Manuel Ángel			
Lecturers	García Lomba, Guillermo Sobreira Seoane, Manuel Ángel			
E-mail	msobre@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this subject, the use of advanced calculation methods in Acoustics are introduced. The Finite Element Method (FEM) and the Boundary Element Method (BEM) are applied to study problems of acoustic radiation, diffraction and modal analysis (calculation of mode shapes and resonance frequencies). Statistical Analysis Methods (SEA) are also introduced and applied to the calculation of flanking transmission in buildings. The language of the subject is mostly English, although the first lessons on Finite Element Methods could be explained in Spanish.			

Competencies	
Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A84	(CE75/OP18) The ability to elaborate noise maps and their geographical information display.
A85	(CE76/OP19) The ability to apply numerical methods in acoustical problem solving.
A86	(CE77/OP20) The ability to indentify industrial noise problems and to design appropriate control solutions.

Learning aims		
Subject competences	Typology	Competences
CE75: The ability to elaborate noise maps and their geographical information display. CE76: The ability to apply numerical methods in acoustical problem solving. CE77:The ability to indentify industrial noise problems and to design appropriate control solutions.	know Know How	A84 A85 A86
CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws. CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area. CG7: The ability to analyse and assess the social and environmental impact of technical solutions.	know	A2 A5 A7
Learning results: • Knowledge of the application of numerical methods in acoustics. (CE 76) • Knowledge on the models of sound transmission in buildings and building elements. (CE 76, CE 77) • Knowledge of the design techniques of acoustic mufflers. (CE 77) • Ability to understand the results of complex acoustic measurements and relate the results to those obtained by numerical calculation.(CE 76) • Knowledge of the main techniques in industrial noise control.(CE77)	know Know How	A85 A86

Contents

Topic	
Introduction.	Review of acoustic concepts: impedance, boundary conditions, Helmholtz and Euler equations.
The Finite Elements Method in Acoustics (FEM)	Theoretical introduction to the Finite Element Method. Radiation Problems with FEM. Diffraction Problems. Modal analysis with FEM: resonance frequencies and modes
The Boundary Element Method in Acoustics (BEM)	Introduction to the Boundary Element Method in Acoustics. Integral equation of Kirchhoff Helmholtz. Application to f radiation and diffraction problems. The calculation of of resonances in BEM.
Calculation methods based in S.E.A. Calculation of sound transmission in buildings.	Building Acoustics: acoustic insulation in buildings and determination of the flanking transmission. Calculation method of the international standard ISO 12354.
Other calculation methods.	Ray tracing and application to evaluation of sound propagation outdoors. Prediction of noise levels in industrial plants. Noise control.

Planning

	Class hours	Hours outside the classroom	Total hours
Tutored works	6	24	30
Practice in computer rooms	12	9	21
Previous studies / activities	0	15	15
Master Session	19	38	57
Short answer tests	2	8	10
Reports / memories of practice	2	10	12
Jobs and projects	1	4	5

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

Methodologies

	Description
Tutored works	Practical projects that the students have to develop: 1. Design of a diffuser to optimise the radiation pattern of a loudspeaker. 2. Design and calculation of the acoustic insulation of a building.
Practice in computer rooms	THe student will work with different software packages to apply the different calculation methods presented un the subject. 1. CAD and mesh generation: FreeCAD and Gmsh. 2. Finite Element calculations : COMSOL. 3. Boundary Element calculations: OpenBEM. 4. Calculations in building acoustics.
Previous studies / activities	The students must study and prepare with the sources of information given before the lectures and the practical sessions.
Master Session	Lectures will be given, developing the main theoretical concepts of the subject.

Personalized attention

	Description
Master Session	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Tutored works	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Practice in computer rooms	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Short answer tests	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Reports / memories of practice	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Jobs and projects	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Assessment

	Description	Qualification
Tutored works	Tutored practical project, with the delivery of a final report. The learning aims related to the ability to elaborate projects and application of calculation methods (numerical methods) are assesed. Learning aims related to the identification of problems are also assessed (through the application of numerical calculations). Learning Aims: A2/CG2, A84 (CE75/OP18), A85 (CE76/OP19), A87 (CE76/OP20)	20
Short answer tests	Written test, with short questions on the theory of the subject. Evaluation of learning aims involving knowledge of legislation and how to perform measurements. (Learning Aims: A2/CG2 , A5/CG5)	30
Reports / memories of practice	Questions and report of the practical tasks. Evaluation of those learning aims related to noise measurement and analysis of acoustic problems using numerical calculations. Learning aims: A5/CG5, A7/CG7, A85 (CE76/OP19), A86 (CE77/OP20).	50

Other comments and second call

Following the guidelines of the degree, two systems of evaluation are offered: continuous assessment (recommended) and a final examination. Â Evaluation with only a final examination will be only allowed in situations in which it is imposible to follow the system recommended.Â

LANGUAGE: Any student can choose which language will use during the assessment process (English, Spanish).

CONTINUOUS ASSESSMENT:Â

The continuous Â assessment will be based in the evaluation of practical task, projects and two tests. Once a student has signed a document of agreement with the process of continuous assessment, the final degree will be obtained by the application of the criteria described bellow, even though a student could miss some of the tasks or tests envolved in the process.

Once the student has shown good skills in all the assesed learning aims (at least 4 over 10 points in each learning aim assesed), the final grade with be obtained from the weighted sum of the grade obtained in the Â following tasks with the weights given.

1. Tutored works: 20 % of the final grade.Â
2. Reports of practical tasks(Weight: 50 %).Â
3. Two short answer tests Â (Total weight:30 %)

FINAL EXAMINATION:

A final examination is Â available Â for those students that for some reason could not follow the continuous evaluation assessment process. In this case there is date scheduled and officially published for final examination. Â The final examination will consist in two short answer tests, and some additional questions related with the practical tasks and projects.Â

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if the final Â grade obtained if equal or greater than 5.Â

RETAKE:

There is scheduled date at the end of the semester for a final examination retake, for those students that either dropped out during the semester or failed. Prior the examination, a student can choose to follow the continuous assessment or the final examination. In the former selection, the grades obtained in the projects and practical tasks will be taken into account and the student will only answer to the short answer tests. If the later, (final examination), the student will have also to answer a full examination as described before.Â

Sources of information
Johnson C. , Numerical solution of PDE by the finite element method. , , Dover
Reddy, J.N., An introduction to the Finite Element Method,, 2ª y 3ª ed, Mc Graw Hill
Quarteroni A, Valli A. , Numerical approximation of partial differential equations, , Springer Verlag
Ciskowski R.D. and Brebbia C.A., Boundary Element Methods in Acoustics, , Elsevier
Juhl, P.M. , The Boundary Element Method for Sound Field Calculations, , www.openbem.dk
CEN European Standards, EN 12354-1:2000. Building Acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 1: Airborne sound insulation between rooms, , CEN

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105
Mathematics: Calculus II/V05G300V01203
Fundamentals of Sound and Image/V05G300V01405
Room Acoustics/V05G300V01635
Fundamentals of Acoustics Engineering/V05G300V01531

IDENTIFYING DATA				
Noise Measurement Techniques and Regulations				
Subject	Noise Measurement Techniques and Regulations			
Code	V05G300V01934			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	English			
Department				
Coordinator	Torres Guijarro, María Soledad			
Lecturers	Torres Guijarro, María Soledad			
E-mail	marisol@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this subject, the main methods of measurement of environmental noise are discussed. The European an national regulations on noise and acoustic insulation are also presented. As part of the measurement process, a guide for the evaluation of the measurement uncertainty in acoustics is also presented. The teaching will be in English.			

Competencies	
Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A87	(CE78/OP21) The ability to write essays on environmental, construction and automation acoustics.
A88	(CE79/OP22) The ability to elaborate specific acoustic essay procedures.

Learning aims		
Subject competences	Typology	Competences
CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws, related with acoustic engineering. The specific learning aim are: • Knowledge of the regulations on the field of acoustic engineering.. • Knowledge of the usual international standards on acoustic measurements. CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling in the field of acoustic engineering (noise and acoustic insulation). CG7: The ability to analyse and assess the social and environmental impact of technical solutions. Specific Learning aims: Ability to write technical and reports, measurement reports on fields related to acoustic engineering. CG8.4 Knowledge on the regulations in telecommunications, mainly those related to acoustic engineering.	know	A2 A5 A7 A8
CE 78: The ability to write essays on environmental, construction and automation acoustics. CE79: The ability to elaborate specific acoustic essay procedures. Learning results: Ability to design measurement procedures matching the regulations and standard specifications.	know Know How	A87 A88

Contents	
Topic	
Introduction: noise, its description and annoyance.	Classification of noise and descriptors. The assessment of noise. General overview of measurements in acoustics. Nose levels, vehicle noise: pass by measurements, sound power determination.
Description and measurement of environmental noise	Characterization of the noise sources. Influence of the propagation conditions. Noise measurements.
Environmental noise regulations in Europe.	The EU Environmental Noise Directive. Directive 2002/49/EC of the European Parliament and of the Council of 25th June 2002 relating to the assessment and management of environmental noise. National noise regulations.
Acoustic Insulation, description and regulations in Europe.	Acoustic insulation, descriptors. National Code Buildings in Europe, and the regulations on acoustic insulation.
Measurement uncertainty.	The need to assess the measurement uncertainty: quality management in laboratories. The guide for expression of uncertainty in measurement- GUM. Measurement Uncertainty in Acoustics.

Planning			
	Class hours	Hours outside the classroom	Total hours
Tutored works	6	24	30
Laboratory practises	12	9	21
Previous studies / activities	0	15	15
Master Session	19	38	57
Short answer tests	2	8	10
Reports / memories of practice	2	10	12
Jobs and projects	1	4	5

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

Methodologies	
	Description
Tutored works	The student has to develope in group and write a report on two projects: 1. Procedure to describe and assess environmental noise un a real scenario. 2. An student may choose between: a)Project of acoustic insulation according to the simplified method described in the CTE-DB HR (Spanish Building Code, document for protection against noise). b) Detailed uncertainty budget for some of the measurements carried out. This methodology is targeted to competencies A2, A5, A7, A8, A87 and A88.
Laboratory practises	Laboratory practises on: 1. Characterisation and assessment of noise annoyance. 2. Noise measurements in closed spaces. 3. Measurement of pass-by noise. 4. Measurement of acoustic insulation in buildings. This methodology is targeted to competencies A2, A5, A7, A8, A87 and A88.
Previous studies / activities	The students must study and prepare with the sources of information given before the lectures and the practical sessions. This methodology is targeted to competencies A2 and A5, A7, A8, A87.
Master Session	Lectures will be given, developing the main concepts of the subject. This methodology is targeted to competencies A2, A5, A7, A8, A87 and A88.

Personalized attention	
	Description
Master Session	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Tutored works	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Laboratory practises	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Short answer tests	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Reports / memories of practice	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Jobs and projects	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Assessment

	Description	Qualification
Tutored works	Tutored practical project, with the delivery of a final report. (Learning Aims:A2, A5, A7, A8, A87, A88)	30
Short answer tests	Written test, with short questions on the theory of the subject. (Learning Aims; A2, A5, A7, A87, A88)	40
Reports / memories of practice	Questions and report of the practical tasks. (Learning Aims; A2, A5, A7, A87, A88)	30

Other comments and second call

Following the guidelines of the degree, two systems of evaluation are offered: continuous assessment (recommended) and a final examination. Evaluation with only a final examination will be only allowed in situations in which it is imposible to follow the recommended system.

LANGUAGE: The student can choose the language to use during the assessment process between english and spanish.

CONTINUOUS ASSESSMENT:

The continuous assessment will be based in the evaluation of practical task, projects and two tests. Once a student has signed a document of agreement with the process of continuous assessment, the final degree will be obtained by the application of the criteria described bellow.

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if each activity is graded equal or greater than 4, and the final grade obtained is equal or greater than 5.Â The final grade with be obtained from the weighted sum of the grade obtained in the following tasks with the given weights.

1. Tutored works: 30 % of the final grade. Two reports will be delivered: the first during the 6th week and the second during the 11th week
2. Reports of practical tasks(Weight: 40 %).
3. Short answer tests : Two short answer tests are included in the process of continuous assesment, (test 1 is scheduled on the 5th week and test 2 on the 11th week) (Total weight :20% each, with a total weight of 40% on the final grade).

FINAL EXAMINATION:

A final examination is available for those students that for some reason could not follow the continuous evaluation assessment process. In this case there is date scheduled and officially published for final examination. The final examination will consist in two short answer tests, and some additional questions related with the practical tasks and projects.

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if the final grade obtained is equal or greater than 5.

RETAKE IN JULY:

There is scheduled date in july for a final examination retake, for those students that either dropped out during the semester or failed. Prior the examination, a student can choose to follow the continuous assessment or the final examination. In the former selection, the grades obtained in the projects and practical tasks will be taken into account and the student will only answer to the short answer tests. If the later, (final examination), the student will have also to answer a full examination as described before.

Sources of information
, DIRECTIVE 2002/49/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 June 2002 relating to the assessment and management of environmental noise, , Official Journal of the European Communities, 18.0
ISO Standard, ISO 1996-1. Acoustics -- Description, measurement and assessment of environmental noise -- Part 1: Basic quantities and assessment procedures, , ISO Standard
ISO Standard, ISO 1996-2. Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of environmental noise levels, , ISO Standard
Birgit Rasmussen, J. H. Rindel, Sound insulation between dwellings – Descriptors applied in building regulations in Europe, , Applied Acoustics 71 (2010) 171–180
Birgit Rasmussen, Sound insulation between dwellings – Requirements in building regulations in Europe, , Applied Acoustics 71 (2010) 373–385
ISO Standard., ISO 140-4:1998 Acoustics -- Measurement of sound insulation in buildings and of building elements -- Part 4: Field measurements of airborne sound insulation between rooms., , ISO Standard.

Hyperlinks:

- *Evaluation of measurement data – Guide to the expression of uncertainty in measurement.Â*
- *Evaluation of measurement data – An introduction to the "Guide to the expression of uncertainty in measurement" and related documents*
- *Evaluation of measurement data – Supplement 1 to the "Guide to the expression of uncertainty in measurement" – Propagation of distributions using a Monte Carlo method*

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204
Fundamentals of Sound and Image/V05G300V01405
Room Acoustics/V05G300V01635
Fundamentals of Acoustics Engineering/V05G300V01531

IDENTIFYING DATA				
Audiovisual Production				
Subject	Audiovisual Production			
Code	V05G300V01935			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	English			
Department				
Coordinator	Fernández Santiago, Luís Emilio			
Lecturers	Fernández Santiago, Luís Emilio			
E-mail	faraon@uvigo.es			
Web	http://faitic.uvigo.es			
General description	General knowledge of the processes and language of AudioVisual production and direction, compression oriented them to get the ability to integrate into production / direction team, after organization charts, technical positions. Also, achieve general skills on cameras, Sets and NLE Editing Systems. Documentation in english.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A89	(CE80/OP23) The ability to conceptually and technically manage the phases in an audiovisual production.
A90	(CE81/OP24) The ability to creatively and skillfully use the technical equipment for production development.
A91	(CE82/OP25) The ability to use specific software applications in audiovisual production.
A92	(CE83/OP26) The ability to organize an audiovisual production.
B3	The development of discussion ability about technical subjects

Learning aims		
Subject competences	Typology	Competences
(CE80/OP23) The ability to conceptually and technically manage the phases in an audiovisual production.	know Know How	A89
(CE81/OP24) The ability to creatively and skillfully use the technical equipment for production development.	know Know How	A90
(CE82/OP25) The ability to use specific software applications in audiovisual production.	know Know How	A91
(CE83/OP26) The ability to organize an audiovisual production.	know Know How	A92
CG4: The ability to solve problems with initiative, to make creative decisions and skills	know Know be	A4
CG4: The ability to communicate and transmit knowledge and skills.	know Know How	A4
CG8.3 To know project organization and planning	know	A8
CG12 The development of discussion ability about technical subjects	know Know be	B3

Contents
Topic

Audiovisual Concepts:	Basic audiovisual language. Polysemy audiovisual, formats and genres. Production development, From Script to Broadcast: -script, revision, screenplay, development. shooting script, Storyboard. -Production Breakdown script, blocking shoots,shooting schedule, call sheets. Generic Organization of a studio. Generic Organization of production.
Definition of technical positions:	Preproduction: -Advisor (foresight other stages) -Technical Direction. -IT system Administration. (Networks, databases-nomenclatures-, adaptation ...) Production: -Electrical (lighting, rush ...) -Physical effects (mechanical, electronic, computer ...) -Sound. (Record, registration) -Signal Control. -Camera Control. Postproduction: -Transfer of information. -Quality control, compression. -Postprodcution operator (editing, Grading) -Computer effects. Broadcast: -Recoding, compressing and reformatting. -Replication. -Streaming.
Audiovisual Genres	Specific studio / production genre based: -Fiction -Advertising -Industrial -News -Magazines -Visual Effects -Animation TV as a set
Theoretical information linked to practices	NEWS -news, scipting, call sheets, recording. -Capture, editing and export. -Playlist, headers, bursts, direction, broadcast. REPORT: -Types, definition, development, DOCUMENTARY: -Documentation, rhythm, graphics. FICTION: -single camera, multi camera.

PRÁCTICAS	Camera: -Installation. -Specific and common elements. -Settings. -Analysis of the signal. -Variables involved in filming. NEWS -News, scipting, call sheets, recording. -News scripting and Recording. Edition: -Setting projects -Footage capture. -online/offline - linear / nonlinear -Three points editing -Triming -Audio setting. (Levels) -Export. NEWS -Capture, editing and export. -Editing news. Set -Set's camera. -Camera control -Lighting -Chroma lighting -Set's Resources -Direction NEWS -Playlist, headers, bursts, direction, broadcast. REPORT: -Types, definition, development, -Developing, recording and editing a story. DOCUMENTARY: -Documentation, rhythm, graphics. FICTION: -Single camera, multi camera. -Development, directión, production design, conducting a fictional Gag in single camera and set. POSTPRODUCTION (the basics): quality lost in compression / quality comparison. chroma key. wire removal. track. 3D track. integration.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	16	40	56
Laboratory practises	7	11	18
Classroom work	10	45	55
Outdoor study / field practices	5.84	0	5.84
Practical tests, real task execution and / or simulated.	0.16	0	0.16
Multiple choice tests	1	0	1
Reports / memories of practice	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	Theoretical sessions on concepts of visual language, formats, sets and use, workflow and integration of technical human resources in the production's team.
Laboratory practises	practise on images and sound gathering and their postproduction to develop audiovisual products.
Classroom work	Realization of Audiovisual contents to suitable for differect formats, apliying the knowledge learnt in the laboratory practices.
Outdoor study / field practices	Practices in the TV Set of CC.SS. Aimed to the understanding of direction workflow for news and fictional programs.

Personalized attention	
	Description
Reports / memories of practice	Personal review of the Edition of the individual report, aiming to the new knoweledge adquired by the student about the subject. Assistance in the development of the single/Multicamera report about format/genre, in wich the theoretical knowledge seen in the subject are included.

Assessment		
	Description	Qualification
Classroom work	Group products developed in the classroom and in the self time: News Repor Documentary Fiction CE80, CE81, CE82, CE83, G4.1, CG4.2, CG83, CG12	40
Practical tests, real task execution and / or simulated.	Individual Editing of the report and set's individual test. CE81, CE82, CG4.1, CG4.2.	25
Multiple choice tests	Test, theoretical contents and practical concepts of the subject. CG4.2, CG8.3.	20
Reports / memories of practice	Report of the differences between multicamera and singlecamera productions over the various studied formats. Study of a project. CE80, CE83, CG4.1, CG4.2, CG8.3, CG12	15

Other comments and second call

In second call will be necessary pass an Test (30%-theoretical contents and practical concepts of the subject-CG4.2, CG8.3.-) and questions to develop(30%-knowledge of the process of production formats-CE80, CE81, CE82, CE83, CG4.2, CG8.3, CG12-) and a practical exercise of efficience in the handle of camera and NLE edition (40%-CE81, CE82, CE83, CG4.1, CG8.3-).

Sources of information

ALTEN, STANLEY, Audio in media, , Wadsworth

TRIBALDOS, CLEMENTE, Sonido profesional, , Paraninfo

RUMSEY, FRANCIS. MCCORMICK, TIM, Sonido y grabación; Introducción a las técnicas sonoras, 2ª edición, IORTV

ONDAATJE, MICHEL, The Conversations: Walter Murch and the Art of Editing Film, , Bloomsbury Publishing Plc

BRINKMANN, R., The art and science of digital compositing, 2nd ed, Elsevier

MMILLERSON, GERALD. OWENS, JIM, Television production, , Taylor & Francis

HERRERO, JULIO CESAR, Manual de teoria de la información y telecomunicación, 2009 , Universitas

Recommendations

Subjects that are recommended to be taken simultaneously

Image Processing and Analysis/V05G300V01931
Multimedia Technology and Computer Graphics/V05G300V01932

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Fundamentals of Image Processing/V05G300V01632
Sound Processing/V05G300V01634
Imaging Systems/V05G300V01633
Audiovisual Technology/V05G300V01631
Video and Television/V05G300V01533

IDENTIFYING DATA				
Multimedia Services				
Subject	Multimedia Services			
Code	V05G300V01941			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish			
Department				
Coordinator	Blanco Fernández, Yolanda			
Lecturers	Blanco Fernández, Yolanda López Nores, Martín			
E-mail	yolanda@det.uvigo.es			
Web	http://www.faitic.es			
General description	The aim of this subject is to provide the students with the theoretical foundations and the practical skills that allow them to understand the basic principles of the digital treatment of the multimedia information. To this aim, it is necessary to present the main standards in the field of the multimedia processing, as well as the available mechanisms for the transmission of the audiovisual information through telematic networks. The focus is put on the realm of television, dealing with both the digital terrestrial TV broadcasting (DTTV) and the transmission over IP networks (IPTV). The practical part of the subject will allow the students to experiment with the design and development of telematic services based on the transmission of multimedia streams, along with the programming of interactive services about digital television broadcasting and video-on-demand. The documentation of the subject will be available in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A93	(CE84/OP27) The ability to apply the techniques based on computer, networks and distributed applications and services, in the broadcasting and interchange of audiovisual information.

Learning aims		
Subject competences	Typology	Competences
Understand the basic foundations of the digital treatment of the multimedia information.	know	A3
Know the main standards in the field of the processing of the multimedia information.	know	A6 A93
Understand the foundations and the main mediums adopted in digital TV broadcasting.	know	A3 A6
Know the basic foundations of the transmission of audiovisual information through telematic networks.	know	A3 A6
Acquire skills in the design and development of telematic services based on exchanging audiovisual contents.	know Know How	A3 A9 A93
Acquire skills for the programming of telematic services in the scope of interactive digital television.	Know How	A6 A93

Contents
Topic

1. Multimedia systems: Foundations and basic concepts	a. Digitalization of audio and video signals. b. Format for storage of audio and video signals. c. Conditional access and digital rights management.
2. Terrestrial Digital TV broadcasting	a. Architecture b. Transport of bitstreams c. Signaling d. Middlewares e. Mobile Digital Television
3. IP Television and video-on-demand	a. Architecture b. Data distribution. VoD and nVoD. c. Broadcasting, multicasting and P2P d. Systems and protocols e. Signaling

Planning

	Class hours	Hours outside the classroom	Total hours
Presentations / exhibitions	2	2	4
Projects	7	33	40
Practice in computer rooms	4	7	11
Practice in computer rooms	8	22	30
Master Session	19	35	54
Multiple choice tests	2	9	11

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

Methodologies

	Description
Presentations / exhibitions	The students, organized into groups of 2-3 people (as per professor's criteria), will expose to their mates in the computer room the design proposed for the project planned for the group classes. The aim is to argue the advantages and problems of each model, promoting the debate around the proposal of each group. The professor will carry out a personalized follow-up of each group, with the goal of fixing possible deficiencies and guiding right design decisions. These methodologies will assess the skills CG3, CG6 and CG9.
Projects	The students, organized in groups of 2-3 people (as per professor's criteria), will implement the project posed by the professor. The goal is to boost a collective discussion to identify the key points in the development of the project. The students will combine face-to-face work in the computer room with the individual work. These methodologies will assess the skills CG3 and CG6.
Practice in computer rooms	The professor will propose practices in which the students will deal with the main concepts explained in the subject, putting the focus on the coding formats adopted in the transmission of multimedia information. The doubts arisen during the autonomous work of the students in the computer room will allow to promote the debate of the group to agree the best solution for each problem. These methodologies will assess the skills CE84 and CG6.
Practice in computer rooms	The professor will propose practices in which the students will deal with the main concepts explained in the subject, putting the focus on possible applications in the realm of Terrestrial Digital TV and transmission of television over IP. The doubts arisen during the autonomous work of the students in the computer room will allow to promote the debate of the group to agree the best solution for each problem. These methodologies will assess the skills CE84, CG3 and CG6.
Master Session	Classes where the main theoretical concepts of the subject will be explained, by proposing examples and possible application scenarios in the context of the transmission of multimedia streams. These methodologies will assess the skills CG3 and CG6.

Personalized attention

	Description

Presentations / exhibitions	The personalized attention will be based on following-up the work of each student, by tracking the solutions proposed for the practices in room computers and group projects, and the public presentation of their designs and implementations.
Projects	The personalized attention will be based on following-up the work of each student, by tracking the solutions proposed for the practices in room computers and group projects, and the public presentation of their designs and implementations.
Practice in computer rooms	The personalized attention will be based on following-up the work of each student, by tracking the solutions proposed for the practices in room computers and group projects, and the public presentation of their designs and implementations.
Practice in computer rooms	The personalized attention will be based on following-up the work of each student, by tracking the solutions proposed for the practices in room computers and group projects, and the public presentation of their designs and implementations.

Assessment

	Description	Qualification
Presentations / exhibitions	The students, organized into groups of 2-3 people (as per professor's criteria), will present the design proposed for the project planned for group classes. These oral presentations will take place in the lab during the penultimate week of the course. In these practices the skills CG6 and CG9 will be assessed.	10
Projects	The students, organised in groups of 2-3 people (according to the criterion of the professor), will have to develop a project linked to the command of the digital TV by diffusion or to the TV on IP. This project must be delivered in a date to be confirmed between 8th and 17th January, 2015. The project must include the code and the necessary documentation to justify the decisions of design and the criteria considered in the development of the solution proposed. This proof will evaluate the competitions CG3 and CG6.	30
Practice in computer rooms	The students, organized in groups of 2 people, will submit a report about the solution proposed for the first practice in the computer room, which will be about coding formats adopted in the transmission of multimedia streams. If necessary, the submission will include also the software used in the development of the solution proposed. This first practice will be submitted during the 4th week of the course. In these practices the skills CG6 and CE84 will be assessed.	10
Practice in computer rooms	Each student will submit individually a report about the solution proposed for the second practice in the computer room. This practice will be about Digital TV broadcasting. The submissions will include the software used in the development of the solution, along with documentation to justify design decision and implementation details. This second practice will be submitted during the 8th week of the course. In these practices the skills CE84, G6 and CG3 will be assessed.	20
Multiple choice tests	Each student will take an exam including multiple choice tests, where the goal is to validate their practical skills and understanding level about the theoretical concepts acquired during the course. This exam will take place in the official date published at http://www.teleco.uvigo.es. Note that support materials are not allowed. In these practices the skills CG6 and CG3 will be assessed.	30

Other comments and second call

There exist two mechanisms for the assessment of students in this subject: continuous assessment (CA) and traditional assessment (TA). Regardless of the considered assessment mechanism, the pass mark for the subject is 5 out of 10.Â

The students must choose one of the possible mechanisms by bearing in mind the following conditions:Â

- CA includes the 5 tests described above.
- Students who sit CA must submit during the 4th week of the course their solution for the first practice proposed in the computer room (3rd test in the previous section). By the submission of this practice the student makes a commitment to be assessed via CA, thus renouncing the TA mechanism.Â In virtue of this commitment,Â these students will not be listed as "Not Present".
- Students who do not submit the first practice during the 4th week of the course renounce to the CA, thus being assessed through the TA mechanism. Note that it will not be possible to join the CA in the next tests.Â
- CA tests will be carried outÂ onlyÂ in the dates defined by the professors. These CA tests cannot be repeated later.
- The grades obtained in the CA and other exams and practical projects are only valid for the current academic year.Â

- CA will be just considered in the first opportunity to pass the subject. In the second one only TA will be valid.

Students who sit CAÂ in the first opportunity to pass the subject will be assessed as follows: Â

- CA tests will be 100% of the final remark of the student. This assessment mechanism consists of five CA tests that have been previously described (a multiple-choice test, two practices in the computer room, public presentation of the design of a practical project and the final implementation of this project). Note that the student makes a commitment to follow-up CA by submitting the first practice during the 4th week of the course, thus renouncing the TA mechanism.

Students who sit TAÂ in the first opportunity to pass the subjectÂ will be assessed as follows:

- A final exam that these students will take in the official date published at http://www.teleco.uvigo.es. This test will include short-answer questions and/or multiple-choice tests, along with problems and practical use cases to be analyzed and resolved. The weight of this exam in the final remark is 50%. Note that support materials are not allowed. Â
- Submission of a practical project that will include software and documentation to justify design decisions and describe implementation details. The weight of this project in the final remark is 50%. Note that that each student must submit this project individuallyÂ in a date to be confirmed between 8th and 17th January, 2015.

Students who did not pass the subject in the first opportunity, will have **a second opportunity** where theyÂ cannot be assessed via CA, so that **only TA is valid**. Therefore, these students must (i) take the final exam (in the official date published at http://www.teleco.uvigo.es) and (ii) submit individually the practical project (in the date published by professors at www.faitic.uvigo.es), as described above for the TA mechanism. The weight of each part in the final remark will be 50%.Â

Sources of information

Wes Simpson, Video over IP IPTV, Internet video, H.264, P2P, Web TV, and streaming: a complete guide to understanding the technology, Elsevier, 2008

Artur Lugmayr, Samuli Niiranen, Seppo Kalli, Digital Interactive TV and metadata, Springer, 2004

George Lekakos, Konstantinos Chorianopoulos, Georgios Doukidis, Interactive Digital Television: technologies and applications, IGI Publishing, 2007

José J. Pazos Arias, Carlos Delgado Kloos, Martín López Nores, Personalization of Interactive Multimedia Services: a research and development perspective, Nova Science Publishers, 2008

Liliana Ardissono, Alfred Kobsa, Mark Maybury, Personalized Digital Television: targeting programs to individual viewers, Kluwer Academic Publishers, 2004

Other sources of information related with DVB standards (http://www.dvb.org/technology/standards/):

- Framing structure, channel coding and modulation for digital terrestrial television (IN 300 744 V1.6.1). January 2009.
- Implementation guidelines for DVB terrestrial services; Transmission aspects (TR 101 190 V1.3.2). May 2011.
- Mega-frame for Single Frequency Network (SFN) synchronization (TS 101 191 V1.4.1). June 2004.

Recommendations

Other comments

It is recommendable that the Telematics module had been passed.

IDENTIFYING DATA				
Mobile and Wireless Networks				
Subject	Mobile and Wireless Networks			
Code	V05G300V01942			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish Galician English			
Department				
Coordinator	Gil Castiñeira, Felipe José			
Lecturers	Gil Castiñeira, Felipe José López Bravo, Cristina			
E-mail	xil@gti.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The subject "Wireless and Mobile Networks" (redes sen fíos e móbiles) examines the area of wireless and mobile networks, studying the existing challenges for the communications protocols, and looks at the opportunities that provides continuous connectivity even in movement. The focus of this subject will be on network protocols above physical layer (nevertheless, it will touch the most important physical layer properties). The documentation will be available in english.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A94	(CE85/OP28) The ability to analyze, plan and deploy wireless communication networks for different coverage ranges: metropolitan, local and short range.

Learning aims		
Subject competences	Typology	Competences
Understand the main concepts of wireless communications.	know	A3 A94
Understand the main concepts of mobile communications.	know	A3 A94
Know the main protocols used in wireless communication networks.	know	A3 A94
Know the architectures used in wireless communication networks.	know	A3 A94
Ability to design mobile wireless networks.	Know How	A3 A4 A9 A94

Contents
Topic

Introduction to wireless communications	Channel characteristics Multiple access Modulation
Principles of operation of wireless networks	Mobility management Introduction to ubiquitous computing Ad hoc networks, routing Security Network topologies
Wide area networks	Architecture Mobile networks Network topologies Practical case
Local networks	Architecture: ad hoc and infrastructure based networks User authentication approaches Security Quality of services Practical case
Low range networks	Architecture Bandwidth/power consumption balance Personal communication Industrial communication

Planning			
	Class hours	Hours outside the classroom	Total hours
Practice in computer rooms	13	39	52
Integrated methodologies	6	28	34
Master Session	19	38	57
Reports / memories of practice	0	3	3
Systematic observation	1	0	1
Jobs and projects	1	0	1
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
Practice in computer rooms	Students will complete guided and supervised practices in the laboratory. Competences A4, A9, A94 will be developed
Integrated methodologies	Team development of the design, implementation and validation of a protocol, system, application or service. Competences A3, A4, A9, A94 will be developed.
Master Session	Professors present the main theoretical contents related to wireless and mobile networks. Competences A3, and A94 will be developed.

Personalized attention	
	Description
Practice in computer rooms	The professors of the subject will provide individual attention to the students during the course, solving his doubts and questions. In addition, the professors will advise and will guide the students during the realization of the tasks.
Integrated methodologies	The professors of the subject will provide individual attention to the students during the course, solving his doubts and questions. In addition, the professors will advise and will guide the students during the realization of the tasks.

Assessment		
	Description	Qualification

Master Session	Students will be evaluated to asses what they have learned in master sessions. Competences A3, and A94 will be evaluated.	30
Practice in computer rooms	Students will fill lab reports to asses the correct realization and understanding of the laboratory tasks. Competences A4, A9, and A94 will be evaluated.	20
Integrated methodologies	Students will be divided in groups to complete the design, implementation and validation of a protocol, a system, an application or service. The result will be evaluated after the delivery, having into account key aspects such as the correction, the quality, the performance and the functionalities. In addition, during the implementation of the project, the design and the evolution of the development will be evaluated. Competences A3, A4, A9, and A94 will be evaluated.	50

Other comments and second call

In order to pass the course it is necessary to complete the different parts of the subject (master sessions, practices in labs, and tutored works). The final grade will be the **weighted geometric mean** of the grades of the different parts (i.e. it is not possible to pass the subject with a zero in one part). If "x" is the grade obtained for the master sessions, "y" for the practices in labs, and "z" for the tutored works, the final grade will be: grade = x^0.3*y^0.2*z^0.5

During the first month, students must declare if they opt for continuous or final assessment. Students who select continuous assessment and submit the first task or lab report may not be listed as "Not Present".

Students that opt by the final assessment procedure, must submit an additional dossier with detailed information about the events and issues that arose during the execution of the different tasks, and especially the tutored work. In addition, during the first month of the course, professors will notify students if they have to do the tutored work individually, in the case they opt for final assessment.

Second opportunity to pass the course

The course final exam will only be held for students who failed the course in the first oportunity (semester final exam).

In order to pass the course it is necessary to complete the different parts of the subject, which will be evaluated as is indicated in the tests description section. Besides, it will be necessary to submit an additional dossier with detailed information about the events and issues that arose during the execution of the different tasks, and especially the tutored work.

Students that have opted by the continuous assessment procedure, can decide to maintain the grades of the parts they have already passed in the first opportunity or discard them.

Other comments

The grades obtained are only valid for the current academic year.

The use of any material during the tests will have to be explicitly authorized.

Sources of information

Viajy Garg, Wireless Communications and Networking, 1, 2007

Kaveh Pahlavan, Prashant Krishnamurthy, Networking Fundamentals: Wide, Local and Personal Area Communications , 1, 2009

Pei Zheng, Larry L. Peterson, Bruce S. Davie, Adrian Farre, Wireless Networking Complete, 1, 2009

James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6, 2012

Recommendations

Subjects that it is recommended to have taken before

Computer Networks/V05G300V01403
Data Networks: Technology and Architecture/V05G300V01542

IDENTIFYING DATA				
Programming of Intelligent Systems				
Subject	Programming of Intelligent Systems			
Code	V05G300V01943			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish			
Department				
Coordinator	Burguillo Rial, Juan Carlos			
Lecturers	Burguillo Rial, Juan Carlos Costa Montenegro, Enrique			
E-mail	jrial@uvigo.es			
Web				
General description	This course will begin providing the notion of agent, to comprise what is, how build it and how can, the agents interact for modeling and solving complex problems. Later we will study the design, implementation and application of intelligent agents and multiagent systems in current communications technologies and relate them with other current paradigms such as: object oriented programming, mobile agents, the management distributed of networks, the adaptive user interfaces and the electronic commerce. The students will learn to program multiagent systems in suitable platforms and mobile terminals (Android). Besides, they will perform a work in group, where they will extend the concepts studied in the subject to other topics of their own interest. This subject will be taught and evaluated in Spanish by defect. Nevertheless, the teacher will ask the students about the possibility to provide the whole subject or part of it in English. In any case, all the documentation of the subject will be provided in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A95	(CE86/OP29) The ability to program computer applications and services based on artificial intelligence.

Learning aims		
Subject competences	Typology	Competences
To understand the basic concepts of intelligent systems: search, reasoning and learning.	know	A3
To know the main concepts related with intelligent agents and multiagent systems.	know	A3 A95
To understand the basic concepts of software engineering in intelligent systems.	know	A3 A95
To achieve a suitable level of expertise in the use of IDEs for programming intelligent systems.	know Know How	A3 A4 A95
To acquire skills in the design and development of intelligent services applied to electronic devices.	know Know How	A3 A4 A95
To acquire skills for the application of intelligent systems in complex telematic services.	know Know How Know be	A3 A4 A9 A95

Contents	
Topic	
Introduction to intelligent systems	a) Searching b) Reasoning c) Learning
Intelligent agents	a) Definition of intelligent agent b) Architectures for intelligent agents c) Learning and adaptability
Multiagent systems	a) Distributed Artificial Intelligence and multiagent systems b) Communication between agents: KQML, FIPA-ACL c) Coordination and protocols of interaction d) Learning in multiagent systems e) Self-organised multiagent-systems
Software engineering of oriented to agents	a) Programming and methodologies oriented to agents b) Agents vs. Objects c) Agents vs. Expert Systems d) The JADE development platform
Multiagent systems and Game Theory	a) Cooperation vs. Competition b) Negotiation c) Auctions d) electronic Commerce
Mobile agents	a) Concept of mobile agent b) Security problems c) Possible applications

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	3	6	9
Master Session	9	36	45
Laboratory practises	14	28	42
Proceedings	9	0	9
Forum Index	0	4	4
Tutored works	6	30	36
Multiple choice tests	1	4	5

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

Methodologies	
	Description
Introductory activities	We start doing a generic introduction to the aims, and the global contents of the subject together with the results expected at the end of the course.
Master Session	We describe the different topics of the subject providing the necessary educational material.
Laboratory practises	Every student must do a practical task in the laboratory with the JADE development platform.
Proceedings	In the classes there will be open discussion, among groups of students, in order to focus on a topic of subject content, the analysis of a case, the outcome of a project, exercise or problem previously developed a keynote address.
Forum Index	The students must perform some activities within the TEMA platform at FAITIC in order to discuss topics related to the subject.
Tutored works	The students must perform a project in group, with the support of the professor, to extend and personalize the topics seen along the theoretical and practical classes. At the same time, we will try that the students perform such project demos using Android terminals.

Personalized attention	
	Description
Tutored works	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.

Laboratory practises	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Proceedings	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Forum Index	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.

Assessment

	Description	Qualification
Tutored works	Evaluation of the works developed: understanding, maturity, importance and originality of the work and interaction between the group. These works evaluate the competencies: A3, A4, A9.	30
Laboratory practises	The students will perform a practical task in the laboratory with the JADE development platform where they will work with the concepts studied in the theoretical classes. These practices evaluate the competencies: A95, A3, A4.	30
Proceedings	Discussions done along classes related with expositions done or read previously. These discussions evaluate the competencies: A3, A4	5
Forum Index	Short answers and interaction done individually by students within the TEMA platform to discuss topics related with the subject. This forum evaluates the competencies: A3, A4	5
Multiple choice tests	Three successive tests (weeks 4, 7 and 10) to evaluate the contents given up to that time in the course. The tests will be individual and with time limit. These tests evaluate the competencies: A3	30

Other comments and second call

The elements that are part of the evaluation of the subject are the following:

- **Questionnaires**: along the course the student will fill 3 questionnaires that will contribute 10% to the final mark (eachÂ one).

- **Practical tasks**: each student will have to perform a practical task in the laboratory that will contribute 30% to the final mark.

- **Final work**: each student will have to do a work in group, about one among several possible topics, that will contributeÂ 30% (5% proposal + 15% work done + 10% presentation) to the final mark.

- **Class participation**: students will discuss in class about expositions done by the professor, and this contributes in a 5% to the final mark.

- **Forum participation**: students must interact in the forum of the subject individually to achieve a 5% of the final mark.

Therefore, we have: questionnaires (3*x10 = 30%) + Practical task (30%) + Group Work (30%) + Class participation (5%) + Forum (5%) = 100%.

Following theÂ degreeÂ guidelines, the students that will follow this subject can choose between two evaluation: continuous evaluation and evaluation at the end of the semester.

Continuous evaluation: the student follows the continuous evaluation from the moment in that it fills two questionnaires.

Â From that moment we assume that he/she has participated in the subject, independently of he/she assist to the final exam.

Evaluation at the end of the semester: the student will have to perform a final exam that substitutes the questionnaires done along the course, in addition to providing the practical task and the equivalent work to be done as part of the continuous evaluation.

Evaluation at the end of the second semester: the student will have to perform the part that has not passed previously.

The questionnaires and task proposed and performed in this course are only valid for the currentÂ course.

Sources of information
Michael Wooldridge,, An Introduction to Multiagent Systems, Addison-Wesley, 2a, 2009
Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach,, Prentice Hall, 3a, 2014
Jacques Ferber, Multi-Agent Systems: an Introduction to Distributed Artificial Intelligence, Addison-Wesley, 1a, 1999
Alison Cawsey, The Essence of Artificial Intelligence, Prentice Hall Europe, 1a, 1998

Recommendations

Subjects that it is recommended to have taken before

Programming II/V05G300V01302

Other comments

The only requirement for the students, in order to follow this subject, is to have a basic understanding of Java programming.

IDENTIFYING DATA				
Embedded Systems Design				
Subject	Embedded Systems Design			
Code	V05G300V01944			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish Galician			
Department				
Coordinator	Rodríguez Hernández, Pedro Salvador			
Lecturers	Gil Castiñeira, Felipe José Rodríguez Hernández, Pedro Salvador			
E-mail	pedro.rodriguez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Embedded systems are part of almost all the diary activities that involve an electronic device (the alarm clock, the mobile phone, the car...). This course introduces the main concepts behind modern embedded systems that include an operating system, and puts them in practice through a series of exercises and projects. The documentation will be provided in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A96	(CE87/OP30) The ability to understand the specific requirements for integrated circuits with strict real time restrictions.
A97	(CE88/OP31) The ability to formulate and solve problems of design and development of integrated systems.

Learning aims		
Subject competences	Typology	Competences
Know the technological base which supports the most recent investigations in the study and design of integrated systems.	know	A96
Understand the basic aspects of the special requirements inherent to embedded systems with hard real time restrictions	know	A3 A96
Adopt a global view of the problem of programming environments with real-time restrictions, and know the proper tools for dealing with them, so that embedded systems can be addressed with a system level approach.	Know How	A3 A4 A9 A97
Understand the basic elements of fault prevention and fault tolerance	know Know How	A4 A9 A97
Master the concepts related to the organisation of this kind of systems software	know Know How	A4 A9 A97
Handle the tasks scheduling and resources sharing techniques in embedded systems	know Know How	A97
Become familiar with the use of abstraction platforms for developing embedded systems	Know How	A4 A97

Contents
Topic

Concept of embedded system	Definition of embedded system Real-time systems Characteristics
Operating systems for embedded systems	Operating systems with real-time restrictions Multitasking: threads and processes Synchronization
Architectures of embedded systems	ARM, MIPS Microprocessors
Process scheduling	Cyclic executives Priority-driven scheduling: DMS, EDF Access synchronization
Reliability and fault tolerance	Fault prevention and fault tolerance Static and dynamic redundancy Security, reliability and dependability
Distributed embedded systems	Communication mechanisms Field buses
Abstraction platforms for the development of embedded systems	OSGI Android MAEMO
Communication with sensors and actuators	I/O Hardware Coping with concurrency The Analog/Digital interface

Planning

	Class hours	Hours outside the classroom	Total hours
Presentations / exhibitions	1	5	6
Laboratory practises	14	0	14
Group tutoring	6	10	16
Integrated methodologies	0	55	55
Master Session	19	38	57
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
Presentations / exhibitions	Presentation by the students of the developed projects results. Competencies A4, A9, A96 and A97 will be practised.
Laboratory practises	Development by the students of guided and supervised assignments in the laboratory. Competencies A3, A4, A96 and A97 will be practised.
Group tutoring	Meetings of the professors with the students for tracking the current status and further planning the project activities. Competencies A4, A9, A96 and A97 will be practised.
Integrated methodologies	We use learning projects based training: the students carry out a project along the semester to resolve a complex problem by means of planning, design and implementation of a series of activities. Competencies A3, A4, A9, A96 and A97 will be practised.
Master Session	Professors present the main theoretical contents related to embedded systems with real-time restrictions. Competencies A3, A96 and A97 will be practised.

Personalized attention

	Description
Master Session	The professors of the subject will provide individual attention to the students during the, solving their doubts and questions. In addition, the professors will advise and guide the students during the realization of their tasks.

Laboratory practises	The professors of the subject will provide individual attention to the students during the, solving their doubts and questions. In addition, the professors will advise and guide the students during the realization of their tasks.
Group tutoring	The professors of the subject will provide individual attention to the students during the, solving their doubts and questions. In addition, the professors will advise and guide the students during the realization of their tasks.
Integrated methodologies	The professors of the subject will provide individual attention to the students during the, solving their doubts and questions. In addition, the professors will advise and guide the students during the realization of their tasks.

Assessment

	Description	Qualification
Presentations / exhibitions	Once their project is implemented, the students will perform a public presentation of its design, development and results, having to answer successfully to questions. Competencies A4, A9 and A96 will be evaluated.	10
Laboratory practises	The students will fill questionnaires to asses the correct realization and understanding of the laboratory tasks. Competencies A3, A4, A96 and A97 will be evaluated	10
Group tutoring	A continuous tracking of the design and evolution of the implementation will be held during the realization of the project. Periodically, the students will present the state and results of their projects, as well as the scheduled taskss. Competencies A4, A9, A96 and A97 will be evaluated	10
Integrated methodologies	The students will be divided in groups for accomplishing the design, implementation and proof of an embedded system. The result will be evaluated after the his delivery, assessing aspects such as correction, quality, performance and functionalities. Competencies A3, A4, A9, A96 and A97 will be evaluated	30
Short answer tests	Students will be evaluated to asses what they have learned in master sessions. Competencies A4, A96 and A97 will be evaluated	40

Other comments and second call

In order to pass the course it is necessary to complete the different parts of the subject (master sessions, practices in labs,Â and projects). The final grade will be the **weighted geometric mean** of the grades of the different parts (i.e. it is notÂ possible to pass the subject with a zero in one part). If "x" is the grade obtained for the master sessions, "y" for the practicesÂ in labs, and "z" for the project, the final grade will be: grade = x^0.4*y^0.1*z^0.5

During the first month, students must declare if they opt for continuous or final assessment. Students who select continuousÂ assessment and submit the first task or questionnaire may not be listed as "Absent".

Students who opt for the final assessment procedureÂ must pass the short answer test (40%), submit a project (50%) and submit the laboratory practises (10%). These partsÂ will be evaluated as indicated in the tests description section.Â The final grade will be theÂ **weighted geometric meanÂ** of the grades of the different parts. Besides, theyÂ must submit an additional dossier with detailed information about theÂ events and issues that arose during the execution of the different tasks, and especially the project. In addition, duringÂ the first month of the course, professors will notify studentsÂ who opted for finalÂ assessmentÂ if they have to do the tutored work individually.

Second opportunity to pass the course

The end of course exam will only be held by students who failed the end of semester exams.

In order to pass the course it is necessary to complete the different parts of the subject:Â pass the short answer test (40%), submit a project (50%) and submit the laboratory practises (10%). These partsÂ will be evaluated as indicated in the tests description section.Â The final grade will be theÂ **weighted geometric meanÂ** of the grades of the different parts. Besides, it will be necessary to submit an additional dossier with detailedÂ information about the events and issues that arose during the execution of the different tasks, and especially the project.

Students that have opted by the continuous assessment procedure, can decide to maintain the grades of the parts theyÂ have already passed in the first opportunity or discard them.

Other comments

The grades obtained are only valid for the current academic year.

The use of any material during the tests will have to be explicitly authorized.

Sources of information
A. Burns & A. Wellings, istemas de Tiempo Real y Lenguajes de Programación, 3, 2003
E.A. Lee & S.A. Seshia, Introduction to Embedded Systems, 1, 2012
P. Marwedel, Embedded System Design, 2, 2012
P. Barry & P. Crowley, Modern Embedded Computing, 1, 2012
S. Barrett & J. Kridner, Bad to the Bone: Crafting Electronics Systems with Beaglebone and BeagleBone Black, 1, 2013

Recommendations

Subjects that it is recommended to have taken before

Informatics: Computer Architecture/V05G300V01103
Distributed and Concurrent Programming/V05G300V01641
Operating Systems/V05G300V01541

IDENTIFYING DATA				
New Telematic Services				
Subject	New Telematic Services			
Code	V05G300V01945			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language	Spanish			
Department				
Coordinator	Llamas Nistal, Martín			
Lecturers	Álvarez Sabucedo, Luis Modesto Llamas Nistal, Martín			
E-mail	martin@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The overall objective of the course is that students gain a global vision of the new technologies in the field of telematic services. Thus the contents of this course will be open and try to gradually adapt to technological developments in this field. At first we focus on semantic technologies.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A98	(CE89/OP32) The ability to design and construct new computer services.

Learning aims		
Subject competences	Typology	Competences
CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.	know	A4
CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.	Know How	A9
(CE89/OP32) The ability to design and construct new computer services.	Know How	A98

Contents	
Topic	
Information Retrieval.	Algorithms and classic applications. Algorithms based on links. Applications to social networks.
Structure of a typical search engine.	Basic architecture of a search engine. Description and objectives of each of the modules.
Introduction to semantic web.	Metadata, RDF. Examples of metadata: LOM and Dublin Core.
Semantic web and related technologies.	Semantic Web languages and tools:OWL, and SPARQL. Vocabularies, Taxonomies and Ontologies. Folksonomies.
e-technologies	e-learning, e-government and e-health

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	16	40	56
Laboratory practises	14	28	42
Case studies / analysis of situations	5	25	30

Introductory activities	3	6	9
Jobs and projects	1	3	4
Jobs and projects	1	4	5
Long answer tests and development	2	2	4

*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 contents and their practical application will be presented during the lectures. Student are expected to play an active role during lectures.
Laboratory practises	During practical sessions, it will be developed a semantic project with the support of adhoc software tools.
Case studies / analysis of situations	Use cases will presented to the students. Thus, they will be able to analyze and to study them in depth in order to prepeare their academic projects.
Introductory activities	Program of the subject will be presented along with the methodologies used, the classroom, practical contents, final project, final and continuous evaluation criteria, and, in general, all aspects of the subject.

Personalized attention	
	Description
Master Session	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor’s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Laboratory practises	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor’s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Case studies / analysis of situations	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor’s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Jobs and projects	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor’s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Jobs and projects	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor’s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Long answer tests and development	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor’s office at hours established by the professor for this purpose at the beginning of the semester and published online.

Assessment	
Description	Qualification

Jobs and projects	-It consists of the presentation of a practical project using semantics. -It will take place at about the 11th week of the course. - Competencies A4, A9 and A98 are evaluated.	30
Jobs and projects	- It consists of the presentation of a project covering all telematics solution. - It will take place at the end of the course. - Competencies A4, A9 and A98 are evaluated.	30
Long answer tests and development	- It will cover all the theoretical contents. - It will take place on the 8th week of the course. - A4 competence is evaluated.	40

Other comments and second call

1. Continuous assessment

The course can be passed with full marks from continuous assessment, with no need to sit the final exam.

Students who sit any of the assessment tests may not be listed as "Not Present".

The weighting and content of each continuous assessment test are as follows:

AssessmentÂ 1 (40%):

·Â Â Â Â Â Â All theoretical contents.

·Â Â Â Â Â Â It will take place about the 8th week of the course.

AssessmentÂ 2 (30%):

·Â Â Â Â Â Â It will consist of the presentation of a semantic project (specified in due course).

·Â Â Â Â Â Â It will take place about the 11th week of the course.

AssessmentÂ 3 (30%):

·Â Â Â Â Â Â It will consist of a presentation of a holistic project involving telematic based services

·Â Â Â Â Â Â At the end of the course.

It is mandatory to pass each part of the continuous assessment (that is, the minimum score of each part must be 5 out of 10)

The course may be passed only with continuous assessment. Those students who failed the first assessment are allowed to compensate it in the final exam.

2.Â Final exam

·Â Â Â Â Â Â There is a final exam at the end of the semester and another at the end of the course.Â All content presented along the course is included in this exam.

·Â Â Â Â Â Â Students sitting this final exam will be asked to submit in advance some works to be done according to specific instructions on each call. These works must be originalÂ and will involve task related to assessments 2 and 3. Should the work not be original, the student will be banned from the entire course.

·Â Â Â Â Â Â The pass mark for this test is 5 out of 10.Â

Â

Sources of information

R. Baeza-Yates y B. Ribeiro-Neto. , R. Baeza-Yates y B. Ribeiro-Neto. "Modern Information Retrieval"., R. Baeza-Yates y B. Ribeiro-Neto. "Modern Information Retrieval". Addison Wesley.,

Gómez-Pérez, A.; Fernández-López, M.; Corcho, O, Ontological Engineering, Springer-Verlag, November 2003

BIBLIOGRAPHY

- Arasu, A., Cho, J., García-Molina, H., Paepcke, A., and Raghavan, S. “Searching the web”. ACM Transactions on Internet Technology, Vol. 1, No. 1, pp. 2-43, August 2001.

- S.Â Chakrabarti, B.Â Dom, D.Â Gibson, J.Â Kleinberg, P.Â Raghavan, and S.Â Rajagopalan. Automatic resource compilation by analyzing hyperlink structure and associated text. In *Proceedings of the 7th World-wide web conference (WWW7)*, 1998. Online at http://www7.scu.edu.au/1898/com1898.htm.
- S. Brin and L. Page. The anatomy of a large-scale hypertextual Web search engine. *7th International World Wide Web Conference*, Brisbane, Australia, April 1998. Online at http://www7.scu.edu.au/1921/com1921.htm and Â http://infolab.stanford.edu/~backrub/google.html
- Lassila, O., and Swick,R.R. "Resource Description Framework (RDF) Model and Syntax Specification". World Wide Web Consortium Recommendation.Â Available on: http://www.w3.org/TR/REC-rdf-syntaxÂ
- Lassila, Ora "Web Metadata: A Matter of Semantics". IEEE Internet Computing, Vol. 2, No. 4, pp.30-37, Julio-Agosto 1998. Available on:Â http://computer.org/internet/ic1998/w4030abs.htm
- Deborah L. McGuinness. "Ontologies Come of Age." http://www.ksl.stanford.edu/people/dlm/papers/ontologies-come-of-age-mit-press-(with-citation).htmÂ
- Â Grigoris Antoniou and Frank van Harmelen. "Web Ontology Language: OWL". http://www.cs.vu.nl/~frankh/postscript/OntoHandbook03OWL.pdf
- RDF web-site: http://w3c.org/RDFÂ
- Dublín CoreÂ web-site: http://dublincore.orgÂ
- LOMÂ web-site: http://ltsc.ieee.org/wg12. Standard available onÂ http://ltsc.ieee.org/wg12/files/LOM_1484_12_1_v1_Final_Draft.pdf
- Semantic Web Activity web-siteÂ : http://www.w3.org/2001/sw/

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Recommendations

IDENTIFYING DATA				
External placements: Placements in Companies I				
Subject	External placements: Placements in Companies I			
Code	V05G300V01981			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language				
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)Estancia nunha empresa desenvolvendo funcións propias dun/a Enxeñeiro/a Técnico/a de Telecomunicación relacionadas co perfil profesional cursado polo alumno (Sistemas de Telecomunicación, Telemática, Sistemas Electrónicos ou Son e Imaxe) e supervisado por profesorado do Centro e persoal da empresa.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A30	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
A31	CE22/ST2 The ability of applying the basic techniques of telecommunication networks, services and applications for mobile and fixed environments, personal, local or long distance, with different bandwidth, including telephony, radio broadcasting, TV and data, from the point of view of transmission systems.
A32	CE23/ST3 The ability to analyze the components and their specifications for guided and non-guided communications systems
A33	CE24/ST4 The ability to select circuits, subsystems and systems of radiofrequency, microwaves, broadcasting, radio link and radio determination.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.
A35	CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques.
A36	CE27/TEL1The ability to construct, operate and manage telecommunication networks, services, processes and applications considered as systems to receive, transport, represent, process, store, manage and present multimedia information from the computer services point of view.
A37	CE28/TEL2 The ability to apply the techniques that are basis of computer networks, services and applications, such as management, signaling and switching, routing and securing systems (cryptographic protocols, tunneling, firewalls, charging mechanisms, authentication and content protection) traffic engineering (graph theory, queuing theory and teletraffic) rating, reliability and quality of service in both fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.
A38	CE29/TEL3 The ability to build, operate and manage computer services using planning, sizing and analytical tools
A39	CE30/TEL4 The ability to describe, program, assess and optimize communication protocols and interfaces at different network architecture layers .
A40	CE31/TEL5 The ability to follow the technological progress of transmission, switching and processing to improve computer networks and services.
A41	CE32/TEL6 The ability to design networks and service architectures.
A42	CE33/TEL7 The ability to program network and distributed applications and services.

A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A44	CE35/SI2 The ability to analyze, specify, carry out and maintain systems, equipments, heads and installations of TV, audio and video for mobile and fixed environments.
A45	CE36/SI3 The capacity to implement projects at places and installations for the production and recording of audio and video signals.
A46	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.
A47	CE38/SI5 The ability to create, modify, manage, broadcast and distribute multimedia contents taking into account the use and accessibility criteria to audiovisual, broadcasting and interactive services.
A48	(CE39/SE1): The ability to construct, exploit and manage the receiving, transporting, representation, processing, storage, manage and presentation multimedia information from the electronic systems point of view.
A49	(CE40/SE2): The ability to select electronic circuits and devices specialized in transmission, forwarding or routing, and terminals for fixed and mobile environments.
A50	(CE41/SE3):The ability to make the specification, implementation, documenting and tuning of electronic systems and equipment (both instrumentation and control oriented), considering the corresponding technical aspects and the regulations.
A51	(CE42/SE4): The ability to apply electronics as support technology in other fields and activities and not only in information and communication technologies.
A52	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
A54	(CE45/SE7): The ability to design interface, data capturing and storage devices, and terminals for services and telecommunication systems.
A55	(CE46/SE8): The ability to specify and use electronic instrumentation and measurement systems.
A56	(CE47/SE9): The ability to analyze and solve interference and electromagnetic compatibility problems .
B3	The development of discussion ability about technical subjects
B4	The ability to use software tools that support problem solving in engineering

Learning aims

Subject competences	Typology	Competences
(*)	know Know How Know be	A4 A5 A30 A31 A32 A33 A34 A35 A36 A37 A38 A39 A40 A41 A42 A43 A44 A45 A46 A47 A48 A49 A50 A51 A52 A54 A55 A56 B3 B4

Contents

Topic
(*)A definir polo titor da empresa e o titor académico.

Planning

	Class hours	Hours outside the classroom	Total hours
External practises	147	0	147
Reports / memories of internships or practicum	0	3	3

*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	(*)Estancia nunha empresa desenvolvendo funcións propias dun Enxeñeiro/a Técnico/a de Telecomunicación con perfil determinado pola tecnoloxía que estudase o alumno (Sistemas de Telecomunicación, Sistemas Electrónicos, Telemática ou Son e Imaxe)

Personalized attention

	Description
External practises	

Assessment

	Description	Qualification
External practises	(*)Valorarase tanto a aptitude como a actitude do alumno no desenvolvemento das actividades encomendadas.	90
Reports / memories of internships or practicum	(*)A memoria presentada polo alumno deberá axustarse ás indicacións recollidas nas normativas de prácticas en empresa vixentes (Universidade de Vigo e interna do grao en Enxeñaría de Tecnoloxías de Telecomunicación).	10

Other comments and second call

Sources of information

Recommendations

IDENTIFYING DATA				
External placements: Placements in Companies II				
Subject	External placements: Placements in Companies II			
Code	V05G300V01982			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	1st
Language				
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)Estancia nunha empresa desenvolvendo funcións propias dun/a Enxeñeiro/a Técnico/a de Telecomunicación relacionadas co perfil profesional cursado polo alumno (Sistemas de Telecomunicación, Telemática, Sistemas Electrónicos ou Son e Imaxe) e supervisado por profesorado do Centro e persoal da empresa.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A30	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
A31	CE22/ST2 The ability of applying the basic techniques of telecommunication networks, services and applications for mobile and fixed environments, personal, local or long distance, with different bandwidth, including telephony, radio broadcasting, TV and data, from the point of view of transmission systems.
A32	CE23/ST3 The ability to analyze the components and their specifications for guided and non-guided communications systems
A33	CE24/ST4 The ability to select circuits, subsystems and systems of radiofrequency, microwaves, broadcasting, radio link and radio determination.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.
A35	CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques.
A36	CE27/TEL1The ability to construct, operate and manage telecommunication networks, services, processes and applications considered as systems to receive, transport, represent, process, store, manage and present multimedia information from the computer services point of view.
A37	CE28/TEL2 The ability to apply the techniques that are basis of computer networks, services and applications, such as management, signaling and switching, routing and securing systems (cryptographic protocols, tunneling, firewalls, charging mechanisms, authentication and content protection) traffic engineering (graph theory, queuing theory and teletraffic) rating, reliability and quality of service in both fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.
A38	CE29/TEL3 The ability to build, operate and manage computer services using planning, sizing and analytical tools
A39	CE30/TEL4 The ability to describe, program, assess and optimize communication protocols and interfaces at different network architecture layers .
A40	CE31/TEL5 The ability to follow the technological progress of transmission, switching and processing to improve computer networks and services.
A41	CE32/TEL6 The ability to design networks and service architectures.
A42	CE33/TEL7 The ability to program network and distributed applications and services.

A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A44	CE35/SI2 The ability to analyze, specify, carry out and maintain systems, equipments, heads and installations of TV, audio and video for mobile and fixed environments.
A45	CE36/SI3 The capacity to implement projects at places and installations for the production and recording of audio and video signals.
A46	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.
A47	CE38/SI5 The ability to create, modify, manage, broadcast and distribute multimedia contents taking into account the use and accessibility criteria to audiovisual, broadcasting and interactive services.
A48	(CE39/SE1): The ability to construct, exploit and manage the receiving, transporting, representation, processing, storage, manage and presentation multimedia information from the electronic systems point of view.
A49	(CE40/SE2): The ability to select electronic circuits and devices specialized in transmission, forwarding or routing, and terminals for fixed and mobile environments.
A50	(CE41/SE3):The ability to make the specification, implementation, documenting and tuning of electronic systems and equipment (both instrumentation and control oriented), considering the corresponding technical aspects and the regulations.
A51	(CE42/SE4): The ability to apply electronics as support technology in other fields and activities and not only in information and communication technologies.
A52	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
A54	(CE45/SE7): The ability to design interface, data capturing and storage devices, and terminals for services and telecommunication systems.
A55	(CE46/SE8): The ability to specify and use electronic instrumentation and measurement systems.
A56	(CE47/SE9): The ability to analyze and solve interference and electromagnetic compatibility problems .
B3	The development of discussion ability about technical subjects
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Subject competences	Typology	Competences
(*)	know Know How Know be	A4 A5 A30 A31 A32 A33 A34 A35 A36 A37 A38 A39 A40 A41 A42 A43 A44 A45 A46 A47 A48 A49 A50 A51 A52 A54 A55 A56 B3 B4

Contents

Topic
(*)A definir por el tutor de la empresa y el tutor académico.

Planning

	Class hours	Hours outside the classroom	Total hours
External practises	147	0	147
Reports / memories of internships or practicum	0	3	3

*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	(*)Estancia nunha empresa desenvolvendo funcións propias dun Enxeñeiro/a Técnico/a de Telecomunicación con perfil determinado pola tecnoloxía que estudase o alumno (Sistemas de Telecomunicación, Sistemas Electrónicos, Telemática ou Son e Imaxe)

Personalized attention

	Description
External practises	

Assessment

	Description	Qualification
External practises	(*)Valorarase tanto a aptitude como a actitude do alumno no desenvolvemento das actividades encomendadas.	90
Reports / memories of internships or practicum	(*)A memoria presentada polo alumno deberá axustarse ás indicacións recollidas nas normativas de prácticas en empresa vixentes (Universidade de Vigo e interna do grao en Enxeñaría de Tecnoloxías de Telecomunicación).	10

Other comments and second call

Sources of information

Recommendations

IDENTIFYING DATA				
Final Degree Work				
Subject	Final Degree Work			
Code	V05G300V01991			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	12	Mandatory	4th	2nd
Language				
Department				
Coordinator	Cuiñas Gómez, Íñigo			
Lecturers	Cuiñas Gómez, Íñigo			
E-mail	inhigo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)O Traballo de Fin de Grao (TFG) forma parte, como módulo, do plan de estudos do título de Grao en Enxeñaría de Tecnoloxías de Telecomunicación. É un traballo orixinal e persoal que cada estudiante realizará de forma autónoma baixo titorización docente, e debe permitirlle amosar de forma integrada a adquisición dos contidos formativos e as competencias asociadas ao título. Su definición y contenidos están explicados de forma más extensa en la normativa para la realización del Trabajo de Fin de Grado aprobada por la Comisión Académica de Grado, en sesión celebrada el 3/4/2013, cuyo contenido se puede consultar en la web de la Escuela de Ingeniería de Telecomunicación.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A99	(CE90/TFG)Original and individual exercise to be defended before an examining board consisting of a project in a specific technology of Telecommunication Engineering and of a professional nature, where the abilities acquired from the teachings are integrated and synthesized.
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Subject competences	Typology	Competences
Search, management and structuring of information on any topic	Know How	A2 B5
Development and writing of a project document which are collected: history, state of the art or problematic, objectives, project phases, project development, conclusions and future lines.	Know How	A9 A99
Prototyping, programming simulation software, etc., according to specifications.	Know How	A4 A9 A99
CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.	Know How	A1

Contents
Topic

The contents of each TFG will be defined in individual proposals offered by tutors and approved by the Academic Degree Commission under the rules for carrying out the Final Project Work, which content is available on the website of the School of Telecommunication Engineering.	Each TFG will have different contents

Planning			
	Class hours	Hours outside the classroom	Total hours
Previous studies / activities	0	20	20
Integrated methodologies	0	20	20
Presentations / exhibitions	0	8	8
Tutored works	20	200	220
Jobs and projects	2	10	12

*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	Search, read and work documentation, troubleshooting suggestions and / or exercises to be performed in the classroom and / or laboratory ... independently by students.
Integrated methodologies	The student presents the results obtained in the preparation of a document on the subject matter. It will be carried out individually, and both in writing (memory) and orally.
Presentations / exhibitions	Students must prepare and defend the work in front of a jury.
Tutored works	The student, individually, produces a paper on the subject matter, or he/she prepares seminars, research, memoirs, essays, summaries, etc.

Personalized attention	
	Description
Tutored works	Each tutor will devote some time to personally respond to each student work to grade their dependents, to guide their work and guide the learning process, and to review and correct memory and oral presentation.

Assessment		
	Description	Qualification
Jobs and projects	A panel of three teachers for each of the mentions of the Degree shall be appointed. The evaluation was carried out according to the rules for carrying out the Final Year Work and assessment rubric approved by the Academic Degree Committee, which contents are available on the website of the school of Telecommunication Engineering.	100

Other comments and second call

All information related to the TFG is available on the website of the School of Telecommunication Engineering at the following link:

http://www.teleco.uvigo.es/index.php/es/estudios/gett/planificacion-academica/tfg

Sources of information

The bibliography will be specific to each individual proposed work.

Recommendations

Other comments

Having passed all necessary subjects to obtain the Bachelor degree except the TFG, or enroll simultaneously in all subjects.

IDENTIFYING DATA				
Credits obtanied in the Framework of Mobility Programmes				
Subject	Credits obtanied in the Framework of Mobility Programmes			
Code	V05G300V01R02			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Type	Year	Quadmester
	0	Optional	4th	1st
Language				
Department				
Coordinator				
Lecturers				
E-mail				

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