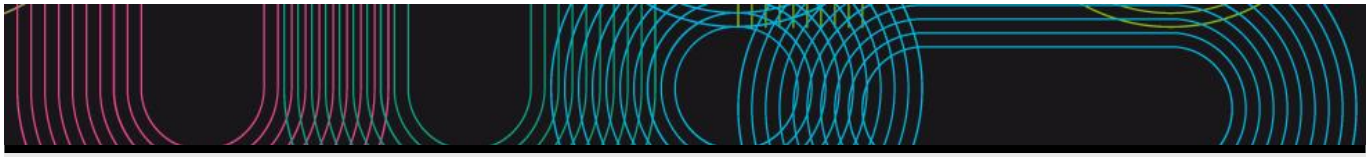

(*)Escola de Enxeñaría de Telecomunicación

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(*)E. T. S. Enx. Telecomunicación

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Toda a información relacionada coa Escola Técnica Superior de Enxeñaría de Telecomunicación da Universidade de Vigo así como das titulacións que se imparten, pódese atopara na páxina web do centro:

http://www.teleco.uvigo.es

Toda la información relacionada con la Escuela Técnica Superior de Ingeniería de Telecomunicación de la Universidad de Vigo y de las titulacións que allí se imparten, se puede encontrar en la página web del centro:

http://www.teleco.uvigo.es

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Toda a información relacionada coa Escola Técnica Superior de Enxeñaría de Telecomunicación da Universidade de Vigo pódese atopar na páxina web do centro:

http://www.teleco.uvigo.es

Toda la información relacionada con la Escuela Técnica Superior de Ingeniería de Telecomunicación de la Universidad de Vigo se puede encontrar en la página web del centro:

http://www.teleco.uvigo.es

(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación

Subjects

Year 2nd

Code	Name	Quadmester	Total Cr.
V05G300V01301		1st	6
V05G300V01302		1st	6
V05G300V01303		1st	6
V05G300V01304		1st	6

V05G300V01305		1st	6
V05G300V01401		2nd	6
V05G300V01402		2nd	6
V05G300V01403		2nd	6
V05G300V01404		2nd	6
V05G300V01405		2nd	6

IDENTIFYING DATA				
(*)Comunicación de datos				
Subject	(*)Comunicación de datos			
Code	V05G300V01301			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	López García, Cándido Antonio			
Lecturers	Fernández Veiga, Manuel 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	
Expected results from this subject	Training and Learning Results
Knowledge of the foundations of discrete Information Theory	A3
Understanding of the basic properties of lossless data compression methods and linear error control codes	A4
Knowledge of logical link protocols and physical level interfaces	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	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, token passing 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	26	0	26
Autonomous troubleshooting and / or exercises	0	47	47
Long answer tests and development	4	0	4

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

Methodologies

	Description
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

Methodologies	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	(*)Exame final da materia.	100

Other comments on the Evaluation

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**, 2002,
C. López García, M. Fernández Veiga, **Cuestiones de Teoría de la Información y Codificación**, 2003,
J. F. Kurose, K. W. Ross, **Computer Networking, 5/e**, 2010,

Recommendations

Subjects that continue the syllabus

(*)Redes de ordenadores/V05G300V01403

Subjects that it is recommended to have taken before

(*)Matemáticas: Probabilidade e estatística/V05G300V01204

IDENTIFYING DATA				
(*)Programación II				
Subject	(*)Programación II			
Code	V05G300V01302			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Fernández Masaguer, Francisco			
Lecturers	Blanco Fernández, Yolanda Fernández Masaguer, Francisco Servia Rodríguez, Sandra			
E-mail	f_masaguer@yahoo.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		
Expected results from this subject	Training and Learning Results	
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).	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.	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.	A60 A62	

To adquiry maturity in development and debugging programming techniques to allow the autonomous learning of new capacities and programming languages.	A62
To adquiry familiarity with the use of a modern software development tool (Eclipse) to facilitate the design, development and debugging of programs.	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
7. Recursion	a. Recursive void methods b. Recursive methods that return a value c. Thinking recursively

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	28	42	70
Troubleshooting and / or exercises	9	9	18
Presentations / exhibitions	1	1	2
Autonomous troubleshooting and / or exercises	5	10	15
Projects	7	31	38
Practical tests, real task execution and / or simulated.	2	0	2
Case studies / analysis of situations	0	1	1
Troubleshooting and / or exercises	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
Master Session	Classes that combines explanation of theoretical concepts and realization of exercises. These exercises can be either resolved by the professor or by the students individually or in groups. The goal is to promote the debate and reinforce the acquisition of skills.
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.
Presentations / exhibitions	The students will present in the computer room the design proposed to resolve the software project defined by the professor during the second part of the course. The goal is to compare the different proposals, identifying advantages and possible deficiencies that will serve as feedback to face the final design.
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.
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.

Personalized attention	
Methodologies	**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.
Presentations / exhibitions	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.

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 and CE50 competences will be assessed.	15
Practical tests, real task execution and / or simulated.	During the week from 9 to 13 of December of the educational period, the students will have an interview with the professor where they must answer questions related to the software project submitted (e.g. justify design decisions and propose solutions to face modifications in the developed functionalities. The two students of each group must be present in this interview. The questions must be answered individually with the goal of checking the authorship, the degree of understanding and implication of the student in the development of the project. If the student fails in proving these aspects, the student will have to take a practical exam in the computer room in the official date published in www.teleco.uvigo.es.	15
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 and CE52 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 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.	10

Other comments on the Evaluation

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.

The students must choose one of the possible mechanisms by bearing in mind the following conditions:

- CA includes the 5 tests described above.
- In both cases, CA and TA, students must do a laboratory project. To easy the selection between CA and TA, students will have to see in Faitic Web the project to do since 20 September.
- In TA regimen the proyect must be made in an individual form.
- Students who sit CA must submit during the week from 4 to 7 of November of the course, the UML class diagrams of the proposed software project. By the submission of this practice the student makes a commitment to be assessed via CA, thus renouncing the TA mechanism. In virtue of this commitment, these students will not be listed as "Not Present".
- Students who do not submit the UML-compliant design during the week from 4 to 7 of November 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.

- CA tests will be only carried out in the dates defined by the teachers. These tests cannot be repeated out of these dates.
- The grades obtained in the CA and other exams and practical projects are only valid for the current academic year.
- CA will be just considered in January. In the rest of examination sessions (i.e., May, July and others) only TA will be valid.

The students who opt for CA will be assessed by the tests described above:

- Java initiation practices (10%). 2 people groups. It is the 5th test described in the CA assessment mechanism.
- Software project (40%). 2 people groups. It includes three parts: design(10%), implementation (15%) and interview (15%). They are the 3rd, 1st and 2nd tests, respectively.
- Exam about theoretical concepts and use cases. It is the 4th test described above.

The students who opt by the TA mechanism will be assessed as follows:

- An exam whose description matches the 4th CA test. The result of this exam will be 50% of the final remark of the student.
- A software project that must be submitted individually during the week from 2 to 5 of December of the course. The submission must include the class diagrams of UML-compliant design, and the documentation to explain the implementation details. The program must run correctly on the computer in the laboratory. The assessment of the project will consider both the right execution of the program and the proposed design. The weight of the project will be 30% of the final remark of the student.
- A personal interview where the student must answer the questions posed by the professor, with regard to main design decisions and the way to face possible modifications in the developed functionalities. This interview will take place during the week from 9 to 13 of December of the course in the computer room. The weight of this interview will be 20% of the final remark of the student.

Students who opt for the **examination sessions of July** cannot be assessed via CA, so that only TA is valid. These students will be assessed as per the following tests:

- A final exam (whose description matches the 4th CA test) that will take place in the official date published at www.teleco.uvigo.es. The result of this exam will be 50% of the final remark of the student.
- A practical exam in the computer room, which will take place in the official date published at www.teleco.uvigo.es, where the student must develop a Java program as per the guidelines described by the professor. The weight of this practical exam in the final remark will be 50%.

Sources of information

Basic references:

[2] *Introduction to Java programming*. Y. Daniel Liang, 8ª edición. 2010, Pearson.

Other references:

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

[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 Hall

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

[8] *How to Think Like a Computer Scientist. 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/

[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.

[17] "*Fundamentals of Object-oriented design in UML*". Meilir Page-Jones. 2002, Addison Wesley.

Recommendations

Subjects that it is recommended to have taken before

(*)Programación I/V05G300V01205

IDENTIFYING DATA				
(*)Transmisión electromagnética				
Subject	(*)Transmisión electromagnética			
Code	V05G300V01303			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Vera Isasa, María			
Lecturers	Aguado Agelet, Fernando Antonio Arias Acuña, Alberto Marcos García-Tuñón Blanca, Inés Gómez Araújo, Marta Lorenzo Rodríguez, María Edita de Rubiños López, José Óscar 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	
Expected results from this subject	Training and Learning Results
To understand the mechanisms of propagation and transmission of electromagnetic waves.	A3 A22
To identify and define the main parameters that characterize transmission media of electromagnetic waves.	A3 A17 A18
To solve problems that require the handling of basic concepts related to guided and radio transmission.	A4 A22
To estimate transmission losses in different media.	A3 A5
To measure antenna basic parameters.	A5 A18 A29
To search updated information about specifications and regulations.	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	2	2	4
Master Session	18	27	45
Laboratory practises	21	21	42
Presentations / exhibitions	2	4	6
Autonomous troubleshooting and / or exercises	0	18	18
Systematic observation	9	0	9
Troubleshooting and / or exercises	2	6	8
Multiple choice tests	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
Introductory activities	Activities focused to take contact and gather 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).
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.
Presentations / exhibitions	Student presentation of the results of a group work.
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.

Personalized attention	
Methodologies	**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 .	20
Presentations / exhibitions	Performing lab practices of software tools to search of information and a work about telecommunication regulation.	10
Systematic observation	Techniques designed to collect data about student participation, based on attendance, laboratory previous preparation and autonomous tasks implementation .	5
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	30
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.	35

Other comments on the Evaluation

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 (65%) and a multiple-choice test (35%) performed on date according to the official exam schedule. To participate in this evaluation system is necessary to attend at least to 80% of ordinary class hours and attend the test.

The tasks in the course include the laboratory practices, their corresponding reports and two tests of problem solving (the first scheduled at the middle of the semester 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 it and will only be valid for the academic year in which they are made.

Evaluation by final exam

In addition to the continuous assesment system described above, the student may choose to perform one final exam that will have two parts:

Part I: multiple-choice test (40%).
Part II: Problem Solving (60%).

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, independently that they present to other tasks or not.

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 (65%) may elect to perform only the first part of the exam (35%).

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,
S.M. Wentworth, **Applied electromagnetics. Early transmission line approach**, 1ª,
D. K. Cheng, **Fundamentos de electromagnetismo para ingeniería**,

Bibliografía adicional:

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

(*)Fundamentos de son e imaxe/V05G300V01405
(*)Técnicas de transmisión e recepción de sinais/V05G300V01404
(*)Circuítos de microondas/V05G300V01611
(*)Circuítos de radiofrecuencia/V05G300V01511
(*)Xestión e certificación radioeléctricas/V05G300V01612
(*)Infraestruturas ópticas de telecomunicación/V05G300V01614
(*)Redes e sistemas sen fíos/V05G300V01615
(*)Sistemas de comunicacións por radio/V05G300V01512

Subjects that are recommended to be taken simultaneously

(*)Procesado dixital de sinais/V05G300V01304

Subjects that it is recommended to have taken before

(*)Física: Análise de circuítos lineais/V05G300V01201
(*)Física: Campos e ondas/V05G300V01202
(*)Matemáticas: Cálculo I/V05G300V01105
(*)Matemáticas: Cálculo II/V05G300V01203

IDENTIFYING DATA				
(*)Procesado dixital de sinais				
Subject	(*)Procesado dixital de sinais			
Code	V05G300V01304			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Abreu Sernández, María Victoria			
Lecturers	Abreu Sernández, María Victoria Alonso Alonso, Ignacio Márquez Flórez, Óscar Willian			
E-mail	vabreu@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, including filtering, FFT, windowing and sampling of image and sound signals and touch-tone telephone 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.
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	
Expected results from this subject	Training and Learning Results
Managing specific software for digital signal processing	A57
Applying mathematical knowledgements for signal filtering	A58
Mastering filtering opperations in frequency domain.	A3 A58
Learning mathematical issues for understanding the processes of sampling and windowing signals.	A4 A57
Analysis of simple processing systems.	A58

Contents	
Topic	
Subject 1. Introduction and Review	Presentation. Detailed explanation of the program, assessment procedure. Review. Sinusoids and complex exponential. Fourier transform of continuous signals.

Subject 2. Analog-to-Digital Conversion	Uniform Sampling. Quantification and binary rate. Nyquist Theorem. Aliasing. D/A Conversion. Zero-Order and Linear Interpolation. C-D Conversion. Analog frequency vs discrete frequency.
Subject 3. FIR Filters	Difference equation. Filter Coefficients. Block Diagrams. Causality, linearity and time-invariance. LTI systems and convolution. FIR frequency response.
Subject 4. Spectrum of a Discret-Time Signal	DTFT and IDTFT definitions. Properties. Basic pairs. Windowing. Spectrum of a windowed signal. DFT and IDFT definitions. Properties.
Subject 5. Z Transform	Definition and properties. Convolution theorem. Poles and zeros of a FIR filter.
Subject 6. IIR Filters	Difference equation. Filter Coefficients. Block Diagrams. Stability. Relation between the position of poles and zeros of the system function and the frequency response.
Project 1. A/D and D/A Conversion	Digitalisation of Continuous-Time Signals. Quantization. Aliasing.
Project 2. FIR Filters	FIR filters in the time and frequency domains.
Project 3. FFT. IIR Filters	FFT and windowing. IIR Filters

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 solving 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

Methodologies	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
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
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

Other comments on the Evaluation

1. Basic knowledge test

- The objective of this test is to determine whether the student has acquired the minimum knowledge and skills needed to pass the course.
- Students are graded as pass or fail. Students must obtain a pass grade in this test in order to pass the course.
- To pass, the student must correctly answer at least 70% of the questions.
- There are 3 opportunities to pass this test: in an hour of classroom time in the second-last week of the course, in the December exam period and in the July exam period. A pass grade is valid for the entire academic year.
- Students may not use books, notes or a calculator for this test.
- The test, which lasts about an hour, usually consists of 10 sections including multiple-choice questions and short theoretical and practical questions. Note that this structure may change.

2. 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:

Assessment 1 (25%):

- Subject 2.
- It will take place during the 6th week of the course.

Assessment 2 (35%):

- From Subject 2 to Subject 4.
- It will take place during the 11th week of the course.

Assessment 3 (40%):

- From Subject 2 to Subject 6.
- It will take place during the last week of the course.

3. 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.
- There will be three mandatory tests in the lab. The student will pass this part if he/she gets an average greater than or equal to 5.

4. Final exam

- There is a final exam in December and another in July. In the final 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.
- The final exam usually consists of 3 problems and lasts about 2.5 hours. Note that this structure may change.

4.1 First opportunity to pass the course (December)

- Students can opt for continuous assessment and also take the exam. The note will be the highest of the two grades provided the student has passed the basic knowledge test.
- If the student passes the course in this period, the grade will be final and will become part of their academic record.
- If the student fails the course, a provisional fail grade will be recorded on their academic record along with the grade obtained.

3.2 Second opportunity to pass the course (July)

- The July final exam, a lab test and a basic knowledge test will only be held for students who failed the course in January.
- Students who obtained a pass grade in the basic knowledge test in the previous assessment period will not need to do this test in July.
- The basic knowledge test must be taken by students who obtained a fail in the basic knowledge test in the previous assessment period but who passed the continuous assessment or the final examination in January.
- Students who do not sit any of the tests corresponding to this second period will be listed as "Not Present" if this was their situation after the first assessment period.
- Provisional fails will become definitive fails for students who do not present for the second period assessment tests.

4. Other comments

- The grades obtained in the basic knowledge test, the lab test, the continuous assessment and the December and July 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. 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,
A. Quarteroni y F. Saleri, **Cálculo científico con Matlab y Octave**, Springer,
M. J. Roberts, **Señales y Sistemas**, McGraw Hill,
A.V. Oppenheim y R.W. Schafer, **Tratamiento de señales en tiempo discreto**, Prentice Hall,

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.
- 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
(*)Fundamentos de son e imaxe/V05G300V01405
(*)Técnicas de transmisión e recepción de sinais/V05G300V01404
(*)Fundamentos de procesado de imaxe/V05G300V01632
(*)Procesado de son/V05G300V01634
(*)Sistemas de audio/V05G300V01532
(*)Sistemas de imaxe/V05G300V01633
(*)Sistemas electrónicos de procesado de sinal/V05G300V01522
(*)Tratamento de sinais multimedia/V05G300V01513
(*)Vídeo e televisión/V05G300V01533

Subjects that it is recommended to have taken before
(*)Física: Análise de circuítos lineais/V05G300V01201
(*)Matemáticas: Álxebra lineal/V05G300V01104
(*)Matemáticas: Cálculo I/V05G300V01105
(*)Matemáticas: Cálculo II/V05G300V01203

IDENTIFYING DATA				
(*)Física: Fundamentos de electrónica				
Subject	(*)Física: Fundamentos de electrónica			
Code	V05G300V01305			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Domínguez Gómez, Miguel Ángel			
Lecturers	Domínguez Gómez, Miguel Ángel 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. Below are taught basic concepts on devices and basic electronic circuits: · 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. · 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. · Logic digital circuits, with special emphasis on CMOS technology. Basics of logic circuits, inverter CMOS, NOR and NAND gates. A brief introduction to optoelectronics, their devices and their operating principles is also done. 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 the student to acquire 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 correctly handle laboratory instruments, should distinguish and characterize the different components, and have practical skills in assembly and measurement. It will also start students in 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		
Expected results from this subject	Training and Learning Results	
Understanding and control of the basic concepts of the physical principles of semiconductors.	A13	
Understanding and control of the basic concepts of operation of the electronic and photonic devices.	A13	
Understanding and control of simple electronic circuits based on the electronic and photonic devices and their applications.	A13	
Understanding and control of the basic concepts of the logic families.	A13	
Basic knowledges on CAD (Computer Aided Design) tools for the simulation of electronic circuits.		B4
Capacity utilization of CAD tools for designing simple electronic circuits.		B4

Contents	
Topic	
Subject 1: Introduction	Electronic systems. Design process. Integrated circuits.

Subject 2: Diodes and circuits with diodes	Characteristics of the diode. Analysis of the load line. Ideal model of the diode. Rectifier Circuits. Clamping and clipping Circuits. Logic circuits with diodes. Voltage regulator circuits. Small signal equivalent linear circuits. Basic concepts of semiconductors. Physics of the diode.
Subject 3: Bipolar Junjction Transistors (BJT)	Operation of the npn Bipolar Junction Transistor (BJT). Analysis of the load line of an amplifier in common emisor. The pnp Bipolar Junction Transistor. Models of circuits. Analysis of circuits with BJTs.
Subject 4: Field Effect Transistors (FET)	NMOS Transistor. Analysis of the load line of a simplified NMOS amplifier. Polarization circuits. JFET and deplexion MOSFET transistors and channel p devices.
Subject 5: Digital logic circuits	Digital logic circuits. Basic concepts. Electrical specifications of the logic gates. The inverter CMOS. CMOS gates NOR and NAND.
Subject 6: Optoelectronics Devices	Introduction to the optoelectronics. Basic optoelectronics devices. Light emmitting devices: LED and LASER diodes. Light detecting devices: Light Dependent Resistors (LDRs), photodiodes and phototransistors. Optocouplers.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	4	6
Master Session	13	24	37
Troubleshooting and / or exercises	14	34	48
Laboratory practises	14	32	46
Short answer tests	2	0	2
Troubleshooting and / or exercises	5	0	5
Practical tests, real task execution and / or simulated.	5	0	5
Systematic observation	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
Introductory activities	Presentation of the subject. Presentation of the laboratory practices and of the instrumentation and software that will be used.
Master Session	Exposition of the 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 for 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 a electronic laboratory and 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

Methodologies	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 of 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 practices of laboratory, 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 of 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 practices of laboratory, 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 of 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 practices of laboratory, the handle of the instrumentation, the implementation of the electronic circuits and the software of simulation will be resolved too.

Assessment

	Description	Qualification
Short answer tests	Tests to be carried out in the classroom, after each topic or group of topics exposed on the master session, to assess the knowledge acquired by the student. These tests will be of type test and/or issues.	20
Troubleshooting and / or exercises	Tests which will be carried out in the classroom throughout the year and that will evaluate the competencies of the student to resolve problems and/or the exercises over a part of the contents of the subject.	40
Practical tests, real task execution and / or simulated.	Tests to be carried out in the laboratory along the course on management of instrumentation, mounting of electronic circuits and simulation. The skills acquired by the student on the contents of the subject laboratory practices will be evaluated.	35
Systematic observation	Techniques aimed to collect data on the participation of the student, based on attendance, preparation of practices and carry out autonomous tasks.	5

Other comments on the Evaluation

1. Continuous evaluation

Following the own guidelines of the bachelor and the agreements of the academic commission will offer to the students a system of continuous evaluation. Students presented to the first test of resolution of problems and/or exercises shall be deemed that they opt for continuous evaluation. Those students who do not present to the first test of resolution of problems and/or exercises shall be deemed that they renounce to the continuous evaluation and will only have the possibility to present to the final examination. Students who do not follow the continuous evaluation and do not present to the final examination will be considered "not presented".

1.a Systematic observation

Teachers will evaluate the student attendance and the accomplishment of its autonomous tasks, getting the student a rating from 0 to 10 (OS).

The final note of systematic observation (NOS) will be:

NOS = 0.5*OS

1.b Theory

They will realise 4 tests of short answer properly programmed along the course. These tests will value from 0 to 10 and the final note of these tests will be the average (NPRC -> Note Test Short Answer):

NPRC = (NPRC1 + NPRC2 + NPRC3 + NPRC4)/4

They will realise 2 exams of resolution of problems and/or exercises properly programmed along the course. These exams will value from 0 to 10 and the final note will be the average (NPE -> Note of Problems and/or Exercises):

NPE = (NPE1 + NPE2)/2

It is necessary to obtain a minimum of 3 points in each one of these exams (NPE1 >= 3 and NPE2 >= 3) to pass the subject.

The final note of theory (NT) will be:

NT = 0.2*NPRC + 0.4*NPE

The tests and exams are not recoverable, that is to say, that if a student can not assist the day in that they are scheduled, the professor does not have obligation to repeat them. The note of the tests and exams to which was missing will be of 0.

1.c Practical

They will realise 2 practical proofs properly programmed along the course. These proofs will value from 0 to 10 and the final note of the practical (NP) will be:

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

The practical proofs are not recoverable, that is to say, that if a student can not assist the day in that they are scheduled, the professor does not have obligation to repeat them. The note of the proofs to which was missing will be of 0.

1.d Final note of the subject

It should be obtain a minimum of 4 points on 10 in theory (NT >= 2.4) and in practical (NP >= 1.4) to pass the subject. Also it is necessary to obtain a minimum of 3 points on 10 in each one of the 2 exams of resolution of problems and/or exercises (NPE1 >= 3 and NPE2 >= 3)

The final note (NF) will be:

If NT >= 2.4 and NP >= 1.4 and NPE1 >= 3 and NPE2 >= 3 => NF = NOS + NT + NP

If NT < 2.4 or NP < 1.4 or NPE1 < 3 or NPE2 < 3 => NF = min {4.5; NOS +NT + NP}

2. Final exam

The students that 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 realise in the dates that establish the School and will consist in a exam type test and/or short questions and/or resolution of problems and/or exercises. This exam will be evaluated from 0 up to 10 and the final mark of theory (NT) will be the points of the exam multiplied by 0.6. The practices exam will realise in the corresponding laboratory in the dates that establish the School and will consist in a practical proof that will be evaluated from 0 up to 10 and the final mark of practices (NP) will be the points of the proof multiplied by 0.4.

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 they will be able to present to the final exam of practices those students that have inscribed in time and form of agreement to the norms indicated by the professors in the corresponding announcement.

The students that have opted by the continuous evaluation and failed and present to the final exam can do it only to the theoretical part or to the practice one or both. It will conserve them the mark that had in the continuous evaluation of the part to which do not present if the minimums marked in the continuous evaluation process were achieved. If they are not presented to the practice part, the practice note (NP) of the continuous evaluation is recalculated multiplying by 0.4 instead of by 0.35.

The final note (NF) will be:

If NT >= 2.4 and NP >= 1.6 => NF = NT + NP

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

3. Recovery (July)

The announcement of recovery (July) will feature of a theoretical part and another practice with the same format that the final exam.

The students that present to this announcement can do it only to the theoretical part or to the practice or both. It will conserve them the mark that had in the ordinary announcement (continuous evaluation or final exam). The calculation of the final mark of the subject will realise as was explained in the section 2.

The final mark of the subject will be the best of the obtained by the student in the ordinary announcement 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 they will be able to present to this exam those students that have inscribed in time and form of agreement to the norms indicated by the professors in the corresponding announcement.

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 was obtained.

Sources of information

Hambley, A. R., **Electrónica**, 2ª ed., Prentice Hall,
Quintáns, C., **Simulación de circuitos electrónicos con OrCAD 16 Demo**, Marcombo,

Recommendations

Subjects that continue the syllabus

(*)Electrónica dixital/V05G300V01402
(*)Tecnoloxía electrónica/V05G300V01401

Subjects that it is recommended to have taken before

(*)Física: Análise de circuítos lineais/V05G300V01201

IDENTIFYING DATA				
(*)Tecnoloxía electrónica				
Subject	(*)Tecnoloxía electrónica			
Code	V05G300V01401			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Raña García, Herminio José			
Lecturers	Cao Paz, Ana María Quintáns Graña, Camilo Raña García, Herminio José Río Vázquez, Alfredo del 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		
Expected results from this subject	Training and Learning Results	
CE14/T9 Capacity of analysis and design of combinational and sequential circuits , both synchronous and asynchronous, and utilisation of microprocessors and integrated circuits.	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.	A25	
B4 CG13 Capacity to handle software tools that support the resolution of problems in engineering.		B4
CG14 Capacity to use computer tools of research of bibliographic resources or information.		B5

Contents	
Topic	
1 - Amplifiers	General concepts. Characteristics of amplifiers. Types of amplifiers. Small signal models the bipolar junction transistor (BJT). Physical interpretation of the hybrid parameters for common emitter (CE). Analysis of one-stage amplifiers with bipolar transistor in common emitter (CE), common base (CB) and common colector (CC)/emitter follower. Calculation of the input and output impedances, current gain and voltage gain. Small-signal model for field-effect transistors (FET) in low frequency. Analysis of one stage amplifiers with FETs in common source and common drain. Amplifiers with several stages.
2 - Frequency response in amplifiers	High-frequency models for transistors. Low-frequency and high-frequency equivalents for amplifiers. Calculation of the transfer function in the s plane. Application of Miller's theorem.
3 - Operational amplifiers I	Ideal operational amplifier (op amp). Transfer function. Equivalent model and ideal parameters. Open-loop operation (comparator). Feedback concept. Feedback effects. Closed-loop operational amplifier. Virtual ground. Inverter amplifier. Non-inverter amplifier. Real characteristics of operational amplifiers.

4 - Operational amplifiers II	Other basic circuits with operational amplifiers. Linear circuits: Inverter adder, differential amplifier. Non-linear circuits: half wave rectifier, peak detector - envelope demodulator. Schmitt trigger (inverter).
5 - Electrotechnics.	Components of an electrical installation. Protections. Rule.
6- Electronic of Power: introduction and devices	6-a: Introduction. Types of electronic power converters. The power switch. Elementary calculations in power electronics: power calculation; behaviour of coils; calculations of rms values; apparent power; factor of power; series of Fourier: components of frequency; harmonics; calculations of power with non-sinusoidal sources or with non-linear loads; total harmonic distortion. 6-b: electronic power devices. Classification. General characteristics. The power diode. The thyristor or SCR. The bipolar power transistor (BJT). The power MOSFET. The isolated-gate bipolar transistor (IGBT). The TRIAC. Cases. Disipadores.
7 - DC power supplies.	Introduction to the DC power supplies. Series voltage regulators. Introduction switching DC power supplies. DC converters: buck, boost. Isolated DC power supplies. General diagram of a switching DC power supply.
8 - Rectifiers and inverters.	7-a: Rectification: Introduction. Monofasical rectifiers (half wave, double wave). Controlled and not controlled, with resistive load and with R-L load. 7-b: Single phase inverters. Topologies. Analysis of the harmonic content. PWM Inverters.
9 - Solar energy photovoltaic and thermal conversion	Thermal and photovoltaic solar installations : The solar radiation that reaches the photovoltaic and thermal generators. Principle of operation of the photovoltaic and thermal reception installations . Thermal solar installations of high temperature. Thermal solar installations of low temperature. Isolated photovoltaic installations. Photovoltaic installations connected to power network. The solar cell. The photovoltaic generator. Design of photovoltaic systems. Generation and conversion of photovoltaic energy The battery and the voltage regulator. Types of batteries and operation modes. Types of regulators. Maximum power point tracking. Practical case of calculations of photovoltaic solar installations.

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	
Methodologies	**Description**
Master Session	The professor will attend personally doubts and queries of the students, on the study of theoretical concepts, on exercises or on practices of laboratory. The students will have occasion to attend 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.

Laboratory practises	The professor will attend personally doubts and queries of the students, on the study of theoretical concepts, on exercises or on practices of laboratory. The students will have occasion to attend 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.
Troubleshooting and / or exercises	The professor will attend personally doubts and queries of the students, on the study of theoretical concepts, on exercises or on practices of laboratory. The students will have occasion to attend 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.

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 on the Evaluation

1. Continuous assessment:

The student is graded by means of a continuous assessment, which consists of "partial exams", including both written exams ("exámenes teóricos") and laboratory exams ("exámenes prácticos").

Nevertheless, a student may choose between that continuous assesment or a one-session exam ("examen final"). The rules of both kind of assessment are as follows:

1.1.Written exams ("exámenes teóricos"):

The theoretical contents of the course are divided into three blocks. The 1st block and the 2nd block are graded by means of a "partial theoretical exam" for each (examen parcial teórico). They take place in the usual weekly scheduling of the theoretical classes of the course. The 3rd block is graded by means of another exam which takes place only in the "final theoretical exam", the "(April-)May exam". All the student must attend at this 3rd block exam. The final theoretical exam consists of a "block exam" for each of the three blocks of the contents. The 1st and the 2nd block are made only by the students who did not pass the respective partial exam (grade

Sources of information

Hambley, A. R., **Electrónica**, Prentice-Hall, 2ª ed. en español,

Hart, D. W., **Electrónica de potencia**, Prentice-Hall,

Rashid, Muhammad H., **Electrónica de potencia: circuitos, dispositivos y aplicaciones**, Pearson Education,

Reglamento Electrotécnico para Baja Tensión (REBT) e Instrucciones Técnicas Complementarias (ITC),

Schneider Electric España, S.A., **Manual electrotécnico: Telesquemario (http://www.schneiderelectric.es)**, Schneider Electric España, S.A,

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,

Quintáns Graña, C., **Simulación de circuitos con OrCAD 16 DEMO**, Marcombo,

Recommendations

Subjects that continue the syllabus

(*)Electrónica analóxica/V05G300V01624

(*)Electrónica de potencia/V05G300V01625

Subjects that it is recommended to have taken before

(*)Física: Fundamentos de electrónica/V05G300V01305

Other comments

En la Tecnología "Sistemas electrónicos", la asignatura "Electrónica analógica" de 3er curso, continúa una parte del temario (amplificadores operacionales).

IDENTIFYING DATA				
(*)Electrónica dixital				
Subject	(*)Electrónica dixital			
Code	V05G300V01402			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Machado Domínguez, Fernando			
Lecturers	Álvarez Ruíz de Ojeda, Luís Jacobo Machado Domínguez, Fernando Moure Rodríguez, María José Pérez López, Serafín Alfonso			
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		
Expected results from this subject	Training and Learning Results	
Knowledge of digital design principles, components and tools.	A23	
Ability to analyse and design combinational systems.	A23	
Knowledge of the combinational functional blocks and their aplications.	A23	
Knowledge of the basic storage elements, the sequential blocks and their aplications.	A23	
Ability to analyse and design synchronous sequential systems.	A23	
Knowledge of description and simulation methods based on hardware description languages (HDL).	A24	
Ability to use softwaare tools to describe and simulate digital systems.		B4
Ability to use software tools to search digital circuit data sheets and information resources.		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	13	26
Laboratory practises	26	38	64
Troubleshooting and / or exercises	8	12	20
Practical tests, real task execution and / or simulated.	2	8	10
Troubleshooting and / or exercises	6	22	28

*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.
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.
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.

Personalized attention	
Methodologies	**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 lecturers 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 lecturers 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 lecturers 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.	50
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.	50

Other comments on the Evaluation

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 (50%) and laboratory (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

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 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):

$$FMT = 0.3 \cdot ETT1 + 0.3 \cdot ETT2 + 0.4 \cdot ETT3$$

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 ETT2 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: 50% theory (FMT) and 50% 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 4 in each part (FMT>=4 and FML>=4). In this case the final mark (FM) will be:

FM = (FMT + FML)/2

However, when the students do not pass both parts (FMT or FML less than 4) 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 = ((FMT + FML)/2)·2.5/5

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 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).

In order to pass the subject, students will be required to pass the laboratory and theory exams (FMT>=4 and FML>=4). In this case the final mark (FM) will be:

FM = (FMT + FML)/2

However, when the students do not pass both parts (FMT or FML less than 4) the final mark will be:

FM = ((FMT + FML)/2)·2.5/5

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,

S. Pérez, L. J. Álvarez, M.J. Moure, F. Machado, **Electrónica Digital**, Curso 2012-2013,

Wakerly J. F., **Digital Design. Principles and Practices**, 4ª,

E. Mandado, **Sistemas Electrónicos Digitales**, 9ª,

Thomas L. Floyd, **Fundamentos de Sistemas Digitales**, 9ª,

L.J. Álvarez, E. Mandado, M.D. Valdés, **Dispositivos Lógicos Programables y sus aplicaciones**, 1ª,

S. Pérez, E, Soto, S. Fernández, **Diseño de sistemas digitales con VHDL**,

L.J. Álvarez, **Diseño Digital con Lógica Programable**, 1ª,

Recommendations

Subjects that it is recommended to have taken before

(*)Informática: Arquitectura de ordenadores/V05G300V01103
(*)Matemáticas: Álxebra lineal/V05G300V01104

IDENTIFYING DATA				
(*)Redes de ordenadores				
Subject	(*)Redes de ordenadores			
Code	V05G300V01403			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	López Ardao, José Carlos			
Lecturers	Herrería Alonso, Sergio López Ardao, José Carlos Rodríguez Pérez, Miguel Sousa Vieira, Estrella			
E-mail	jardao@det.uvigo.es			
Web	http://www.socialwire.es/groups/profile/155431/ro1314			
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	
Expected results from this subject	Training and Learning Results
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.	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	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.	A4
CG6: The aptitude to manage mandatory specifications, procedures and laws.	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	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.	A20
CE17/T12 The knowledge and usage of concepts of communication network architecture, protocols and interfaces	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	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	A28

Contents

Topic	
1. Introduction I. General concepts	a) Nodes, lonks and networks b) Access networks c) Core network: circuit & packet switching
2. Introduction II	a) Layered model. Encapsulation b) Performance: throughput, delay, losses
3. Internet	a) Architecture. Service model b) Layering
4. Links and subnetworks	a) LAN switching. Technology b) VLAN and trunking c) Spanning tree d) Wireless networks
5. IP	a) Anatomy b) Addressing & fragmentation
6. IP switching & forwarding	a) IP forwarding b) Switching fabrics
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	Lectures 1 to 8
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	52	78
Troubleshooting and / or exercises	16	24	40
Workshops	6	6	12
Autonomous troubleshooting and / or exercises	0	12	12
Long answer tests and development	4	0	4
Jobs and projects	4	0	4

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

Methodologies	
	Description
Master Session	Exposition of ideas, concepts, techniques and algorithms that shape every lecture.
Troubleshooting and / or exercises	Resolution by the students of problems and exercises about the material covered in the lectutres. Work supervised by the teaching staff.
Workshops	Learning of basic tools stop the diagnostic, monitor and control of computer networks. Development of basic software for networking (20%) and participation in online activities (10%)
Autonomous troubleshooting and / or exercises	Midterm (20%) and final exam (50%)

Personalized attention	
Methodologies	**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 troubleshooting and / or exercises	Midterm	20
Long answer tests and development	Final exam	50
Jobs and projects	Project: software development (20%) and class participation (10%)	30

Other comments on the Evaluation

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

The **continuous assessment** comprises three intermediate tasks plus a final exam:

- A midterm (20% of the final grade) proposed on week 10, covering all material up to lecture 8.
- A programming assignment (10% of the final grade). Due date in week 13. Correct implementation and software quality will be the key issues for grading this task.
- Participation in the online learning activities proposed weekly (10% of the final grade).
- A final exam covering all the course material (lectures, problem sessions, programming skills). 60% of the final grade.

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 to the midterm, the programming assignment or the final exam will be graded. Attending the midterm or submitting the software project will be considered as choosing the continuous assessment mode.

Any gradings are only valid during the academic year, and will be reported to the students within ten labour days after the due date.

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

J.F. Kurose, K.W. Ross, **Computer networking: a top-down approach featuring the Internet**, 6,

L. Peterson, B. Davie, **Computer networks: a systems approach**, 5,

C. López, M. Rodríguez, S. Herrería, M. Fernández, **Cuestiones de redes de datos: principios y protocolos**, 1,

Recommendations

Subjects that continue the syllabus

(*)Arquitectura e tecnoloxía de redes/V05G300V01542
(*)Teoría de redes e conmutación/V05G300V01642

Subjects that are recommended to be taken simultaneously

(*)Comunicación de datos/V05G300V01301

Other comments

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

IDENTIFYING DATA

(*)Técnicas de transmisión e recepción de sinais

Subject	(*)Técnicas de transmisión e recepción de sinais			
Code	V05G300V01404			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	López Valcarce, Roberto			
Lecturers	Fernández Barciela, Mónica González Prelcic, Nuria Isasi de Vicente, Fernando Guillermo López Valcarce, Roberto Márquez Flórez, Óscar Willian Rodríguez Banga, Eduardo			
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

Expected results from this subject	Training and Learning Results
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.	A16
Ability to analyse and specify the fundamental parameters of a communications system.	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.	A19
Knowledge of basic technologies that enable the student to learn new methods and techniques, with the flexibility required to adapt to new situations.	A3
Ability to solve problems with initiative, decision making, and creativity.	A4
Familiarity with telecommunication regulations and standards at the national, European and world levels.	A29
(*)	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	25	25	50
Practice in computer rooms	16	16	32
Troubleshooting and / or exercises	2	19	21
Laboratory practises	10	10	20
Long answer tests and development	2	18	20
Short answer tests	1	6	7
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
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 the different components and effects in analog transmitter/receiver frontends

Personalized attention	
Methodologies	**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	60

Short answer tests	Three short tests will be given during the semester	40

Other comments on the Evaluation

For those students that opt for continuous evaluation:

- Final Exam: 60%

- Three short tests: 40% (10% the first one, 15% each of the other two)

(approximately in weeks 5, 9 and 14). Results will be announced within a reasonable time. If a student does not show up, the instructors have no obligation to reschedule the test for him/her. Each short test will cover the material from the beginning of the semester to the previous week.

For those students that do not opt for continuous evaluation:

- Final Exam: 100%

Any student showing at any of the tests (short tests or final exam) will be assigned a grade. Any student showing at any of the short tests will be graded under the continuous evaluation format. The grade of any student that only shows at the final exam will be the grade of the final exam.

Students that choose the continuous evaluation format as specified above and do not pass the course will be assigned the grade "fail" regardless of any potential no-shows.

The short tests grades will be kept for the second call, if the case, but they will not be kept for future years. In the second call, students will be allowed to opt out of the continuous evaluation format.

Sources of information

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

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

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

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

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

B. Razavi, **RF Microelectronics**, 1,

Recommendations

Subjects that continue the syllabus

(*)Principios de comunicacións dixitais/V05G300V01613

Subjects that it is recommended to have taken before

(*)Física: Análise de circuítos lineais/V05G300V01201
(*)Matemáticas: Probabilidade e estatística/V05G300V01204
(*)Procesado dixital de sinais/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				
(*)Fundamentos de son e imaxe				
Subject	(*)Fundamentos de son e imaxe			
Code	V05G300V01405			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Abreu Sernández, María Victoria			
Lecturers	Abreu Sernández, María Victoria Docio Fernández, Laura Martín Rodríguez, Fernando Pena Giménez, Antonio			
E-mail	vabreu@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	
Expected results from this subject	Training and Learning Results
Analysing the basic properties of the sound.	A3 A22
Explaining different sound production systems: human sound production, musical instruments, machines and other vibrant systems.	A22
Interpreting results of acoustic measures and selecting tools for the appropriate analysis.	A5
Describing the human perception of sound based on the physiological interface and the psychology of the perception.	A3 A22
Reviewing diffrent processes and systems associated to the sound production	A3 A5
Applying the basic rules of the colorimetry.	A3
Analysing lens systems.	A3
Choosing the most suitable capture and presentation image sytems.	A3 A5
Choosing the most adapted formats for image and video.	A3 A5
Relating the influence of the coding parameters with the results of compression and quality.	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.
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.
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.
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	
Methodologies	**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.

Tests	Description
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
Multiple choice tests	On the faitic website. In these tests the skill A3 will be evaluated.	7.5
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
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
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

Other comments on the Evaluation

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.
If the student does the "Examen 1", she/he will be evaluated by continuous assessment.

Types and assessment of activities:

1. Exam 1 (Weight: 15%): weeks 7-8. It includes the subjects explained until this week.
2. Tests (Weight: 7.5%): developed along the course on the faitic website.
3. Exam of practices (Weight: 7.5%): week 6-7.
4. Short answer exam (Weight: 5%): week 13. It includes several subjects.
5. Lab project report (Weight: 15%): 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.

The final grade will be the addition of all the activities results. To pass the course, students have to obtain, at least, five points.

NON CONTINUOUS ASSESSMENT

Students will be evaluated by means of an only exam, in the official date, if they don't do the □Exam 1□. The grades for this final exam are between 0 and 10 points. It includes all the subjects of the course, including the laboratory works.
Student can do the activities of Continuous Assessment, except the Exam 2.

June/July exam:

⇒ 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.
2. Be evaluated with an only final exam in the official date assigned by the Centre. The grades for this final exam are between 0 and 10 points. It includes all the subjects of the course, including the laboratory works.

⇒ Studentss not evaluated by Continuous Assessment:
The grades for this final exam are between 0 and 10 points. It includes all the subjects of the course, including the laboratory works.

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

In addition to the previous bibliography, students will be provided 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
(*)Acústica arquitectónica/V05G300V01635
(*)Fundamentos de enxeñaría acústica/V05G300V01531
(*)Fundamentos de procesado de imaxe/V05G300V01632
(*)Procesado de son/V05G300V01634
(*)Sistemas de audio/V05G300V01532
(*)Sistemas de imaxe/V05G300V01633
(*)Tecnoloxía audiovisual/V05G300V01631
(*)Vídeo e televisión/V05G300V01533
Subjects that are recommended to be taken simultaneously
(*)Técnicas de transmisión e recepción de sinais/V05G300V01404
Subjects that it is recommended to have taken before
(*)Física: Campos e ondas/V05G300V01202
(*)Física: Fundamentos de mecánica e termodinámica/V05G300V01102
(*)Procesado dixital de sinais/V05G300V01304
(*)Transmisión electromagnética/V05G300V01303