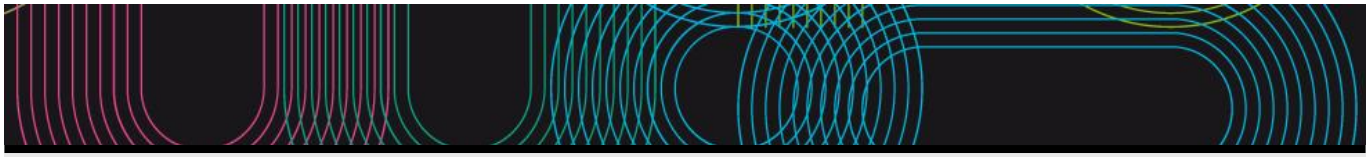

(*)Escola de Enxeñaría de Telecomunicación

(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación

Subjects			
Year 4th			
Code	Name	Quadmester	Total Cr.
V05G300V01801	Technology Management	2nd	6
V05G300V01802	Projects Lab	2nd	12
V05G300V01911	Remote Sensing	1st	6
V05G300V01912	Satellite Navigation and Communication Systems	1st	6
V05G300V01913	Real Time Digital Processing	1st	6
V05G300V01914	Digital Communications	1st	6
V05G300V01915	Fundamentals of Bioengineering	1st	6
V05G300V01921	Designing Applications with Microcontrollers	1st	6
V05G300V01922	Optoelectronic Devices	1st	6
V05G300V01923	Design and Synthesis of Digital Systems	1st	6
V05G300V01924	Advanced Electronic Sensors	1st	6
V05G300V01925	Industrial Communications	1st	6
V05G300V01931	Image Processing and Analysis	1st	6
V05G300V01932	Multimedia Technology and Computer Graphics	1st	6
V05G300V01933	Advanced Acoustics	1st	6
V05G300V01934	Noise Measurement Techniques and Regulations	1st	6
V05G300V01935	Audiovisual Production	1st	6
V05G300V01941	Multimedia Services	1st	6
V05G300V01942	Mobile and Wireless Networks	1st	6
V05G300V01943	Programming of Intelligent Systems	1st	6
V05G300V01944	Embedded Systems Design	1st	6
V05G300V01945	New Telematic Services	1st	6
V05G300V01981	External placements: Placements in Companies I	1st	6
V05G300V01982	External placements: Placements in Companies II	1st	6

V05G300V01991	Final Degree Work	2nd	12
V05G300V01R02	Credits obtanied in the Framework of Mobility Programmes	1st	0

IDENTIFYING DATA				
Technology Management				
Subject	Technology Management			
Code	V05G300V01801			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	González Castaño, Francisco Javier			
Lecturers	Díaz Redondo, Rebeca Pilar Fernández Hermida, Xulio Fernández Vilas, Ana González Castaño, Francisco Javier			
E-mail	javier@det.uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	This course provides skills in design, management and leadership of technological projects. This includes detection of needs, technological surveys, team creativity techniques, project management, property definition and protection, and entrepreneurship strategies.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A63	(CE54/PY1) The ability to elaborate the proposal of technical projects according to the specified requirements in a public competitive bidding.
A64	(CE55/PY2) The ability for technical direction of telecommunication project.
A65	(CE56/PY3) The ability to manage telecommunication project human resources and economic.
A66	(CE57/PY4) The ability to elaborate technical reports and for the follow up of a telecommunication project.
B2	To approach a new problem considering first the essential and then the secondary aspects
B4	The ability to use software tools that support problem solving in engineering
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Expected results from this subject	Training and Learning Results	
Interpreting needs as technological problems	A4	B2
Identifying and handling relevant sources for technological surveys	A66	B5
Techniques to boost team creativity	A4 A9 A65	

Design and management of large-scale technological projects	A1 A5 A63 A64 A65 A66	
Choosing and using project management tools		B4
Management of R&D human resources	A4 A8 A9 A64 A65	
Legal aspects	A2 A4 A6 A7 A8	
First steps towards the creation of a start-up	A2 A4 A6 A8	

Contents	
Topic	
Identifying and interpreting needs	- Gathering requisites - Translating needs into technical objectives - Technological perspective. Hype cycles - Sources and methods for technical surveys
Creativity techniques	- Research, development and innovation - Team methods to boost creativity - Is my idea original? Formulating and evaluating it
Project design and management	- Definition of technical goals - Translating goals into tasks - Planning the project - Project resources - Human team. R&D profiles - Budget - Tracking project evolution
Business models	- Product proposal - Risk analysis - Customer survey - Business plan
Entrepreneurship	- From the idea to the business plan - Looking for capital - Technological partnerships - First steps towards the creation of an enterprise
Legal aspects	- Types of property: Intellectual and industrial - Technological actives vs. legal property. Models, patents. Licenses - Spanish case/international case. Europe and the US. Internationalization hints - CIN/352/2009 regulation
(*)-	(*)-

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	22	26	48
Projects	4	20	24
Troubleshooting and / or exercises	2	12	14
Practice in computer rooms	28	36	64
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies

	Description
Master Session	Oral presentation of the main concepts of the course by the professors, supported by multimedia. Lectures by experts
Projects	Personal project (individual or in groups) to be presented during class hours A of the last week
Troubleshooting and / or exercises	Brief individual assignments on the topics of the master sessions
Practice in computer rooms	Práctice on aspects of specification of requisites, creativity and project design and tracking using computer tools

Personalized attention

Methodologies	Description
Projects	- The professors will publish a timetable to attend the students individually at their offices - Course documentation (slides employed in the classroom, homework, questionnaires of practical assignments, documentation for the seminars, recommended lectures) will be available through the TEMA platform (http://faitic.uvigo.es)
Troubleshooting and / or exercises	- The professors will publish a timetable to attend the students individually at their offices - Course documentation (slides employed in the classroom, homework, questionnaires of practical assignments, documentation for the seminars, recommended lectures) will be available through the TEMA platform (http://faitic.uvigo.es)

Assessment

	Description	Qualification
Master Session	Exam	25
Projects	Individual defense (commitee)	30
Troubleshooting and / or exercises	Correction by the professors	5
Practice in computer rooms	Evaluation of partial results+exam	40

Other comments on the Evaluation

The exam will take place in the official date. It will consist of two parts, with the same weight in the final score: a written part covering the whole course content and an oral part on the project of the current course. The project assignment must be handed to the professors three days before the exam date.

Competencies considered in the assessment process:

Exam: all

Evaluation of partial results in lab practice & problems: A4, A9, B2, B4, B5

Project: A4, A9, A63, B2, B4, B5

Note: in case problems will not be proposed, their weight in the assessment process will be transferred to the project.

Sources of information

- V. Chiesa (2001), R&D Strategy and Organisation, Imperial College Press
- R. Florida, J. Goodnight, Managing for Creativity, Harvard Business Review
- M. Michalko, Thinkertoys: A Handbook of Creative-Thinking Techniques (2nd edition, ISBN-10: 1580087736 | ISBN-13: 978-1580087735)
- A. Osterwalder, Y. Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers (ISBN: 978-2-8399-0580-0)

Recommendations

IDENTIFYING DATA

Projects Lab

Subject	Projects Lab			
Code	V05G300V01802			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	12	Mandatory	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Mosquera Nartallo, Carlos			
Lecturers	Alba Castro, José Luis Álvarez Sabucedo, Luis Modesto Caeiro Rodríguez, Manuel Díaz Otero, Francisco Javier Docio Fernández, Laura Eguizábal Gándara, Luis Eduardo Fariña Rodríguez, José Fernández Manin, Generosa Fernández Vilas, Ana García Mateo, Carmen González Castaño, Francisco Javier Isasi de Vicente, Fernando Guillermo Lorenzo Rodríguez, María Edita de Machado Domínguez, Fernando Mosquera Nartallo, Carlos Prol Rodríguez, Miguel Rodríguez Rodríguez, José Luis Sánchez Real, Francisco Javier Santos Gago, Juan Manuel Valdés Peña, María Dolores			
E-mail	mosquera@gts.uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	Interdisiciplinary projects must be addressed by a group of students who must represent at least two of the four technologies of the Telecommunication Technologies Engineering Degree. The teams are supervised by two faculty members from different Departments to enrich and facilitate the cross-fertilization between different areas of work. The work developed by the different teams will be defended at the end of the course as part of the evaluation process.			

Competencies

Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A63	(CE54/PY1) The ability to elaborate the proposal of technical projects according to the specified requirements in a public competitive bidding.
A64	(CE55/PY2) The ability for technical direction of telecommunication project.
A65	(CE56/PY3) The ability to manage telecommunication project human resources and economic.
A66	(CE57/PY4) The ability to elaborate technical reports and for the follow up of a telecommunication project.
B2	To approach a new problem considering first the essential and then the secondary aspects
B3	The development of discussion ability about technical subjects

Learning aims

Expected results from this subject	Training and Learning Results	
The ability to develop projects in the field of Telecommunication Engineering	A1	
The skills to handle technical specifications and standards	A6	
The capacity to evaluate the potential social impact of the developed solutions	A7	
Familiarity with project management and planning	A8	
Skills to work as a member of an interdisciplinary team	A9	
Oral and written presentation skills in the field of Telecommunication Engineering	A9	
Ability to get into a new problem gradually		B2
Discussion skills on technical problems		B3
Skills to anticipate technical challenges and issues in Engineering projects.	A63	
Skills to take responsabilities on technical tasks	A64	
Skills to manage human and financial resources	A65	
Skills to monitor the evolution of a telecommunications project	A66	

Contents
Topic
1. Team work
2. Technical writing
3. Public speaking

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	0	2
Classroom work	4	4	8
Projects	14	244	258
Presentations / exhibitions	8	24	32
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	Some practical hints on skills such as oral and written presentation, and team working.
Classroom work	Partial review of the different projects evolution, with short presentations and discussions.
Projects	This is the core of the course: the team of students must address a project initially proposed by two faculty members. During the duration of the course the team members must work in close cooperation to achieve the objectives of the project; the supervision is such that a weekly one hour meeting willl take place with one or both advisors. All members of the team must be able to defend its project at the end of the course in both oral and poster sessions.
Presentations / exhibitions	Every team must defend its project in a final oral presentation and a poster session. The oral presentation can be made by one or more members of the team, and must include evidences to show proof of the work developed and achieved results. At the end of the presentation all members must be available for Q&A. The poster session requires the presence of all members of the team. An executive summary of the work must be available to the evaluation committee three days in advance.

Personalized attention	
Methodologies	**Description**
Projects	The two advisors will hold a one hour weekly meeting with the students. In addition, they will be available during their regular office hours for additional support.

Assessment		
	Description	Qualification
Projects	A portion of the final grade will be based on: 1. Advisors recommendations. For an adequate tracking of the project development, advisors will request different pieces of evidence, both oral and/or written, including partial and/or final reports. Each pair of advisors must submit a justified recommendation to the committee as to the team work methodology and the performance of the team members in the accomplishment of the project goals. Competences A1, A6, A7, A8, B2, B3, A63, A64, A65, A66 will be evaluated here. 2. Group mates. A peer review among the team members will be also requested as additional evidence for competence A9.	65

Presentations / exhibitions	A portion of the final grade will be based on the committee evaluation during the LPRO DAYS. The attendance to these days will be mandatory for all students. They must submit an executive summary of the project at least three days in advance to help assess their work. The members of the evaluation committe will be the instructors of the Type-A ECTS, as long as they are not involved in the supervision of any project. Otherwise, additional assistance for the evaluation of those conflicting projects will be requested from other instructors from the course. Competences A1, A7, A9 and B3 will be evaluated here. Although the grade is expected to be similar for the entire group as a general principle, exceptions might apply. Thus, especially underperforming students not contributing to the team effort can get a different grade. Similarly, students contributing well above the average of the group can get a higher grade.	35

Other comments on the Evaluation

Final presentations are allowed in Galician, Spanish or English.

Those teams not getting the minimum grade to pass the course will have some additional weeks till the allocated date in the second call to present their work again. If the performance of a given student is graded differently from his/her team-mates, and this leads to failing the course, then he/she will need to show a comprehensive domain of the project developed by his/her team in the second call, together with sufficient additional contributions of his/her own.

Sources of information

The advisors of each project will detail the recommended sources of information

Recommendations

Subjects that are recommended to be taken simultaneously

Technology Management/V05G300V01801

Other comments

Attendance to the different activities of the course is mandatory.
Final presentations are allowed in Galician, Spanish or English.
Those teams (or members of the teams) not getting the minimum grade to pass the course will have some additional weeks till the allocated date in the
second call to present their work again. If the performance of a given student is graded differently from his/her team-mates, and this leads to failing the course, then he/she will need to show a comprehensive domain of the project developed by his/her team in the second call, together with sufficient additional contributions of his/her own.

IDENTIFYING DATA				
Remote Sensing				
Subject	Remote Sensing			
Code	V05G300V01911			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Cuiñas Gómez, Íñigo			
Lecturers	Cuiñas Gómez, Íñigo			
E-mail	inhigo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Remote Sensing is the topic devoted to all systems that allow the collection of data about object or surface characteristics without physical contact. This topic presents the basic principles of Remote Sensing, both in visible and infrared spectrum, and in microwaves. Special care will be put on active and passive sensors, with a deep explaination of RADAR and optic-electronic systems. The topic involves technological elements and signal processing, with a focus on the applications.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A74	(CE65/OP8)Applying conceptual, theoretical and practical tools of telecommunications in the development and applications of radar and remote sensing systems.
A75	(CE66/OP9) The ability for selection of circuits, subsystems and systems of remote sensing.

Learning aims	
Expected results from this subject	Training and Learning Results
Analyze and specify radar systems, subsystems and radar signal	A3 A74
Analyze and specify passive sensors	A3 A75
Develop image forming algorithms.	A9 A74 A75
Suggest solutions based on microwave remote sensing, infrared remote sensing and remote sensing in the visible spectrum	A4 A7 A9

Contents	
Topic	
Introduction to Remote Sensing	Panoramic of the meaning and application of the distance observation of earth, sea and air, doing upsetting in the different points of view between our usual perception of the Earth and his appearance when it is observed from a satellite or another airlifted platform. Besides, it exposes the historical evolution of the Remote Sensing and his implication in the human life, standing out the appearances of the space exploration and the distinct programs that have gone conforming it. The contents given in group A have an autonomous activity associated, called "The Earth from the air/space".

Fundamental concepts	In this subject three fundamental concepts are explained: the spectral signature, the classification and the compositions of colour. All this, after an introduction to the multispectral sensors.
Sensors	Explanation of the concept of sensor, introduction to the distinct types of sensors, the concept of resolution and calibration. Afterwards, it devotes at least a session of two hours to the passive sensors (optical-electronic, thermal and radiometers of microwaves) and another session to the active sensors (RADAR and LIDAR). This exhibition includes the foundations and operation, its characteristics, advantages and inconvenient and applications. The contents given in group A have several practices of laboratory (group B) associated, those called "Sensors calibration", "Passive Sensors: infrared", and "RADAR Fundamentals". Besides, there will be an autonomous activity, "Microwave active RADAR".
Processing, interpretation and formation of images	The subject results a summary of the distinct techniques of processing applied for the interpretation and classification of images taken from satellites. It employs an image example to which go applying the distinct processed explained, for a better understanding of the applications of each technique. Besides, the subject occupies of the formation of images of big regions of the surface of the Earth from images of areas more reduced, by means of the use of mosaics. It exposes the process of the mosaic both from satellite and airborne images. All the contents are given in laboratory (group B), for four sessions of 2 hour each. Besides, the works developed in group C support the contents of this subject.
Geographic Information Systems (GIS)	It treats to introduce the foundations and applications of the GIS, orienting all the exhibition to the support in the decisions process related with geographic locations. The second part of the session devotes to deepen in the knowledge of applications of GIS by means of the study of practical cases.
Terrestrial exploration	In this subject present some examples of applications of the Remote Sensing in diverse fields: studies of the floor, agriculture, mining, geology. The own actuality in the moment of teaching can determine the applications in which more upsetting is done. The contents given in group A have associated the work developed by students in groups C.
Meteorology and Oceanography	In this subject the applications that more satellites have occupied along the history of the Remote Sensing are exposed: the meteorology and the oceanography. In Meteorology, it indicates which types of sensors employ , analyses the distinct parameters of interest, the characteristics regarding resolution and the results of climatic studies along all the planet. Regarding Oceanography, the subject indicates the observed parameters, the sensors, and it also presents images that show the results of the observations both directly and after the application of distinct processed.
Space exploration	The aim of the subject is to present a panoramic of the space exploration. Beginning with the sensors employed along the years of history of the humanity in the space, the subject shows the main knowledges that we have obtained from the distinct bodies of the solar system and it exposes how they arrived to this knowledge (missions, peculiarities of the ships and sensors employed, etc.).

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	17.2	25.8	43
Laboratory practises	4	8	12
Practice in computer rooms	10	15	25
Tutored works	5	45	50
Presentations / exhibitions	2	4	6
Autonomous practices through ICT	0	2	2
Introductory activities	1	1.2	2.2
Short answer tests	2.8	0	2.8
Systematic observation	0	2	2

Jobs and projects	0	5	5

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

Methodologies	
	Description
Master Session	Exhibition by the professor of the contents of the topic "Remote Sensing": foundations, theoretical bases, applications, etc. Reserves for the sessions of group A. This methodology works on competences A74, A75, and A3
Laboratory practises	Activities of application of the knowledges to concrete situations and of acquisition of basic skills and procedures related with the matter object of study. They are developed in laboratories with the suitable equipment. They are two face-to-face sessions of 2 hours each one: one centred in calibration of sensors (using LEGO Mindstorm), and another in thermography by infrared (learning to handle termographic cameras). Both are developed in groups B. This methodology works on competences A74, A75, and A4
Practice in computer rooms	Activities of application of the knowledges to concrete situations and of acquisition of basic skills and procedures related with the matter object of study. They are developed in laboratories with computers. They are five sessions of two hours each one: 1. Foundations of RADAR, by means of a game of computer designed specifically, "RADAR Technology". 2. Processing and Interpretation of satellite images, with a program for processing LandSat images (it takes four sessions). This methodology works on competences A74, A75, A9, and A4
Tutored works	The student, in groups, prepares a document on an application of the Remote Sensing in the daily life. For this, the students will begin with a research of news on a subject that are propose to each group, related to the actuality, in which the remote sensing appear like a basic tool (for example, the research of corpses buried by a murderous, the follow-up of some floods, the study of the outlines of the continental plate under the ocean). The groups will begin for locating actual related news. From them, they will treat to identify the technologies, sensors, processing techniques, employee. They will have to look for technical and scientific information on these and, finally, elaborate a report and a presentation. The interaction with the professors will be face-to-face along five meetings of one hour each, and through forums during the research of information, and by email for the exchange of ideas. This methodology works on competences A4, A7, and A9
Presentations / exhibitions	Exhibition by part of the students in front of the professor and the rest of students of the work realised in small groups (C). These works will be presented as an activity of group A. This methodology works on competence A9
Autonomous practices through ICT	Activities to be autonomously developed, with software provided by means of FaiTIC platform: 1. "Earth from air/space", to learn about points of view. 2. "Microwave active RADAR", to learn on RADAR imaging. This methodology works on competences A74 and A75
Introductory activities	Activities directed to take contact and gather information on the students, as well as to present the topic. For this activity reserves a face-to-face hour of group A, in which the professor presents the topic, explain the practices of laboratory and computer, and what expects of the works in group C. This methodology works on competences A74, A75, and A4

Personalized attention	
Methodologies	**Description**
Introductory activities	Time that each professor has reserved to attend and resolve doubts of the students.
Master Session	Time that each professor has reserved to attend and resolve doubts of the students.
Laboratory practises	Time that each professor has reserved to attend and resolve doubts of the students.
Practice in computer rooms	Time that each professor has reserved to attend and resolve doubts of the students.

Tutored works	Time that each professor has reserved to attend and resolve doubts of the students.
Presentations / exhibitions	Time that each professor has reserved to attend and resolve doubts of the students.
Autonomous practices through ICT	Time that each professor has reserved to attend and resolve doubts of the students.

Assessment

	Description	Qualification
Master Session	Proofs of short answer: there will be four proofs, the weeks 3, 6, 8 and 10, of 5-10 minutes of length, that allows the student to pass part of the matters. In these short proofs the skils A74, A75, A3 and A7 will be evaluated.	40
Laboratory practises	Systematic observation: During the practices of laboratory and computer, the obtaining of results and the demonstration to having comprised the procedure to arrive to them will be evaluated: 1. "Sensors calibration": 5% 2. "Infrared thermography": 10% In these practices the skils A75, A4 and A9 will be evaluated.	15
Practice in computer rooms	Systematic observation: During the practices of laboratory and computer, the obtaining of results and the demonstration to having comprised the procedure to arrive to them will be evaluated: 1. "Foundations of RADAR": 7% 2. "Image Processing": 13% In these practices the skils A74 and A4 will be evaluated.	20
Tutored works	The realisation of the works in groups will be evaluated in two parts: the own dynamics of the works and the presentations. The work itself will receive 15% of the mark In these works the skils A75, A7 and A9 will be evaluated.	15
Presentations / exhibitions	Presentations of the works by part of the groups In the presentation of the works the skil A9 will be evaluated.	5
Autonomous practices through ICT	Students will give the lecturer their autonomous work results: 1. "The Earth from the air/space": 3% 2. "Active RADAR of microwaves": 2% In these practices the skils A74 and A4 will be evaluated.	5
Short answer tests	The final examination, in case to have to do it, will consist of 10 questions of short answer, with questions related with the classes of theory, of laboratory and the presentations of the works, and will cost by 100% of the note of the topic.	0

Other comments on the Evaluation

All proofs will be performed in English.

The proofs of continuous evaluation allow the student to obtain a final qualification based only in his path along the course, and consist in:

1. Four proofs of short answer, with 10% of the total note each one, adding 40%.

2. Proofs of systematic observation in the practices of laboratory and computer, that add another 40%

3. Evaluation of the tutored works (15%) and of the presentation of the same (5%)

The tasks of continuous evaluation are not recoverable, and they are only valid for the current course. A student is supposed that has opted by continuous evaluation when he has done two of the proofs of short answer and he has attended two practices of laboratory. A student that opts by the continuous evaluation is considered to be presented to the topic, independently that he attends or not the final examination.

If a student, having presented to continuous evaluation, opts for presenting to the final examination, the final mark of the topic will be the average of both.

According to the regulations of the University of Vigo, the student that wish has to be able to opt to 100% of the final note by means of an only final examination. The final examination is that he realises in the official dates marked in Board of School

in the months of December or January (or July, in the case extraordinary exam), and to those that have to attend those students that have not opted by continuous evaluation and wish to approve the topic. The final examination will consist of ten brief questions related with the contents of the classes of classroom, of laboratory, and the presentations of the works.

The extraordinary examination will have a similar structure to the final examination.

Sources of information
Emilio Chuvieco Salinero, **Teledetección ambiental**, Ariel,
Nicholas M. Short, Sr., **The Remote Sensing Tutorial**, Code 935, Goddard Space Flight Center,
Exploring the Moon, NASA,
Águeda Arquero Hidalgo, Consuelo Gonzalo Martín, Estíbaliz Martínez Izquierdo, **Teledetección: Una aproximación desde la superficie al satélite**, Fundación General de la UPM,
Fundamentals of Remote Sensing, Canadian Centre for Remote Sensing,
Gerald C. Holst, **Common Sense Approach to Thermal Imaging**, SPIE Optical Engineering Press,
Gary Jedlovec, **Advances in Geoscience and Remote Sensing**, In-Teh,
Iñigo Cuiñas, Verónica Santalla, Ana V. Alejos, María Vera-Isasa, Edita de Lorenzo, Manuel G. Sánche, **Playing LEGO Mindstorms® while Learning Remote Sensing**, International Journal of Engineering Education, vol. 27, no. 3, pp. 571-579,
Iñigo Cuiñas, Verónica Santalla, Pablo Torío, **Aprender jugando: fundamentos de Termografía en asignaturas de Teledetección**, Jornada de Innovación Educativa 2012,

Recommendations

Subjects that are recommended to be taken simultaneously

Satellite Navigation and Communication Systems/V05G300V01912

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Signal Transmission and Reception Techniques/V05G300V01404
Electromagnetic Transmission/V05G300V01303
Microwave Circuits/V05G300V01611
Radio Frequency Circuits/V05G300V01511
Spectrum Management/V05G300V01612
Optical Telecommunication Infrastructures/V05G300V01614
Principles of Digital Communications/V05G300V01613
Wireless Systems and Networks/V05G300V01615
Radio Communication Systems/V05G300V01512
Multimedia Signal Processing/V05G300V01513

Other comments

The topic is going to be taught in English.
All the documents will be in English.

IDENTIFYING DATA				
Satellite Navigation and Communication Systems				
Subject	Satellite Navigation and Communication Systems			
Code	V05G300V01912			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Mosquera Nartallo, Carlos			
Lecturers	Aguado Agelet, Fernando Antonio García Sánchez, Manuel Mosquera Nartallo, Carlos			
E-mail	mosquera@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The contents of this course cover the basics of satellite navigation and satellite communication systems: GPS and Galileo, the different segments of satellite communication systems, and an introduction to the planning and development standards. The course will be entirely conducted in English; the use of Spanish or Galego will be optionally allowed in the last exam.			

Competencies	
Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A76	(CE67/OP10) Applying conceptual, theoretical and practical tools of telecommunications in the development and applications of navigation and satellite communications systems.
A77	(CE68/OP11) The ability for selection of navigation and satellite communications systems and subsystems.

Learning aims	
Expected results from this subject	Training and Learning Results
To know the planning and development standards of satellite systems.	A2 A3 A76 A77
To know the different alternatives of communication and navigation satellite systems, their different segments (space, ground and user) and the type of orbits.	A3 A4 A76 A77
To know the more usual systems and services for satellite communications, including their technological capabilities and limitations.	A3 A76 A77
To know and apply satellite navigation systems: GPS, Galileo, and other systems.	A2 A3 A4 A76 A77

Contents
Topic

Introduction	- System definition - Standards - Regulations - Allocated frequency bands
Elements of a System	- Ground Segment - Space Segment - Launch Segment - User Segment
Architecture of the Communication Subsystems	Subsystems: - Antennas - Payload: transponders
Introduction to Satellite Communications	- Main elements in a communications payload - Signal propagation impairments - Link budget - Multibeam satellites
Satellite Communication Services	- Fixed Satellite Services (FSS) - Broadcast Satellite Services (BSS) - Mobile Satellite Services (MSS)
Introduction to Navigation Systems (GNSS)	- GPS, Galileo, Glonass, and other systems.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Practice in computer rooms	13	39	52
Laboratory practises	4	8	12
Tutored works	3	9	12
Short answer tests	1	10	11

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

Methodologies

	Description
Master Session	We describe the different aspects of the subject providing all the necessary educational material.
Practice in computer rooms	Every student will apply the theoretical knowledge to different practical tasks covering the main part of the contents of the subject with the help of the software suites.
Laboratory practises	Every student will apply in a practical way the different theoretical knowledge in a specific context.
Tutored works	The student will work in groups, with the support of the university lecturers, to apply, extend and personalize the contents covered in the theoretical and laboratory hours.

Personalized attention

Assessment

	Description	Qualification
Practice in computer rooms	The students will perform laboratory practice where they will work with concepts studied in the theoretical classes. In these laboratory practices the capabilities A76, A77, A3 and A4 will be evaluated.	40
Laboratory practises	Each student will perform field practices. The evaluation will be performed by means of a report for a total weight of 10% of the final mark. In these field practices, the capabilities A76, A77, A3 and A4 will be evaluated.	10
Tutored works	The evaluation of the group work will be taken into account as well as the understanding, maturity, importance and originality of the work and interaction between the group. In these tutored works the capabilities A76, A77, A3 and A4 will be evaluated.	5
Short answer tests	A final test to evaluate the contents presented in the master sessions. The test will be individual with time limit. In this short answers test, the capabilities A76, A77, A2, A3 and A4 will be evaluated.	45

Other comments on the Evaluation

At the beginning of the term, the student will choose the assessment methodology: final exam or continuous evaluation.

Both, documentation and presentations of this subject will be exclusively in English.

English shall be used for writing the reports to evaluate the laboratory practices and the tutored works.

The students may use either English, Spanish or Galego to respond the short answer test.

The subject will be evaluated through one of the following mechanisms:

Final exam:

- The exam will include questions and/or numerical problems related with the contents presented in master sessions, laboratory practices and tutored works. It will be necessary to obtain 5 points over 10 to pass the exam.

***Continuous* evaluation** (the students who choose the continuous evaluation method will not be allowed to attend the final exam in the first call). The subject will be assessed throughout the entire term:

- **Laboratory practices**: each student will have to perform different tasks with a total weight of 40% of the final mark.
- **Tutored works:** each student will participate in different tutored works proposed during the lecture period. This part will be evaluated by written reports. These reports will have a total weight of 5% of the final mark.
- **Outdoor study/field practices:** each student will perform field practices. A report must be turned in to get a maximum score of 10% of the final grade.
- **Short answer test**: This exam will be the final assessment of the continuous evaluation, and it will have a total weight of 45% of the final mark.

Make-up exam (second exam): the student will have to take an exam which will include questions and/or numerical problems related with the contents presented in the master sessions, the laboratory practices and the tutored works (100% of the final mark). Optionally, they could take a partial exam on the contents of the master session (45% of the final mark).

All the different grades are only valid for the current course, and will expire after the second call in case someone needs to take the course again.

Sources of information

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

Maral and Bousquet, **Satellite Communications Systems: Systems, Techniques and Technology.**, Wiley,

http://www.ecss.nl,

Teresa M. Braun, **Satellite Communications, Payload and System**, Wiley,

E. Lutz, M. Werner, A. Jahn, **Satellite Systems for Personal and Broadband Communications**, Springer,

Organización de Aviación Civil Internacional, **Telecomunicaciones aeronáuticas : Anexo 10 al Convenio sobre aviación civil internacional. Volumen III, Sistemas de telecomunicaciones / Organizacion de Aviación Civil Internacional**,

Elliott D. Kaplan, Christopher J. Hegarty, editors, **Understanding GPS : principles and applications**, Artech House,

Bernhard Hofmann-Wellenhof, Herbert Lichtenegger, Elmar Wasle, **GNSS - global navigation satellite systems : GPS, GLONASS, Galileo, and more**, Springer,

http://www.trimble.com/gps_tutorial/,

http://www.insidegnss.com/magazine,

http://igs.bkg.bund.de/,

http://waas.stanford.edu/index.html,

Recommendations

Subjects that are recommended to be taken simultaneously

Remote Sensing/V05G300V01911

Subjects that it is recommended to have taken before

Signal Transmission and Reception Techniques/V05G300V01404
Electromagnetic Transmission/V05G300V01303
Radio Communication Systems/V05G300V01512

IDENTIFYING DATA				
Real Time Digital Processing				
Subject	Real Time Digital Processing			
Code	V05G300V01913			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Cardenal López, Antonio José			
Lecturers	Cardenal López, Antonio José			
E-mail	cardenal@gts.uvigo.es			
Web				
General description	This course is designed to provide the student with basic knowledge about the design and implementation of real-time digital signal processing (DSP) algorithms. The main objective for the student is to obtain knowledge about the different platforms available for this purpose in scenarios with real-time restrictions, and to learn the practical issues related with the implementation of DSP algorithms in such platforms. Knowledge acquired on lectures will be reinforced by laboratory practices. For this purpose a Digital Signal Processor development board, will be employed. The course will be taught in Spanish, but all teaching materials will be in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A78	(CE69/OP12) The ability to implement digital signals processing schemes in programming devices.
A79	(CE70/OP13) The ability to interact digitally with radio signals.

Learning aims	
Expected results from this subject	Training and Learning Results
Know the architectures for applications in real time. Develop applications in real time on selected architectures. Adapt the knowledges of digital signal processing to real time tasks. Propose digital solutions for its integration in radio transceptors.	A3 A4 A78 A79

Contents	
Topic	
Topic 1 Elementary concepts	Definition of real-time processing. Real-time restrictions for digital signal processing. Overview of hardware platforms for real time digital signal processing.
Topic 2 Time-domain algorithms.	Signal generation. Advanced structures for IIR filters. Finite-precision effects.
Topic 3 Frequency-domain Algorithms	Fast Fourier Transform (FFT). Discrete Cosine Transform. Goertzel algorithm
Topic 4 Introduction to Digital Signal Processors.	DSP architecture. Arithmetic-logic unit. Address-Generation Unit. Program flow control. Performance measures.
Topic 5 High level programming for DSP	Development systems structure. Fixed point programming techniques. Optimising high level code.
Practice 1: Introduction to the development system	Compiling, runing and debugging programs on the DSP development system.
Practice 2: Signal generator	Generation of a sinusoidal signal using several approaches.
Practice 3: IIR filters (I)	IIR filters implementation using transposed and cascade structures.
Practice 4: IIR filters (II)	IIR filter programming using fixed-point arithmetic.
Practice 5: Frequency domain processing.	Using the DSP libraries for FFT computation. Frequency domain filtering.
Practice 6: Software defined radio.	Programming of basic algorithms for programmable transmiters and receptors.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Tutored works	7	35	42
Laboratory practises	12	24	36
Long answer tests and development	2	7	9
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Master Session	Presentation of main topics in class. Multimedia material will be made available in faitic before classes take place. Personal study. Support from the instructors through tutorial help.
Tutored works	Group work on a project centered in a practical application using the DSP development board employed in the laboratory.
Laboratory practises	Practical exercises on a DSP development board. Matlab will be used for designing filters, and for simulation purpose if necessary.

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

Assessment		
	Description	Qualification
Tutored works	Group work centred in a practical application of real-time signal processing, using the DSP development board.(Competencies A2, A4, A78)	30
Laboratory practises	Evaluation of practical exercices using the DSP development board. (Comptencies A2, A4, A78, A79)	50
Long answer tests and development	Written exam encompassing all the material exposed in the classroom and laboratory. (Competencies A2, A4, A78,)	20

Other comments on the Evaluation

Evaluation

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

CONTINUOUS EVALUATION

The continuous evaluation of the course will consist in:

- 5 practices developed on the DSP development board.These practices will account for 50% of the final grade.
- 1 project to be carried out in group, that will account for 30% of the final grade.
- A written exam encompassing all the material exposed in the classroom and in the laboratory. It will take place in the dates scheduled by the school. It will account for 20% of the final grade.

The final qualification of the student will be computed as a weighted sum (50%, 30% and 20%, respectively) of the qualifications of laboratory, group project and final exam.

The contents and the weight of each continuous evaluation exercise are the following:

- Signal generation (10%)
- IIR filter programming (10%)

- Programming IIR filters with fixed point arithmetic. (10%)
- Frequency domain processing (10%)
- Software defined radio (10%)
- Project: (30%)

EVALUATION AT THE END OF THE SEMESTER

Should a student decide not to be graded through continuous evaluation, he will have a written examination opportunity that will take place the same day of the final exam for all the students. The exam will cover all the material mastered in the classroom and the laboratory. Students should communicate their intention to renounce to be graded through continuous evaluation at least a week before the date of the final exam.

Students who do not pass the course at the end of the semester have an oportunity to retest on the end of the academic year. Previously to the exam, students will be asked to choose to be evaluated by continuous evaluation system or only by the final exam. In the former case, they will have the opportunity to improve the continous evaluation grade by means of redoing and improving selected practices.

Sources of information

Sen M. Kuo, Bob H. Lee, **Real-Time Digital Signal Processing,: Implementations, Application and Experiments with the TMS320C55X**, John Wiley & Sons,

Sanjit K. Mitra, **Digital Signal Processing: A Computer Based Approach**, McGraw-Hill,

Alan V. Oppenheim, Ronald W. Schafer, **Discrete-Time Signal Processing**, Prentice Hall,

Recommendations

Subjects that it is recommended to have taken before

Digital Signal Processing/V05G300V01304
Multimedia Signal Processing/V05G300V01513

IDENTIFYING DATA				
Digital Communications				
Subject	Digital Communications			
Code	V05G300V01914			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Pérez González, Fernando			
Lecturers	Mosquera Nartallo, Carlos Pérez González, Fernando			
E-mail	fperez@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course presents the modulations that are used in practically all modern communication standards. Teaching and exams are in English.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A80	(CE71/OP14) The ability to analyze the physical layer in modern digital communications systems.
B3	The development of discussion ability about technical subjects

Learning aims		
Expected results from this subject	Training and Learning Results	
Acquire the intuition and needed math skills to understand the role played by diversity in improving the provision of communication systems.	A4 A9 A80	B3
Develop the capability of analyzing the physical layer of current telecommunication systems.	A4 A9 A80	B3
Handle the necessary tools to understand the different aspects of the physical layer of communications system a system and put them to practice when it comes to simulating, designing or dimensioning.	A4 A9 A80	B3
Strengthen the capacity to follow a technical class in English.	A9	B3

Contents	
Topic	
Subject 1: Multicarrier modulations	1.Introduction. 2 Analog and digital OFDM modulations 3 Diagram of an OFDM transmitter. 4 Effect of the channel on the received signal. 5 Diagram of an OFDM receiver. 6 OFDM seen as a block process.
Subject 2: Equalization, coding and synchronization in multicarrier modulations.	1. Pilot carriers. 2 ZF and MMSE equalization. 3 Zero-padding methods. 4 Coded OFDM (COFDM). 5 Carrier synchronization algorithms. 6 Timing recovery algorithms. 7 Channel state information estimation.
Subject 3: Applications	1 Digital Radio/TV standards. 2 OFDM wireless communications standards. 3 OFDM wire communications standards.

Subject 4: Advanced digital communications.	1 MIMO ystems. 2 Advanced coding: turbo and LDPC codes. 3 Spread-spectrum systems. 4 Generalized multicarrier systems.

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	6	6	12
Laboratory practises	12	24	36
Master Session	21	40	61
Short answer tests	2	10	12
Reports / memories of practice	0	14	14
Jobs and projects	1	14	15

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

Methodologies

	Description
Troubleshooting and / or exercises	Each subject will be complemented with exercises. Previous work by the students on the exercises will be required. Competences: CG4, CG9, CE71, B3
Laboratory practises	Lab practices will consist in the demodulation of Digital Radio Mondiale (DRM) signals. This will allow students to practically implement some of the concepts seen in the lectures: OFDM, demodulations, synch recovery,... Competences: CG4, CG9, CE71
Master Session	The course is structured in four main subjects that revolve around the concept of multicarrier modulations. Each subject will be taught through lectures in the classroom. Competences: CG4, CG9, CE71

Personalized attention

Methodologies	**Description**
Master Session	Students will have the opportunity to meet in person with the instructor at some office hours that will be announced at the beginning of the course. The schedule will published in the course webpage.
Troubleshooting and / or exercises	Students will have the opportunity to meet in person with the instructor at some office hours that will be announced at the beginning of the course. The schedule will published in the course webpage.
Tests	**Description**
Reports / memories of practice	Students will have the opportunity to meet in person with the instructor at some office hours that will be announced at the beginning of the course. The schedule will published in the course webpage.
Jobs and projects	Students will have the opportunity to meet in person with the instructor at some office hours that will be announced at the beginning of the course. The schedule will published in the course webpage.

Assessment

	Description	Qualification
Short answer tests	Final exam with short questions on the contents of the subject, that will include also some questions on the projects. Competences: CG4, CG9, CE71, B3.	20

Reports / memories of practice	Deliverables for the lab project. 50% of the final grade corresponds to tasks associated to a lab project. Along the course there will be six milestones, corresponding to each of the stages for the Matlab implementation of a simplified OFDM receiver. The weight given to each of these tasks is the following: Task 1 (Demodulation to baseband): 5% Task 2 (Mode detection and temporal allignment): 5% Task 3 (Frequency error correction): 10% Task 4 (Frame synchronization): 10% Task 5 (Channel estimation and equalization - I): 10% Task 6 (Channel estimation and equalization - II): 10% Competences: CG4, CG9, CE71, B3.	50
Jobs and projects	Projects on any of the digital communication standards that employ the techniques presented in the classroom. Possible topics include: - Digital radio (DAB, DAB+, DRM) - Digital terrestrial television (DVB-T, DVB-H, DVB-T2) - LAN and MAN wireless networks. - ADSL and VDSL - Comunicaciones over PLC and multimedia over coax (MoCA) - LTE The project must focus on those aspects of the standards that are related to the subjects covered by the lectures and should consider the following issues: - Historical aspects: previous standards solving similar problems. - Technical aspects: details about the employed modulation, bandwidth, channel coding, etc. - Applications of the standard. - Deployment degree at national and international levels. Competences: CG4, CG9, CE71, B3.	30

Other comments on the Evaluation

In those cases in where the student decides not to carry out the continuous evaluation tasks, the final score will be solely

based on the exam with short questions of the subject. This applies as well to the second call.

Once the student turns in any of the deliverables, he/she will be considered to be following the continuous evaluation track. Any student that chooses the continuous evaluation track will get a final score, regardless of he/she takes the final exam.

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

Sources of information
Ye Li, G.L. Stuber, **Orthogonal Frequency Division Multiplexing for Wireless Communications**, Springer-Verlag,
J.R. Barry, E.A. Lee, D.G. Messerschmitt, **Digital Communication**, Kluwer,
M. Engels, Ed, **Wireless OFDM Systems. How to make them work?**, Springer-Verlag,
Antonio Artés, Fernando Pérez González, Carlos Mosquera et al., **Comunicaciones Digitales**, Pearson,

Recommendations

Subjects that it is recommended to have taken before
Principles of Digital Communications/V05G300V01613

IDENTIFYING DATA				
Fundamentals of Bioengineering				
Subject	Fundamentals of Bioengineering			
Code	V05G300V01915			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Hermida Domínguez, Ramón Carmelo			
Lecturers	Hermida Domínguez, Ramón Carmelo			
E-mail	rhermida@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course provides an introduction to several aspects of biomedical engineering, including basic concepts of human physiology, description of most common systems and biomedical signals, and a brief introduction to several electromedical systems. This course will be tough and evaluated in English. All the documentation for this course will be in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A81	(CE72/OP15) The knowledge of biomedical engineering elements and techniques and their application in solving therapy, monitoring and diagnostic problems.
B1	The ability for critical reading of scientific papers and docs.

Learning aims		
Expected results from this subject	Training and Learning Results	
Know the systemic structure of the human physiology.	A3 A81	B1
Identify biomedical signals and learn their utility in the clinical environment.	A3 A4 A9 A81	B1
Adapt the adquired knowledge to propose solutions for the design of systems for diagnosis, monitorization and therapy.	A3 A4 A9 A81	B1
Strengthen the capacity to follow a technical class in English.	A9	B1

Contents	
Topic	
1. Introduction to biomedical engineering.	Physiology and anatomy of the circulatory system. Measurements in the cardiovascular system. Nervous and endocrine systems. Introduction to chronobiology.
2. Biomedical signals and systems.	Linear least-square estimation. Model comparison and analysis of variance. Techniques for model construction. Introduction to rhythmometry.

3. Diagnosis, monitorization, and therapy.	Criteria for the diagnosis of vascular risk. Ambulatory blood pressure monitoring. Treatment of hypertension: Current approaches. Chronotherapy for cardiovascular risk reduction. Early identification and prevention of complications in pregnancy.
4. Electromedical systems.	Diagnosis by X rays. Nuclear medicine. Ultrasounds. Nuclear magnetic resonance. Biotelemetry. Telemedicine.

Planning			
	Class hours	Hours outside the classroom	Total hours
Tutored works	2	35	37
Presentations / exhibitions	7	9	16
Troubleshooting and / or exercises	10	15	25
Master Session	21	42	63
Short answer tests	2	7	9

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

Methodologies	
	Description
Tutored works	The student, in groups, prepares a document on an application of Biomedical Engineering.
Presentations / exhibitions	Exhibition by the students in front of the professor and the rest of students of the work realized in small groups.
Troubleshooting and / or exercises	Some topics will be complemented with problem resolution.
Master Session	Exposición por parte del profesor de los conceptos principales de cada tema. Trabajo personal posterior del estudiante preparando o repasando los conceptos vistos en el aula.

Personalized attention	
Methodologies	**Description**
Master Session	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Tutored works	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Troubleshooting and / or exercises	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.

Assessment		
	Description	Qualification
Tutored works	Composition, in small groups, of a monographic document related to one of the electromedical systems in bioengineering (nuclear medicine, ultrasounds, magnetic resonance, biotelemetry, telemedicine). In these works the skills A9, A81 and B1 will be evaluated.	30
Presentations / exhibitions	Exhibition by the students of the tutored work, and discussion of the findings with the professor and other students. In these presentations the skills A9, A81 and B1 will be evaluated.	10
Troubleshooting and / or exercises	Short questions on the problems solved in the practices in relation to the contents of the master sessions. In these short questions the skills A3, A4 and A81 will be evaluated.	30
Short answer tests	The final exam will consist on small questions and problems in relation to the master sessions, laboratory practices, and presentation of the tutored works. In this exam the skills A3, A4 and A81 will be evaluated.	30

Other comments on the Evaluation

Following the guidelines of the studies, two evaluation systems will be offered to the students inscribed on this course: continuous evaluation and evaluation at the end of the semester. Students should communicate their intention to renounce

to be graded through continuous evaluation before the third week of class.

The continuous evaluation will be based on the grades obtained in the tutored works and their exposition, the laboratory practices and the final test. The grades obtained throughout the continuous evaluation will only be valid for the current academic year.

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

The second chance of examination at the end of the academic year will have a similar structure to the final examination of those students who do not choose the continuous evaluation.

Sources of information

Smolensky MH, Siegel RA, Haus E, Hermida RC, Portaluppi F. Biological rhythm, drug delivery, and chronotherapeutics. In: Siepmann J, Siegel RA, Rathbone MJ, eds.Fundamentals and Applications of Controlled Release Drug Delivery (Chapter 13). Advances in Delivery Science and Technology (MJ Rathbone, ed.). New York: Springer. 2012:359-443. doi 10.1007/978-1-4614-0881-9_13.

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204

IDENTIFYING DATA				
Designing Applications with Microcontrollers				
Subject	Designing Applications with Microcontrollers			
Code	V05G300V01921			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Costas Pérez, Lucía			
Lecturers	Costas Pérez, Lucía Río Vázquez, Alfredo del			
E-mail	lcostas@uvigo.es			
Web	http://cursos.faitic.uvigo.es/tema1415/claroline/course/index.php			
General description	Design and development of microcontroller-based applications, including design methodologies to develop real time applications, peripheral components configuration and connectivity. The scope of these contents will be adapted to the academic level reached by the students.			

Competencies	
Code	
A67	(CE58/OP1) The ability to design hardware and software systems based on microcontrollers.
A68	(CE59/OP2) The ability to use software tools for microcontrollers simulation.

Learning aims	
Expected results from this subject	Training and Learning Results
Ability to know in deep the design methodologies of microcontroller-based electronic systems.	A67
Ability to configure peripheral components and to connect them to the microcontroller.	A67
Ability to know in deep the software design of the microcontroller-based electronic systems.	A67 A68
Ability to design microcontroller-based instrumentation systems and the connection between several microcontrollers.	A67 A68
Ability to know and to use design methodologies of microcontroller-based real time applications.	A67 A68

Contents	
Topic	
Introduction. Previous topics review.	Introduction. Previous topics review. PIC18F45K20. Internal Structure. Arithmetic and Logic Unit. Control Unit. Program memory. Data memory. Peripherals. Watch Dog Timer (WDT).
Instruction set. Addressing modes.	Introduction: Instruction Set. Transfer Instructions. Arithmetic Instructions. Logic Instructions. Jumps. Addressing Modes.
Input/Output.	Introduction. I/O Structure. Ports (A B C D E). Configuration Registers. Parallel Slave Port. Signal Coupling.
Timers.	Introduction. Timers/Counters: TMR0/TMR1/TMR2/TMR3.
Excepctions and interrupts.	Introduction. Excepctions. Interrupts. Interrupt Response. Registers.
Analog interface.	Introduction. ADC. ADC Operation. Analog Comparator Module.
Compare Mode.	Introduction. Capture Mode. Compare Mode. PWM. ECCP1: Enhanced Mode.
Power-Managed modes.	Introduction. Different Modes. Switching between modes.
MSSP: Master Synchronous Serial Port SPI. I2C	Introduction. Registers. SPI Mode. I2C Mode.

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practises	12	38	50
Master Session	12	33	45
Troubleshooting and / or exercises	5	15	20

Tutored works	7	22	29
Short answer tests	2	0	2
Short answer tests	2	0	2
Practical tests, real task execution and / or simulated.	2	0	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Laboratory practises	The students will perform simulations and electronic circuits.
Master Session	The lecturer will explain in the classroom the subject contens.
Troubleshooting and / or exercises	The lecturer will solve exercices related to the subject contebts.
Tutored works	The students have to develop a project. The lecturers will help and monitor them.

Personalized attention	
Methodologies	**Description**
Tutored works	The lecturers will be available to help students in order to deal with the contents of the subject, the laboratory practices as well as the monitored work. The students can go to the lecturer's desk (individually or in a group). The timetable will be available on the subject website at the beginning of the term.
Laboratory practises	The lecturers will be available to help students in order to deal with the contents of the subject, the laboratory practices as well as the monitored work. The students can go to the lecturer's desk (individually or in a group). The timetable will be available on the subject website at the beginning of the term.
Master Session	The lecturers will be available to help students in order to deal with the contents of the subject, the laboratory practices as well as the monitored work. The students can go to the lecturer's desk (individually or in a group). The timetable will be available on the subject website at the beginning of the term.
Troubleshooting and / or exercises	The lecturers will be available to help students in order to deal with the contents of the subject, the laboratory practices as well as the monitored work. The students can go to the lecturer's desk (individually or in a group). The timetable will be available on the subject website at the beginning of the term.

Assessment		
	Description	Qualification
Tutored works	The students will be asked to elaborate a report related to the project they have to carry out. The lecturer will also assess the student's work developed during the laboratory sessions. Competencies A67 and A68 are assessed.	20
Short answer tests	Exam to evaluate the knowledge acquired by the student after the first part of the subject. It is carried out in a classroom sesión. Competency A67 is assessed.	25
Short answer tests	Exam to evaluate the knowledge acquired by the student related to the second part of the subject. It is carried out in a classroom session. Competency A67 is assessed.	25
Practical tests, real task execution and / or simulated.	Laboratory exam. The student has to deal with some real and/or simulated tasks and answer several questions. Competencies A67 and A68 are assessed.	30

Other comments on the Evaluation

CONTINUOUS ASSESSMENT:

A continuous assessment learning scheme will be offered to the students:

- Two partial exams will be held related to the theory (A sessions).

- The laboratory work will be assessed by means of an exam (B sessions).

- The student has to elaborate a report describing the monitored project (C sessions).

The first partial exam will take place in the classroom after the first six sessions approximately. It will last ninety minutes. If the student passes this part, he/she is not required to retake it. In this case, after finishing the term, he/she has to take only the second partial exam. The date will be specified in the academic calendar.

In partial exams, a minimum score (5 out of 10) is required in order to get a pass.

The laboratory exam will take place at the laboratory during the last session.

In order to assess the monitored project, the lecturer will consider the quality of the final report, the work in the laboratory and the student□s behavior.

The final mark (FM) is calculated as the weighted average of the three individual marks. The formula will apply a weight of 50% to the theory mark (TM), a 30% to the laboratory mark (LM) and a 20 % to the project mark (PM):

FM = 0,5*TM + 0,3*LM + 0,2*PM

The minimum passing score required in order to get a pass in the subject is 5.

When a student takes the first partial exam, it is considered that he/she choose the continuous assessment scheme and he/she will be assessed in June.

FINAL EXAM:

Students who refuse the continuous assessment scheme will be assessed by means of a final exam to evaluate the theory. The exam will be the same for them as for the students who fail the first partial exam.

The assessment of the laboratory for these students will be carried out by means of a laboratory exam. The date will be fixed within the examination period. In this case, the final mark (FM) is calculated as the weighted average of the two individual marks. The formula will apply a weight of 50% to the theory mark (TM) and a 50% to the laboratory mark (LM):

FM = 0,5*TM + 0,5*LM

The minimum passing score required in order to get a pass in the subject is 5.

IMPORTANT REMARK:

Students who refuse the continuous assessment scheme have to contact the lecturer at least two weeks before the exam date. It is necessary to organize the laboratory exams.

FINAL EXAM (JULY):

The assessment policy in July follows the scheme described in the previous section (FINAL EXAM).

Sources of information

F. E. Valdés Pérez, R. Pallás Areni, **Microcontroladores. Fundamentos y Aplicaciones con PIC.**, Marcombo,
http://ww1.microchip.com/downloads/en/DeviceDoc/41303F.pdf, **PIC18FXXK20 Data Sheet**,
http://ww1.microchip.com/downloads/en/DeviceDoc/52116A.pdf, **PICkit□ 3 In-Circuit Debugger/Programmer User□s Guide**,
http://ww1.microchip.com/downloads/en/DeviceDoc/41370C.pdf, **PICkit□ 3 Debug Express PIC18F45K20 □ MPLAB® C Lessons**,

Recommendations

Subjects that it is recommended to have taken before

Programmable Electronic Circuits/V05G300V01502
Electronic Instrumentation and Sensors/V05G300V01621

IDENTIFYING DATA				
Optoelectronic Devices				
Subject	Optoelectronic Devices			
Code	V05G300V01922			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish English			
Department				
Coordinator	Moure Rodríguez, María José			
Lecturers	Cao Paz, Ana María Moure Rodríguez, María José			
E-mail	mjmoure@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject deals with the optoelectronic properties of semiconductors and their application in electronic devices for detection, emission, amplification and conversion of optical/electrical signals. Devices include light-emitting diodes, lasers diodes, photodiodes, phototransistors and solar cells. The contents of the course and the laboratory activities coverage the basic operating principles, design considerations, driving circuits and applications of optoelectronic devices. The subject will enable students to apply the physics of optoelectronic devices in optical sensors design and fiber optic communications. Emphasis will also be place on understanding the data sheets of optoelectronic components and their applications to different technologies. Finally integrated optoelectronics, display and image sensor technologies are introduced.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A69	(CE60/OP3) The ability to design circuits based on optoelectronics devices used in telecommunication systems.
A70	(CE61/OP4) The ability to acquire, condition and process the information obtained from optoelectronic sensors.
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Expected results from this subject		Training and Learning Results
The knowledge of the operating principles of the different optoelectronic devices. The ability to design basic control circuits for photoemitters. The ability to design basic control circuits for photodetection. The knowledge of the architecture and operating mode of displays. The knowledge of the architecture and characteristics of image sensors	A69	
The knowledge of the different optoelectronic sensors and their applications. The ability to acquire, condition and process the information obtained from optoelectronic sensors	A70	
The ability to select de optimal optoelectronic devices for each application. The ability to integrate optoelectronic devices and sensors in information processing systems	A1	
The ability to analyze the data sheets and to compare different optoelectronic devices or sensors. The ability to design optical systems following the standards applicable to communications, reliability or environmental protection	A6	
The ability to use computer-aided design tools for the design of electronic systems based on optoelectronic devices		B4

Contents	
Topic	
Unit 1: Introduction	Fundamentals and classification of optoelectronic devices. Radiometric and photometric units and their relationships.
Unit 2: Light Emitting Diodes	Principles of LED operation. Types of LEDs and properties. Parameters and characteristics. Driving circuits. Basic applications.

Unit 3: Optoelectronic Detectors	Light Dependent Resistors: principles of LDR operation, properties, parameters, driving circuits and applications. Photodiodes: principles of photoconductive detectors, types, parameters, driving circuits and applications. Phototransistor: principles of phototransistor operation, types, parameters, driving circuits and applications. Photodetector comparison.
Unit 4: Solar Cells	Photovoltaic detectors: principles and properties. Manufacture and performance of solar cells, parameters and characteristics. Applications.
Unit 5: Laser Diodes	Principles of Laser operation. Types of lasers. Laser diode operation. Driving circuits and applications.
Unit 6: Image Sensors	Principles of CCD and CMOS operation. Parameters and characteristics. Color detection. Applications.
Unit 7: Optical Sensors	Principles of optical sensing. Internal design, types, parameters and applications of: optocouplers, optical encoders, object sensors, code-bar readers, humidity sensors, color detection, distance sensors, anemometers, temperature sensors and biomedical sensors.
Unit 8: Display Technologies	Principles of Liquid Crytal Display operation. Principles of LED and Organic LED displays. Introduction to plasma, electroluminescence and digital light processor technologies.
Unit 9: Introduction to Fiber Optics	Fiber Optic fundamentals. Classification of fibers. Fiber optic emitters and detectors. Principles of fiber optic communications. Principles of fiber optic sensors.
Laboratory Practices	1. Basic optoelectronic circuits. LEDs and LDRs. Laboratory measurements. 2. Optical detectors. Circuits based on photodiodes. 3. Analog optical modulation. Optical detectors based on photodiodes and phototransistors. 4. Digital communications based on fiber optic. 5. Optoelectronic sensors for object sensing. 6. Optical circuits for color measurement. 7. Basic drive circuit for laser diodes.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	15	30	45
Case studies / analysis of situations	4	8	12
Projects	6	30	36
Presentations / exhibitions	1	3	4
Laboratory practises	14	9	23
Multiple choice tests	2	24	26
Reports / memories of practice	0	4	4

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

Methodologies

	Description
Master Session	The professor explains the theoretical contents of the course, encouraging critical discussion and the student involvement. Reading assignments for each session will be previously available via FaiTIC, and students are expected to come to the theoretical class having completed the assigned reading.
Case studies / analysis of situations	The study and analysis of actual technological solutions completes the theoretical presentations. This activity includes the study of different alternatives, commercial devices or systems, cost and power estimation, environmental impact and performance analysis.
Projects	This activity focuses on applying the techniques described in the lecture classes and the skills developed at laboratory to a mini-project implementation. These sessions are developed in a laboratory with skilled equipment. Students should obtain well founded solutions, choosing appropriate methods and devices. These projects are planned and tutored in small size groups.
Presentations / exhibitions	The project developed by the students must be oral presented by the authors.
Laboratory practises	During laboratory sessions the student learns the design, hardware implementation, verification and measurement of basic optoelectronics circuits. All the sessions are guided and supervised by the professor.

Personalized attention

Methodologies	Description

Master Session	Students have the opportunity to solve doubts in personalized attention sessions. The appointment with the corresponding professor should be required and agreed by e-mail, preferably in the timetable and place officially assigned. Besides, the group of students developing a project will attend periodic follow-up meetings
Laboratory practises	Students have the opportunity to solve doubts in personalized attention sessions. The appointment with the corresponding professor should be required and agreed by e-mail, preferably in the timetable and place officially assigned. Besides, the group of students developing a project will attend periodic follow-up meetings
Projects	Students have the opportunity to solve doubts in personalized attention sessions. The appointment with the corresponding professor should be required and agreed by e-mail, preferably in the timetable and place officially assigned. Besides, the group of students developing a project will attend periodic follow-up meetings

Assessment

	Description	Qualification
Projects	The students should present a tutored project which deserves the 40% of the final qualification. The progress of this job will be supervised from continuous assessment but the final work should be oral presented by the authors. This project will assess competencies A69, A70, A1, A6 and B4.	40
Multiple choice tests	A multiple choice test, performed preferably online via the FaiTic platform. This test covers all of the contents taught in the theoretical classes. The estimated date will be the 11th week, after the completion of the theoretical classes. This test will deserve the 30% of the final qualification. This test will assess competencies A69, A70 and A1.	30
Reports / memories of practice	The assistance to the laboratory practices is mandatory: at least the student should complete 6 of the 7 sessions. The implementation of the circuits described in the practice guidelines and the reports submitted at the end on each session will deserve the 30% of the final qualification. This reports will assess competencies A69, A70, A1 and A6.	30

Other comments on the Evaluation

1. Continuous assessment

The course can be passed with full marks from continuous assessment, with no need to sit the final exam. Students who assist to more than 2 laboratory sessions may not be listed as "Not Present".

The weighting and content of each continuous assessment part are as follows:

1.1 Test (NTest):

- It covers all of the contents taught in the theoretical classes.
- The estimated date will be the 11th week of the course.
- The student pass this part if he/she gets a mark greater than or equal to 5.

1.2 Laboratory practices (NPrac):

- The student should complete 6 of the 7 sessions in order to pass this part.
- The student should correctly implement the circuits described in the guidelines of the practice and submit a report corresponding to each laboratory session. The qualification of each practice depends on these achievements.
- It can be developed individually or by groups of 2 students.
- The student will pass this part if he/she gets an average greater than or equal to 5. The weighting of each practice is the same to obtain the NPrac mark.

1.3 Project (NPro):

- It can be developed individually or by groups of 2 students.
- It should be oral presented by the authors.
- The student will pass this part if he/she gets a mark greater than or equal to 5.

1.4 Final qualification of continuous assessment (Final_ca)

The final qualification (Final_ca) of continuous assessment is obtained as follows:

Final_ca: = (NTest*0.3 + NPrac*0.3 + NPro*0.4) if NTest is greater than or equal to 5 and NPrac is greater than or equal to 5

and NPro is greater than or equal to 5;

Final_ca = min [(NTest*0.3 + NPrac*0.3 + NPro*0.4), 4] in other case;

The student who fails one or more of the parts of continuous assessment has another opportunity to pass any part in the Final exam:

- He/she can repeat the test and this mark replaces the previous one (NTest).
- He/she student can improve his/her Laboratory mark (NPrac) by means of an exam. This exam consists of several problems related to the contents of laboratory practices.
- He/shet can complete and present his/her project before the date of the final exam.

2. Final exam and qualification

There is a final exam at the end of each quadmester.

- In the final exam, all content is evaluated. It usually consists of several questions and problems and lasts about 2.5 hours. The pass mark for this exam is 5 out of 10 and deserves 60% of the final qualification (NEx).
- In order to pass the subject the students should present a project with the same objectives and complexity of the project developed in continuous assessment. This project deserves 40% of the final qualification (NPro) and should be presented before the date of the final exam.

The final qualification (Final_ex) is obtained as follows:

Final_ex = (NEx*0.6 + NPro*0.4) if NEx is greater than or equal to 5 and NPro is greater than or equal to 5;

Final_ex = min [(NEx*0.6 + NPro*0.4) , 4] in other case;

3. Other comments

- The grades obtained from the continuous assessment and final exams are only valid for the current academic year.
- The use of books, notes or electronic devices such as phones or computers is not permitted in any test or exam. Mobile phones must be turned off and out of reach of the student.

Sources of information
S.O. Kasap, **Optoelectronics and Photonics**, Pearson,
Vaughn D. Martin, **Optoelectronics**, PROMPT Publications,
John Wilson, John Hawkes, **Optoelectronics. An introduction**, Prentice-Hall,
Francis T.S. Yu, Xiangyang Yang, **Introduction to optical Engineering**, Cambribge University Press,
Endel Uiga, **Optoelectronics**, Prentice-Hall,
J.E. Midwinter, Y.L. Guo, **Optoelectronics and Lightwave Technology**, Wiley,
Gerald C. Holst, **CCD Arrays, Cameras and Displays**, Optical Engineering Press,
Josephn J. Carr, **Electro-Optics. Electronic Circuit Guidebook**, Prompt Publications,
Ed. W. Göpel, J. Hesse, J.N. Zemel, **Sensors. A comprehensive Survey**,
A. Goetzberger, J. Knobloch, B. Voss, **Crystalline Silicon Solar Cells**, Wiley,
J. Watson, **Optoelectrónica**, Limusa,
S. Desmond Smith, **Optoelectronic Devices**, Prentice Hall,
Albert J.P. Theuwissen, **Solid-state Imaging with Charge-Coupled Devices**, Kluwer,
R.C. Lasky, U.L. Österberg, D.P. Stigliani, **Optoelectronics for Data Communication**,
David Wood, **Optoelectronic Semiconductors Devices**, Prentice Hall,
David R. Goff, **Fiber Optic Reference Guide. A Practical Guide to the Technology**, Focal Press,
Eric Udd, **Fiber Optic Sensors. An Introduction for Engineers and Scientists**, John Wiley&Sons,
R.M. Marston, **Circuitos de optoelectrónica**, CEAC,
Kasap, Ruda, Boucher, **Cambridge Illustrated Handbook of Optoelectronics and Photonics**, Cambridge University Press,

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

- Notes of the course which cover the contents of theoretical sessions.
- Documentation for laboratory which includes the guidelines of the practices and the data sheets of optoelectronic devices or sensors.

The language used for this support material is the English and this material is available via the FaiTIC platform (http://faitic.uvigo.es)

Recommendations

Subjects that it is recommended to have taken before

Physics: Fundamentals of Electronics/V05G300V01305
Electronic Technology/V05G300V01401

IDENTIFYING DATA				
Design and Synthesis of Digital Systems				
Subject	Design and Synthesis of Digital Systems			
Code	V05G300V01923			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Álvarez Ruíz de Ojeda, Luís Jacobo			
Lecturers	Álvarez Ruíz de Ojeda, Luís Jacobo			
E-mail	jalvarez@uvigo.es			
Web	http://www.faitic.uvigo.es			
General description	This course will be taught and assessed in English. The course documentation is in English. The main learning goals of this course are: □ Introduction to VHDL for synthesis. □ Design and synthesis of synchronous digital systems. □ Development, synthesis and verification of programmable digital circuits, using VHDL for its application in the field of the Telecommunications.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A71	(CE62/OP5) The ability to design and synthesize complex digital systems by hardware description language.
B4	The ability to use software tools that support problem solving in engineering

Learning aims		
Expected results from this subject	Training and Learning Results	
To be able to distinguish the differences between the use of Hardware Description Languages for simulation and for synthesis.	A71	
To deepen the understanding of synchronous digital design techniques using VHDL for synthesis.	A71	
To acquire skills at designing complex synchronous digital systems using VHDL.	A1 A9	
To use the hardware and software tools available for the design of digital systems by means of VHDL and for their implementation on programmable digital circuits.	A1 A9	B4

Contents	
Topic	
LESSON 1 THEORY (2 h.). INTRODUCTION TO COMPLEX DIGITAL SYSTEM DESIGN AND SYNTHESIS.	1.1.- Introduction. 1.2.- Types of digital integrated circuits. Microprocessors. DSPs. ASICs. FPGAs. 1.2.1.- Comparative analysis. 1.3.- Field Programmable Gate Arrays (FPGAs). 1.4.- Complex application specific digital system design by means of FPGAs. 1.4.1.- Sequential processing systems. Operational unit. Control Unit. 1.4.2.- Continuous processing systems.

LESSON 2 THEORY (2 h.). ADVANCED DIGITAL SYSTEM DESIGN.	2.1.- Introduction. 2.2.- General rules for the design of digital systems. 2.2.1.- Hierarchical design. 2.2.2.- Technology independent design. 2.2.3.- Design timing. 2.2.4.- Design for reuse. 2.2.5.- Design for verificability. 2.2.6.- Design documentation. 2.3.- Intellectual Property (IP) cores.
LESSON 3 THEORY (2 h.). INTRODUCTION TO SYNTHESIS OF DIGITAL SYSTEMS DESCRIBED IN VHDL.	3.1.- Introduction. 3.2.- Definition of synthesis. Basic concepts on synthesis. 3.3.- Conversion of a VHDL description to real hardware. Differences between the original VHDL model and the result of the synthesis / implementation. Timing simulation model. 3.4.- Recommendations for the description in VHDL synthesisable of distinct types of circuits. 3.5.- Examples of synthesisable models of commonly used circuits.
LESSON 4 THEORY (6 h.). VHDL FOR SYNTHESIS. RESTRICTIONS.	4.1.- Introduction. 4.2.- IEEE standard for synthesis. 4.3.- Time sentences (□After□, □Wait□). 4.4.- Loops (□Loop□). Loops □generate□. 4.5.- □Real□ data type. Type conversion. 4.6.- Complex arithmetical operations. Division (□/□). 4.7.- Complex mathematical functions. (□Without□, □Cos□, □Log□). 4.8.- Two-dimensional matrices. (□Array□). 4.9.- Exercises of non- synthesisable models and equivalent synthesisable circuits.
LESSON 5 THEORY (2 h.). ARITHMETICAL CIRCUITS DESIGN IN VHDL.	5.1.- Introduction. 5.2.- Representation of binary numbers with decimal part. Fixed point. Floating point. 5.3.- Design of fixed point applications. 5.4.- Design of floating point applications. 5.5.- Implementation of arithmetical circuits in FPGAs.
LESSON 6 THEORY (4 h.). VHDL ADVANCED SENTENCES.	6.1.- Introduction. 6.2.- Libraries and packages. 6.3.- Access to files. 6.3.1.- Memory initialisation. 6.3.2.- Testbench stimuli. 6.4.- □Generic□ data type. Parameterisable circuits. 6.5.- Subprograms. 6.5.1.- Functions. 6.5.2.- Procedures. 6.6.- Conditional compilation.
LESSON 7 THEORY (1 h.). VERIFICATION OF COMPLEX DIGITAL SYSTEMS.	7.1.- Introduction. 7.2.- Verification through simulation. 7.2.1.- Signals. Delay models. Definition of □driver□. 7.2.2.- Design analysis and simulation. Simulation cycle. Delta delay. 7.2.3.- Recommendations for VHDL simulation. Examples. Testbench design. 7.2.4.- Differences between functional and timing simulation. 7.3.- Verification through timing analysis. 7.4.- Verification through test in a development board. 7.5.- Exercises.
LESSON 1 LABORATORY (4 h. TYPE B). PRACTICAL TUTORIAL OF DIGITAL SYSTEM DESIGN AND SYNTHESIS.	1.1.- Introduction. 1.2.- Basic digital system design in synthesisable VHDL. 1.3.- Testbench design in VHDL. 1.4.- Implementation of digital systems in FPGAs. 1.5.- Testing digital systems.
LESSON 2 LABORATORY (2 h. TYPE B). DIGITAL SYSTEM DEBUGGING. VIRTUAL LOGICAL ANALYSERS.	2.1.- Introduction. 2.2.- Xilinx virtual logical analyser. □Chipscope core□. 2.3.- Parameters of the Xilinx virtual logical analyser. 2.4.- Implementation of the Xilinx virtual logical analyser. 2.5.- Analysis of a digital system by means of the Xilinx virtual logical analyser.

LESSON 3 LABORATORY. (15 h. = 8 H. TYPE B + 7 h. TYPE C). DESIGN OF A MEDIUM-COMPLEXITY DIGITAL SYSTEM IN SYNTHESISABLE VHDL.	3.1.- Introduction. Task explanation. (2 h. TYPE B) 3.2.- Project based learning. Discussions on the most suitable approach. (6 h. TYPE C) 3.2.- Design of a medium-complexity digital system in synthesisable VHDL. (6 h. TYPE B) 3.3.- Oral presentation. (1 h. TYPE C)

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	4	8	12
Integrated methodologies	15	31.5	46.5
Laboratory practises	6	7.5	13.5
Integrated methodologies	14	51	65
Presentations / exhibitions	1	8	9
Introductory activities	2	2	4

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

Methodologies

	Description
Master Session	Conventional lectures. Through this methodology the outcome CE62/OP5 is developed.
Integrated methodologies	Problem based learning (PBL): Problem solving. Design of non- synthesisable models and synthesisable circuits in VHDL. To solve them, the student has to previously develop certain outcomes. Through this methodology the outcomes CG9, CG13 and CE62/OP5 are developed.
Laboratory practises	VHDL design of digital circuits and circuit implementation in FPGAs. Through this methodology the outcomes CG9, CG13 and CE62/OP5 are developed.
Integrated methodologies	Project based learning. The students must design a digital system in VHDL to solve a problem. In order to that, the students must plan, design and implement the necessary steps. The project development will be implemented in laboratory hours (type B). Besides, in type C hours there will be discussions and one-to-one interaction with the teacher. Activities to develop in the groups C: Analysis and debate about the project approach and different alternatives. Analysis and follow-up of the proposed solution. Design implementation. Analysis and debate of results. Oral presentations of the project results. Through this methodology the outcomes CG1, CG9, CG13 and CE62/OP5 are developed.
Presentations / exhibitions	Presentations/exhibitions: Exhibition of the results of the project developed. Through this methodology the outcomes CG1 and CG9 are developed.
Introductory activities	Introduction to the subject key topics both theoretical and practical. Through this methodology the outcomes CG13 and CE62/OP5 are developed.

Personalized attention

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

Assessment

	Description	Qualification

Integrated methodologies	Resolution of theoretical problems and exercises. The majority of them will be focused on the design of non-synthesisable models and synthesisable circuits in VHDL. The problems will be based on the theoretical topcis. It will be necessary to teach to the professor the operation of each one of the models and circuits. The correct application of the theoretical concepts to the problems will be assessed, based on the published criteria. It will be necessary to deliver the documentation requested by the professor for each one of the exercises. Through this methodology the outcomes CG9, CG13 and CE62/OP5 are assessed.	50
Integrated methodologies	Laboratory Project. Design of a medium-complexity synthesisable digital system in VHDL. It will be necessary to deliver the design source files. The assessment will be based on the operation of the digital system and the correct application of the theoretical concepts, according to the published criteria. Through this methodology the outcomes CG1, CG9, CG13 and CE62/OP5 are assessed.	40
Presentations / exhibitions	It will be necessary to do an oral presentation of 15 minutes as a maximum about the work, according to the index supplied by the teacher. Through this methodology the outcomes CG1 and CG9 are assessed.	10

Other comments on the Evaluation

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

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

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

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

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

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

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

CONTINUOUS ASSESSMENT:
The students are considered to have chosen the continuous assessment when they have done 2 laboratory practices and/or 2 reports of theoretical exercises.
The students that have chosen continuous assessment, but do not pass the course, will have to do the final assessment at the end of the year.
The students that pass the course by means of continuous assessment will not be allowed to repeat any task in the final assessment in order to improve the mark.
The different tasks should be delivered in the date specified by the teacher, otherwise they will not be assessed for the continuous assessment.
The students will develop the theoretical exercises, the laboratory practices and the laboratory projects in groups of two students during the continuous assessment.
The students who want to be assessed in the continuous assessment can only miss two sessions as a maximum.. If they miss more than 2 sessions, it will be compulsory to do an additional individual task or an examination.

FINAL ASSESSMENT:
The students that opt for the final assessment will have to do all the theoretical and practical tasks and the project individually.
The tasks for the final assessment have to be delivered before the official date of the examination set by the faculty.

In case the students pass the theoretical exercises (TE) and the Laboratory Project (LP), that is, the mark of each part >= 5, the final mark (FM) will be the weighted sum of the marks of each part of the subject:
FM = 0'50 * TE + 0'40 * LP + 0'10 * OP

In case the students do not pass any of the two main parts of the subject, the theoretical exercises (TE) or the Laboratory Project (LP), that is, the mark of any task < 5, the final mark (FM) will be:
FM = Minimum [4'5; (FM = 0'50 * TE + 0'40 * LP + 0'10 * OP)]

Where:
TE = Global mark of the theoretical exercises and problems.
LP = Laboratory Project.
OP = Oral presentation.

ASSESSMENT CRITERIA.

1) Theoretical exercises and problems.
Each one of the theoretical exercises and problems proposed in the theoretical sessions will be marked from 0 to 10. Its influence in the total mark of the subject will be weighted in function of the number of exercises assigned.
There will be eight reports of exercises.
The majority of the exercises will consist in the design of non-synthesisable models and synthesisable circuits in VHDL.

The assessment criteria are the following:
1. Correct design (CORR).
a. Behavioural model adequate to the project specifications.
b. Synchronous design.
c. Reusable design.

2. Functionality (FUNC). For each one of the exercises, the behavioural circuit model has to work perfectly to obtain the maximum mark. If the circuit is synthesisable, the temporary simulation of the resultant circuit also has to work perfectly.
a. Behavioural simulation.
b. Synthesis.
c. Timing simulation.

3. Project documentation (DOC).
a. Design source files.
b.Enough comments in the VHDL files to explain the sentences used.
It will be necessary to deliver the required source files.
The total mark will be the sum of the marks of each one of the exercise reports divided by the number of reports:
TE = (Report 1 + □ + Report 8) / 8

2) Laboratory Project.
This project consists in the design of a synthesisable digital system of medium complexity in VHDL.

The assessment criteria are the following:

1. Correct design (CORR).
a. System entirely synthesisable.
b. Suitable hierarchy arrangement.
c. Design totally synchronous.
d. Technology independent design.
e. Reusable design.

2. Analysis of the design and the implementation in FPGAs (ANA).
a. Analysis of the FPGA logical resources used and their justification.
b. Analysis of the internal system delays.
c. Analysis of the chosen implementation options.
d. Optimal utilisation of the FPGA logical resources.
e. Achievement of an optimal processing speed.
f. □Chipscope□ Verification.

3. Functionality (FUNC). For each circuit, the behavioral simulation, the timing simulation and the board test should work perfectly to obtain the maximum mark.
a. Individual circuits.
b. Complete system.

4. Documentation (DOC).
a. Design source files.
b. Enough comments in the VHDL files to explain the sentences used.
For the Laboratory Project (LP), it will be necessary to do an oral presentation.

3) Oral Presentation.
The assessment criteria are the following:
1. Clear structure and presentation order.
2. Clear explanations.
3. Enough explanations to understand the project.
4. Suitable figures.
5. Relevant data.

Sources of information

BASIC BOOKS OF THE SUBJECT: [CHU 06] CHU, PONG P., "RTL Hardware Design Using VHDL: Coding for Efficiency, Portability, and Scalability", John Wiley & Sons Inc, 2006. [ÁLVAREZ 13] ÁLVAREZ RUIZ DE OJEDA, L.J., Digital Design with FPGAs, Vision books, Madrid, 2013. COMPLEMENTARY BIBLIOGRAPHY OF THE SUBJECT: Course documentation, available on the following website "http://www.faitic.uvigo.es". DESIGN OF DIGITAL SYSTEMS: [ÁLVAREZ 04] ÁLVAREZ RUIZ DE OJEDA, Digital Design with Programmable Logic, Publisher Tórculo, Santiago de Compostela, 2004. [ÁLVAREZ 02] ÁLVAREZ RUIZ DE OJEDA, L. Jacobo, COMMANDED PÉREZ, And., VALDÉS CRAG, M.D., Programmable Logical Devices and his applications, Publisher Thomson-Paraninfo, 2002. [ÁLVAREZ 01] ÁLVAREZ RUIZ DE OJEDA, Design of applications by means of PLDs and FPGAs, Publisher Tórculo, Santiago de Compostela, 2001. [ARTIGAS 02] ARTIGAS MAESTRE, J.I., BARRAGÁN PÉREZ, L.To., ORRITE URUÑUELA, C., URRIZA PARROQUÉ, I., Digital Electronics. Applications and problems with VHDL, Prentice-Hall, Madrid, 2002. [BOLTON 90] BOLTON, M., "Digital systems design with programmable logic", Addison-Wesley, 1990. [LALA 90] LALA, Parag K., "Digital system design using programmable logic devices", Prentice Hall, New Jersey, 1990. [PELLERIN 91] PELLERIN, D., HOLLEY, M., "Practical design using programmable logic", Prentice Hall, London, 1991. [SCARPINO 98] SCARPINO, F., "VHDL and AHDL digital system implementation", Prentice Hall, London, 1998. FPGAs: [CHAN 94] CHAN, Pak K., MOURAD, Samiha, "Digital design using Field Programmable Gate Arrays", Prentice Hall, New Jersey, 1994. [JENKINS 94] JENKINS, Jesse H., "Designing with FPGAs and CPLDs", Prentice Hall, New Jersey, 1994. [OLDFIELD 95] OLDFIELD, J.V., DORF, R.C., "Field Programmable Gate Arrays: Reconfigurable logic for rapid prototyping and Implementation of Digital Systems", John Wiley & Sons, 1995. [SHARMA 98] SHARMA, To. K., "Programmable logic handbook", McGraw Hill, Fairfield, 1998. [XILINX] Direction of Internet, http://www.xilinx.com, Xilinx. VHDL: [ASHENDEN 08] ASHENDEN, PETER J., "The Designer's Guide to VHDL", 3rd edition, Morgan Kaufmann Publishers, 2008. [ASHENDEN 98] ASHENDEN, PETER J., "The VHDL Cookbook", University of Adelaide,1998. [BHASKER 98] BHASKER, "To VHDL Synthesis First", 2nd edition, Star Galaxy Pub, 1998. [CHU 08] CHU, PONG P., "FPGA Prototyping by VHDL Examples", John Wiley & Sons Inc, 2008. [IEEE 01] Standard IEEE VHDL Language Reference Manual (IEEE Srd 1076-2001), Institute of Electrical and Electronics Engineers, 2001. [PÉREZ 02] PÉREZ LÓPEZ, S.A., SOTO CAMPOS, E., FERNÁNDEZ GÓMEZ, S., Design of digital systems with VHDL, Thomson-Paraninfo, Madrid, 2002. [PERRY 02] PERRY, DOUGLAS L., "VHDL: Programming by example", 4th edition, McGraw-Hill, 2002.

Recommendations

Subjects that it is recommended to have taken before

Digital Electronics/V05G300V01402
Programmable Electronic Circuits/V05G300V01502

Other comments

The students will have previously followed the subjects Digital Electronics and Programmable Electronic Circuits. They give the necessary knowledge to understand the topics of this course.
It is not necessary to have passed them.
The students of the specialisation "Electronic Systems", should have previously followed the subject Electronic Systems of Processed of Signal, but is not indispensable.

IDENTIFYING DATA				
Advanced Electronic Sensors				
Subject	Advanced Electronic Sensors			
Code	V05G300V01924			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Mariño Espiñeira, Perfecto			
Lecturers	Costas Pérez, Lucía Mariño Espiñeira, Perfecto Pastoriza Santos, Vicente			
E-mail	pmarino@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main purpose of this subject is to train students in order that they become well-qualified to understand the physical principles and current techniques employed in the most recent electronic sensors technology. Course outline: + Optical fiber sensors. + Laser sensors. + Microelectromechanical sensors (MEMS). + Image sensors. + Integrated sensors. + Intelligent sensors. + Acoustic wave sensors. + Biosensores. The main goal of the laboratory sessions (practical work) is to enable the students to acquire sufficient understanding and knowledge to: Analyze the parameters and main features of the sensors. Know the applications of each group of sensors. Manage specific software tools developed to design (virtual) instruments that allow store, display and analyze recorded data. The documentation of the course will be in English. It will be taught and assessed in Spanish.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A72	(CE63/OP6) The ability to design and use optoelectronic sensors, micromechanical sensors (MEMS) and acoustic wave sensors.

Learning aims	
Expected results from this subject	Training and Learning Results
Knowledge of the modes of operation and applications of fiber optic sensors.	A3 A72
Knowledge of the modes of operation and applications of microelectromechanical sensors.	A3 A72
Knowledge of the modes of operation and applications of acoustic wave sensors.	A3 A72
Ability to select and work with next generation electronic sensors.	A4 A72
Ability to work in groups and to develop communications skills in order to elaborate and present technical reports related to the subject.	A9 A72

Contents	
Topic	
Unit 1: Fiber Optic Sensors I.	Introduction. Classification. FOS types. Basic structure. Extrinsic, intrinsic and evanescent wave sensors. Applications. Interferometric FOS. Applications.
Unit 2: Fiber Optic Sensors II.	Multisensory FOS systems. Distributed and multiplexed FOS. OTDR reflectometry. OFDR reflectrometry. Fiber Bragg grating. Applications. Intelligent systems. Laser vibrometry and interferometry. Applications.
Unit 3: Integrated Optical Sensors.	Introduction. Classification of optical integrated waveguides. Materials. Devices. Interferometry in IO. Active integrated optic devices; detectors and sources. Sensors. Biosensors. OF-IO Coupling. Applications.
Unit 4: Microelectromechanical Sensors (MEMS).	Microelectronic technologies. MEMS fabrication processes. MEMS materials. MEMS Sensors. Micromachined free space integrated micro optics. CMOS Microsensors. Applications.
Unit 5: Image Sensors and Displays I.	Introduction. Display specifications. Display classification. Illumination technologies. Image capture technology: CCD and CMOS. Night vision technology: PMTs y IR cameras.
Unit 6: Image Sensors and Displays II.	Introduction to pyrometry. Operating principle General features. Disappearing filament pyrometer. Conditioning. Bolometric detector. Quantum detectors. Radiometers. IR cameras. Applications.
Unit 7: Acoustic Wave Sensors (AWS).	Classification. Materials features. Comparative study of AWS sensors. Applications. FPW microsensor. FPW integrated systems. Coatings for AWS. Pattern recognition in electronic nose.
Unit 8: Intelligent Sensors.	Definition. Classification. Architectures. Multisensorial systems. International standars. Applications.
Unit 9: Virtual Reality Sensors.	Introduction. Tactile response systems. RV features. Architectures. Neuronal processes. Mechanoreceptors. Projective field. Visual tactile synesthesia. Visual immersion systems. UAV (Unmanned Aerial Vehicle) systems.
Unit 10: Sensor Technology in Particle Physics.	Introduction. Specific instrumentation standars: CAMAC, FASTBUS and SCI. The standard model. Features of the standard model. Beta decay. Evolution of particle accelerators. Particle Detectors in accelerators. Nuclear medicine applications.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	2	3
Master Session	17	17	34
Tutored works	3	26	29
Laboratory practises	12	30	42
Integrated methodologies	7	25	32
Practical tests, real task execution and / or simulated.	2	8	10
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	Subject presentation. Presentation of laboratory sessions, instrumentation and software resources to be used. In these sesions, the skills A3, A4, A72, and A9 will be worked.
Master Session	The lecturer will explain in the classroom the main contents of the subject. The students have to manage the proposed bibliography to carry out a self-study process in a way that leads to acquire the knowledge and the skills related to the subject. The lecturer will answer the students questions in the classroom or at the office. In these sesions, the skills A3, A4, A72, and A9 will be worked.
Tutored works	The students have to manage basic concepts to search and select information in order to get a deeper understanding in some specific fields related to the subject. The lecturer will propose in the classroom the topic of this individual task and monitor the student s work in personalized attention sessions. In these sesions, the skills A3, A4, A72, and A9 will be worked.
Laboratory practises	Activities designed to apply the main concepts and definitions of the subject. The student will be asked to acquire the basic skills to manage the laboratory instrumentation, software tools and components in order to construct and test electronic circuits. The student has to develop and demonstrate autonomous learning and collaborative skills. He/she is supposed to be able to manage bibliography and recently acquired knowledge. Possible questions can be answered in the laboratory sessions or at the lecturer s office. In these sesions, the skills A3, A4, A72, and A9 will be worked.

Integrated methodologies	Project-based learning: students have to develop a group activity that goes on over a period of time and address a specific problem. They have to design, schedule and carry out a set of tasks to achieve a solution. The assessment will be based on the quality of the proposed solution, the depth of content understanding demonstrated and the final presentation. The sessions will be performed in the laboratory. In these sesions, the skills A3, A4, A72, and A9 will be worked.

Personalized attention

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

Assessment

	Description	Qualification

Tutored works	The lecturers will consider the results, the presentation, the analysis and the quality of the final report. Marks will be assigned in a 10 points scale. In these works, the skills A3, A4, A72, and A9 will be evaluated.	50
Laboratory practises	The lecturers will check the level of compliance of the students with the goals related to the laboratory skills. They will consider the work of the students carried out before the laboratory session to prepare the proposed tasks and the work in the laboratory. Marks for each session (LSM: Laboratory Session Mark) will be assigned in a 10 points scale. In these practices, the skills A3, A4, A72, and A9 will be assessed.	30
Practical tests, real task execution and / or simulated.	The lecturers will consider the results and the quality of their analysis. Marks will be (GPM: Group Project Mark) assigned in a 10 points scale. In these tasks, the skills A3, A4, A72, and A9 will be evaluated.	20

Other comments 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 go to the lectures regularly (less than 10% unjustified absence) or miss at most one laboratory session, they will be assessed by continuous assessment.

The subject comprises three different parts: theory (50 %), laboratory (30%) and group project (20%). Once a task has been assessed, the students cannot do/repeat the task at a later date. The marks are valid only for the current academic course.

1.a Theory

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

The final mark of this part will be:

FMT (Final Mark of Theory) = TWM (Tutored Work Mark)

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

1.b Laboratory

Six laboratory sessions are scheduled. Each session lasts approximately 120 minutes and the students will work in pairs. This part also will be assessed by continuous assessment.

Each session will be only evaluated according to the developed work at the schedule date. The lecturers will consider the work of the students carried out before the laboratory session to prepare the proposed tasks, the work in the laboratory to deal with them as well as the student□s behavior. Marks for each session will be (LSM: Laboratory Session Mark) assigned in a 10 points scale. A mark of 0 will be obtained for missing sessions.

The final mark of this part is calculated as the arithmetic mean of the six individual marks:

FML (Final Mark of Laboratory) = Sum(LSMi)/6; i = 1, 2, □, 6

Attendance at the laboratory classes is compulsory. If the student miss more than one laboratory session without a valid documented reason (medical, bereavement or other) he/she will be assigned a grade of 0 for that laboratory class.

1.c Group project

In the first session lecturers will present the objectives and the schedule of the project. They also assign a specific project to each group. After that, the most important part of the workload will be developed in the laboratory. Two hours of B laboratory sessions and six hours of C laboratory sessions.

In order to assess the project, the lecturer will consider the results and the quality of their analysis. Marks will be (GPM: Group Project Mark) assigned in a 10 points scale.

The students are only allowed to miss one project session without a valid documented reason.

1.d Final mark of the subject

In order to past the subject, students will be required:

+ to obtain FMT >=5, and

+ no more than one missed laboratory session, and

+ no more than one missed group project session.

The weighted *points* from all assessed parts are added together to calculate the final *mark (FM)*. The following weightings will be applied: 50% theory, 30% laboratory and 20% group project.

FM = 0,50·FMT + 0,30·FML + 0,20·GPM

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

However, when:

+ FMT < 5, or

+ more than one missed laboratory session, or

+ or more than one missed group project session,

the final mark (FM) will be the minimum value among them.

FM = min{ FMT, FML, GPM }

2. Final Exam

If a student prefers a different educational policy he/she can take an exam on a scheduled *date*. The date will be specified in the academic calendar. This exam will comprise four parts (similar to the activities completed by the continuously assessed students):

+ an **exam** if they didn't go to the lectures regularly (more than 10% unjustified absence).

+ a **task monitored by a tutor**, (tutored work)

+ a **practical exam carried out in the laboratory** if they have missed more than one laboratory session.

+ a previously assigned **project**.

The tutored work and the project will be assigned following the procedure described in advance by the lecturer. The student will prepare a writing report to be handed in just before the exam.

2.a Theory

2.a.1 Theory Exam

In order to pass the theory, the student cannot miss more than 10 % of the lectures without a valid documented reason (medical, bereavement or other). Otherwise, he/she will have to attend to an exam (with short or long answer questions). Marks will be (EM: Exam Mark) assigned in a 10 points scale.

2.a.2 Tutored Work

To evaluate the tutored work the lecturer will consider the results, the presentation, the analysis and the quality of the final report. Marks will be (TWM: Tutored Work Mark) assigned in a 10 points scale.

2.a.3 Theory Final Mark

The final mark of theory (FMT) will be:

FMT = TWM (Tutored Work Mark) if the student don't miss more than 10 % of the lectures**.**

FMT = EM (Exam Mark) if the student miss more than 10 % of the lectures and MTM >= 5.

FMT = 0 in any other case.

2.b Laboratory

In order to pass the laboratory part, the student cannot miss more than one laboratory session lectures without a valid

documented reason (medical, bereavement or other**). Otherwise,**he/she will have to attend to a practical exam carried out in the laboratory. In this exam the student will be asked to deal with some of the electronic circuits developed in the laboratory sessions as well as some short answer questions related to these sessions. Marks will be (LEM: Laboratory Exam Mark) assigned in a 10 points scale.

The final mark of laboratory (FML) will be:

FML = the arithmetic mean of the laboratory session marks (LSM) when the student didn't miss more than one laboratory session, that is:

FML = Sum(LSMi)/6 i = 1, 2, , 6

FML = LEM (Laboratory Exam Mark) when the student missed more than one laboratory session.

LFM = 0 in any other case.

2.c Project

In order to assess the project, the lecturer will consider the results and the quality of their analysis. Marks will be (GPM: Group Project Mark) assigned in a 10 points scale.

2.d Final mark

In order to pass the subject, it is mandatory:

+ FMT >= 5, and

+ no more than one missed laboratory session or FML >= 5, and

+ no more than one missed group project session or GPM >= 5.

The final mark will be the weighted average of the marks obtained by the student in the different parts. The final mark (FM) will apply a weight of 50% to the final theory mark (FMT), a 30% to the laboratory final mark (FML) and a 20 % to the group project mark (GPM).

FM = 0,50·FMT + 0,30·FML + 0,20·GPM

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

However, when:

+ FMT < 5, or

+ FML < 5 and the student missed more than one laboratory session, or

+ GPM < 5 and the student missed more than one group project session,

the final mark will be the minimum value among them.

FM = min{ FMT, FML, GPM }

3. Second opportunity to pass the subject.

The assessment policy in this call will follow the scheme described in the previous section. Dates will be specified in the academic calendar. The lecturer will assign the tutored work and the project to the student. The student has to contact to the lecturer according to an established procedure. The procedure will be published in advance.

Marks obtained in the previous continuous assessment or final exam are kept if the student have got a pass in some parts. Moreover, students cannot take an exam, develop a project or a tutored work task if they have got a pass previously.

The final mark will be the weighted average of the marks obtained by the student as it has described in section 2.

Sources of information
Pérez García, M.A., Álvarez Antón, J.C., Campo Rodríguez, J.C., Ferrero Martín F.C., y Grillo Ortega, **Instrumentación Electrónica**, 2ª,
Pallás Areny, R., **Sensores y Acondicionadores de Señal**, 4ª,
Norton, H.N., **Sensores y analizadores**,
Fraile Mora, J., García Gutiérrez, P., y Fraile Ardanuy, J., **Instrumentación aplicada a la ingeniería**, 3ª,

Martín Fernández, A., **Instrumentación electrónica. Transductores y acondicionadores de señal y sistemas de adquisición de datos**,
del Río Fernández, J., Shariat-Panahi, S., Sarriá Gandul, S., y Lázaro, A.M., **LabVIEW: Programación para Sistemas de Instrumentación**, 1ª,

Recommendations

Subjects that it is recommended to have taken before

Analogue Electronics/V05G300V01624
Electronic Instrumentation and Sensors/V05G300V01621
Data Acquisition Systems/V05G300V01521

IDENTIFYING DATA				
Industrial Communications				
Subject	Industrial Communications			
Code	V05G300V01925			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Domínguez Gómez, Miguel Ángel			
Lecturers	Domínguez Gómez, Miguel Ángel Poza González, Francisco			
E-mail	mdgomez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	There are more electronic units of control in the systems used in diverse areas of the engineering (industrial control, automotion, domotic, aircrafts, ships, etc.). These units must be connected between them of an efficient way and in real time to transmit all the necessary information. The use of industrial communications networks has had a very big peak in the last years and the knowledge of the different fieldbus protocols existing in the market is of big interest for the engineering. This subject intends that the student know the different protocols of communications that exist in various areas of application and acquires the capacity to choose the most adapted solution for a determinate problem. In accordance with the exposed, will treat the following contents: * Introduction to industrial communications systems * Introduction to fieldbuses * Standards * General Characteristics * Applications * Study of the most used protocols * Tools of design and analysis			

Competencies	
Code	
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A73	(CE64/OP7) Comprehension and command of basic concepts of industrial communication networks of field buses.
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Expected results from this subject	Training and Learning Results	
Understanding and control of the industrial communications systems.	A73	
Understanding and control of the basic concepts of industrial communications networks (fieldbuses).	A73	
Understanding and control of fieldbuses applications and the most important protocols.	A73	
Capacity to choose the better solution for a determinate problem of communication.	A6 A73	
Capacity to design simple industrial communication systems.	A6	B5
Basic knowledges of software tools for analysis and design.	A6	B5
Capacity of use and configurate communication hardware modules.	A6	B5

Contents	
Topic	
Theme 1: Communication networks	OSI and TCP/IP models. Local Area Networks (LAN). Wide Area Networks (WAN). Wireless and mobile communication systems. Interconnection resources. Hierarchy.
Theme 2: Fieldbuses	Origin. Main characteristic. standardization. Applications.
Theme 3: CAN/LIN	History. Applications. Main characteristic. Physical layer. Data link layer. Media access control. Frames format. Coding of frames. Errors management.

Theme 4: Domotic fieldbuses: KNX	Basic concepts (domotic, inmotic, digital home). Physical levels of transmission. Main protocols used in domotic. KNX (Generalities, main characteristic, topology, telegram).
Theme 5: P-NET	Physical layer. Data link layer. Frames format. Media access control. Transmission of frames.
Theme 6: PROFIBUS	Physical layer. Topology. Data link layer. Media access control. Transmission methods. Timers. Structure of the frames.
Theme 7: WorldFIP	Physical layer. Data link layer. Variables and messages. Media access control. Frames format. Timers. Bus arbitrator. Producers/Consumers entities.
Theme 8: Industrial Ethernet	Main characteristic. Solutions based in Ethernet IEC 61784-2.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	4	8	12
Master Session	12	36	48
Tutored works	9	40	49
Laboratory practises	12	24	36
Short answer tests	5	0	5

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

Methodologies

	Description
Introductory activities	Presentation of the course. Presentation of the laboratory practices and the instrumentation and software to use.
Master Session	Exhibition by professor of the contents. Personal homework of the student reviewing the concepts seen in the classroom and preparing the topics using the proposed bibliography. Identification of doubts that require to be resolved in personalised attention.
Tutored works	A work about a specific protocol will be assigned to the students, individually or in group. This work will have to be exposed and argued in class.
Laboratory practises	Activities of application of the theoretical knowledges purchased. It will learn to handle specific software of design, simulation and analysis of industrial communication networks. They will program simple hardware modules of some protocol studied in theory. Personal work of the student preparing the practices using the available documentation and reviewing the related theoretical concepts. Preparation and analysis of results. Identification of doubts that require to be resolved in personalised attention.

Personalized attention

Methodologies	Description
Master Session	The students will have occasion of personalised attention in the office of the professor in the schedule that the professors will establish for this purpose at the beginning of the course and that will publish in the web page of the subject. The doubts arisen to the students about the contents of the subject will be resolved and they will be oriented on how study. The doubts arisen to the students about the development of the laboratory practices, the handle of the software of design, simulation and analysis and the specifications and operation of the hardware modules will be resolved too. The doubts arisen to the students about the work they have to do and present in the last weeks of classes will be resolved.
Tutored works	The students will have occasion of personalised attention in the office of the professor in the schedule that the professors will establish for this purpose at the beginning of the course and that will publish in the web page of the subject. The doubts arisen to the students about the contents of the subject will be resolved and they will be oriented on how study. The doubts arisen to the students about the development of the laboratory practices, the handle of the software of design, simulation and analysis and the specifications and operation of the hardware modules will be resolved too. The doubts arisen to the students about the work they have to do and present in the last weeks of classes will be resolved.
Laboratory practises	The students will have occasion of personalised attention in the office of the professor in the schedule that the professors will establish for this purpose at the beginning of the course and that will publish in the web page of the subject. The doubts arisen to the students about the contents of the subject will be resolved and they will be oriented on how study. The doubts arisen to the students about the development of the laboratory practices, the handle of the software of design, simulation and analysis and the specifications and operation of the hardware modules will be resolved too. The doubts arisen to the students about the work they have to do and present in the last weeks of classes will be resolved.

Assessment		
	Description	Qualification
Tutored works	Work that have to do the students and present in class. It will evaluate the work and the quality of the implementation and presentation. The skills A6 and B5 will be evaluated in these works.	50
Laboratory practises	The work of the student in the laboratory will be evaluated, as well as the memories that should be deliver of the practices. The skills A6, A73 and B5 will be evaluated in these practises.	20
Short answer tests	Exams that will be realised in the classroom after a set of exposed subjects to evaluate the knowledges acquired by the student. The skill A73 will be evaluated in these tests.	30

Other comments on the Evaluation

1. Continuous evaluation

Following the own guidelines of the degree and the agreements of the academic commission, a system of continuous evaluation will be offered to the students.

1.a Proofs of short answer

There will be 3 proofs of short answer (type test and/or questions) properly programmed along the course. These proofs will be valued from 0 up to 10 and the final mark will be the average (NPRC):

NPRC = (NPRC1 + NPRC2 + NPRC3)/3

The proofs are not recoverable,that is to say, that if a student cannot attend the day in that they are programmed, the professor has no obligation to repeat them. The mark of the proofs that were missed will be of 0.

1.b Personalized works

A work will be assigned to the students, individually or by groups (depending of the number of students) in the first weeks of the course. This work should be delivered and presented in the last weeks of the course. The presentation of the works will be properly programmed by the professors. The implemented work and its presentation will be valued with a final mark (NT) from 0 up to 10.

The student that does not deliver the work or does not present it in the indicated day will have a mark of 0.

1.c Laboratory practices

Each practice will be valued from 0 up to 10 taking into account the work made in the laboratory. The final mark of laboratory (NPL) will be the average of the qualifications obtained in the practices:

NPL = (NPL1 + NPL2 + □ + NPLn)/n

The practices are not recoverable, that is to say, that if a student cannot attend the day in that they are programmed, the professor has no obligation to repeat them. The mark of the practices that were missed will be of 0.

1.d Final mark

The final mark (NF) will be:

NF = 0,3*NPRC + 0,5*NT + 0,2*NPL

2. Final exam

The students that do not pass by continuous evaluation (final qualification less than 5), will be able to present to a final exam.

The final exam will be in the dates provided for the School and will consist in a proof of short answer (type test and/or questions) (NPRC), the delivery and presentation of a work that the professors will have assigned to the student and the delivery of a laboratory work (NPL) previously assigned to the student by the professors. Each one of these parts will be valued from 0 up to 10. The students will be able to present to all these parts or which they consider appropriate. They will conserve the mark of the continuous evaluation in the parts that do not present.

The calculation of the final mark will be as it was explained in the section 1.d.

3. On the announcement of recovery (July)

The announcement of recovery (July) will have the same format that the final exam and will be in the dates provided for the School.

The students that present to this announcement can do it to all the parts or only which they consider appropriate. They will conserve the mark of the ordinary announcement (continuous evaluation or final exam) in the parts that do not present .

The calculation of the final mark will be as it was explained in the section 1.d. The final mark will be the best of the obtained by the student in the ordinary announcement and the recovery one.

4. Validity of the qualifications

The qualifications of the student will be valid only for the academic course in which they were obtained.

Sources of information

Oliva N. y otros, **Redes de comunicaciones industriales**, 1ª,

Castro M.A. y otros, **Comunicaciones industriales: principios básicos**, 1ª,

Castro, M.A. y otros, **Comunicaciones industriales: sistemas distribuidos y aplicaciones**, 1ª,

Documentation elaborated by the professors (slides, papers,...) available in FaiTIC. This documentation is in English.

Recommendations

Other comments

It is recommended to have passed all the subjects of the Electronic Systems module

IDENTIFYING DATA				
Image Processing and Analysis				
Subject	Image Processing and Analysis			
Code	V05G300V01931			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course follows "Fundamentals of Image Processing" (3rd year). The student will acquire knowledge and skills on high-level techniques to analyze and extract relevant information from images of different application field in computer vision, medical imaging and multimedia resources. The course is lectured and assessed in english. The documentation is also in english.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A82	(CE73/OP16) The ability to construct, exploit and manage artificial vision, medical imaging, and multimedia data base systems.
B1	The ability for critical reading of scientific papers and docs.
B3	The development of discussion ability about technical subjects

Learning aims		
Expected results from this subject	Training and Learning Results	
Know how to solve problems with initiative, for decision making, creativity, and to communicate and transmit knowledge, skills and abilities, understanding the ethic and professional responsibility on the activity of a telecommunications engineer. Know how to build, exploit and manage machine vision systems, medical image systems and Multimedia DataBases.	A4 A82	B1 B3

Contents	
Topic	
Analysis of image.	Segmentation based in colour, textures, shapes and models. Extraction of descriptive and invariant characteristics. Examples in actual problems.
Description and classification of objects.	Clustering. Image descriptors. Classical and probabilistic decisors. Classification. Examples in actual problems.
Aplications	RGB image processing. Medical image processing. Real-time video processing

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	10	10	20
Tutored works	24	82	106
Presentations / exhibitions	3	6	9
Introductory activities	3	0	3
Multiple choice tests	2	0	2
Reports / memories of practice	0	10	10
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies

	Description
Master Session	Each 3-hour class will include one hour of explanation of subject contents, encouraging critical discussion and assimilation through computer programming and visualization.
Tutored works	Each 3-hour session will include 2 hours of "hands-on" working to assimilate the explained concepts through problem-based learning (PBL). Every Problem/Task will take 4 or 5 weeks of the subject during which the student will have to discover, alone or with the professor guidance, what he needs to solve the problem effectively.
Presentations / exhibitions	The third and last task will be presented in front of the class mates. The students from the same group will have to split the presentation, so both of them explain one part of the work.
Introductory activities	In the first class of the course, concepts learned in FPI and the programming tools for the course will be reviewed: C/C++, QT, OpenCV

Personalized attention

Methodologies	Description
Introductory activities	Personalized attention will be carried out during the 3-hour sessions in the lab, guiding and advising each student to make the most of his time for solving the practical problem at hand. Plus, the student can make use of the counseling hours whenever he needs them.
Master Session	Personalized attention will be carried out during the 3-hour sessions in the lab, guiding and advising each student to make the most of his time for solving the practical problem at hand. Plus, the student can make use of the counseling hours whenever he needs them.
Tutored works	Personalized attention will be carried out during the 3-hour sessions in the lab, guiding and advising each student to make the most of his time for solving the practical problem at hand. Plus, the student can make use of the counseling hours whenever he needs them.
Presentations / exhibitions	Personalized attention will be carried out during the 3-hour sessions in the lab, guiding and advising each student to make the most of his time for solving the practical problem at hand. Plus, the student can make use of the counseling hours whenever he needs them.

Assessment

	Description	Qualification
Multiple choice tests	These tests are linked to the delivery of each guided task and are meant to score each student individually. This tests help to assess competence A82.	15
Reports / memories of practice	The score of the guided task includes: the follow-up of each student, the techniques used, the results achieved and the presentation of them. This tasks help to assess competence A82, A4, B1 and B3	85

Other comments on the Evaluation

Attendance is compulsory in continuous assessment, unless special circumstances are alleged. Continuous assessment will be based on the student lab work and guided tasks related to contents of the subject. There will be an official final exam scheduled by the "Junta de Escuela" that the students that didn't pass the continuous assessment will have to take if they want to pass the course. This final exam will be scored from 0 to 10 points and includes all the topics explained during the course and also concepts and techniques explained for the guided tasks. To pass this exam the student has to score, at least, 5 points. The students that are eager to improve their continuous assessment score can also take the final exam. In this case the final score of the course will be the maximum score of the final exam and continuous assessment. Throughout the semester the students will be receiving feedback about his performance on the continuous assessment, along with the scores obtained in the tests and guided tasks. Delivering any of the guided tasks or sitting any test will automatically mean that the student is following the course in the continuous assessment mode. That means that he will appear as "presented" in the records of the subject even if the final exam is not taken.

The continuous assessment contains the next milestones:

Guided task 1: linked to the image analysis topic (25%). 20% for the computer work and 5% for the test.

Guided task 2: linked both to the image analysis and classification topics (25%). 10% for the computer work and 5% for the test.

Guided task 3: linked to all topics (35%). 30% for the computer work an 5% for the test.

Public presentation of the 3rd guided task (15%).

The extraordinary final exam will only be held for students who failed the course both in continuous assesment mode or final exam. The score of the subject will be the score of this exam. The exam will be scored between 0 and 10. To pass the subject, at least 5 points are needed.

Sources of information
Rafael C. Gonzalez, Richard E. Woods, **Digital Image Processing**, 3ª (2008),
Robert Laganière, **OpenCV 2 Computer Vision Application Programming Cookbook**, 2011,
Jasmin Blanchette, Mark Summerfield, **C++ GUI Programming with Qt 4**, 2008,
Richard O. Duda, Peter E. Hart, David G. Stork, **Pattern Classification**, 2ª (2001),

OpenCV book can be freely dowload from here

Recommendations

Subjects that it is recommended to have taken before
Mathematics: Probability and Statistics/V05G300V01204
Programming I/V05G300V01205
Fundamentals of Sound and Image/V05G300V01405
Digital Signal Processing/V05G300V01304
Fundamentals of Image Processing/V05G300V01632
Imaging Systems/V05G300V01633

IDENTIFYING DATA				
Multimedia Technology and Computer Graphics				
Subject	Multimedia Technology and Computer Graphics			
Code	V05G300V01932			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Fernández Hermida, Xulio			
Lecturers	Fernández Hermida, Xulio			
E-mail	xuliofh@gmail.com			
Web	http://faitic.uvigo.es			
General description	Subject mainly based in projects to be done between the classroom and out of it. It consist of works to be done in groups of 2, 3 or 4 studets. It is necessassry to do a presentation and defence of the work in front of the rest of the classmates. It tackles fundamentally the 3D design, the construction of multimedia dynamic web pages and the construction of games.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A83	(CE74/OP17) The ability to construct, exploit and manage image and synthetic video generation systems and interactive multimedia applications.

Learning aims	
Expected results from this subject	Training and Learning Results
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
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
(CE74/OP17) The ability to construct, exploit and manage image and synthetic video generation systems and interactive multimedia applications.	A83

Contents	
Topic	
Synthesis of image by computer	Description of the underlying mathematics to the charts by computer. Description of the philosophy of the electronics associated to the cards of graphic processing in the computers
3D Modelling	Getting familiar with software programs for 3D design. Understanding of the differences between different applications and the implications that these differences suppose in what can be done with the designs realised in each program. (Blender, Sketchup, Solid Works, etc.). Texture mapping and material mapping: UV mapping. Formats of files for virtual surroundings and games.
3D Animation	Simple animation of rigid objects (rotation, traslation, scale). Illumination of scenes and obtaining of videos of these scenes. Realistic animation (a ball bouncing) Foundations of the animation with skeletons (animation of complex objects; walk of a person, etc.)
Virtual Reality, Enhanced Reality	Description of applications of virtual reality and enhanced reality. Limitations in the sensorization necessary for applications of virtual reality and enhanced reality.

Video games	Multisubject knowledge in the construction of a video game. Hardware platforms for video games. Software platforms for the creation of video games. Business Model in companies of video games. (Play Station, Xbox, Laptops, Smartphones. Apple store, etc.) Study of different graphic engines for video games (free and non free)

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	4	4	8
Practice in computer rooms	26	26	52
Tutored works	7	69	76
Presentations / exhibitions	4	8	12
Short answer tests	1	1	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Master Session	Only some classes in which the teacher shows concepts and/or explains knowledges interesting to learn and that are not easy to turn into works that can be done by the students.
Practice in computer rooms	Are the main part of the course. In these practices the students use the programs and applications with which, in parallel, they are realising the tutored works that are the main element of learning. The tutored works also give place to the presentations and to the main part of the evaluation.
Tutored works	Are only two or three works along the four month curse. They are to be done in groups of 2 to 4 students, in the classroom of practices and out of the classroom. Some presentations are to be done in class in front of the other classmates. They are the fundamental element of the course.
Presentations / exhibitions	To present the work is an important learning object in this subject. Through the shared work done in the classroom while they manage the tutored projects and afterwards the public presentation of the tutored work that has been done, we do the fundamental part of the evaluation. (evaluation that is to be done by the own students).

Personalized attention	
Methodologies	**Description**
Presentations / exhibitions	Taking advantage of that this is a subject with not too many students, the professor will do an individual follow-up of each student trying to be slope at all times of what his follow-up of the subject is and what his feeling is concerning what it is being done in classes. As a part of the work of the tutored works is being done in the informatic classrooms, these classes are the fundamental point of interaction between the professor and each student. The professor moves around the classroom helping to the groups in the realisation of the projects. If, in any point, all the studens need help, the teacher will do the explanation as in a masterclass. If the help is individual or for several ones, it will be given to the specific students wich need it.
Practice in computer rooms	Taking advantage of that this is a subject with not too many students, the professor will do an individual follow-up of each student trying to be slope at all times of what his follow-up of the subject is and what his feeling is concerning what it is being done in classes. As a part of the work of the tutored works is being done in the informatic classrooms, these classes are the fundamental point of interaction between the professor and each student. The professor moves around the classroom helping to the groups in the realisation of the projects. If, in any point, all the studens need help, the teacher will do the explanation as in a masterclass. If the help is individual or for several ones, it will be given to the specific students wich need it.
Tutored works	Taking advantage of that this is a subject with not too many students, the professor will do an individual follow-up of each student trying to be slope at all times of what his follow-up of the subject is and what his feeling is concerning what it is being done in classes. As a part of the work of the tutored works is being done in the informatic classrooms, these classes are the fundamental point of interaction between the professor and each student. The professor moves around the classroom helping to the groups in the realisation of the projects. If, in any point, all the studens need help, the teacher will do the explanation as in a masterclass. If the help is individual or for several ones, it will be given to the specific students wich need it.

Assessment		
	Description	Qualification

Tutored works	These works are done with the supervision of the professor. But also with the 'crossed supervision' of the own students during the times of simultaneous work in the practical classes. Works usually are very good because the students are very motivated with them. The works done in the practical classes are 'the guiding thread' of all the subject. This probe evaluates the competence A83 (CE74/OP17)	60
Presentations / exhibitions	We will evaluate the quality of the work realized and also the quality of the presentation. In order this assessment to be done by the own students (self and crossed assessments) we give them a Rúbric where details on how to assess the different aspects. This probe evaluates the competence A9	30
Short answer tests	This is a test where questions fundamentally go over materials explained in the magistral classes. It also includes questions about basic conceps learnt in the development of the projects. This test could be different for those students that do not follow the Continuous Assessment. This probe evaluates the competence A3 (CG3)	10

Other comments on the Evaluation

Learning is thoght to be automatic for the students who do a continuous following of the classes works and lessons. (It's similar to learning a different language being introduced in a conversation group in that language: It's enough to be there and participate).
We will use some tools to realize some works. We will explain our mates what we are going to do, how we will do it, and finally what we do. With this dynamics we learn to use the tools at the same time that we do a project. We see how our classmates use the tools and how they realize their projects. We can help others and be helped by others. We enjoy doing and learn to value our work also the work of our mates.
And ... well. Finally it's necessary to put a note. But the note has little importance. If we learn, and enjoy, the fundamental profit has already been collected.

Those that did not take advantage of the previous, worry for the note. For them, and for those that did not show the minimum knowledges, we create a Second opportunity and a No Continuous Evaluation in the ending of the academic course.

Sources of information

D. Roland Hess, **Animating with Blender**, Focal Press,

Blender Is the program of Free Software that will be used as the base for the 3D Design and the 3D Animation.

Recommendations

Subjects that are recommended to be taken simultaneously

Image Processing and Analysis/V05G300V01931
Audiovisual Production/V05G300V01935

Subjects that it is recommended to have taken before

Fundamentals of Image Processing/V05G300V01632
Imaging Systems/V05G300V01633
Audiovisual Technology/V05G300V01631
Video and Television/V05G300V01533

Other comments

This subject is thought to be done by the method of EVALUATION CONTINUA and with assistance to all the classes. The learning process is being done day to day out and class to class. If it is done this way, the evaluation loses leadership because the fact of the learning is real and very clear for all: professor and students.

By imperative of educational organisation it is necessary to enable the option of EVALUACIÓN NO CONTINUA. I understand that this is a badly recommended way for the students wishing to take advantage of what they have paid and wishing to LEARN.

In any case, in the method of evaluación no contínua, we will try to give the possibility to the student to undoubtedly demonstrate that they know all what the students that assisted to class learnt during the development of the course.

The students that opt by the evaluación no contínua will equally have to do the works that the other students have done by evaluación contínua. They have to do a presentation of the work done, and answer to the questions that the professor can

do in order the student to show that they dominate the tools that have had to use for these works.
They will do also a written examination in which they will answer to questions of the subjects given in the masterclasses and of any subject developed during the course.
The material used in the classes, projects, etc. will be located in FAITIC where it will be going put simultaneously with the development of the classes.

IDENTIFYING DATA				
Advanced Acoustics				
Subject	Advanced Acoustics			
Code	V05G300V01933			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish English			
Department				
Coordinator	Sobreira Seoane, Manuel Ángel			
Lecturers	García Lomba, Guillermo Sobreira Seoane, Manuel Ángel			
E-mail	msobre@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this subject, the use of advanced calculation methods in Acoustics are introduced. The Finite Element Method (FEM) and the Boundary Element Method (BEM) are applied to study problems of acoustic radiation, diffraction and modal analysis (calculation of mode shapes and resonance frequencies). Statistical Analysis Methods (SEA) are also introduced and applied to the calculation of flanking transmission in buildings. The language of the subject is mostly English, although the first lessons on Finite Element Methods could be explained in Spanish.			

Competencies	
Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A84	(CE75/OP18) The ability to elaborate noise maps and their geographical information display.
A85	(CE76/OP19) The ability to apply numerical methods in acoustical problem solving.
A86	(CE77/OP20) The ability to indentify industrial noise problems and to design appropriate control solutions.

Learning aims	
Expected results from this subject	Training and Learning Results
CE75: The ability to elaborate noise maps and their geographical information display. CE76: The ability to apply numerical methods in acoustical problem solving. CE77:The ability to indentify industrial noise problems and to design appropriate control solutions.	A84 A85 A86
CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws. CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area. CG7: The ability to analyse and assess the social and environmental impact of technical solutions.	A2 A5 A7
Learning results: □ Knowledge of the application of numerical methods in acoustics. (CE 76) □ Knowledge on the models of sound transmission in buildings and building elements. (CE 76, CE 77) □ Knowledge of the design techniques of acoustic mufflers. (CE 77) □ Ability to understand the results of complex acoustic measurements and relate the results to those obtained by numerical calculation.(CE 76) □ Knowledge of the main techniques in industrial noise control.(CE77)	A85 A86

Contents	
Topic	
Introduction.	Review of acoustic concepts: impedance, boundary conditions, Helmholtz and Euler equations.

The Finite Elements Method in Acoustics (FEM)	Theoretical introduction to the Finite Element Method. Radiation Problems with FEM. Diffraction Problems. Modal analysis with FEM: resonance frequencies and modes
The Boundary Element Method in Acoustics (BEM)	Introduction to the Boundary Element Method in Acoustics. Integral equation of Kirchhoff Helmholtz. Application to f radiation and diffraction problems. The calculation of of resonances in BEM.
Calculation methods based in S.E.A. Calculation of sound transmission in buildings.	Building Acoustics: acoustic insulation in buildings and determination of the flanking transmission. Calculation method of the international standard ISO 12354.
Other calculation methods.	Ray tracing and application to evaluation of sound propagation outdoors. Prediction of noise levels in industrial plants. Noise control.

Planning			
	Class hours	Hours outside the classroom	Total hours
Tutored works	6	24	30
Practice in computer rooms	12	9	21
Previous studies / activities	0	15	15
Master Session	19	38	57
Short answer tests	2	8	10
Reports / memories of practice	2	10	12
Jobs and projects	1	4	5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Tutored works	Practical projects that the students have to develop: 1. Design of a diffuser to optimise the radiation pattern of a loudspeaker. 2. Design and calculation of the acoustic insulation of a building.
Practice in computer rooms	THe student will work with different software packages to apply the different calculation methods presented un the subject. 1. CAD and mesh generation: FreeCAD and Gmsh. 2. Finite Element calculations : COMSOL. 3. Boundary Element calculations: OpenBEM. 4. Calculations in building acoustics.
Previous studies / activities	The students must study and prepare with the sources of information given before the lectures and the practical sessions.
Master Session	Lectures will be given, developing the main theoretical concepts of the subject.

Personalized attention	
Methodologies	**Description**
Master Session	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Tutored works	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Practice in computer rooms	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Tests	**Description**
Short answer tests	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Reports / memories of practice	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Jobs and projects	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Assessment

	Description	Qualification
Tutored works	Tutored practical project, with the delivery of a final report. The learning aims related to the ability to elaborate projects and application of calculation methods (numerical methods) are assesed. Learning aims related to the identification of problems are also assessed (through the application of numerical calculations). Learning Aims: A2/CG2, A84 (CE75/OP18), A85 (CE76/OP19), A87 (CE76/OP20)	20
Short answer tests	Written test, with short questions on the theory of the subject. Evaluation of learning aims involving knowledge of legislation and how to perform measurements. (Learning Aims: A2/CG2 , A5/CG5)	30
Reports / memories of practice	Questions and report of the practical tasks. Evaluation of those learning aims related to noise measurement and analysis of acoustic problems using numerical calculations. Learning aims: A5/CG5, A7/CG7, A85 (CE76/OP19), A86 (CE77/OP20).	50

Other comments on the Evaluation

Following the guidelines of the degree, two systems of evaluation are offered: continuous assessment (recommended) and a final examination. Evaluation with only a final examination will be only allowed in situations in which it is imposible to follow the system recommended.

LANGUAGE: Any student can choose which language will use during the assessment process (English, Spanish).

CONTINUOUS ASSESSMENT:

The continuous assessment will be based in the evaluation of practical task, projects and two tests. Once a student has signed a document of agreement with the process of continuous assessment, the final degree will be obtained by the application of the criteria described bellow, even though a student could miss some of the tasks or tests envolved in the process.

Once the student has shown good skills in all the assesed learning aims (at least 4 over 10 points in each learning aim assesed), the final grade with be obtained from the weighted sum of the grade obtained in the following tasks with the weights given.

1. Tutored works: 20 % of the final grade.
2. Reports of practical tasks(Weight: 50 %).
3. Two short answer tests (Total weight:30 %)

FINAL EXAMINATION:

A final examination is available for those students that for some reason could not follow the continuous evaluation assessment process. In this case there is date scheduled and officially published for final examination. The final examination will consist in two short answer tests, and some additional questions related with the practical tasks and projects.

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if the final grade obtained if equal or greater than 5.

RETAKE:

There is scheduled date at the end of the semester for a final examination retake, for those students that either dropped out during the semester or failed. Prior the examination, a student can choose to follow the continuous assessment or the final examination. In the former selection, the grades obtained in the projects and practical tasks will be taken into account and the student will only answer to the short answer tests. If the later, (final examination), the student will have also to answer a full examination as described before.

Sources of information

Johnson C., **Numerical solution of PDE by the finite element method.**,

Reddy, J.N., **An introduction to the Finite Element Method,**, 2ª y 3ª ed,

Quarteroni A, Valli A., **Numerical approximation of partial differential equations**,

Ciskowski R.D. and Brebbia C.A., **Boundary Element Methods in Acoustics**,

Juhl, P.M., **The Boundary Element Method for Sound Field Calculations**,
CEN European Standards, **EN 12354-1:2000. Building Acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 1: Airborne sound insulation between rooms**,

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105
Mathematics: Calculus II/V05G300V01203
Fundamentals of Sound and Image/V05G300V01405
Room Acoustics/V05G300V01635
Fundamentals of Acoustics Engineering/V05G300V01531

IDENTIFYING DATA				
Noise Measurement Techniques and Regulations				
Subject	Noise Measurement Techniques and Regulations			
Code	V05G300V01934			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Torres Guijarro, María Soledad			
Lecturers	Torres Guijarro, María Soledad			
E-mail	marisol@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this subject, the main methods of measurement of environmental noise are discussed. The European an national regulations on noise and acoustic insulation are also presented. As part of the measurement process, a guide for the evaluation of the measurement uncertainty in acoustics is also presented. The teaching will be in English.			

Competencies	
Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A87	(CE78/OP21) The ability to write essays on environmental, construction and automation acoustics.
A88	(CE79/OP22) The ability to elaborate specific acoustic essay procedures.

Learning aims	
Expected results from this subject	Training and Learning Results
CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws, related with acoustic engineering. The specific learning aim are: Knowledge of the regulations on the field of acoustic engineering.. Knowledge of the usual international standards on acoustic measurements. CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling in the field of acoustic engineering (noise and acoustic insulation). CG7: The ability to analyse and assess the social and environmental impact of technical solutions. Specific Learning aims: Ability to write technical and reports, measurement reports on fields related to acoustic engineering. CG8.4 Knowledge on the regulations in telecommunications, mainly those related to acoustic engineering.	A2 A5 A7 A8
CE 78: The ability to write essays on environmental, construction and automation acoustics. CE79: The ability to elaborate specific acoustic essay procedures. Learning results: Ability to design measurement procedures matching the regulations and standard specifications.	A87 A88

Contents	
Topic	
Introduction: noise, its description and annoyance.	Classification of noise and descriptors. The assessment of noise. General overview of measurements in acoustics. Nose levels, vehicle noise: pass by measurements, sound power determination.

Description and measurement of environmental noise	Characterization of the noise sources. Influence of the propagation conditions. Noise measurements.
Environmental noise regulations in Europe.	The EU Environmental Noise Directive. Directive 2002/49/EC of the European Parliament and of the Council of 25th June 2002 relating to the assessment and management of environmental noise. National noise regulations.
Acoustic Insulation, description and regulations in Europe.	Acoustic insulation, descriptors. National Code Buildings in Europe, and the regulations on acoustic insulation.
Measurement uncertainty.	The need to assess the measurement uncertainty: quality management in laboratories. The guide for expression of uncertainty in measurement- GUM. Measurement Uncertainty in Acoustics.

Planning

	Class hours	Hours outside the classroom	Total hours
Tutored works	6	24	30
Laboratory practises	12	9	21
Previous studies / activities	0	15	15
Master Session	19	38	57
Short answer tests	2	8	10
Reports / memories of practice	2	10	12
Jobs and projects	1	4	5

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

Methodologies

	Description
Tutored works	The student has to develope in group and write a report on two projects: 1. Procedure to describe and assess environmental noise un a real scenario. 2. An student may choose between: a)Project of acoustic insulation according to the simplified method described in the CTE-DB HR (Spanish Building Code, document for protection against noise). b) Detailed uncertainty budget for some of the measurements carried out. This methodology is targeted to competencies A2, A5, A7, A8, A87 and A88.
Laboratory practises	Laboratory practises on: 1. Characterisation and assessment of noise annoyance. 2. Noise measurements in closed spaces. 3. Measurement of pass-by noise. 4. Measurement of acoustic insulation in buildings. This methodology is targeted to competencies A2, A5, A7, A8, A87 and A88.
Previous studies / activities	The students must study and prepare with the sources of information given before the lectures and the practical sessions. This methodology is targeted to competencies A2 and A5, A7, A8, A87.
Master Session	Lectures will be given, developing the main concepts of the subject. This methodology is targeted to competencies A2, A5, A7, A8, A87 and A88.

Personalized attention

Methodologies	**Description**
Master Session	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Tutored works	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Laboratory practises	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Tests	**Description**

Short answer tests	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Reports / memories of practice	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Jobs and projects	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students) Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Assessment

	Description	Qualification
Tutored works	Tutored practical project, with the delivery of a final report. (Learning Aims:A2, A5, A7, A8, A87, A88)	30
Short answer tests	Written test, with short questions on the theory of the subject. (Learning Aims; A2, A5, A7, A87, A88)	40
Reports / memories of practice	Questions and report of the practical tasks. (Learning Aims; A2, A5, A7, A87, A88)	30

Other comments on the Evaluation

Following the guidelines of the degree, two systems of evaluation are offered: continuous assessment (recommended) and a final examination. Evaluation with only a final examination will be only allowed in situations in which it is imposible to follow the recommended system.

LANGUAGE: The student can choose the language to use during the assessment process between english and spanish.

CONTINUOUS ASSESSMENT:

The continuous assessment will be based in the evaluation of practical task, projects and two tests. Once a student has signed a document of agreement with the process of continuous assessment, the final degree will be obtained by the application of the criteria described bellow.

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if each activity is graded equal or greater than 4, and the final grade obtained is equal or greater than 5. The final grade with be obtained from the weighted sum of the grade obtained in the following tasks with the given weights.

1. Tutored works: 30 % of the final grade. Two reports will be delivered: the first during the 6th week and the second during the 11th week
2. Reports of practical tasks(Weight: 40 %).
3. Short answer tests : Two short answer tests are included in the process of continuous assesment, (test 1 is scheduled on the 5th week and test 2 on the 11th week) (Total weight :20% each, with a total weight of 40% on the final grade).

FINAL EXAMINATION:

A final examination is available for those students that for some reason could not follow the continuous evaluation assessment process. In this case there is date scheduled and officially published for final examination. The final examination will consist in two short answer tests, and some additional questions related with the practical tasks and projects.

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if the final grade obtained is equal or greater than 5.

RETAKE IN JULY:

There is scheduled date in july for a final examination retake, for those students that either dropped out during the semester or failed. Prior the examination, a student can choose to follow the continuous assessment or the final examination. In the former selection, the grades obtained in the projects and practical tasks will be taken into account and the student will only answer to the short answer tests. If the later, (final examination), the student will have also to answer a full examination as described before.

Sources of information
DIRECTIVE 2002/49/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 June 2002 relating to the assessment and management of environmental noise,
ISO Standard, **ISO 1996-1. Acoustics -- Description, measurement and assessment of environmental noise -- Part 1: Basic quantities and assessment procedures**,
ISO Standard, **ISO 1996-2. Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of environmental noise levels**,
Birgit Rasmussen, J. H. Rindel, **Sound insulation between dwellings Descriptors applied in building regulations in Europe**,
Birgit Rasmussen, **Sound insulation between dwellings Requirements in building regulations in Europe**,
ISO Standard., **ISO 140-4:1998 Acoustics -- Measurement of sound insulation in buildings and of building elements -- Part 4: Field measurements of airborne sound insulation between rooms.**,

Hyperlinks:

- *Evaluation of measurement data Guide to the expression of uncertainty in measurement.*
- *Evaluation of measurement data An introduction to the "Guide to the expression of uncertainty in measurement" and related documents*
- *Evaluation of measurement data Supplement 1 to the "Guide to the expression of uncertainty in measurement" Propagation of distributions using a Monte Carlo method*

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204
Fundamentals of Sound and Image/V05G300V01405
Room Acoustics/V05G300V01635
Fundamentals of Acoustics Engineering/V05G300V01531

IDENTIFYING DATA				
Audiovisual Production				
Subject	Audiovisual Production			
Code	V05G300V01935			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Fernández Santiago, Luís Emilio			
Lecturers	Fernández Santiago, Luís Emilio			
E-mail	faraon@uvigo.es			
Web	http://faitic.uvigo.es			
General description	General knowledge of the processes and language of AudioVisual production and direction, compression oriented them to get the ability to integrate into production / direction team, after organization charts, technical positions. Also, achieve general skills on cameras, Sets and NLE Editing Systems. Documentation in english.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
A89	(CE80/OP23) The ability to conceptually and technically manage the phases in an audiovisual production.
A90	(CE81/OP24) The ability to creatively and skillfully use the technical equipment for production development.
A91	(CE82/OP25) The ability to use specific software applications in audiovisual production.
A92	(CE83/OP26) The ability to organize an audiovisual production.
B3	The development of discussion ability about technical subjects

Learning aims		
Expected results from this subject	Training and Learning Results	
(CE80/OP23) The ability to conceptually and technically manage the phases in an audiovisual production.	A89	
(CE81/OP24) The ability to creatively and skillfully use the technical equipment for production development.	A90	
(CE82/OP25) The ability to use specific software applications in audiovisual production.	A91	
(CE83/OP26) The ability to organize an audiovisual production.	A92	
CG4: The ability to solve problems with initiative, to make creative decisions and skills	A4	
CG4: The ability to communicate and transmit knowledge and skills.	A4	
CG8.3 To know project organization and planning	A8	
CG12 The development of discussion ability about technical subjects		B3

Contents	
Topic	
Audiovisual Concepts:	Basic audiovisual language. Polysemy audiovisual, formats and genres. Production development, From Script to Broadcast: -script, revision, screenplay, development. shooting script, Storyboard. -Production Breakdown script, blocking shoots,shooting schedule, call sheets. Generic Organization of a studio. Generic Organization of production.

Definition of technical positions:	Preproduction: -Advisor (foresight other stages) -Technical Direction. -IT system Administration. (Networks, databases-nomenclatures-, adaptation ...) Production: -Electrical (lighting, rush ...) -Physical effects (mechanical, electronic, computer ...) -Sound. (Record, registration) -Signal Control. -Camera Control. Postproduction: -Transfer of information. -Quality control, compression. -Postprodcution operator (editing, Grading) -Computer effects. Broadcast: -Recoding, compressing and reformatting. -Replication. -Streaming.
Audiovisual Genres	Specific studio / production genre based: -Fiction -Advertising -Industrial -News -Magazines -Visual Effects -Animation TV as a set
Theoretical information linked to practices	NEWS -news, scipting, call sheets, recording. -Capture, editing and export. -Playlist, headers, bursts, direction, broadcast. REPORT: -Types, definition, development, DOCUMENTARY: -Documentation, rhythm, graphics. FICTION: -single camera, multi camera.

PRÁCTICAS	Camera: -Installation. -Specific and common elements. -Settings. -Analysis of the signal. -Variables involved in filming. NEWS -News, scipting, call sheets, recording. -News scripting and Recording. Edition: -Setting projects -Footage capture. -online/offline - linear / nonlinear -Three points editing -Triming -Audio setting. (Levels) -Export. NEWS -Capture, editing and export. -Editing news. Set -Set's camera. -Camera control -Lighting -Chroma lighting -Set's Resources -Direction NEWS -Playlist, headers, bursts, direction, broadcast. REPORT: -Types, definition, development, -Developing, recording and editing a story. DOCUMENTARY: -Documentation, rhythm, graphics. FICTION: -Single camera, multi camera. -Development, direction, production design, conducting a fictional Gag in single camera and set. POSTPRODUCTION (the basics): quality lost in compression / quality comparison. chroma key. wire removal. track. 3D track. integration.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	16	40	56
Laboratory practises	7	11	18
Classroom work	10	45	55
Outdoor study / field practices	5.84	0	5.84
Practical tests, real task execution and / or simulated.	0.16	0	0.16
Multiple choice tests	1	0	1
Reports / memories of practice	2	12	14
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Master Session	Theoretical sessions on concepts of visual language, formats, sets and use, workflow and integration of technical human resources in the production's team.
Laboratory practises	practise on images and sound gathering and their postproduction to develop audiovisual products.
Classroom work	Realization of Audiovisual contents to suitable for differect formats, apliying the knowledge learnt in the laboratory practices.
Outdoor study / field practices	Practices in the TV Set of CC.SS. Aimed to the understanding of direction workflow for news and fictional programs.

Personalized attention	
Tests	**Description**
Reports / memories of practice	Personal review of the Edition of the individual report, aiming to the new knoweledge adquired by the student about the subject. Assistance in the development of the single/Multicamera report about format/genre, in wich the theoretical knowledge seen in the subject are included.

Assessment		
	Description	Qualification
Classroom work	Group products developed in the classroom and in the self time: News Repor Documentary Fiction CE80, CE81, CE82, CE83, G4.1, CG4.2, CG83, CG12	40
Practical tests, real task execution and / or simulated.	Individual Editing of the report and set's individual test. CE81, CE82, CG4.1, CG4.2.	25
Multiple choice tests	Test, theoretical contents and practical concepts of the subject. CG4.2, CG8.3.	20
Reports / memories of practice	Report of the differences between multicamera and singlecamera productions over the various studied formats. Study of a project. CE80, CE83, CG4.1, CG4.2, CG8.3, CG12	15

Other comments on the Evaluation

In second call will be necessary pass an Test (30%-theoretical contents and practical concepts of the subject-CG4.2, CG8.3.-) and questions to develop(30%-knowledge of the process of production formats-CE80, CE81, CE82, CE83, CG4.2, CG8.3, CG12-) and a practical exercise of efficience in the handle of camera and NLE edition (40%-CE81, CE82, CE83, CG4.1, CG8.3-).

Sources of information

ALTEN, STANLEY, **Audio in media**,

TRIBALDOS, CLEMENTE, **Sonido profesional**,

RUMSEY, FRANCIS. MCCORMICK, TIM, **Sonido y grabación; Introducción a las técnicas sonoras**, 2ª edición,

ONDAATJE, MICHEL, **The Conversations: Walter Murch and the Art of Editing Film**,

BRINKMANN, R., **The art and science of digital compositing**, 2nd ed,

MMILLERSON, GERALD. OWENS, JIM, **Television production**,

HERRERO, JULIO CESAR, **Manual de teoria de la información y telecomunicación**, 2009,

Recommendations

Subjects that are recommended to be taken simultaneously

Image Processing and Analysis/V05G300V01931
Multimedia Technology and Computer Graphics/V05G300V01932

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405
Fundamentals of Image Processing/V05G300V01632
Sound Processing/V05G300V01634
Imaging Systems/V05G300V01633
Audiovisual Technology/V05G300V01631
Video and Television/V05G300V01533

IDENTIFYING DATA				
Multimedia Services				
Subject	Multimedia Services			
Code	V05G300V01941			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Blanco Fernández, Yolanda			
Lecturers	Blanco Fernández, Yolanda López Nores, Martín			
E-mail	yolanda@det.uvigo.es			
Web	http://www.faitic.es			
General description	The aim of this subject is to provide the students with the theoretical foundations and the practical skills that allow them to understand the basic principles of the digital treatment of the multimedia information. To this aim, it is necessary to present the main standards in the field of the multimedia processing, as well as the available mechanisms for the transmission of the audiovisual information through telematic networks. The focus is put on the realm of television, dealing with both the digital terrestrial TV broadcasting (DTTV) and the transmission over IP networks (IPTV). The practical part of the subject will allow the students to experiment with the design and development of telematic services based on the transmission of multimedia streams, along with the programming of interactive services about digital television broadcasting and video-on-demand. The documentation of the subject will be available in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A93	(CE84/OP27) The ability to apply the techniques based on computer, networks and distributed applications and services, in the broadcasting and interchange of audiovisual information.

Learning aims	
Expected results from this subject	Training and Learning Results
Understand the basic foundations of the digital treatment of the multimedia information.	A3
Know the main standards in the field of the processing of the multimedia information.	A6 A93
Understand the foundations and the main mediums adopted in digital TV broadcasting.	A3 A6
Know the basic foundations of the transmission of audiovisual information through telematic networks.	A3 A6
Acquire skills in the design and development of telematic services based on exchanging audiovisual contents.	A3 A9 A93
Acquire skills for the programming of telematic services in the scope of interactive digital television.	A6 A93

Contents	
Topic	
1. Multimedia systems: Foundations and basic concepts	a. Digitalization of audio and video signals. b. Format for storage of audio and video signals. c. Conditional access and digital rights management.

2. Terrestrial Digital TV broadcasting	a. Architecture b. Transport of bitstreams c. Signaling d. Middlewares e. Mobile Digital Television
3. IP Television and video-on-demand	a. Architecture b. Data distribution. VoD and nVoD. c. Broadcasting, multicasting and P2P d. Systems and protocols e. Signaling

Planning			
	Class hours	Hours outside the classroom	Total hours
Presentations / exhibitions	2	2	4
Projects	7	33	40
Practice in computer rooms	4	7	11
Practice in computer rooms	8	22	30
Master Session	19	35	54
Multiple choice tests	2	9	11

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

Methodologies	
	Description
Presentations / exhibitions	The students, organized into groups of 2-3 people (as per professor's criteria), will expose to their mates in the computer room the design proposed for the project planned for the group classes. The aim is to argue the advantages and problems of each model, promoting the debate around the proposal of each group. The professor will carry out a personalized follow-up of each group, with the goal of fixing possible deficiencies and guiding right design decisions. These methodologies will assess the skills CG3, CG6 and CG9.
Projects	The students, organized in groups of 2-3 people (as per professor's criteria), will implement the project posed by the professor. The goal is to boost a collective discussion to identify the key points in the development of the project. The students will combine face-to-face work in the computer room with the individual work. These methodologies will assess the skills CG3 and CG6.
Practice in computer rooms	The professor will propose practices in which the students will deal with the main concepts explained in the subject, putting the focus on the coding formats adopted in the transmission of multimedia information. The doubts arisen during the autonomous work of the students in the computer room will allow to promote the debate of the group to agree the best solution for each problem. These methodologies will assess the skills CE84 and CG6.
Practice in computer rooms	The professor will propose practices in which the students will deal with the main concepts explained in the subject, putting the focus on possible applications in the realm of Terrestrial Digital TV and transmission of television over IP. The doubts arisen during the autonomous work of the students in the computer room will allow to promote the debate of the group to agree the best solution for each problem. These methodologies will assess the skills CE84, CG3 and CG6.
Master Session	Classes where the main theoretical concepts of the subject will be explained, by proposing examples and possible application scenarios in the context of the transmission of multimedia streams. These methodologies will assess the skills CG3 and CG6.

Personalized attention	
Methodologies	**Description**
Presentations / exhibitions	The personalized attention will be based on following-up the work of each student, by tracking the solutions proposed for the practices in room computers and group projects, and the public presentation of their designs and implementations.
Projects	The personalized attention will be based on following-up the work of each student, by tracking the solutions proposed for the practices in room computers and group projects, and the public presentation of their designs and implementations.

Practice in computer rooms	The personalized attention will be based on following-up the work of each student, by tracking the solutions proposed for the practices in room computers and group projects, and the public presentation of their designs and implementations.
Practice in computer rooms	The personalized attention will be based on following-up the work of each student, by tracking the solutions proposed for the practices in room computers and group projects, and the public presentation of their designs and implementations.

Assessment

	Description	Qualification
Presentations / exhibitions	The students, organized into groups of 2-3 people (as per professor's criteria), will present the design proposed for the project planned for group classes. These oral presentations will take place in the lab during the penultimate week of the course. In these practices the skills CG6 and CG9 will be assessed.	10
Projects	The students, organised in groups of 2-3 people (according to the criterion of the professor), will have to develop a project linked to the command of the digital TV by diffusion or to the TV on IP. This project must be delivered in a date to be confirmed between 8th and 17th January, 2015. The project must include the code and the necessary documentation to justify the decisions of design and the criteria considered in the development of the solution proposed. This proof will evaluate the competitions CG3 and CG6.	30
Practice in computer rooms	The students, organized in groups of 2 people, will submit a report about the solution proposed for the first practice in the computer room, which will be about coding formats adopted in the transmission of multimedia streams. If necessary, the submission will include also the software used in the development of the solution proposed. This first practice will be submitted during the 4th week of the course. In these practices the skills CG6 and CE84 will be assessed.	10
Practice in computer rooms	Each student will submit individually a report about the solution proposed for the second practice in the computer room. This practice will be about Digital TV broadcasting. The submissions will include the software used in the development of the solution, along with documentation to justify design decision and implementation details. This second practice will be submitted during the 8th week of the course. In these practices the skills CE84, G6 and CG3 will be assessed.	20
Multiple choice tests	Each student will take an exam including multiple choice tests, where the goal is to validate their practical skills and understanding level about the theoretical concepts acquired during the course. This exam will take place in the official date published at http://www.teleco.uvigo.es. Note that support materials are not allowed. In these practices the skills CG6 and CG3 will be assessed.	30

Other comments 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.
- Students who sit CA must submit during the 4th week of the course their solution for the first practice proposed in the computer room (3rd test in the previous section). By the submission of this practice the student makes a commitment to be assessed via CA, thus renouncing the TA mechanism. In virtue of this commitment, these students will not be listed as "Not Present".
- Students who do not submit the first practice during the 4th week of the course renounce to the CA, thus being assessed through the TA mechanism. Note that it will not be possible to join the CA in the next tests.
- CA tests will be carried out only in the dates defined by the professors. These CA tests cannot be repeated later.
- The grades obtained in the CA and other exams and practical projects are only valid for the current academic year.
- CA will be just considered in the first opportunity to pass the subject. In the second one only TA will be valid.

Students who sit CA in the first opportunity to pass the subject will be assessed as follows:

- CA tests will be 100% of the final remark of the student. This assessment mechanism consists of five CA tests that

have been previously described (a multiple-choice test, two practices in the computer room, public presentation of the design of a practical project and the final implementation of this project). Note that the student makes a commitment to follow-up CA by submitting the first practice during the 4th week of the course, thus renouncing the TA mechanism.

Students who sit TA in the first opportunity to pass the subject will be assessed as follows:

- A final exam that these students will take in the official date published at http://www.teleco.uvigo.es. This test will include short-answer questions and/or multiple-choice tests, along with problems and practical use cases to be analyzed and resolved. The weight of this exam in the final remark is 50%. Note that support materials are not allowed.
- Submission of a practical project that will include software and documentation to justify design decisions and describe implementation details. The weight of this project in the final remark is 50%. Note that that each student must submit this project individually in a date to be confirmed between 8th and 17th January, 2015.

Students who did not pass the subject in the first opportunity, will have **a second opportunity** where they cannot be assessed via CA, so that **only TA is valid**. Therefore, these students must (i) take the final exam (in the official date published at http://www.teleco.uvigo.es) and (ii) submit individually the practical project (in the date published by professors at www.faitic.uvigo.es), as described above for the TA mechanism. The weight of each part in the final remark will be 50%.

Sources of information

Wes Simpson, **Video over IP IPTV, Internet video, H.264, P2P, Web TV, and streaming: a complete guide to understanding the technology**, Elsevier,

Artur Lugmayr, Samuli Niiranen, Seppo Kalli, **Digital Interactive TV and metadata**, Springer,

George Lekakos, Konstantinos Chorianopoulos, Georgios Doukidis, **Interactive Digital Television: technologies and applications**, IGI Publishing,

José J. Pazos Arias, Carlos Delgado Kloos, Martín López Nores, **Personalization of Interactive Multimedia Services: a research and development perspective**, Nova Science Publishers,

Liliana Ardissono, Alfred Kobsa, Mark Maybury, **Personalized Digital Television: targeting programs to individual viewers**, Kluwer Academic Publishers,

Other sources of information related with DVB standards (http://www.dvb.org/technology/standards/):

- Framing structure, channel coding and modulation for digital terrestrial television (IN 300 744 V1.6.1). January 2009.
- Implementation guidelines for DVB terrestrial services; Transmission aspects (TR 101 190 V1.3.2). May 2011.
- Mega-frame for Single Frequency Network (SFN) synchronization (TS 101 191 V1.4.1). June 2004.

Recommendations

Other comments

It is recommendable that the Telematics module had been passed.

IDENTIFYING DATA				
Mobile and Wireless Networks				
Subject	Mobile and Wireless Networks			
Code	V05G300V01942			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Gil Castiñeira, Felipe José			
Lecturers	Gil Castiñeira, Felipe José López Bravo, Cristina			
E-mail	xil@gti.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The subject "Wireless and Mobile Networks" (redes sen fíos e móbiles) examines the area of wireless and mobile networks, studying the existing challenges for the communications protocols, and looks at the opportunities that provides continuous connectivity even in movement. The focus of this subject will be on network protocols above physical layer (nevertheless, it will touch the most important physical layer properties). The documentation will be available in english.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A94	(CE85/OP28) The ability to analyze, plan and deploy wireless communication networks for different coverage ranges: metropolitan, local and short range.

Learning aims	
Expected results from this subject	Training and Learning Results
Understand the main concepts of wireless communications.	A3 A94
Understand the main concepts of mobile communications.	A3 A94
Know the main protocols used in wireless communication networks.	A3 A94
Know the architectures used in wireless communication networks.	A3 A94
Ability to design mobile wireless networks.	A3 A4 A9 A94

Contents	
Topic	
Introduction to wireless communications	Channel characteristics Multiple access Modulation

Principles of operation of wireless networks	Mobility management Introduction to ubiquitous computing Ad hoc networks, routing Security Network topologies
Wide area networks	Architecture Mobile networks Network topologies Practical case
Local networks	Architecture: ad hoc and infrastructure based networks User authentication approaches Security Quality of services Practical case
Low range networks	Architecture Bandwidth/power consumption balance Personal communication Industrial communication

Planning			
	Class hours	Hours outside the classroom	Total hours
Practice in computer rooms	13	39	52
Integrated methodologies	6	28	34
Master Session	19	38	57
Reports / memories of practice	0	3	3
Systematic observation	1	0	1
Jobs and projects	1	0	1
Short answer tests	2	0	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Practice in computer rooms	Students will complete guided and supervised practices in the laboratory. Competences A4, A9, A94 will be developed
Integrated methodologies	Team development of the design, implementation and validation of a protocol, system, application or service. Competences A3, A4, A9, A94 will be developed.
Master Session	Professors present the main theoretical contents related to wireless and mobile networks. Competences A3, and A94 will be developed.

Personalized attention	
Methodologies	**Description**
Practice in computer rooms	The professors of the subject will provide individual attention to the students during the course, solving his doubts and questions. In addition, the professors will advise and will guide the students during the realization of the tasks.
Integrated methodologies	The professors of the subject will provide individual attention to the students during the course, solving his doubts and questions. In addition, the professors will advise and will guide the students during the realization of the tasks.

Assessment		
	Description	Qualification
Practice in computer rooms	Students will fill lab reports to asses the correct realization and understanding of the laboratory tasks. Competences A4, A9, and A94 will be evaluated.	20
Integrated methodologies	Students will be divided in groups to complete the design, implementation and validation of a protocol, a system, an application or service. The result will be evaluated after the delivery, having into account key aspects such as the correction, the quality, the performance and the functionalities. In addition, during the implementation of the project, the design and the evolution of the development will be evaluated. Competences A3, A4, A9, and A94 will be evaluated.	50

Master Session	Students will be evaluated to asses what they have learned in master sessions. Competences A3, and A94 will be evaluated.	30

Other comments on the Evaluation

In order to pass the course it is necessary to complete the different parts of the subject (master sessions, practices in labs, and tutored works). The final grade will be the **weighted geometric mean** of the grades of the different parts (i.e. it is not possible to pass the subject with a zero in one part). If "x" is the grade obtained for the master sessions, "y" for the practices in labs, and "z" for the tutored works, the final grade will be: grade = x^0.3*y^0.2*z^0.5

During the first month, students must declare if they opt for continuous or final assessment. Students who select continuous assessment and submit the first task or lab report may not be listed as "Not Present".

Students that opt by the final assessment procedure, must submit an additional dossier with detailed information about the events and issues that arose during the execution of the different tasks, and especially the tutored work. In addition, during the first month of the course, professors will notify students if they have to do the tutored work individually, in the case they opt for final assessment.

Second opportunity to pass the course

The course final exam will only be held for students who failed the course in the first oportunity (semester final exam).

In order to pass the course it is necessary to complete the different parts of the subject, which will be evaluated as is indicated in the tests description section. Besides, it will be necessary to submit an additional dossier with detailed information about the events and issues that arose during the execution of the different tasks, and especially the tutored work.

Students that have opted by the continuous assessment procedure, can decide to maintain the grades of the parts they have already passed in the first opportunity or discard them.

Other comments

The grades obtained are only valid for the current academic year.

The use of any material during the tests will have to be explicitly authorized.

Sources of information

Viajy Garg, **Wireless Communications and Networking**, 1,

Kaveh Pahlavan, Prashant Krishnamurthy, **Networking Fundamentals: Wide, Local and Personal Area Communications**, 1,

Pei Zheng, Larry L. Peterson, Bruce S. Davie, Adrian Farre, **Wireless Networking Complete**, 1,

James F. Kurose, Keith W. Ross, **Computer Networking: A Top-Down Approach**, 6,

Recommendations

Subjects that it is recommended to have taken before

Computer Networks/V05G300V01403
Data Networks: Technology and Architecture/V05G300V01542

IDENTIFYING DATA				
Programming of Intelligent Systems				
Subject	Programming of Intelligent Systems			
Code	V05G300V01943			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Burguillo Rial, Juan Carlos			
Lecturers	Burguillo Rial, Juan Carlos Costa Montenegro, Enrique			
E-mail	jrial@uvigo.es			
Web				
General description	This course will begin providing the notion of agent, to comprise what is, how build it and how can, the agents interact for modeling and solving complex problems. Later we will study the design, implementation and application of intelligent agents and multiagent systems in current communications technologies and relate them with other current paradigms such as: object oriented programming, mobile agents, the management distributed of networks, the adaptive user interfaces and the electronic commerce. The students will learn to program multiagent systems in suitable platforms and mobile terminals (Android). Besides, they will perform a work in group, where they will extend the concepts studied in the subject to other topics of their own interest. This subject will be taught and evaluated in Spanish by defect. Nevertheless, the teacher will ask the students about the possibility to provide the whole subject or part of it in English. In any case, all the documentation of the subject will be provided in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A95	(CE86/OP29) The ability to program computer applications and services based on artificial intelligence.

Learning aims	
Expected results from this subject	Training and Learning Results
To understand the basic concepts of intelligent systems: search, reasoning and learning.	A3
To know the main concepts related with intelligent agents and multiagent systems.	A3 A95
To understand the basic concepts of software engineering in intelligent systems.	A3 A95
To achieve a suitable level of expertise in the use of IDEs for programming intelligent systems.	A3 A4 A95
To acquire skills in the design and development of intelligent services applied to electronic devices.	A3 A4 A95
To acquire skills for the application of intelligent systems in complex telematic services.	A3 A4 A9 A95

Contents
Topic

Introduction to intelligent systems	a) Searching b) Reasoning c) Learning
Intelligent agents	a) Definition of intelligent agent b) Architectures for intelligent agents c) Learning and adaptability
Multiagent systems	a) Distributed Artificial Intelligence and multiagent systems b) Communication between agents: KQML, FIPA-ACL c) Coordination and protocols of interaction d) Learning in multiagent systems e) Self-organised multiagent-systems
Software engineering of oriented to agents	a) Programming and methodologies oriented to agents b) Agents vs. Objects c) Agents vs. Expert Systems d) The JADE development platform
Multiagent systems and Game Theory	a) Cooperation vs. Competition b) Negotiation c) Auctions d) electronic Commerce
Mobile agents	a) Concept of mobile agent b) Security problems c) Possible applications

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	3	6	9
Master Session	9	36	45
Laboratory practises	14	28	42
Proceedings	9	0	9
Forum Index	0	4	4
Tutored works	6	30	36
Multiple choice tests	1	4	5

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

Methodologies

	Description
Introductory activities	We start doing a generic introduction to the aims, and the global contents of the subject together with the results expected at the end of the course.
Master Session	We describe the different topics of the subject providing the necessary educational material.
Laboratory practises	Every student must do a practical task in the laboratory with the JADE development platform.
Proceedings	In the classes there will be open discussion, among groups of students, in order to focus on a topic of subject content, the analysis of a case, the outcome of a project, exercise or problem previously developed a keynote address.
Forum Index	The students must perform some activities within the TEMA platform at FAITIC in order to discuss topics related to the subject.
Tutored works	The students must perform a project in group, with the support of the professor, to extend and personalize the topics seen along the theoretical and practical classes. At the same time, we will try that the students perform such project demos using Android terminals.

Personalized attention

Methodologies	Description
Tutored works	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.

Laboratory practises	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Proceedings	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Forum Index	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.

Assessment

	Description	Qualification
Laboratory practises	The students will perform a practical task in the laboratory with the JADE development platform where they will work with the concepts studied in the theoretical classes. These practices evaluate the competencies: A95, A3, A4.	30
Proceedings	Discussions done along classes related with expositions done or read previously. These discussions evaluate the competencies: A3, A4	5
Forum Index	Short answers and interaction done individually by students within the TEMA platform to discuss topics related with the subject. This forum evaluates the competencies: A3, A4	5
Tutored works	Evaluation of the works developed: understanding, maturity, importance and originality of the work and interaction between the group. These works evaluate the competencies: A3, A4, A9.	30
Multiple choice tests	Three successive tests (weeks 4, 7 and 10) to evaluate the contents given up to that time in the course. The tests will be individual and with time limit. These tests evaluate the competencies: A3	30

Other comments on the Evaluation

The elements that are part of the evaluation of the subject are the following:

- **Questionnaires**: along the course the student will fill 3 questionnaires that will contribute 10% to the final mark (each one).

- **Practical tasks**: each student will have to perform a practical task in the laboratory that will contribute 30% to the final mark.

- **Final work**: each student will have to do a work in group, about one among several possible topics, that will contribute 30% (5% proposal + 15% work done + 10% presentation) to the final mark.

- **Class participation**: students will discuss in class about expositions done by the professor, and this contributes in a 5% to the final mark.

- **Forum participation**: students must interact in the forum of the subject individually to achieve a 5% of the final mark.

Therefore, we have: questionnaires (3*x10 = 30%) + Practical task (30%) + Group Work (30%) + Class participation (5%) + Forum (5%) = 100%.

Following the degree guidelines, the students that will follow this subject can choose between two evaluation: continuous evaluation and evaluation at the end of the semester.

Continuous evaluation: the student follows the continuous evaluation from the moment in that it fills two questionnaires.

From that moment we assume that he/she has participated in the subject, independently of he/she assist to the final exam.

Evaluation at the end of the semester: the student will have to perform a final exam that substitutes the questionnaires done along the course, in addition to providing the practical task and the equivalent work to be done as part of the continuous evaluation.

Evaluation at the end of the second semester: the student will have to perform the part that has not passed previously.

The questionnaires and task proposed and performed in this course are only valid for the current course.

Sources of information

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

Stuart Russell, Peter Norvig, **Artificial Intelligence: A Modern Approach,**, Prentice Hall, 3a,

Jacques Ferber, **Multi-Agent Systems: an Introduction to Distributed Artificial Intelligence**, Addison-Wesley, 1a,

Alison Cawsey, **The Essence of Artificial Intelligence**, Prentice Hall Europe, 1a,

Recommendations

Subjects that it is recommended to have taken before

Programming II/V05G300V01302

Other comments

The only requirement for the students, in order to follow this subject, is to have a basic understanding of Java programming.

IDENTIFYING DATA				
Embedded Systems Design				
Subject	Embedded Systems Design			
Code	V05G300V01944			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Rodríguez Hernández, Pedro Salvador			
Lecturers	Gil Castiñeira, Felipe José Rodríguez Hernández, Pedro Salvador			
E-mail	pedro.rodriguez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Embedded systems are part of almost all the diary activities that involve an electronic device (the alarm clock, the mobile phone, the car...). This course introduces the main concepts behind modern embedded systems that include an operating system, and puts them in practice through a series of exercises and projects. The documentation will be provided in English.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A96	(CE87/OP30) The ability to understand the specific requirements for integrated circuits with strict real time restrictions.
A97	(CE88/OP31) The ability to formulate and solve problems of design and development of integrated systems.

Learning aims	
Expected results from this subject	Training and Learning Results
Know the technological base which supports the most recent investigations in the study and design of integrated systems.	A96
Understand the basic aspects of the special requirements inherent to embedded systems with hard real time restrictions	A3 A96
Adopt a global view of the problem of programming environments with real-time restrictions, and know the proper tools for dealing with them, so that embedded systems can be addressed with a system level approach.	A3 A4 A9 A97
Understand the basic elements of fault prevention and fault tolerance	A4 A9 A97
Master the concepts related to the organisation of this kind of systems software	A4 A9 A97
Handle the tasks scheduling and resources sharing techniques in embedded systems	A97
Become familiar with the use of abstraction platforms for developing embedded systems	A4 A97

Contents	
Topic	
Concept of embedded system	Definition of embedded system Real-time systems Characteristics
Operating systems for embedded systems	Operating systems with real-time restrictions Multitasking: threads and processes Synchronization

Architectures of embedded systems	ARM, MIPS Microprocessors
Process scheduling	Cyclic executives Priority-driven scheduling: DMS, EDF Access synchronization
Reliability and fault tolerance	Fault prevention and fault tolerance Static and dynamic redundancy Security, reliability and dependability
Distributed embedded systems	Communication mechanisms Field buses
Abstraction platforms for the development of embedded systems	OSGI Android MAEMO
Communication with sensors and actuators	I/O Hardware Coping with concurrency The Analog/Digital interface

Planning

	Class hours	Hours outside the classroom	Total hours
Presentations / exhibitions	1	5	6
Laboratory practises	14	0	14
Group tutoring	6	10	16
Integrated methodologies	0	55	55
Master Session	19	38	57
Short answer tests	2	0	2

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

Methodologies

	Description
Presentations / exhibitions	Presentation by the students of the developed projects results. Competencies A4, A9, A96 and A97 will be practised.
Laboratory practises	Development by the students of guided and supervised assignments in the laboratory. Competencies A3, A4, A96 and A97 will be practised.
Group tutoring	Meetings of the professors with the students for tracking the current status and further planning the project activities. Competencies A4, A9, A96 and A97 will be practised.
Integrated methodologies	We use learning projects based training: the students carry out a project along the semester to resolve a complex problem by means of planning, design and implementation of a series of activities. Competencies A3, A4, A9, A96 and A97 will be practised.
Master Session	Professors present the main theoretical contents related to embedded systems with real-time restrictions. Competencies A3, A96 and A97 will be practised.

Personalized attention

Methodologies	Description
Master Session	 The professors of the subject will provide individual attention to the students during the, solving their doubts and questions. In addition, the professors will advise and guide the students during the realization of their tasks.
Laboratory practises	 The professors of the subject will provide individual attention to the students during the, solving their doubts and questions. In addition, the professors will advise and guide the students during the realization of their tasks.
Group tutoring	 The professors of the subject will provide individual attention to the students during the, solving their doubts and questions. In addition, the professors will advise and guide the students during the realization of their tasks.
Integrated methodologies	 The professors of the subject will provide individual attention to the students during the, solving their doubts and questions. In addition, the professors will advise and guide the students during the realization of their tasks.

Assessment

	Description	Qualification

Presentations / exhibitions	Once their project is implemented, the students will perform a public presentation of its design, development and results, having to answer successfully to questions. Competencies A4, A9 and A96 will be evaluated.	10
Laboratory practises	The students will fill questionnaires to asses the correct realization and understanding of the laboratory tasks. Competencies A3, A4, A96 and A97 will be evaluated	10
Group tutoring	A continuous tracking of the design and evolution of the implementation will be held during the realization of the project. Periodically, the students will present the state and results of their projects, as well as the scheduled taskss. Competencies A4, A9, A96 and A97 will be evaluated	10
Integrated methodologies	The students will be divided in groups for accomplishing the design, implementation and proof of an embedded system. The result will be evaluated after the his delivery, assessing aspects such as correction, quality, performance and functionalities. Competencies A3, A4, A9, A96 and A97 will be evaluated	30
Short answer tests	Students will be evaluated to asses what they have learned in master sessions. Competencies A4, A96 and A97 will be evaluated	40

Other comments on the Evaluation

In order to pass the course it is necessary to complete the different parts of the subject (master sessions, practices in labs, and projects). The final grade will be the **weighted geometric mean** of the grades of the different parts (i.e. it is not possible to pass the subject with a zero in one part). If "x" is the grade obtained for the master sessions, "y" for the practices in labs, and "z" for the project, the final grade will be: grade = x^0.4*y^0.1*z^0.5

During the first month, students must declare if they opt for continuous or final assessment. Students who select continuous assessment and submit the first task or questionnaire may not be listed as "Absent".

Students who opt for the final assessment procedure must pass the short answer test (40%), submit a project (50%) and submit the laboratory practises (10%). These parts will be evaluated as indicated in the tests description section. The final grade will be the **weighted geometric mean** of the grades of the different parts. Besides, they must submit an additional dossier with detailed information about the events and issues that arose during the execution of the different tasks, and especially the project. In addition, during the first month of the course, professors will notify students who opted for final assessment if they have to do the tutored work individually.

Second opportunity to pass the course

The end of course exam will only be held by students who failed the end of semester exams.

In order to pass the course it is necessary to complete the different parts of the subject: pass the short answer test (40%), submit a project (50%) and submit the laboratory practises (10%). These parts will be evaluated as indicated in the tests description section. The final grade will be the **weighted geometric mean** of the grades of the different parts. Besides, it will be necessary to submit an additional dossier with detailed information about the events and issues that arose during the execution of the different tasks, and especially the project.

Students that have opted by the continuous assessment procedure, can decide to maintain the grades of the parts they have already passed in the first opportunity or discard them.

Other comments

The grades obtained are only valid for the current academic year.

The use of any material during the tests will have to be explicitly authorized.

Sources of information

A. Burns & A. Wellings, **istemas de Tiempo Real y Lenguajes de Programación**, 3,

E.A. Lee & S.A. Seshia, **Introduction to Embedded Systems**, 1,

P. Marwedel, **Embedded System Design**, 2,

P. Barry & P. Crowley, **Modern Embedded Computing**, 1,

S. Barrett & J. Kridner, **Bad to the Bone: Crafting Electronics Systems with Beaglebone and BeagleBone Black**, 1,

Recommendations

Subjects that it is recommended to have taken before

IDENTIFYING DATA				
New Telematic Services				
Subject	New Telematic Services			
Code	V05G300V01945			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Llamas Nistal, Martín			
Lecturers	Álvarez Sabucedo, Luis Modesto Llamas Nistal, Martín			
E-mail	martin@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The overall objective of the course is that students gain a global vision of the new technologies in the field of telematic services. Thus the contents of this course will be open and try to gradually adapt to technological developments in this field. At first we focus on semantic technologies.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A98	(CE89/OP32) The ability to design and construct new computer services.

Learning aims	
Expected results from this subject	Training and Learning Results
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
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
(CE89/OP32) The ability to design and construct new computer services.	A98

Contents	
Topic	
Information Retrieval.	Algorithms and classic applications. Algorithms based on links. Applications to social networks.
Structure of a typical search engine.	Basic architecture of a search engine. Description and objectives of each of the modules.
Introduction to semantic web.	Metadata, RDF. Examples of metadata: LOM and Dublin Core.
Semantic web and related technologies.	Semantic Web languages and tools:OWL, and SPARQL. Vocabularies, Taxonomies and Ontologies. Folksonomies.
e-technologies	e-learning, e-government and e-health

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	16	40	56
Laboratory practises	14	28	42
Case studies / analysis of situations	5	25	30
Introductory activities	3	6	9
Jobs and projects	1	3	4
Jobs and projects	1	4	5
Long answer tests and development	2	2	4

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

Methodologies	
	Description
Master Session	Theoretical contents and their practical application will be presented during the lectures. Student are expected to play an active role during lectures.
Laboratory practises	During practical sessions, it will be developed a semantic project with the support of adhoc software tools.
Case studies / analysis of situations	Use cases will presented to the students. Thus, they will be able to analyze and to study them in depth in order to prepeare their academic projects.
Introductory activities	Program of the subject will be presented along with the methodologies used, the classroom, practical contents, final project, final and continuous evaluation criteria, and, in general, all aspects of the subject.

Personalized attention	
Methodologies	**Description**
Master Session	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor□s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Laboratory practises	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor□s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Case studies / analysis of situations	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor□s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Tests	**Description**
Jobs and projects	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor□s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Jobs and projects	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor□s office at hours established by the professor for this purpose at the beginning of the semester and published online.
Long answer tests and development	In the tutorial class, all questions related to practices, problem solving sessions and lectures will be tackled. Through continuous evaluation, students with non optimal performance will be identifed. In order to tackle those issues, some procedures will be launched such as call for mentoring and analyzing the reasons that are ledding to these bad results, and to search for solutions. Students will have the opportunity to attend personal tutorials in the professor□s office at hours established by the professor for this purpose at the beginning of the semester and published online.

Assessment		
	Description	Qualification
Jobs and projects	-It consists of the presentation of a practical project using semantics. -It will take place at about the 11th week of the course. - Competencies A4, A9 and A98 are evaluated.	30

Jobs and projects	- It consists of the presentation of a project covering all telematics solution. - It will take place at the end of the course. - Competencies A4, A9 and A98 are evaluated.	30
Long answer tests and development	- It will cover all the theoretical contents. - It will take place on the 8th week of the course. - A4 competence is evaluated.	40

Other comments on the Evaluation

1. Continuous assessment

The course can be passed with full marks from continuous assessment, with no need to sit the final exam.

Students who sit any of the assessment tests may not be listed as "Not Present".

The weighting and content of each continuous assessment test are as follows:

Assessment 1 (40%):

· All theoretical contents.

· It will take place about the 8th week of the course.

Assessment 2 (30%):

· It will consist of the presentation of a semantic project (specified in due course).

· It will take place about the 11th week of the course.

Assessment 3 (30%):

· It will consist of a presentation of a holistic project involving telematic based services

· At the end of the course.

It is mandatory to pass each part of the continuous assessment (that is, the minimum score of each part must be 5 out of 10)

The course may be passed only with continuous assessment. Those students who failed the first assessment are allowed to compensate it in the final exam.

2. Final exam

· There is a final exam at the end of the semester and another at the end of the course. All content presented along the course is included in this exam.

· Students sitting this final exam will be asked to submit in advance some works to be done according to specific instructions on each call. These works must be original and will involve task related to assessments 2 and 3. Should the work not be original, the student will be banned from the entire course.

· The pass mark for this test is 5 out of 10.

Sources of information

R. Baeza-Yates y B. Ribeiro-Neto., **R. Baeza-Yates y B. Ribeiro-Neto. "Modern Information Retrieval".**, R. Baeza-Yates y B. Ribeiro-Neto. "Modern Information Retrieval". Addison Wesley.,

Gómez-Pérez, A.; Fernández-López, M.; Corcho, O, **Ontological Engineering**, Springer-Verlag,

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- S. Chakrabarti, B. Dom, D. Gibson, J. Kleinberg, P. Raghavan, and S. Rajagopalan. Automatic resource compilation by analyzing hyperlink structure and associated text. In *Proceedings of the 7th World-wide web conference (WWW7)*, 1998. Online at http://www7.scu.edu.au/1898/com1898.htm.
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Conference, Brisbane, Australia, April 1998. Online at http://www7.scu.edu.au/1921/com1921.htm and http://infolab.stanford.edu/~backrub/google.html

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- Deborah L. McGuinness. "Ontologies Come of Age." http://www.ksl.stanford.edu/people/dlm/papers/ontologies-come-of-age-mit-press-(with-citation).htm
- Grigoris Antoniou and Frank van Harmelen. "Web Ontology Language: OWL". http://www.cs.vu.nl/~frankh/postscript/OntoHandbook03OWL.pdf
- RDF web-site: http://w3c.org/RDF
- Dublín Core web-site: http://dublincore.org
- LOM web-site: http://ltsc.ieee.org/wg12. Standard available on http://ltsc.ieee.org/wg12/files/LOM_1484_12_1_v1_Final_Draft.pdf
- Semantic Web Activity web-site : http://www.w3.org/2001/sw/

Recommendations

IDENTIFYING DATA				
External placements: Placements in Companies I				
Subject	External placements: Placements in Companies I			
Code	V05G300V01981			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language				
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)Estancia nunha empresa desenvolvendo funcións propias dun/a Enxeñeiro/a Técnico/a de Telecomunicación relacionadas co perfil profesional cursado polo alumno (Sistemas de Telecomunicación, Telemática, Sistemas Electrónicos ou Son e Imaxe) e supervisado por profesorado do Centro e persoal da empresa.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A30	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
A31	CE22/ST2 The ability of applying the basic techniques of telecommunication networks, services and applications for mobile and fixed environments, personal, local or long distance, with different bandwidth, including telephony, radio broadcasting, TV and data, from the point of view of transmission systems.
A32	CE23/ST3 The ability to analyze the components and their specifications for guided and non-guided communications systems
A33	CE24/ST4 The ability to select circuits, subsystems and systems of radiofrequency, microwaves, broadcasting, radio link and radio determination.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.
A35	CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques.
A36	CE27/TEL1The ability to construct, operate and manage telecommunication networks, services, processes and applications considered as systems to receive, transport, represent, process, store, manage and present multimedia information from the computer services point of view.
A37	CE28/TEL2 The ability to apply the techniques that are basis of computer networks, services and applications, such as management, signaling and switching, routing and securing systems (cryptographic protocols, tunneling, firewalls, charging mechanisms, authentication and content protection) traffic engineering (graph theory, queuing theory and teletraffic) rating, reliability and quality of service in both fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.
A38	CE29/TEL3 The ability to build, operate and manage computer services using planning, sizing and analytical tools
A39	CE30/TEL4 The ability to describe, program, assess and optimize communication protocols and interfaces at different network architecture layers .
A40	CE31/TEL5 The ability to follow the technological progress of transmission, switching and processing to improve computer networks and services.
A41	CE32/TEL6 The ability to design networks and service architectures.
A42	CE33/TEL7 The ability to program network and distributed applications and services.
A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A44	CE35/SI2 The ability to analyze, specify, carry out and maintain systems, equipments, heads and installations of TV, audio and video for mobile and fixed environments.

A45	CE36/SI3 The capacity to implement projects at places and installations for the production and recording of audio and video signals.
A46	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.
A47	CE38/SI5 The ability to create, modify, manage, broadcast and distribute multimedia contents taking into account the use and accessibility criteria to audiovisual, broadcasting and interactive services.
A48	(CE39/SE1): The ability to construct, exploit and manage the receiving, transporting, representation, processing, storage, manage and presentation multimedia information from the electronic systems point of view.
A49	(CE40/SE2): The ability to select electronic circuits and devices specialized in transmission, forwarding or routing, and terminals for fixed and mobile environments.
A50	(CE41/SE3):The ability to make the specification, implementation, documenting and tuning of electronic systems and equipment (both instrumentation and control oriented), considering the corresponding technical aspects and the regulations.
A51	(CE42/SE4): The ability to apply electronics as support technology in other fields and activities and not only in information and communication technologies.
A52	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
A54	(CE45/SE7): The ability to design interface, data capturing and storage devices, and terminals for services and telecommunication systems.
A55	(CE46/SE8): The ability to specify and use electronic instrumentation and measurement systems.
A56	(CE47/SE9): The ability to analyze and solve interference and electromagnetic compatibility problems .
B3	The development of discussion ability about technical subjects
B4	The ability to use software tools that support problem solving in engineering

Learning aims

Expected results from this subject	Training and Learning Results	
(*)	A4	B3
	A5	B4
	A30	
	A31	
	A32	
	A33	
	A34	
	A35	
	A36	
	A37	
	A38	
	A39	
	A40	
	A41	
	A42	
	A43	
	A44	
	A45	
	A46	
	A47	
	A48	
	A49	
	A50	
	A51	
	A52	
	A54	
	A55	
	A56	

Contents

Topic
(*)A definir polo titor da empresa e o titor académico.

Planning

	Class hours	Hours outside the classroom	Total hours
External practises	147	0	147

Reports / memories of internships or practicum	0	3	3

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

Methodologies

	Description
External practises	(*)Estancia nunha empresa desenvolvendo funcións propias dun Enxeñeiro/a Técnico/a de Telecomunicación con perfil determinado pola tecnoloxía que estudase o alumno (Sistemas de Telecomunicación, Sistemas Electrónicos, Telemática ou Son e Imaxe)

Personalized attention

Methodologies	Description
External practises	

Assessment

	Description	Qualification
External practises	(*)Valorarase tanto a aptitude como a actitude do alumno no desenvolvemento das actividades encomendadas.	90
Reports / memories of internships or practicum	(*)A memoria presentada polo alumno deberá axustarse ás indicacións recollidas nas normativas de prácticas en empresa vixentes (Universidade de Vigo e interna do grao en Enxeñaría de Tecnoloxías de Telecomunicación).	10

Other comments on the Evaluation

Sources of information

Recommendations

IDENTIFYING DATA				
External placements: Placements in Companies II				
Subject	External placements: Placements in Companies II			
Code	V05G300V01982			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language				
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)Estancia nunha empresa desenvolvendo funcións propias dun/a Enxeñeiro/a Técnico/a de Telecomunicación relacionadas co perfil profesional cursado polo alumno (Sistemas de Telecomunicación, Telemática, Sistemas Electrónicos ou Son e Imaxe) e supervisado por profesorado do Centro e persoal da empresa.			

Competencies	
Code	
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A30	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
A31	CE22/ST2 The ability of applying the basic techniques of telecommunication networks, services and applications for mobile and fixed environments, personal, local or long distance, with different bandwidth, including telephony, radio broadcasting, TV and data, from the point of view of transmission systems.
A32	CE23/ST3 The ability to analyze the components and their specifications for guided and non-guided communications systems
A33	CE24/ST4 The ability to select circuits, subsystems and systems of radiofrequency, microwaves, broadcasting, radio link and radio determination.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.
A35	CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques.
A36	CE27/TEL1The ability to construct, operate and manage telecommunication networks, services, processes and applications considered as systems to receive, transport, represent, process, store, manage and present multimedia information from the computer services point of view.
A37	CE28/TEL2 The ability to apply the techniques that are basis of computer networks, services and applications, such as management, signaling and switching, routing and securing systems (cryptographic protocols, tunneling, firewalls, charging mechanisms, authentication and content protection) traffic engineering (graph theory, queuing theory and teletraffic) rating, reliability and quality of service in both fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.
A38	CE29/TEL3 The ability to build, operate and manage computer services using planning, sizing and analytical tools
A39	CE30/TEL4 The ability to describe, program, assess and optimize communication protocols and interfaces at different network architecture layers .
A40	CE31/TEL5 The ability to follow the technological progress of transmission, switching and processing to improve computer networks and services.
A41	CE32/TEL6 The ability to design networks and service architectures.
A42	CE33/TEL7 The ability to program network and distributed applications and services.
A43	CE34/SI1The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services.
A44	CE35/SI2 The ability to analyze, specify, carry out and maintain systems, equipments, heads and installations of TV, audio and video for mobile and fixed environments.

A45	CE36/SI3 The capacity to implement projects at places and installations for the production and recording of audio and video signals.
A46	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.
A47	CE38/SI5 The ability to create, modify, manage, broadcast and distribute multimedia contents taking into account the use and accessibility criteria to audiovisual, broadcasting and interactive services.
A48	(CE39/SE1): The ability to construct, exploit and manage the receiving, transporting, representation, processing, storage, manage and presentation multimedia information from the electronic systems point of view.
A49	(CE40/SE2): The ability to select electronic circuits and devices specialized in transmission, forwarding or routing, and terminals for fixed and mobile environments.
A50	(CE41/SE3):The ability to make the specification, implementation, documenting and tuning of electronic systems and equipment (both instrumentation and control oriented), considering the corresponding technical aspects and the regulations.
A51	(CE42/SE4): The ability to apply electronics as support technology in other fields and activities and not only in information and communication technologies.
A52	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
A54	(CE45/SE7): The ability to design interface, data capturing and storage devices, and terminals for services and telecommunication systems.
A55	(CE46/SE8): The ability to specify and use electronic instrumentation and measurement systems.
A56	(CE47/SE9): The ability to analyze and solve interference and electromagnetic compatibility problems .
B3	The development of discussion ability about technical subjects
B4	The ability to use software tools that support problem solving in engineering

Learning aims

Expected results from this subject	Training and Learning Results	
(*)	A4	B3
	A5	B4
	A30	
	A31	
	A32	
	A33	
	A34	
	A35	
	A36	
	A37	
	A38	
	A39	
	A40	
	A41	
	A42	
	A43	
	A44	
	A45	
	A46	
	A47	
	A48	
	A49	
	A50	
	A51	
	A52	
	A54	
	A55	
	A56	

Contents

Topic
(*)A definir por el tutor de la empresa y el tutor académico.

Planning

	Class hours	Hours outside the classroom	Total hours
External practises	147	0	147

Reports / memories of internships or practicum	0	3	3

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

Methodologies

	Description
External practises	(*)Estancia nunha empresa desenvolvendo funcións propias dun Enxeñeiro/a Técnico/a de Telecomunicación con perfil determinado pola tecnoloxía que estudase o alumno (Sistemas de Telecomunicación, Sistemas Electrónicos, Telemática ou Son e Imaxe)

Personalized attention

Methodologies	Description
External practises	

Assessment

	Description	Qualification
External practises	(*)Valorarase tanto a aptitude como a actitude do alumno no desenvolvemento das actividades encomendadas.	90
Reports / memories of internships or practicum	(*)A memoria presentada polo alumno deberá axustarse ás indicacións recollidas nas normativas de prácticas en empresa vixentes (Universidade de Vigo e interna do grao en Enxeñaría de Tecnoloxías de Telecomunicación).	10

Other comments on the Evaluation

Sources of information

Recommendations

IDENTIFYING DATA				
Final Degree Work				
Subject	Final Degree Work			
Code	V05G300V01991			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	12	Mandatory	4th	2nd
Teaching language				
Department				
Coordinator	Cuiñas Gómez, Íñigo			
Lecturers	Cuiñas Gómez, Íñigo			
E-mail	inhigo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)O Traballo de Fin de Grao (TFG) forma parte, como módulo, do plan de estudos do título de Grao en Enxeñaría de Tecnoloxías de Telecomunicación. É un traballo orixinal e persoal que cada estudiante realizará de forma autónoma baixo titorización docente, e debe permitirlle amosar de forma integrada a adquisición dos contidos formativos e as competencias asociadas ao título. Su definición y contenidos están explicados de forma más extensa en la normativa para la realización del Trabajo de Fin de Grado aprobada por la Comisión Académica de Grado, en sesión celebrada el 3/4/2013, cuyo contenido se puede consultar en la web de la Escuela de Ingeniería de Telecomunicación.			

Competencies	
Code	
A1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
A99	(CE90/TFG)Original and individual exercise to be defended before an examining board consisting of a project in a specific technology of Telecommunication Engineering and of a professional nature, where the abilities acquired from the teachings are integrated and synthesized.
B5	The ability to use software tools to search for information or bibliographical resources

Learning aims		
Expected results from this subject	Training and Learning Results	
Search, management and structuring of information on any topic	A2	B5
Development and writing of a project document which are collected: history, state of the art or problematic, objectives, project phases, project development, conclusions and future lines.	A9 A99	
Prototyping, programming simulation software, etc., according to specifications.	A4 A9 A99	
CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.	A1	

Contents	
Topic	
The contents of each TFG will be defined in individual proposals offered by tutors and approved by the Academic Degree Commission under the rules for carrying out the Final Project Work, which content is available on the website of the School of Telecommunication Engineering.	Each TFG will have different contents

Planning

	Class hours	Hours outside the classroom	Total hours
Previous studies / activities	0	20	20
Integrated methodologies	0	20	20
Presentations / exhibitions	0	8	8
Tutored works	20	200	220
Jobs and projects	2	10	12

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

Methodologies

	Description
Previous studies / activities	Search, read and work documentation, troubleshooting suggestions and / or exercises to be performed in the classroom and / or laboratory ... independently by students.
Integrated methodologies	The student presents the results obtained in the preparation of a document on the subject matter. It will be carried out individually, and both in writing (memory) and orally.
Presentations / exhibitions	Students must prepare and defend the work in front of a jury.
Tutored works	The student, individually, produces a paper on the subject matter, or he/she prepares seminars, research, memoirs, essays, summaries, etc.

Personalized attention

Methodologies	Description
Tutored works	Each tutor will devote some time to personally respond to each student work to grade their dependents, to guide their work and guide the learning process, and to review and correct memory and oral presentation.

Assessment

	Description	Qualification
Jobs and projects	A panel of three teachers for each of the mentions of the Degree shall be appointed. The evaluation was carried out according to the rules for carrying out the Final Year Work and assessment rubric approved by the Academic Degree Committee, which contents are available on the website of the school of Telecommunication Engineering.	100

Other comments on the Evaluation

All information related to the TFG is available on the website of the School of Telecommunication Engineering at the following link:

http://www.teleco.uvigo.es/index.php/es/estudios/gett/planificacion-academica/tfg

Sources of information

The bibliography will be specific to each individual proposed work.

Recommendations

Other comments

Having passed all necessary subjects to obtain the Bachelor degree except the TFG, or enroll simultaneously in all subjects.

IDENTIFYING DATA				
Credits obtanied in the Framework of Mobility Programmes				
Subject	Credits obtanied in the Framework of Mobility Programmes			
Code	V05G300V01R02			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	0	Optional	4th	1st
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

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