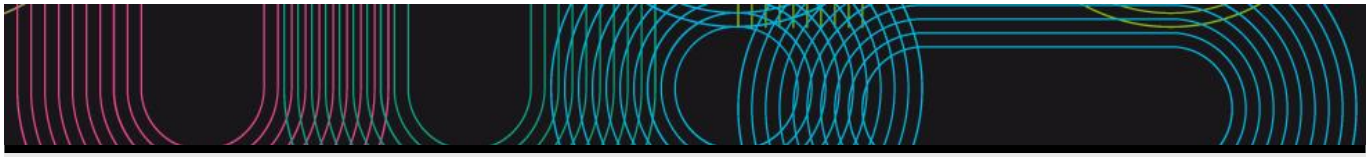

Escola de Enxeñaría de Telecomunicación

(*)Páxina web

(*)

www.teleco.uvigo.es

(*)Presentación

The School of Telecommunication Engineering (EET) is a higher education school of the University of Vigo that offers Bachelor's degrees, Master's degrees and Doctoral programs in the fields of Telecommunications Engineering.

Bachelor's Degree in Telecommunication Technologies Engineering (EUR-ACE®).

The mail goal of the Bachelor's Degree in Telecommunication Technologies Engineering is to form professionals at the forefront of technological knowledge and professional competences in telecommunication engineering. This Bachelor has been recognized with the best quality seals, like the EUR-ACE's. **It has a bilingual option: up to 80% of the degree credits can be taken in English**.

http://teleco.uvigo.es/images/stories/documentos/gett/degree_telecom.pdf

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

Master in Telecommunication Engineering

The Master in Telecommunication Engineering is a Master's degree that qualifies to exercise the profession of Telecommunication Engineer, in virtue of the established in the Order CIN/355/2009 of 9 of February.

http://teleco.uvigo.es/images/stories/documentos/met/master_telecom_rev.pdf

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

Interuniversity Masters

The current academic offer includes interuniversity master's degrees that are closely related to the business sector:

Master in Cybersecurity: www: https://www.munics.es/

Master in Industrial Mathematics: www: http://m2i.es

International Master in Computer Vision: www: https://www.imcv.eu/

(*)Equipo directivo

MANAGEMENT TEAM

Directora: Rebeca Pilar Díaz Redondo (teleco.direccion@uvigo.gal)

Secretaría e Subdirección de Novas Titulacións: Pedro Rodríguez Hernández

(teleco.subdir.secretaria@uvigo.gal;teleco.subdir.novastitulacions@uvigo.gal)

Subdirección de Organización Académica: Pedro Comesaña Alfaro (teleco.subdir.academica@uvigo.gal)

Subdirección de Relaciones Internacionais e Subdirección de Infraestructuras: María Verónica Santalla del

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Subdirección de Calidade: Ana María Cao Paz(teleco.subdir.calidade@uvigo.gal)

BACHELOR□SDEGREE IN TELECOMMUNICATION TECHNOLOGIES ENGINEERING

Generalcoordinator: Lucía Costas Pérez (teleco.grao@uvigo.gal)

https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-gett/

MASTER IN TELECOMMUNICATION ENGINEERING

Generalcoordinator: Manuel García Sánchez (teleco.master@uvigo.gal)

https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-met/

MASTER INCYBERSECURITY

General coordinator:Ana Fernández Vilas (teleco.munics@uvigo.gal)

https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-munics/

MASTER ININDUSTRIAL MATHEMATICS

Generalcoordinator: Elena Vázquez Cendón (USC)

UVigo coordinator:José Durany Castrillo (durany@dma.uvigo.es)

http://www.m2i.es/?seccion=coordinacion

INTERNATIONALMASTER IN COMPUTER VISION

General coordinator: Xose Manuel Pardo López (USC)

UVigo coordinator:José Luis Alba Castro (jalba@gts.uvigo.es)

https://www.imcv.eu/legal-notice/

MASTER'S DEGREE IN QUANTUM INFORMATION SCIENCE AND TECHNOLOGIES (MQIST)

General coordinator: Javier Mas (USC)

Coordinador UVIGO: Manuel Fernández Veiga(teleco.mqist@uvigo.es)

https://quantummastergalicia.es/info

Grado en Ingeniería de Tecnologías de Telecomunicación

Subjects			
Year 2nd			
Code	Name	Quadmester	Total Cr.
V05G301V01201	Physics: Fundamentals of electronics	1st	6
V05G301V01202	Physics: Fields and Waves	1st	6
V05G301V01203	Digital electronics	1st	6
V05G301V01204	Data Communication	1st	6
V05G301V01205	Digital Signal Processing	1st	6

V05G301V01206	Electronic technology	2nd	6
V05G301V01207	Electromagnetic Transmission	2nd	6
V05G301V01208	Signal Transmission and Reception Techniques	2nd	6
V05G301V01209	Fundamentals of Sound and Image	2nd	6
V05G301V01210	Computer Networks	2nd	6

IDENTIFYING DATA				
Physics: Fundamentals of electronics				
Subject	Physics: Fundamentals of electronics			
Code	V05G301V01201			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	2nd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Domínguez Gómez, Miguel Ángel			
Lecturers	Domínguez Gómez, Miguel Ángel Rodríguez Pardo, María Loreto			
E-mail	mdgomez@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The main purpose of this course is to provide students the basis for understanding and mastery of the principles of operation of devices and electronic circuits. It begins with a brief introduction to electronics in order to provide students with a global vision. After, basic concepts about devices and electronic circuits are taught: · Diodes and circuits with diodes, including concepts such as load line, ideal diodes, rectifiers, shaping circuits, logic circuits, voltage regulators and devices physics. · Characteristics of bipolar transistors, analysis of load line, large-signal models, polarization, amplification and small-signal equivalent circuits. · Study of the FET similar to the previous highlighting the MOSFET. · Check the circuit designs studied using SPICE. Mounting and verification using laboratory electronic instrumentation. · Basic concepts about logic digital circuits. On the other hand, in the framework of the course it takes place the first contact of students with the electronics labs. Therefore, the main objective of the practical part of the course is for students to acquire the bases for a correct management of the most common instruments in the laboratories of electronics. At the end of the course the student must know how to handle the laboratory instruments, distinguish and characterize the different components, and have practical skills in assembly and measurement. Students will also start with simulation of circuits, in order to introduce them to computer-aided design. English Friendly subject. International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B13	CG13 The ability to use software tools that support problem solving in engineering.
C4	CE4/FB4: Comprehension and command of basic concepts in linear systems and their related functions and transforms; electric circuits theory, electronic circuits, physical principles of semiconductors and logical families, electronic and photonic devices, materials technology and their application to solve Engineering problems.

Expected results from this subject		Training and Learning Results
Understanding and control of the basic concepts of the physical principles of semiconductors.		C4
Understanding and control of the basic concepts of operation of the electronic and photonic devices.		C4
Understanding and control of simple electronic circuits based on the electronic and photonic devices and their applications.		C4
Understanding and control of the basic concepts of the logic families.		C4
Basic knowledges on CAD (Computer Aided Design) tools for the simulation of electronic circuits.	B13	
Capacity utilization of CAD tools for designing simple electronic circuits.	B13	

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

Subject 2: Diodes and circuits with diodes	Characteristics of the diode. Zeners. Analysis of the load line. Ideal model of the diode. Circuits with diodes (rectifiers, clipping and voltage regulator circuits). Small signal equivalent linear circuits. Basic concepts of semiconductors. Physics of the diode. Capacity effects. LED and laser diodes. Photodiodes.
Subject 3: Principles of amplification	General aims: Voltage, current and power gains. Ideal amplifier. Amplifier Models. Limits. Introduction to amplifier frequency response.
Subject 4: Bipolar Junction Transistors (BJT)	Operation of the npn Bipolar Junction Transistor (BJT). Load-Line Analysis of a Common-Emitter Amplifier. The pnp Bipolar Junction Transistor. Models of circuits. Analysis of circuits with BJTs. Phototransistors and optocouplers.
Subject 5: Analysis of amplifiers with Bipolar Junction Transistors	Small-Signal Equivalent Circuits. Analysis in medium frequencies: the Common-Emitter amplifier, the Emitter-Follower amplifier, the Common-Collector amplifier and the Common-Base amplifier.
Subject 6: Field Effect Transistors (FET)	NMOS Transistor. Analysis of the load line of a simplified NMOS amplifier. Polarization circuits. JFET and depletion MOSFET transistors and channel p devices.
Subject 7: Analysis of amplifiers with Field Effect Transistors	Small-Signal Equivalent Circuits. Analysis in medium frequencies: the Common-Source amplifier and the Source Follower amplifiers.
Subject 8: Digital logic circuits	Digital logic circuits. Basic concepts. Electrical specifications of the logic gates. The inverter CMOS. CMOS gates NOR and NAND.
Practice 1: Introduction to the simulation	Simulation of electronic circuits with OrCAD.
Practice 2: Instrumentation I	Use of the voltage source, function generator and multimeter.
Practice 3: Instrumentation II	Use of digital oscilloscope.
Practice 4: Simulation of circuits with diodes	Simulation of circuits with diodes using OrCAD.
Practice 5: Implementation of circuits with diodes	Implementation of circuits with diodes in protoboard and checking of operation using the laboratory instrumentation.
Practice 6: Simulation of circuits with bipolar transistors	Simulation of circuits with bipolar transistors using OrCAD.
Practice 7: Implementation of circuits with bipolar transistors	Implementation of circuits with bipolar transistors in protoboard and checking of operation using laboratory instrumentation.
Practice 8: Simulation of circuits with field effect transistors	Simulation of circuits with field effect transistors using OrCAD.
Practice 9: Implementation of circuits with field effect transistors	Implementation of circuits with field effect transistors in protoboard and cheking of operation using laboratory instrumentation.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	1	2
Lecturing	16	27	43
Problem solving	16	36	52
Laboratory practical	22	20	42
Problem and/or exercise solving	2	0	2
Problem and/or exercise solving	2	0	2
Problem and/or exercise solving	2	0	2
Laboratory practice	1	0	1
Laboratory practice	1	0	1
Self-assessment	0	3	3

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

Methodologies

	Description
Introductory activities	Presentation of the subject. Presentation of the laboratory practices and the instrumentation and software to be used.Through this methodology the competencies B13 and C4 are developed.
Lecturing	Exposition of contents. Later personal work of the student reviewing the concepts seen in the classroom and preparing the subjects using the proposed bibliography. Identification of doubts that require to be resolved in personal tutorships. Through this methodology the competency C4 is developed.
Problem solving	Activity to formulate and resolve problems and/or exercises related with the subject. Complement of the theoretical sessions. Personal work of the student with resolution of problems and/or exercises proposed in the classroom and extracted of the bibliography. Identification of doubts that require to be resolved in personal tutorships. Through this methodology the competency C4 is developed.

Laboratory practical	Activities of application of the theoretical knowledges. It will learn to handle the typical instrumentation of an electronic laboratory and it will implement basic electronic circuits seen in the theoric sessions. Also they will purchase skills of handle of simulation tools. Personal work of the student preparing the practices using the available documentation and reviewing the theoretical concepts related. Development and analysis of results. Identification of doubts that require to be resolved in personal tutorships.Through this methodology the competency B13 is developed. Software to be used: OrCAD software for students.

Personalized assistance

Methodologies	Description
Lecturing	The students will be able to have personalised tutorials in the schedule that the professors will establish and will publish in the web page of the subject (https://moovi.uvigo.gal/). Here, they will be able to resolve their doubts about the contents given in the Master Sessions and will be oriented about how to deal with them.
Problem solving	The students will be able to have personalised tutorials in the schedule that the professors will establish and will publish in the web page of the subject (https://moovi.uvigo.gal/). Here, they will be able to resolve their doubts about the problems and/or exercises proposed and resolved in the classroom as well as other problems and/or exercises that can appear along the study of the subject.
Laboratory practical	The students will be able to have personalised tutorials in the schedule that the professors will establish and will publish in the web page of the subject (https://moovi.uvigo.gal/). Here, they will be able to resolve their doubts about the development of the laboratory practices, the handle of the instrumentation, the setting of the electronic circuits and the software of simulation.

Assessment

	Description	Qualification	Training and Learning Results	
Problem and/or exercise solving	Test will be carried out in the classroom throughout the year to evaluate the competencies of the student to resolve problems and/or the exercises over the first part of the contents of the subject. These may be test type and/or questions and/or exercices.	20		C4
Problem and/or exercise solving	Test will be carried out in the classroom throughout the year to evaluate the competencies of the student to resolve problems and/or the exercises over the second part of the contents of the subject. These may be test type and/or questions and/or exercices.	20		C4
Problem and/or exercise solving	Test will be carried out in the classroom throughout the year to evaluate the competencies of the student to resolve problems and/or the exercises over the third part of the contents of the subject. These may be test type and/or questions and/or exercices.	20		C4
Laboratory practice	Test will be carried out in the laboratory along the course about management of instrumentation, mounting of electronic circuits and simulation. The skills acquired by the student about the contents of the subject laboratory practices will be evaluated.	17.5	B13	C4
Laboratory practice	Test will be carried out in the laboratory along the course about management of instrumentation, mounting of electronic circuits and simulation. The skills acquired by the student about the contents of the subject laboratory practices will be evaluated.	17.5	B13	C4
Self-assessment	Techniques aimed to collect data about the participation of the student in the proposed self-assessment tests.	5		

Other comments on the Evaluation

1. Ordinary exam (continuous assessment)

A system of continuous assessment will be offered to the students following the guidelines of the bachelor and the agreements of the academic commission. Students who take some of the tests of problem and/or exercise solving or laboratory practice deem to opt for continuous assessment. Those students who take any of those tests deem to renounce to the continuous assessment and they will have the possibility to take the global assessment. Students who have opted for continuous assesment and have not passed the subject can take to the global assesment. Students who do not follow the continuous assessment and do not take the global assessment will be considered "not presented".

1.a Self-assessment tests

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

(AE).

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

NAE = 0.05*AE

1.b Theory

Students will carry out 3 exams (multiple choice test and/or short answer test and/or resolution of problems and/or exercises) properly programmed along the course (PT1, PT2 and PT3). The schedule of these exams will be approved in "CAG" (Degree Academic Commission) and will be made public at te beginning of the corresponding term. PT1 will be about themes 1 and 2 (block 1), PT2 about themes 3, 4 and 5 (block 2) and PT3 about themes 6, 7 and 8 (block 3). These exams will be valued from 0 up to 10 and the final mark will be the average (NPT -> Mark of theory exams):

NPT = (NPT1 + NPT2 + NPT3)/3

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

The final mark of theory (NT) will be:

NT = 0.6*NPT

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

1.c Practical

Attendance to practical sessions is not compulsory.

Students will carry out 2 practical tests properly programmed along the course. The schedule of these tests will be approved in "CAG" (Degree Academic Commission) and will be made public at te beginning of the corresponding term. These tests will be valued from 0 up to 10 and the final mark of the practical (NP) will be:

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

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

1.d Final mark of the subject

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

The final mark (NF) will be:

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

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

2. Ordinary exam (global assessment)

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

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

The practical exam will be carried out in the laboratory in the dates established by the School and it will consist in a practical test which will be evaluated from 0 up to 10 and the final mark of practices (NP) will be the points of the test multiplied by 0.4. It must get a minimum of 4 points out of 10 in the practical exam (NP >= 1.6) to pass the subject.

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

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

The final mark (NF) will be:

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

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

3. Extraordinary exam

It will have a theoretical part and practical one with the same format as the global assessment.

The students who take this call can only do the theoretical part, the practical one or both. They will keep the mark got in the ordinary exam (continuous or global assessment). The students who take the theoretical part will be able to carry out the blocks they want. The mark of the ordinary exam (continuous or global assessment) of the missed blocks will be kept. The calculation of the final mark of the subject will be as described in section 2.

The final mark of the subject will be the best of the ordinary and extraordinary exam.

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

4. End-of-program exam

This exam will be the same as the extraordinary examl.

5. Validity of the marks

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

If a cheating case is detected, the final mark will be FAIL (0) and the case will be communicated to the School Management.

Sources of information

Basic Bibliography

Hambley, A. R., **Electrónica**, 2ª ed., Prentice Hall, 2001

Hambley, Allan R., **Electronics**, 2nd ed., Prentice Hall, 2000

Quintáns Graña, Camilo, **Simulación de circuitos electrónicos con OrCAD 16 Demo**, Marcombo, 2008

Quintáns Graña, Camilo, **Simulación de circuitos electrónicos con OrCAD PSpice**, 2ª edición, Marcombo, 2021

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Electronic technology/V05G301V01206

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G301V01108

IDENTIFYING DATA				
Physics: Fields and Waves				
Subject	Physics: Fields and Waves			
Code	V05G301V01202			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Fraile Peláez, Francisco Javier			
Lecturers	Fraile Peláez, Francisco Javier Obelleiro Basteiro, Fernando Rubiños López, José Óscar			
E-mail	fj_fraile@com.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	Fields and Waves presents the first contact in the student's degree with the phenomena of electromagnetic waves, which are the physical medium for transmission of information at almost instantaneous speed. Mathematical modeling of electromagnetic fields that provide insights into the behavior of electromagnetic waves in real environments will be introduced. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
C1	CE1/FB1: The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial differential equations; numerical methods, numerical algorithms, statistics and optimization
C3	CE3/FB3: Comprehension and command of basic concepts about the general laws of mechanics, thermodynamics, electromagnetic fields and waves and electromagnetism and their application to solve Engineering problems.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

Expected results from this subject	Training and Learning Results		
New	B3	C1 C3	D3
Solve electrostatic and magnetostatic problems: capacity and self-induction.	B3	C1 C3	D3
Calculate the main parameters of electromagnetic waves: frequency, wavelength, propagation constant, polarization, Poynting vector, phase constant, attenuation constant	B3	C3	D3
Analyze the propagación of waves in media with and without losses.	B3	C3	D3
Analyze the incidence of waves over obstacles or discontinuities: decomposition in incident, reflected and transmitted waves.	B3	C3	D3

Contents	
Topic	
1. Vector and differential analysis of fields	1.1 Scalar and vector fields 1.2 Systems of coordinates in space 1.3 Vector Algebra 1.4 Integral operators 1.5 Differential operators 1.6 Properties of operators

2. Electrostatics	2.1 Electric charge 2.2 Electric field and its properties 2.3 Electric potential 2.4 Electric permitivity 2.5 Gauss law 2.6 Equations of Poisson and Laplace. Capacitance
3. Magnetostatics	3.1 Electric current 3.2 Magnetic field and its properties 3.3 Magnetic permeability 3.4 Ampere's Law 3.5 Self-induction
4. Maxwell model	4.1. Maxwell's equations in integral form 4.2. Differential form of Maxwell's equations 4.3. Boundary conditions 4.4. Harmonic time variation and phasor notation 4.5. Energy and power density
5. Fundamentals and characteristics of waves	5.1 Wave equation in the phasor domain 5.2 Solutions in rectangular coordinates 5.3 Wave parameters: frequency, wavelength, propagation constant and impedance of the medium. 5.4 Poynting vector and average power density 5.5 Progressive waves on lossy and lossless media 5.6 Polarization
6. Waves in the presence of obstacles	6.1 Wave incidence on conductors 6.2 Incidence on discontinuity between two media 6.3 Incident, reflected and transmitted wave 6.4 Standing wave diagram 6.5 Power transmission
P1. Vector algebra and coordinate systems.	Review of operations with vectors in space. Vector representation in the Cartesian, cylindrical and spherical systems. Differential elements of length, area and volume in the three systems.
P2. Electrostatics-I.	Integral of circulation of the electric field. The electric dipole. Linear, surface and volume densities of charge. Potential and electric field of charge distributions. Principle of superposition of sources Far field.
P3. Electrostatics-II.	Electric displacement vector flow. Application of Gauss's integral and differential theorem. Capacitors. Image theory.
P4. Magnetostatics.	Integration of surface and volumetric current densities. Magnetic field of current distributions. Principle of superposition of sources. Applications of Ampere's Law integral and differential. Self-induction Imaging theory.
P5. Maxwell's model.	Application of Faraday's and Ampere-Maxwell's laws. Phasor and time domain representation of electromagnetic fields. Application of Maxwell's laws.
P6. Fundamentals and characteristics of waves.	Plane wave propagation. Wave parameters. Determination of wave polarisation. Phasor and time domain representation of plane waves.
P7. Waves in the presence of obstacles	Incidence of a wave on a metallic plane. Incidence of a plane wave on a discontinuity between two dielectric media. Standing wave.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	18	24	42
Case studies	27	36	63
Problem solving	12	16	28
Essay questions exam	2	4	6
Case studies	2	4	6
Problem and/or exercise solving	2	3	5

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

Methodologies

	Description
Lecturing	Exhibition by the professor of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student. Through this methodology the competencies B3, C1, C3 and D3 are developed.

Case studies	Analysis of a fact, problem or real event with the purpose to know it, interpret it, resolve it, generate hypothesis, contrast data, think about it, complete knowledges, diagnose it and train in alternative procedures of solution. This metodology will be used both in large and medium size groups. Through this methodology the competencies B3, C1, C3 and D3 are developed.
Problem solving	Activities application of knowledge to specific situations, and the acquisition of basic skills and procedural matters related to the object of study, which are held in computer rooms. Electromagnetic simulators will be used. Through this methodology the competencies B3, C1, C3 and D3 are developed.

Personalized assistance

Methodologies	Description
Lecturing	The student will receive personalized attention during the tutoring hours (https://moovi.uvigo.gal/)
Problem solving	The student will receive personalized attention during the tutoring hours (https://moovi.uvigo.gal/)
Case studies	The student will receive personalized attention during the tutoring hours (https://moovi.uvigo.gal/)
Tests	**Description**
Essay questions exam	The student will receive personalized attention during the tutoring hours (https://moovi.uvigo.gal/)
Case studies	The student will receive personalized attention during the tutoring hours (https://moovi.uvigo.gal/)
Problem and/or exercise solving	The student will receive personalized attention during the tutoring hours (https://moovi.uvigo.gal/)

Assessment

	Description	Qualification	Training and Learning Results
Essay questions exam	Proof for individual evaluation of the skills that includes open questions on a subject. The students have to develop, relate, organise and present their knowledge about the subject in an extensive answer.	35	B3 C1 C3 D3
Case studies	Test for individual evaluation of the competences that includes the approach of a practical case. Students develop the analysis of the situation in order to know it, interpret it, solve it, generate hypothesis, contrast data, reflect, complete knowledge, diagnose it and train in alternative solution procedures.	35	B3 C1 C3 D3
Problem and/or exercise solving	Individual proof where students must develop appropriate or correct solutions through the exercise of routines, the application of formulas or algorithms, the application of procedures for transforming available information and the interpretation of results	30	B3 C1 C3 D3

Other comments on the Evaluation

Following the policy guidelines of the Center, the students can choose between two systems of evaluation: continuous evaluationand evaluation at the end of the term.

In all the evaluation tests, the competences B3, C1, C3 and D3 will be evaluated.

1. CONTINUOUS ASSESSMENT.

- The system of continuous assessment (EC) will consist of:
  - a) A problem solving deliverables or worked in practical classes. The qualification will be ECa, with maximum score of 1.5 points. It will be necessary to reach 40% of the maximum for this test to have an impact on the final grade.
  - b) A problem solving session on topics 1, 2 and 3. The score will be ECb, and the subtotal EC1 = ECa + ECb can have a maximum value of 5 points.
  - c) A problem solving deliverables or worked in practical classes. The qualification will be ECc, with maximum score of 1.5 poins. It will be necessary to reach 40% of the maximum for this test to have an impact on the final grade.
  - d) A problem solving sessionon topics 4, 5 and 6. The score will be ECd, and the subtotal EC2 = ECc + ECd

can have a maximum value of 5 points.

- The final score of the ordinary exam for students who follow continuous assessment (CE) is obtained by adding the two previous subtotals: EC = EC1 + EC2, unless one of the two subtotals is less than 1.5 (30% of the maximum), in which case the final grade will be limited to a maximum of "Suspense (4.0)".
- The planning of the different intermediate assessment tests will be approved by an Academic Committee of Degree (CAG) and will be available at the beginning of the semester.
- Before the completion or delivery of each test, the date and procedure for reviewing the grades obtained will be indicated, which will be public within a reasonable period of time.
- The continuous assessment tests are not recoverable, that is, if a student cannot meet them within the stipulated period, the teacher does not have to repeat them.
- The qualification obtained in the continuous assessment tests (EC1 and EC2) will be valid only for the current academic year.
- It will be understood that a student accepts this system if he/she presents to take the "ECb" test for continuous assessment.

2. EXAM-ONLY ASSESSMENT

- It will be mandatory for students who do not follow continuous assessment to be able to pass the subject at the ordinary exam.
- It will consist of a problem solving session on topics 1 to 6. The score will be EF, and will have the same requirement of achieving 30% of the maximum possible in each of the two parts corresponding to topics 1 to 3 (part 1) and 4 to 6 (part 2).

3. EXTRAORDINARY EXAM.

- Students who followed the continuous assessment:
    - The extraordinary exam will be divided into two parts: EX1 (items 1 to 3) with a maximum value of 5 points, and EX2 (items 4 to 6) with a maximum value of 5 points.
    - The students who followed the continuous evaluation will choose if to do: only EX1, only EX2 or both parts. The final note will be: EF = max (EX1, EC1) + max (EX2, EC2).
- Students who did not follow the continuous evaluation. It consists of a single evaluation with the same format as the first opportunity (a problem solving session on topics 1 to 6).The score will be EF, and will have the same requirement of achieving 30% of the maximum possible in each of the two parts corresponding to topics 1 to 3 (part 1) and 4 to 6 (part 2).

4. END OF PROGRAM EXAM

- It will have the same format as the global assesment.

5. OBSERVATIONS.

- Student who chose continuous assessment or takes any of the two final global exams of first or second opportunity are considered as presented.
- It is considered that the subject is approved if the final grade is equal to or greater than 5 and in each part at least 30% of the maximum possible is reached. If any of the two subtotals is less than 30% of the maximum, the final grade will be limited to a maximum of "Suspenso (4.0)".
- In case of detection of plagiarism in any of the tests, the final grade will be SUSPENSO (0) and the fact will be communicated to the Center Head for the appropriate purposes.
- English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.

Sources of information
Basic Bibliography
F. T. Ulaby, U. Ravaioli, **Fundamentals of Applied Electromagnetics**, Global Edition 7/e, Pearson Education Limited, 2015
D. K. Cheng, **Fundamentos de Electromagnetismo para Ingeniería**, Addison Wesley, 1998
Antonio Pino, F. Obelleiro, **Apuntes de clase**, (moovi.uvigo.gal/), 2020
Complementary Bibliography

D. K. Cheng, **Fundamentals of Engineering Electromagnetics**, New International Edition, Pearson, 2013
David J. Griffiths, **Introduction to Electrodynamics**, 4ª Edición, Pearson Education Limited, 2012
Javier Fraile Peláez, **Apuntes de Electromagnetismo Báscio**, moovi.uvigo.gal, 2023
J. R. Reitz, F. J. Milford, R. W. Christy, **Fundamentos de la Teoría Electromagnética**, 4ª Edición, Addison Wesley, 1996
F. Dios, D. Artigas, et all., **Campos Electromagnéticos**, Ediciones UPC, 1998
W. H. Hayt, J. A. Buck, **Teoría Electromagnética**, 8ª Edición, Mc Graw Hill, 2012
D. K. Cheng, **Field and Wave Electromagnetics**, 2ª Edición, Addison Wesley, 1998
M. F. Iskander, **Electromagnetic Fields and Waves**, 2ª Edición, Prentice Hall, 2012

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Calculus 1/V05G301V01101
Mathematics: Calculus 2/V05G301V01106

IDENTIFYING DATA				
Digital electronics				
Subject	Digital electronics			
Code	V05G301V01203			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Pérez López, Serafín Alfonso			
Lecturers	Moure Rodríguez, María José Nogueiras Meléndez, Andres Augusto Pérez López, Serafín Alfonso			
E-mail	sperez@uvigo.es			
Web	http://moovi.uvigo.es			
General description	This course is an introduction to the basic principles of digital design and the analysis and design of digital circuits and systems. First, logic circuits, basic digital devices and logic gates representation will be introduced. Then, hardware description languages (HDL) based design, description and simulation methods will be described. Combinational and sequential logic design will be explained using the top-down design paradigm. Finally, the common combinational and sequential logic circuits will be described: operation, diagrams, symbols and VHDL description and simulation.			

Training and Learning Results	
Code	
B13	CG13 The ability to use software tools that support problem solving in engineering.
B14	CG14 The ability to use software tools to search for information or bibliographical resources.
C14	CE14/T9: The ability to analyze and design combinatory and sequential, synchronous and asynchronous circuits and the usage of integrated circuits and microprocessors.
C15	CE15/T10: The knowledge and application of the fundamentals of description languages for hardware devices.

Expected results from this subject	Training and Learning Results	
Knowledge of the concepts, components and basic tools of digital design.	B13 B14	C14 C15
Ability to analyse and design combinational systems.	B13	C14 C15
Knowledge of the combinational functional blocks and their aplications.	B14	C14
Knowledge of the basic storage elements, the sequential blocks and their aplications.	B14	C14
Ability to analyse and design synchronous sequential systems.	B13	C14 C15
Knowledge of description and simulation methods based on hardware description languages (HDL).	B13	C14 C15

Contents	
Topic	
Unit 0: Summary	Teaching Staff. Identifying Data. Lecture sessions. Laboratory Sessions. Planning. Assessment. Lecture Scheduling. Laboratory Scheduling. Bibliography.
Unit 1: Introduction to Digital Electronics	Introduction. Number Systems and Digital Codes. Boolean Algebra. Truth tables. Logic Gates. Logic Circuits. Simplyfing logic funcions. Combinational Systems Design with Logic Gates.
Unit 2: Introduction to VHDL	Relevant Language Elements and Concepts for this Course.
Unit 3: Basic Combinational Systems (I)	Functional Blocks. Technologies and Output Types of the Digital Circuits. Decoders.
Unit 4: Basic Combinational Systems (II)	Multiplexers. Encoders. Demultiplexers. Programmable Memories or Look-Up Tables (LUT).
Unit 5: Arithmetic Systems	Comparators. Parity Detection and Generation. Arithmetic Circuits. Application Examples. VHDL Description.
Unit 6: Sequential Logic Systems Principles	Definition and Classification. Latches and flip-flops. Application Examples. VHDL Description.

Unit 7: Synchronous Sequential Systems	Registers. Counters. Shift Registers. Application examples. VHDL description.
Unit 8: Control Synchronous Sequential Logic Design	Control Synchronous Sequential Systems Design. Application Examples. VHDL Description.
Unit 9: Memory Units	Classification. Active and Pasive Random Access Memories (RAM and ROM). Content Access Memories (CAM). Sequential Access Memories (LIFO, FIFO, Circulars).
Practice 1	Introduction to Design using VHDL and the Vivado Design Tool (I).
Practice 2	Introduction to Design using VHDL and the Vivado Design Tool (II).
Practice 3	Combinational System Design and Implemetation (I).
Practice 4	Combinational System Design and Implemetation (II).
Practice 5	Combinational System Design and Implemetation (III).
Practice 6	Combinational System Design and Implemetation (IV).
Practice 7	Arithmetic Circuits.
Practice 8	Arithmetic Systems.
Practice 9	Sequential Circuits.
Practice 10	Sequential Systems (I).
Practice 11	Sequential Systems (II).
Practice 12	Sequential Systems (III).

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	17	20	37
Laboratory practical	24	22	46
Problem solving	13	20	33
Laboratory practice	2	2	4
Problem and/or exercise solving	6	24	30

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

Methodologies

	Description
Introductory activities	Subject presentation. Presentation of laboratory sessions, instrumentation and software resources to be used.
Lecturing	The lecturer will explain in the classroom the main contents of the subject. The students have to manage the proposed bibliography to carry out a self-study process in a way that leads to acquire the knowledge and the skills related to the subject. The lecturer will answer the students questions in the classroom or in the office. In these sessions the students will develop the skils C14 and C15 ("know").
Laboratory practical	Activities designed to apply the main concepts and definitions of the subject. The students will be asked to acquire the basic skills to manage the laboratory instrumentation, software tools and components in order to construct and test electronic circuits. The students have to develop and demonstrate autonomous learning and collaborative skills. Possible questions can be answered in the laboratory sessions or in the lecturers office. In these sessions the students will develop the skils C15, B13 and B14 ("know how"). Software to be used: VIVADO of Xilinx.
Problem solving	Activities designed to apply the main concepts of the subject to solve problems and exercices. The lecturer will explain a set of problems and the students have to solve diferent take-home sets of problems. The lecturer will answer the students questions in the classroom or at the office. In these sessions the students will develop the skils C14 and B15 ("know how").

Personalized assistance

Methodologies	Description
Lecturing	The lecturer will answer the students questions and also give instructions to guide the studying and learning process. The timetable will be available on the subject website at the beginning of the term. The tutoring sessions will take place, prior appointment by email (sperez@uvigo.gal), in the EEI office #235 or through remote mode in virtual room 1958.
Problem solving	The lecturer will answer the students questions and also give instructions to guide the studying and learning process. The timetable will be available on the subject website at the beginning of the term. The tutoring sessions will take place, prior appointment by email (sperez@uvigo.gal), in the EEI office #235 or through remote mode in virtual room 1958.

Laboratory practical	The teacher will answer the students questions and also give instructions to guide the studying and learning process. The timetable will be available on the subject website at the beginning of the term. The tutoring sessions will take place, prior appointment by email (sperez@uvigo.gal), in the EEI office #235 or through remote mode in virtual room 1958.

Assessment

	Description	Qualification	Training and Learning Results	
Laboratory practical	The lecturer will check the level of compliance of the students with the goals related to the laboratory skills. Final mark of laboratory, FML, will be assessed in a 10 points scale. For the evaluation of the laboratory sessions, the lecturer will assess the group work (the same mark for each member) and the individual answers to personalized questions for each session (individual mark).	30	B13 B14	C15
Problem and/or exercise solving	The lecturer will check the students' skills to solve exercices and troubleshooting. Marks for each test will be assessed in a 10 points scale. Final mark of theory, FMT, will be assessed in a 10 points scale.	70		C14 C15

Other comments on the Evaluation

1. Continuous assessment in ordinary opportunity

Following the own degree's guidelines and the agreements of the academic committee, students who take this subject will be provided with a **continuous assessment** system.

O estudantado que opte por avaliación global deberá notificalo por escrito ao coordinador da materia no prazo dun mes dende o inicio do cuadrimestre.

*Those students who **opt for a global assessment** must send a written notification to the subject coordinator within one month from the beginning of the term.*

The subjetc assessment comprises two parts: theory and practice. The grades obtained in the assessable tasks will be only valid for the ongoing academic year.

1.a. Theory

The intermediate assessment test (PEI) will be held throughout the semester. The date on which it takes place will be approved by the Degree Academic Committee (CAG) and will be available at the beginning of the semester.

The final assessment test (PEF) will be held at the end of the course, on the date established by the CAG.

Each of these tests will consist of a series of short answer questions and/or problem solving and/or exercises and will be scored from 0 to 10 marks.

1.b. Practice

There will be a set of twelve 2-hour laboratory sessions with 2-student groups, whenever possible.

The first four sessions will be guided, aiming at learning the tool management that will be used for the design of digital systems to be implemented into programmable devices. These first four practices are mandatory but will not be scored. In the same way, sessions 5, 7 and 10 are compulsory but will not be scored either.

Nevertheless, sessions 6, 8, 9, 11 and 12 will be graded through continuous assessment.

Each session will be only assessed on the corresponding day and hours to its completion according to the practice schedule and the laboratory group assigned by the centre.

Each session will be scored with a grade (NP) between 0 and 10 marks. The teaching staff will take into account the student previous work to prepare the proposed tasks and the work in the laboratory as well as the student attitude in their posts.

The score for the sessions will be 0 for students who do not attend without any compelling and justified issue.

Laboratory sessions' mark (NP) will be:

$$NP = (NP6 + NP8 + NP9 + NP11 + NP12) / 5.$$

In the case of missing more than 2 sessions, the final grade will be:

$$NP = \min\{3 ; (NP6 + NP8 + NP9 + NP11 + NP12) / 5\}.$$

1 C. Call's assessment

The continuous assessment mark in ordinary opportunity, which is the one that will appear in the acta, is calculated as follows:

NECOD = 0.3.NP + 0.3 PEI + 0.4 PEF

2. Global assessment in ordinary opportunity

Those who discard the continuous assessment must take two tests: the theory one (EGT), which includes all the subject contents, and the laboratory one (EGP), which includes all the concepts involved in the laboratory sessions. Both tests will be scored between 0 and 10 points.

The global assessment grade in global opportunity, which will be the one that will appear in the acta, is calculated as follows:

NEGOD = 0.5 EGP + 0.5 EGT

3. Continuous assessment in extraordinary opportunity

In this case, the mark obtained in the laboratory sessions (NP) will be kept. The exam (EECOE), which includes all the subject contents, will be scored between 0 and 10 points.

The continuous assessment mark in extraordinary opportunity, which will be the one that will appeared in the acta, is calculated as follows:

NECOE = 0.3 NP + 0.7 EECOE

4. Global assessment in extraordinary opportunity

Those who discard the continuous assessment in the extraordinary opportunity must take two tests: the theory one (EGTE), which includes all the subject contents, and the laboratory one (EGPE), which includes all the concepts involved in the laboratory sessions. Both tests will be scored between 0 and 10 marks.

The global assessment mark in extraordinary opportunity, which will be the one that will appear in the acta, is calculated as follows:

NEGOE = 0.5 EGPE + 0.5 EGTE

5. Assessment of the final degree call

Those who sit this exam must take two tests: the theory one (CFCT), which includes all the subject contents, and the laboratory one (CFCP), which includes all the concepts involved in the laboratory sessions. Both tests will be scored between 0 and 10 marks.

The assessment mark of this call, which will be the one that will appear in the acta, is calculated as follows:

NCFC = 0.5 CFCP + 0.5 CFCT

Sources of information

Basic Bibliography

Wakerly J. F., **Digital Design. Principles and Practices**, 4th, Pearson/Prentice Hall, 2007

E. Mandado, **Sistemas Electrónicos Digitales**, 10ª, Marcombo, 2015

Douglas L. Perry, **VHDL : programming by example**, 4th, McGraw-Hill, 2002

Complementary Bibliography

Thomas L. Floyd, **Digital Fundamentals**, 11th, Pearson, 2014

L.J. Álvarez, E. Mandado, M.D. Valdés, **Dispositivos Lógicos Programables y sus aplicaciones**, 1ª, Thomson-Paraninfo, 2002

S. Pérez, E, Soto, S. Fernández, **Diseño de sistemas digitales con VHDL**, Thomson-Paraninfo, 2002

L.J. Álvarez, **Diseño Digital con Lógica Programable**, 1ª, Tórculo, 2004

J. Bhasker, **A VHDL primer**, 3rd, Prentice Hall, 1999

Recommendations

Subjects that continue the syllabus

Programmable Electronic Circuits/V05G301V01302

Subjects that are recommended to be taken simultaneously

Physics: Fundamentals of electronics/V05G301V01201

Subjects that it is recommended to have taken before

Informatics: Computer Architecture/V05G301V01109

IDENTIFYING DATA				
Data Communication				
Subject	Data Communication			
Code	V05G301V01204			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Díaz Redondo, Rebeca Pilar López García, Cándido Antonio			
Lecturers	Díaz Redondo, Rebeca Pilar Herrería Alonso, Sergio López García, Cándido Antonio			
E-mail	candido@det.uvigo.es rebeca@det.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	In this subject the efficiency and reliability of data transmission using discrete memoryless channels will be analyzed, and the next issues will be introduced: * lossless data compression methods, * linear error control codes, * data link layer protocols, and * multiple access channels protocols and technologies.			

Training and Learning Results	
Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	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.
C11	CE11/T6: The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact.
C17	CE17/T12: The knowledge and usage of concepts of communication network architecture, protocols and interfaces.
C18	CE18/T13: The ability to differentiate the concepts of access and transport networks, packet and circuit switched networks, mobile and fixed networks, as well as distributed newtwork application and systems, voice, data, video, audio, interactive and multimedia services.
C20	CE20/T15: The knowledge of national, European and international telecommunication regulations and laws.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

Expected results from this subject	Training and Learning Results		
Understanding the basics of digital transmission of information processes, the mathematical models of channels and the concept of capacity.	B3	C17	
Knowledge and ability to analyze the ways of achieving reliable data transmission.	B3 B4	C17 C20	D2 D3
Understanding the methods of sharing multiple access channels, their limits and the factors that affect their performance.	B3	C11 C18	D3
Master the main technical standards, interfaces and protocols in the field of data transmission and local networks.	B3	C20	D3
Practice with interfaces and protocols in the laboratory, as well as in the development of basic transmission solutions.	B3	C20	D3

Contents
Topic

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	36	0	36
Previous studies	0	44	44
Problem solving	22	0	22
Autonomous problem solving	0	43	43
Essay questions exam	4	0	4
Problem and/or exercise solving	1	0	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Systematic exposition of the theoretical contents of the subject, emphasizing the aims, fundamental concepts and relationships between the different units. Through this methodology the competencies CE11, CE17, CE18, CE20, CG3 and CT2 are developed.
Previous studies	Students will study the theoretical contents of the subject using the textbook and/or further material. Through this methodology the competencies CE11, CE17, CE18, CE20, CG3 and CT2 are developed.

Problem solving	Selected problems and/or exercises will be solved in detail, emphasizing the theoretical concepts involved and the methodology of resolution. Through this methodology the competencies CE11, CE17, CE18, CE20, CG4 and CT3 are developed.
Autonomous problem solving	Students will try to autonomously solve a problems and/or exercises from a proposed collection. Through this methodology the competencies CE11, CE17, CE18, CE20, CG4 and CT3 are developed.

Personalized assistance

Methodologies	Description
Previous studies	Students will receive personalized attention (during the office hours) to resolve doubts that can arise in the autonomous study of the subject. Office hours: Rebeca P. Díaz Redondo: https://moovi.uvigo.gal/user/profile.php?id=11470 Sergio Herrería Alonso: https://moovi.uvigo.gal/user/profile.php?id=11341 Manuel Fernández Veiga: https://moovi.uvigo.gal/user/profile.php?id=11641 Cándido López García: https://moovi.uvigo.gal/user/profile.php?id=11339
Autonomous problem solving	Students will receive personalized attention (during the office hours) to resolve doubts that can arise in the autonomous resolution of exercices. Office hours: Rebeca P. Díaz Redondo: https://moovi.uvigo.gal/user/profile.php?id=11470 Sergio Herrería Alonso: https://moovi.uvigo.gal/user/profile.php?id=11341 Manuel Fernández Veiga: https://moovi.uvigo.gal/user/profile.php?id=11641 Cándido López García: https://moovi.uvigo.gal/user/profile.php?id=11339

Assessment

	Description	Qualification	Training and Learning Results		
Essay questions exam	Two partial examinations. In each one of them we will evaluate all the competencies corresponding to the contents we have seen in class to date of the examination.	80	B3 B4	C11 C17 C18 C20	D2 D3
Problem and/or exercise solving	Two short exams, whose dates will be published at the beginning of the term.	20	B3	C17 C18	D3

Other comments on the Evaluation

A continuous assessment of the learning will be practised. Continuous assessment will consist of two types of tests: two short tests and two partial exams, the first one in the midterm and the second one at the end of the class period. All these tests will not be repeatable and will only be accountable for the ordinary call in the current course. The schedule of the midterm/intermediate exams will be approved in the Comisión Académica de Grado (CAG) and will be available at the beginning of each academic semester.

The continuous assessment grade will be obtained as the weighted average of the grades of all the mentioned tests: 20% due to all the short tests (equally weighted) and 40% of each one of the partial exams, whenever the average grade of partial exams was not less than 3.5. In other case, the grade of the continuous assessment will be the average grade obtained in the partial exams. If, in this case, the grade is 5 or more than 5, the final grade will be No pass (4.5).

All the students can do a final exam (global assessment), that will include ALL the contents of the subject and that will take place in the exam period scheduled by the Centre. In this case, the final grade of the subject will be the exam grade.

All the students following continuous assessment or taking the final exam will be graded. The students that attend to the second partial exam will be considered following continuous assessment. Once a student has decided to follow the continuous assessment, his/her grade will never be no show ("no presentado").

Those students who do not pass the subject at the ordinary exam have a second one consistent in the realisation of a new final exam (extraordinary exam).

In the endo-of-program exam the assessment will just consist in the realisation of a written exam including ALL the contents of the subject.

Plagiarism is regarded as serious dishonest behaviour. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Sources of information

Basic Bibliography

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

Complementary Bibliography

C. López García, M. Fernández Veiga, **Cuestiones de Teoría de la Información y Codificación**, 2003,
J. F. Kurose, K. W. Ross, **Computer Networking, 7/e**, 2017,

Recommendations

Subjects that continue the syllabus

Computer Networks/V05G301V01210

Subjects that it is recommended to have taken before

Mathematics: Linear algebra/V05G301V01102
Mathematics: Calculus 1/V05G301V01101
Mathematics: Probability and Statistics/V05G301V01107

IDENTIFYING DATA				
Digital Signal Processing				
Subject	Digital Signal Processing			
Code	V05G301V01205			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Márquez Flórez, Óscar Willian			
Lecturers	Alonso Alonso, Ignacio Docio Fernández, Laura Márquez Flórez, Óscar Willian			
E-mail	omarquez@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	Digital signal processing is nowadays a feature of most everyday communications and entertainment devices. The aim of this course is to equip students with a mathematical grounding in general signal and systems analysis. In subsequent course subjects, this knowledge will be applied to specific applications of signals and systems, including audio, image, video and voice signals. Objectives cover the following areas: - Managing signals and systems mathematically and visually, including learning and applying their properties. - Studying the different domains for signal and systems analysis: time domain, frequency domain and Z domain. - Learning how to transfer a problem in one domain to a domain in which it is easier to solve. - Mastering the concept of filter frequency response and learning to interpret the system function. - Understanding the relationship between the poles and zeros of the system function and the frequency response. - Acquiring basic notions of filter design in the Z domain. - Managing specific digital signal processing software. - Applying the above knowledge to simple and practical laboratory examples. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	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.
C48	(CE48/T16) The knowledge of the appropriate techniques to develop and exploit signal processing subsystems.
C49	(CE49/T17) The ability to analyze digital signal processing schemes.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

Expected results from this subject	Training and Learning Results		
Managing specific software for digital signal processing	B3	C48	D3
Applying mathematical knowledge for signal filtering	B4	C49	D2
Mastering filtering operations in frequency domain.	B4	C49	D2
Learning mathematical issues for understanding the processes of sampling and windowing of analog signals.	B3	C48	D3
Analysis of simple processing systems.	B4	C49	D2

Contents	
Topic	
Subject 1. Introduction	Concept of signal and system. Mathematical representation
Subject 2. Sinusoids	Sinusoidal signals: Frequency, amplitude and phase. Complex exponentials and phasors. Phasor addition rule.
Subject 3. Spectrum representation	Spectrum of a sum of sinusoids. Mathematical expression and graphical plot. Fourier Series analysis of periodic signals.
Subject 4. Introduction to Sampling and Aliasing	Sampling and digital frequency. Analog frequency vs discrete frequency. Aliasing. The sampling theorem.
Subject 5. FIR Filters	Introduction to discrete-time systems. Difference equation. Filter Coefficients. Block Diagrams. Causality, linearity and time-invariance. LTI systems and convolution. FIR frequency response. Cascaded LTI systems.
Subject 6. Frequency response of FIR filters	Sinusoidal response of FIR systems. Frequency response. Properties. Graphical representation.
Subject 7. Z Transform	Definition and properties. Linear-phase filters.
Subject 8. IIR Filters	Difference equation. Filter Coefficients. Block Diagrams. Impulse response. Relation between the position of poles and zeros of the system function and the frequency response.
Subject 9. Continuous-Time Signals and Systems	Introduction to continuous-time systems. The unit impulse. The unit step. Time delaying. Linearity and time-invariance. Convolution
Subject 10. Continuous-Time Fourier Transform	Definition. Basic pairs. Properties
Subject 11. Sampling and Reconstruction in the Frequency Domain	The sampling theorem in the frequency domain
Project 1. A/D and D/A Conversion	Digitalisation of Continuous-Time Signals. Aliasing.
Project 2. Digital Filters	Digital filters in the time and frequency domains.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	32	37	69
Laboratory practical	10	20	30
Problem solving	14	28	42
Discussion Forum	0	2	2
Objective questions exam	1.5	0	1.5
Problem and/or exercise solving	4.5	0	4.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	Course presentation: programme, reading materials, teaching methodology and assessment system
Lecturing	Instructor presentation of the main concepts of each subject. During the 5 minutes before the lecture, a student will summarize the main concepts presented in the previous session. Students will participate by answering questions during the explanation and by doing exercises. Student will work alone afterwards on the concepts studied in class and on expanding this content using the guidelines provided for each subject. Identification of doubts that need to be resolved in personalized tutorials. Through this methodology the competencies C48, B3, and D3 are developed.
Laboratory practical	Application of Matlab functions and commands for digital signal processing to solve practical exercises. Identification of doubts that need to be resolved in personalized tutorials. Software to be used: MatLab. Through this methodology the competencies C49, B4 and D2 are developed.
Problem solving	Problems and exercises formulated according to the content of the lectures and the guidelines for each subject. Students solve problems and exercises prior to the class in which one or several students explain the solution on the board. Identification of doubts that need to be resolved in personalized tutorials. Through this methodology the competencies C49, B4 and D2 are developed.

Discussion Forum	The website for the course is included in the MooVi platform (https://moovi.uvigo.gal/). Subscription to this platform, including a photograph, is mandatory. The website provides all the information related to the course. It also publishes continuous assessment grades and runs forums for students to exchange ideas and discuss doubts. Through this methodology the competencies C48, C49, B3, B4 , D2 and D3 are developed.

Personalized assistance	
Methodologies	**Description**
Lecturing	Students will have the opportunity to attend one-on-one tutorials at specific times established by lecturers for this purpose at the beginning of the academic year and published on the subject's page, on MooVi (https://moovi.uvigo.gal), within the "Teaching staff and tutorials" section. These tutorials are aimed at resolving student doubts and providing guidance regarding: The content of the lectures and approaches to study. Laboratory projects and the software used. Problems and exercises proposed and solved in the classroom as well as other problems and exercises arising during the course. Online tutorials will be available too by appointment.
Laboratory practical	The same as in the previous section.
Problem solving	The same as in the previous section.

Assessment					
	Description	Qualification	Training and Learning Results		
Objective questions exam	These tests are a requirement to pass the subject. See details in the "Other comments and second call" section.	0	B3	C48 C49	D3
Problem and/or exercise solving	These tests are a requirement to pass the subject. See details in the "Other comments and second call" section.	100	B3 B4	C48 C49	D2 D3

Other comments on the Evaluation

ASSESSMENT PROCEDURE:

A. Overview

The acquired skills are assessed by a series of tests grouped into two parts, with different requirements:

1. **Lab assessment**.
2. **Problems assessment**.

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

- For each part one or more tests are performed to obtain an independent grade on each.
- There are tests for the two parts both in continuous assessment and in global assessment.
- A pass grade in any part is valid for the entire academic year.
- The final grade for Lab assessment is a numerical mark between 0 and 10. A student needs a grade greater than or equal to 5 to pass the Lab. Moreover, if the Lab exams are carried out during the classes period and the Lab grade for that period is greater than 7, the Lab grade will increase the Course mark (see details below).
- The final grade for the Problem assessment is a numerical mark between 0 and 10.
- The **Course mark** is obtained as follows (for both continuous and global assessment):
    - If you have passed all two parts and your continuous assessment Lab grade (the one obtained during the classes period) is not greater than 7:
        - Course mark=Problems assessment grade.
    - If you have passed all two parts and your continuous assessment Lab grade is greater than 7:
        - Course mark=minimum [10 , Problems assessment grade + [(Continuous Assessment Lab grade-7)/3]]
    - If you have not passed any of the two parts:
        - Course mark=minimum [Problems assessment grade, Lab grade]

- In case the student has more than one mark for any part, the highest one will be used.

It is also important to note that:

- The course can be passed with full marks from continuous assessment, with no need to sit the final exam.
- Students who have done continuous assessment and have failed any part, in the final exam, only have to sit the part they failed (Lab or Problems).
- Students who sit any of the tests corresponding to Problem assessment will obtain a mark that will be listed in the academic records.

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

B. Details of the assessment procedure

B1. Lab assessment

- Its goal is to determine whether the student has acquired all the knowledge and/or skills corresponding to the laboratory practice, emphasizing the use of MatLab for digital signal processing.
- Content to be assessed: content of the lab manuals and related theory content.
- Type of test: The test consists of a combination of multiple-choice questions and short questions. Students may use MatLab, lab manuals with personal notes, and text book. Students may not use a calculator for this test.
- The final grade for Lab assessment is a numerical mark between 0 and 10. A student needs a grade greater than or equal to 5 to pass the Lab. If the continuous assessment Lab grade is greater than 7 (not a Lab grade obtained in a final exam), the Lab grade will increase the Course mark.
- Assessment method:
  - **Ordinary exam**: Students will have two nonexclusive ways to pass the Lab part.
    1. Two tests in the lab room during the class period (continuous assessment)
       - The test consists of a series of questions at the end of each Lab assignment. The practice that is completed and all the previous ones are evaluated.
       - The tests will be graded between 0 and 10. The lab grade will be obtained as the weigthed average of the grades of both practices, being the weights the 40% and the 60% for practices 1 and 2 respectively. The student will pass this part if he/she gets a weigthed average greater than or equal to 5. It is compulsory to sit the two tests.
       - The schedule of the tests will be approved in the Comisión Académica de Grado (CAG) and it will be announced on the subject web site at the beginning of the lecture period.
    1. A final exam (global assessment). The pass mark for this test is 5 out of 10.
  - **Extraordinary exam or end-of-program exam**: A final exam (global assessment). The pass mark for this test is 5 out of 10.
- Remarks:
  - Once the Lab part has been passed, the Lab grade will be valid for the entire academic year.

B2. Problems assessment

- Its goal is to determine whether the student has acquired all the knowledge and/or skills corresponding to the course and knows how to apply them to solve problems.
- Content to be assessed: as specified in the guidelines document for each topic (available on the subject web) in the section "Content to be assessed". MatLab knowledge is not assessed.
- Type of test: A problem solving test. Students are not allowed to use books or notes. The use of calculators may be granted on an exam basis.
- It will be graded between 0 and 10. The pass mark is 5.
- Assessment method:
  - **Ordinary exam**: Students will have two nonexclusive ways to pass the Problems part.
    1. Three problem solving tests in the classroom during the class period (continuous assessment). Each

test will be graded between 0 and 10 and it is mandatory to sit the three tests.

- The mark will be obtained as : w1* Test1Mark+ w2*Test2Mark + w3*Test3Mark
- The weight w1 will be 0.25 if the mark of the first test is higher than or equal to 3 out of 10. Otherwise w1 will be 0.
- The weight w2 will be 0.35 if the mark of the second test is higher than or equal to 3 out of 10. Otherwise w2 will be 0.
- The weight w3 will be 0.40 if the mark of the third test is higher than or equal to 3 out of 10. Otherwise w3 will be 0.
- Test1: Units 1 to 4. Test2: Units 1 to 7. Test3: Units 1 to 11.
- The schedule of the tests will be approved in the Comisión Académica de Grado (CAG) and it will be announced on the subject web site at the beginning of the lecture period.

2. A final exam (global assessment). The pass mark for this test is 5 out of 10.

- **Extraordinary exam or end-of-program exam**: A final exam (global assessment). The pass mark for this test is 5 out of 10.

- Remarks:
  - Once the Problems part has been passed, the Problems grade will be valid for the entire academic year.
  - A student who has passed the Problems part in the Ordinary exam through the continuous assessment method is allowed to sit the final exam of the Ordinary exam to try to get a better mark.
  - A student who has passed the Problems part in the Ordinary exam is NOT allowed to sit the Problems Part of the final exam of the Extraordinary exam.

C. Other comments

- After the end of the course students will have a single grade of the subject in their academic record:
  - After the Ordinary exam their corresponding grade is registered. If this grade is greater than or equal to 5, it will be the student final grade
  - If a student who has not passed the subject in the Ordinary exam, gets a better grade in the Extraordinary exam, this new grade will be the one that will be included in his academic record. If it is not better the academic record will stay unchanged. In any of these cases, this grade becomes the final grade.
- Continuous assessment tests may not be rescheduled.
- Lab or Problems grades are only valid for the current academic year.
- The use of books, notes or electronic devices such as phones or computers is not permitted in any test or exam. Mobile phones must be turned off and out of reach of the student. If calculator use is permitted, the calculator must be a conventional scientific calculator. Therefore, calculators that allow formulas to be saved or that have libraries that automatically perform operations with complex numbers, calculation of roots, etc. are not allowed under no circumstances.
- Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.
- Throughout the course, during the celebration of the lectures, the teachers of the subject will eventually propose activities or exercises in which students can be rewarded with up to 1 point out of 10. If they receive it, this bonus will be added to the final grade that the students have obtained following the assessment methods previously described.
- English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.

Sources of information
Basic Bibliography
J.H. McClellan y R.W. Schafer, R, **Signal Processing First**, Pearson Prentice Hall,
Complementary Bibliography
A. Quarteroni y F. Saleri, **Cálculo científico con Matlab y Octave**, Springer,
M. J. Roberts, **Señales y Sistemas**, McGraw Hill,

A.V. Oppenheim y R.W. Schafer, **Tratamiento de señales en tiempo discreto**, Prentice Hall,

Recommendations

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G301V01108
Mathematics: Linear algebra/V05G301V01102
Mathematics: Calculus 1/V05G301V01101
Mathematics: Calculus 2/V05G301V01106

IDENTIFYING DATA				
Electronic technology				
Subject	Electronic technology			
Code	V05G301V01206			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Raña García, Herminio José Quintáns Graña, Camilo			
Lecturers	Álvarez Ruiz de Ojeda, Luís Jacobo Gómez Yepes, Alejandro Raña García, Herminio José Valdés Peña, María Dolores			
E-mail	hrana@uvigo.es quintans@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This course is dedicated to the utilisation of integrated circuits, in particular operational amplifiers, as well as to the following fields: Electronics of Power, Electrotechnics in the aspects of electrical installations and to the conversion of photovoltaic solar energy and thermal. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B13	CG13 The ability to use software tools that support problem solving in engineering.
B14	CG14 The ability to use software tools to search for information or bibliographical resources.
C14	CE14/T9: The ability to analyze and design combinatory and sequential, synchronous and asynchronous circuits and the usage of integrated circuits and microprocessors.
C16	CE16/T11: The ability to use different energy sources, especially photovoltaic and thermal ones, as well as the fundamentals of power electronics and electronics

Expected results from this subject	Training and Learning Results	
To know how to analyse and use circuits with operational amplifiers and with other integrated circuits.	B13 B14	C14
To know the foundations of Electrotechnics.		C16
To know the foundations of the Power Electronics and the basic topologies of the power electronic converters.	B13 B14	C16
Ability to use distinct sources of energy and especially photovoltaic solar energy and thermal solar energy.	B13	C16

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

Laboratory sessions	Assembly and simulation of the most important circuits studied in the different theory topics. Transistor based amplifiers. Linear and nonlinear applications of operational amplifiers. Linear regulators for power supplies. Power devices. DC-DC and DC-AC converters. Photovoltaic solar generator.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Laboratory practical	22	22	44
Problem solving	12	12	24
Essay questions exam	1.5	10	11.5
Problem and/or exercise solving	1.5	10	11.5
Laboratory practice	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
Lecturing	The teacher exposes the theoretical contents. This activity is individual. In these activities skills C14 and C16 are developped.
Laboratory practical	They include circuit mounting and testing and computer electronic circuits simulation. Software to be used: ORCAD PSPICE. Some practical classes will also include some web search made by the student, about some technical information about some specific electronic devices used in the practical classes (e.g. some kind of transistors or operational amplifiers). This activity is collective. The students work in teams of two persons in each laboratory position. Through this methodology the competencies C14, C16, B13 and B14 are developed.
Problem solving	The teacher will solve exercises about most of the chapters. This activity is individual. Through this methodology the competencies C14 and C16 are developed.

Personalized assistance

Methodologies	Description
Lecturing	The students may talk to the professor in the office hours published in the course webpage (https://moovi.uvigo.gal/). Questions about the contents of the master classes will be answered in this tutorship time as well as questions about how to prepare their study.
Laboratory practical	The students may talk to the professor in the office hours published in the course webpage (https://moovi.uvigo.gal/). Questions about the contents of the laboratory practices, about how to use the instrumentation or about the implementation of the electronic circuits and the simulation software will be answered in this sessions.
Problem solving	The students may talk to the professor in the office hours published in the course webpage (https://moovi.uvigo.gal/). Questions about the problems or exercises proposed and solved in the classroom will be answered in this tutorship time as well as other problems or exercises that the student can find along the study of the subject.

Assessment

	Description	Qualification	Training and Learning Results
Essay questions exam	They are part of each partial theory exam. The number of tests and the policy are detailed in 'Other comments' section.	33	C14 C16
Problem and/or exercise solving	They are part of each partial theory exam. The number of tests and the policy are detailed in 'Other comments' section.	33	C14 C16

Laboratory practice	They are carried out in the laboratory. They consist of the type of tasks carried out or prepared during the practices of the subject: the practical tests consist of real assembly of circuits, carrying out measurements on them and questions related to those circuits and/or simulation of circuits equal or similar to those studied in the practices and questions related to that simulation.	34	B13 B14	C14 C16

Other comments on the Evaluation

A continuous assessment (CA) procedure is established based on partial theory and laboratory exams, but students can alternatively opt for a global assessment (GA).

Students are considered to opt for CA from the time they attend the first partial exam, whether it is of the theory or laboratory kind. Students will be able to renounce the CA and opt for the GA until the date in which the first partial exam of laboratory practices is carried out (after the first month of the course).

1. Continuous assessment:

Students who opt for the CA modality will have two assessment opportunities, the ordinary and the extraordinary.

1.1 Ordinary exam for continuous assessment:

The CA is divided into a theory part (66% of the final grade) and another of laboratory practical (34% of the final grade). The planning of the different exams will be published in a shared calendar and will be available at the beginning of the semester.

Regarding the theory part:

- The theoretical part of the subject is evaluated through three exams that will be carried out within the schedule assigned to the subject.
- The weight of each exam is 22% of the final grade.
- Student passes this part if they obtain a grade greater than or equal to 4 out of 10 in each of the exams.
- The TG (theory grade) is the average of the three partial exams.

Regarding laboratory exams:

- The practical part of the subject is evaluated through two partial exams that are carried out within the class hours assigned to the laboratories.
- The weight of each exam is 17% of the final grade.
- The attendance to the laboratory sessions is mandatory. Students must complete at least 80% of the sessions.
- This part is passed if a grade greater than or equal to 4 out of 10 is obtained in each of the partial exams.
- The laboratory grade LG is the average grade of the two partials.

Final grade (FG):

The final grade of the continuous assessment is obtained as follows:

FG = (TG*0.66 + LG*0.34) if the grades of all the theory and laboratory partials are greater than or equal to 4 points out of 10 and FG is greater than or equal to 5,

FG = min [(TG*0.66 + LG*0.34), 4.9] otherwise.

On the date of the final exam, it will be possible to recover the failed partial exams, both theory and practical, but the sum of the weight of these exams cannot exceed 40% of the final grade.

1.2 Extraordinary Opportunity of CA:

Students who do not pass one or more of the partial exams of the ordinary opportunity can recover them in the extraordinary one.

The final grade is obtained in the same way as that of the ordinary opportunity.

2. Global assessment (GA):

Students who choose GA will have two assessment opportunities, the ordinary and the extraordinary.

In both cases the evaluation will consist of two exams, one of the theoretical part (TG) of the subject with a weight of 66%

and another of the laboratory part (LG) with a weight of 34%.

The final grade (FG) of the continuous assessment is obtained as follows:

FG = (TG*0.66 + LG*0.34) if the grades of all the theory and laboratory partials are greater than or equal to 4 points out of 10 and FG is greater than or equal to 5,

FG = min [(TG*0.66 + LG*0.34), 4.9] otherwise.

3. End-of-program call:

The end-of-program assessment will be the same as that described for the global case.

Other comments:

- Any other information/recommendation regarding the organization of the subject will be published on the subject's website.
- During exams, smart electronic devices must be turned off and out of the reach of students.
- Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Sources of information

Basic Bibliography

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

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

Quintáns Graña, C., **Simulación de circuitos electrónicos con OrCAD® PSpice®**, 2.ª edición, Marcombo, 2021

Hambley, Allan R., **Electronics**, 2nd ed., Prentice Hall,

Hart, Daniel W., **Power Electronics**, McGraw-Hill,

Complementary Bibliography

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

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

Schneider Electric España, S.A., **Guía de diseño de instalaciones eléctricas (PDF de uso libre disponible en www.schneiderelectric.es)**, Schneider Electric España, S.A,

Guirado, R., **Tecnología eléctrica**, McGraw-Hill,

AENOR, **Norma UNE 60617 de Símbolos gráficos para esquemas eléctricos**,

Carta, J. A. y otros, **Centrales de energías renovables: Generación eléctrica con energías renovables**, Pearson-UNED,

Quintáns Graña, C., **Simulación de circuitos con OrCAD 16 DEMO**, 1ª ed., Marcombo,

Recommendations

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G301V01108
Physics: Fundamentals of electronics/V05G301V01201

IDENTIFYING DATA				
Electromagnetic Transmission				
Subject	Electromagnetic Transmission			
Code	V05G301V01207			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Vera Isasa, María			
Lecturers	Díaz Otero, Francisco Javier Expósito Pérez, Isabel Santalla del Río, María Verónica Vera Isasa, María			
E-mail	mirentxu@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	Fundamentals of electromagnetic guided and unguided transmission. Analysis of the operating principles of different transmission media models and their characterization in telecommunication engineering. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	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.
B5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
C9	CE9/T4: The ability to analyze and specify the main parameters of a communications system.
C13	CE13/T8: The ability to understand the electromagnetic and acoustic wave mechanisms of propagation and transmission, and their corresponding receiving and transmitting devices.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

Expected results from this subject	Training and Learning Results		
Transmissionm line specification: two-wire line, coaxial wire, coaxial models, twisted pair, optical fibre.	B3	C9	
Tension and current waves, E-H fields and stationary wave analysis.	B5	C13	
Proposing impedance matching solutions.	B4		
Antenna radiated field calculation and related parameters: radiation pattern, gain, beam-width, impedance, polarisation, effective area.	B5	C9 C13	
Resolving problems of propagation and reception of electromagnetic waves.	B3 B4		D2 D3

Contents	
Topic	
Introduction	Types of transmission media, advantages and disadvantages, characterisation.

Transmission lines	Getting started with some of the most commonly used transmission lines: two-wire, coaxial cable, twisted pair. Circuit model of distributed parameters ,general equations, characteristic parameters (characteristic impedance, propagation velocity, attenuation and phase constants). Attenuation, dispersion and crosstalk. Transmission line in a circuit (reflection coefficient, standing wave ratio, input impedance). Smith Chart.
Waveguides and optical fibre	Metallic waveguides: modes of propagation, cutoff frequency, single-mode band , attenuation and dispersion. Optical fibre: structure and types, numerical aperture and acceptance cone, attenuation and dispersion, optical sources and receivers.
Radiowaves and antennas	Characteristics of radiowaves: far field, radiation integral. Antenna concept and fundamental parameters (radiation pattern, secondary lobe level, beamwidth, directivity, gain, polarisation, impedance). Reception: power balance in free space (Friis equation), polarization loss factor. Antenna arrays.
Labs	- Measurement and analysis of voltage and current waves and standing waves. - Basic impedance matching technics. - Optical fiber transmission fundamentals. - Measurements with microwave training system (waveguides). - Radiation pattern plots. - Measurement of antenna basic parameters. - Problem resolution.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	1	2
Lecturing	20	30	50
Autonomous problem solving	14	30	44
Laboratory practical	18	12	30
Problem solving	6	12	18
Problem and/or exercise solving	4	0	4
Self-assessment	0	2	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	Activities focused to take contact and get information about the students and to introduce the subject.
Lecturing	Presentation by the teacher of the contents of the subject of study (theoretical basis). Through this methodology the competencies B3, C9,C13 and D2 are developed.
Autonomous problem solving	Activity in which problems are formulated related to the subject. The student must develop the analysis and solving problems independently. The solutions are provided in ordinary class hours. Through this methodology the competenciesB4, C9 and C13 are developed.
Laboratory practical	Application of knowledge to specific situations and acquisition of basic skills and procedures. They are developed in laboratories with specialized equipment. Software to be used: applets java. Through this methodology the competencies B5 and D3 are developed.
Problem solving	Activity in which problems are formulated related to the subject. The student must develop the analysis and solving problems with the advisor help. Through this methodology the competencies B4, C9 and C13 are developed.

Personalized assistance	
Methodologies	**Description**
Lecturing	In the tutorial schedule, teaching staff will attend the needs and queries of the students related with the study of the subject. See tutorial schedule time in the web of the subject (http://moovi.uvigo.gal)
Laboratory practical	The teaching staff will set the time of the session and will solve the questions about the practical implementation.

Autonomous problem solving	In the tutorial schedule, teaching staff will attend the needs and queries of the students related with the study of the subject. See tutorial schedule time in the web of the subject (http://moovi.uvigo.gal)
Problem solving	In the tutorial schedule, teaching staff will attend the needs and queries of the students related with the study of the subject. See tutorial schedule time in the web of the subject (http://moovi.uvigo.gal)

Assessment

	Description	Qualification	Training and Learning Results	
Problem and/or exercise solving	Test in which the student has to solve a series of problems in a time and conditions established by the teacher, applying the acquired knowledge.	100	B3 B4	C9 C13
Self-assessment	Online tests using the web platform.	0	B3 B4 B5	C9 C13

Other comments on the Evaluation

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

Continuous assessment

Continuous assessment includes two types of tasks: self-assessment tasks using the web platform and problem solving tasks with weight in the final grade:

- T1: Decibel problems (5%).
- T2: Transmission line problems (40%).
- T3: Waveguides and fiber optic problems (15%).
- T4: Radio transmission problems (40%).

The time schedule of these tasks (T1 to T4), approved by the CAG, will be available at the beginning of the semester. The planning of the other continuous assessment tasks will be indicated at the beginning of the course. All these tasks are not recoverable, that is, if a student fulfill on time, the teacher has no obligation to repeat them, and they are valid only for the academic year in which they are made.

After the second problem solving exam (T2) the student must decide between continuous assesment or single assesment. Not to attend to this test implies that the choice is global assessment.

To pass the subject through this evaluation system, it is necessary to pass the self-assessment tests and obtain 30% of the maximum grade of each of the evaluation tests (T1 to T4). If any of these conditions are not met, the official rating will never be higher than 4.5.

Global assessment

Instead of the continuous assessment described above, the student may choose to perform one final problem-solving exam.

Extraordinary exam

It consists of a single problem solving exam.

Students who have chosen continuous assessment and passed all the self-assessment tasks may keep, if they wish, the mark of the T1 to T4 tasks they have passed and repeat the remaining ones.

End-of-program exam

It consists of a single problem solving exam.

Copy

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution

At least 50% in the total qualification must be obtained in any of the assessment systems and calls to pass the subject.

Sources of information

Basic Bibliography

F.T. Ulaby, **Fundamentals of Applied Electromagnetics**, 7ª, Pearson, 2015

S.M. Wentworth, **Applied electromagnetics. Early transmission line approach**, 1ª, Wiley, 2007

D. K. Cheng, **Fundamentos de electromagnetismo para ingeniería**, Addison-Wesley, 1997

Complementary Bibliography

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

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

Y.H. Lee, **Introduction to Engineering Electromagnetics**, Springer, 2013

S. Balaji, **Electromagnetics Made Easy**, Springer, 2020

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Calculus 1/V05G301V01101

Mathematics: Calculus 2/V05G301V01106

Physics: Fields and Waves/V05G301V01202

IDENTIFYING DATA

Signal Transmission and Reception Techniques

Subject	Signal Transmission and Reception Techniques			
Code	V05G301V01208			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Rodríguez Banga, Eduardo			
Lecturers	Gómez Cuba, Felipe Márquez Flórez, Óscar Willian Rodríguez Banga, Eduardo			
E-mail	erbanga@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The course "Signal Transmission and Reception Techniques" is an introduction to the different existing methods for the exchange of information in digital format at the physical layer level. Its main focus is on pulse amplitude modulation (PAM) as illustrative example. The main components of a digital transmitter and receiver are described, as well as the different effects caused by the communication channel and the different performance parameters of a digital system. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	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.
B6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
C7	CE7/T2: The ability to use communication and software applications (ofimatics, databases, advanced calculus, project management, visualization, etc.) to support the development and operation of Electronics and Telecommunication networks, services and applications.
C9	CE9/T4: The ability to analyze and specify the main parameters of a communications system.
C10	CE10/T5: The ability to evaluate the advantages and disadvantages of different technological alternatives in the implementation and deployment of communication systems from the point of view of signals, perturbations, noise and digital and analogical modulation systems.
C20	CE20/T15: The knowledge of national, European and international telecommunication regulations and laws.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Differentiate the blocks and functionalities of a complete data transmission sytem	B3	C9 C10	
Identify the minimum requirements for a reliable data communication.	B3 B4	C9 C10	
Distinguish the fundamental parameters of a complete communications system oriented to data transmission.	B3 B4	C9 C10	
Describe, develop and analyse the different blocks of a data transmission system.	B3 B6	C9 C10 C20	D3
Develop and implement basic circuits for modulation and demodulation of signals.	B4 B6	C9 C10 C20	D2

Use applications of communication and computer (text processing, databases, advanced calculus, management of projects, visualisation, etc.) to support the design of data transmission systems.	B4	C7	D2 D3
Recognise the different quality assessment measures of a digital signal.		C9 C10	
Statistically analyse the noise and understand its effects.	B3	C9 C10	

Contents	
Topic	
1. Introduction to digital communication systems	-Basic elements and general description of a communication system. -Analog and digital communications -Description of a digital transmitter -Description of a digital receiver
2. Signals, systems and stochastic processes in communications	-Review of basic concepts: signals and systems. Continuous time Fourier transform. - Deterministic signals: energy-defined and power-defined. Autocorrelation. Spectral density. - Random variables. Stochastic processes: stationarity, autocorrelation, power spectral density, bandwidth. White noise.
3. Frequency conversion and analog processing	-Amplitude modulation (AM) and frequency modulation (FM) -I/Q modulation and demodulation - Transceiver requirements and specifications -Receiver architectures: direct conversion, intermediate frequency. Analog and digital stages.
4. Pulse amplitude modulation (PAM)	- Baseband PAM - Bandlimited channels and intersymbol interferences (ISI) - Nyquist criterion, raised cosine pulses, eye diagram - Matched filtering - Bandpass PAM
5. Modulation and detection in Gaussian channels	- Introduction to the Signal Subspace - Discrete equivalent channel - Maximum A Posteriori (MAP) and Maximum Likelihood (ML) detectors - Probability of error
6. The communication channel	-Transmission media -Signal to noise ratio -Multipath and frequency selectivity -Fading -Doppler effect
Practical content	In this course there is no division between theoretical and practical content. Indeed, practical exercises related to many of the previously described contents are considered.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	34	34	68
Practices through ICT	24	31	55
Problem and/or exercise solving	3	6	9
Problem and/or exercise solving	2	16	18
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Presentation and discussion of the fundamental theory. The explanation will be complemented by the resolution of questions and exercises. Through this methodology, skills C9, C10, C20, B3, B4, B6, D2, D3 are developed.
Practices through ICT	The concepts presented in the class sessions will be further illustrated and developed by means of Matlab-based simulation and signal processing tools. Through this methodology, skills C7, C9, C10, B3, B4, D2 are developed

Personalized assistance	
Methodologies	**Description**

Lecturing	Personalized attention will be offered during office hours, which can be consulted on the institutional page of the instructors. Spanish Degree: Felipe Gómez Cuba (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/felipe-gomez-cuba) Óscar Márquez Flórez (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/oscar-willian-marquez-florez) Eduardo Rodríguez Banga (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/eduardo-rodriguez-banga) English Degree: Pedro Comesaña Alfaro (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/pedro-comesana-alfaro) Eduardo Rodríguez Banga (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/eduardo-rodriguez-banga)
Practices through ICT	Beyond the initial explanation to the group, instructors will answer individual students' questions. In addition, instructors will be available to students at office hours.

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	Three midterm exams will be given during the semester. Their influence on the final grade is detailed in the section "Other comments on the Evaluation".	60	B3 B4 B6	C7 C9 C10 C20	D2 D3
Problem and/or exercise solving	Final examination with questions of any type. It will cover all of the material covered during the course and will take place during the exam period as established by the Center. The influence of the exam on the final grade is described in the section "Other comments on the Evaluation".	40	B3 B4 B6	C7 C9 C10 C20	D2 D3

Other comments on the Evaluation

The final grade will be computed based on the grades obtained in the three midterm exams (P1, P2 and P3, respectively) and the grade in the final exam (EX), all of them in a ten-point scale.

The contribution of the midterm exams to the final grade (P) is obtained as

P = V1*P1 + V2*P2 + V3*P3

where

V1 =0.15 if P1 >= 5, V1 = 0 otherwise

V2 =0.2 if P2 >= 5, V2 = 0 otherwise

V3 =0.25 if P3 >= 5, V3 = 0 otherwise

Then, the final grade (F) will be computed as:

F =min(10, P + EX*(10-P)/(10-0.3*P)) if EX>=3.5

F = min(4, P + EX*(10-P)/(10-0.3*P)) if EX < 3.5

The schedule of the midterm exams will be approved in the Comisión Académica de Grado (CAG) and will be available at the beginning of each academic semester. These exams are not recoverable, that is to say, if a student does not show up when they take place, the instructors do not have the obligation to repeat them. In each midterm exam, the material covered from the start of the course until the previous week (included) will be evaluated.

For those students who choose to follow global assessment, the final grade will be directly the final exam grade (F = EX).

Students will be graded at the ordinary opportunity of evaluation as long as they take any midterm exam and do not waive the continuous assesment (C.A.) track within a period established by the instructors; this period will last at least for one month and will be included in the period between the publication of the grades of the first midterm exam and the date of the third midterm exam.

For those students following C.A., any not attended midterm exam or final exam will be graded with zero points.

The mark achieved in the three midterm exams (P) will be kept for the second call of evaluation to those students attending the final exam of that call, but not for subsequent years. Regarding this second call, the same rules stated above will apply.

For the end-of-program exam, a comprehensive exam will be given, corresponding to 100% of the final grade.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the

final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Sources of information
Basic Bibliography
A. Grami, **Introduction to Digital Communications**, 1, 2016
A. Artés, F. Pérez González et al., **Comunicaciones Digitales**, 1,
J. G. Proakis, M. Salehi, **Fundamentals of Communication Systems**, 1,
Complementary Bibliography
Bernard Sklar, **Digital Communications: Fundamentals and Applications**, 2,
C.R. Johnson Jr., W.A. Sethares, **Telecommunication Breakdown**, 1,
B. Razavi, **RF Microelectronics**, 1,

Recommendations
Subjects that continue the syllabus
Principles of Digital Communications/V05G301V01324

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G301V01108
Mathematics: Probability and Statistics/V05G301V01107
Digital Signal Processing/V05G301V01205

Other comments

Se asume que el/la estudiante posee conocimientos básicos sobre la disciplina del procesado de señal (analógico y digital), así como de probabilidad y estadística.

IDENTIFYING DATA				
Fundamentals of Sound and Image				
Subject	Fundamentals of Sound and Image			
Code	V05G301V01209			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	González Valdés, Borja			
Lecturers	González Valdés, Borja Pena Giménez, Antonio			
E-mail	bgvaldes@uvigo.es			
Web	http://https://moovi.uvigo.gal			
General description	"Sound & image fundamentals" presents some basic concepts on sound & image nature, the course also deals with some basic processing of these signals.			

Training and Learning Results	
Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
C13	CE13/T8: The ability to understand the electromagnetic and acoustic wave mechanisms of propagation and transmission, and their corresponding receiving and transmitting devices.
C48	(CE48/T16) The knowledge of the appropriate techniques to develop and exploit signal processing subsystems.
C49	(CE49/T17) The ability to analyze digital signal processing schemes.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

Expected results from this subject	Training and Learning Results		
Acquire mathematical tools that allow the understanding of the practical effects of sampling, windowing and time-frequency analysis of sound and image signals.	B3	C48 C49	D3
Apply quantification techniques	B3	C48 C49	D3
Understand the nature, basic properties, generation and capture of sound and image.		C13	D3
Understand and interpret the different levels of measurement present in sound systems.	B5		D3
Review the different processes and systems associated with the treatment of sound and image	B3 B5	C48 C49	D3
Apply the basic rules of the colorimetry.	B3		D3

Contents	
Topic	
Sampling, windowing and quantification of one-dimensional and two-dimensional signals.	- Sampling, Nyquist theorem, reconstruction filter. - 2D sampling, concept of resolution vs. sampling frequency. 2D reconstruction. - Windowing in 1D and 2D. - Uniform quantization. A/D conversion . Quantization noise.
Time-frequency analysis of sound and image signals.	- Sound and image characteristics in time and double spatial dimension, respectively. - Windowing and Discrete Fourier Transform (DFT). DFT in 2D. - Frequency characteristics. Spatial frequencies, physical interpretation.
Basic concepts of light and color.	- The image: numerical nature, colorimetry, visual system basics.
Acoustics: basics. Measurement of acoustic signals.	- The sound: acoustic variables, generation, combination of sources, sound sensations - Measurement levels. - Sound level meter

Sound and image systems and processes: basics. Filter banks.	- Sound capture and calibration. - Specifications and objective quality. - 1D filtering. FIR and IIR filters. Relation between windowing and filtering. - 2D filtering. Separable filters. Point operations and spatial filtering on images.
Practices	Audio -Localized analysis of audio signals -Spectrogram -Calculation of sound pressure levels -Calibration of sound pressure levels Image -Image processing in Matlab -Filtering and restoration of images

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	31	39	70
Problem solving	8	12	20
Practices through ICT	19	18	37
Discussion Forum	0	1	1
Objective questions exam	4	2	6
Problem and/or exercise solving	0	2	2
Problem and/or exercise solving	0	2	2
Essay	0	11	11

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

Methodologies

	Description
Introductory activities	Course presentation: programme, reading materials, teaching methodology and assessment system. Developed capabilities: B3, B5, C13, D3, C48, C49.
Lecturing	Exposition by the teacher of the main concepts of each topic, promoting critical discussion. The theoretical foundations of algorithms and procedures used to solve problems are laid. The student should take as reference the content of the exam indicated in the guide document for each topic. Subsequent personal work of the student reviewing the concepts seen in the classroom and expanding the contents taking as reference the notes documents of each topic. Identification of doubts that need to be resolved in personalized tutorials. Developed capabilities: B3, B5, C13, D3, C48, C49.
Problem solving	Problems and exercises formulated according to the content of the lectures and the documents for each subject. Students solve problems and exercises prior to the class. Identification of doubts that need to be resolved in personalized tutorials. Developed capabilities: B3, B5, C13, D3, , C48, C49.
Practices through ICT	Handling of analysis tools and algorithms. Identifying which one must to be used to solve each specific problem. Identification of doubts that need to be resolved in personalized tutorials. Developed capabilities: B3, B5, C13, D3, , C48, C49.
Discussion Forum	The website for the course is included in the platform (https://moovi.uvigo.gal). Subscription to this platform, including a photograph, is mandatory. The website provides all the information related to the course. It also publishes continuous assessment grades and runs forums for students to exchange ideas and discuss doubts. Developed capabilities: B3, B5, C13, D3, C48, C49.

Personalized assistance	
Methodologies	**Description**
Problem solving	Help with problem solving, in the classroom and/or at the office. https://moovi.uvigo.gal/user/profile.php?id=11310 https://moovi.uvigo.gal/user/profile.php?id=11639
Practices through ICT	Help in the classroom and, if necessary at the office or via e-mail. https://moovi.uvigo.gal/user/profile.php?id=11310 https://moovi.uvigo.gal/user/profile.php?id=11639
Lecturing	Querry and answer in the classroom and, if necessary, at the office. https://moovi.uvigo.gal/user/profile.php?id=11310 https://moovi.uvigo.gal/user/profile.php?id=11639

Assessment					
	Description	Qualification	Training and Learning Results		
Objective questions exam	Made in the platform Moovi.	20	B3	C48 C49	
Problem and/or exercise solving	Exam with brief questions and problems on the thematic of sound	25	B3	C48 C49	
Problem and/or exercise solving	Exam with brief questions and problems on the thematic of image	25	B3	C48 C49	
Essay	Supervised work related with the contents of the practices	30	B3 B5	C13 C48 C49	D3

Other comments on the Evaluation

On detecting any kind of plagiarism in any of the tests (short test, partial or final exam, lab reports) the final qualification will be FAIL (0) and the fact will be transmitted to school regents for taking the appropriate actions.
There are two kinds of assesment: continuous assesment and global assesment.
The schedule for intermediate evaluation tests will be approved by the CAG (DEGREE ACADEMIC COMMITTEE) and will be published at the beginning of four month period in which this course is delivered.

CONTINUOUS ASSESSMENT

The continuous assessment consists of the tests detailed below in this guide and are not recoverable, that is, if a student cannot take them on the stipulated date, the teacher is not required to repeat them. The evaluable tasks will be valid only for the academic year in which they are carried out. The submission of assignments is not mandatory. Assignments not submitted will be evaluated with zero points
It is understood that the student opts for continuous evaluation once the commitment document that will be offered after the first month si signed, so that work can begin in the corresponding groups. Once signed, the student will be assigned the grade that results from the application of the criteria detailed below, regardless of whether or not they take the final exam.
Types and evaluation of tests:
1. Delivery of two supervised group projects related to the practices (weight 30%). The individual grade of the group work will be determined by means of cross evaluation and personal interview.
2. Resolution of tests or short questions related to the practical contents (Weight: 20%): they are developed throughout the course on the Moovi platform.
3. Test 1: final written test of the sound part (development, Weight: 25%): it takes place approximately halfway through the semester.
4. Test 2: final written test of the image part (development, Weight: 25%): coincides with the date of the final exam of the subject.
 In order to guarantee that students acquire a minimum, more or less balanced, of the subject competences, to pass they will need to meet these conditions:
Obtain a minimum of 3.5 in Test 1.Obtain a minimum of 3.5 in Test 2.Get an average of more than 5 in Tests 1 and 2.Obtain an average of more than 5 in supervised group projects.
In case of not fulfilling all the conditions, the final grade (on a scale of 0 to 10) will be the minimum between the overall grade obtained and the value FOUR.
To participate in the Continuous Assessment, 80% attendance is required for groups A and B. In case of non-compliance, the student will be assessed in the single assessment option.
Any student can be called at any time by the teachers to carry out a review of the work done to date in the works or projects in progress.

GLOBAL ASSESSMENT

If the student does not sign the commitment document, he/she will be evaluated by means of an only exam, in the official date. The grades for this final exam are between 0 and 10 points. It includes all the subjects of the course, including the laboratory works.
In order to ensure that students acquire a balanced minimum on the subject competences, they will pass the course if they meet these two conditions:

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

2) and a score equal to or greater than 4 in the questions related with the group B activities.

If some of these conditions are not fulfilled, then the final grade (on a ten-points scale) will be the minimum between the final mark and the value "4.9".

Extraordinary exam:
⇒ Students evaluated by Continuous Assessment in the ordinary opportunity can opt between two possibilities the same day of the exam:

1. Do again Test 1 and 2 and be evaluated according what is stipulated for the system of Continuous Assessment.
2. Be evaluated with a single final exam in the official date assigned by the Centre. The grades for this final exam are between 0 and 10 points. It includes all the subjects of the course. Non Continuous Assessment rules apply.

⇒ Students not evaluated by Continuous Assessment:

They will be evaluated with a single final exam on the official date assigned by the Center.The grades for this final exam are between 0 and 10 points. It includes all the subjects of the course. Non Continuous Assessment rules apply. No other activities are assessed.
End of program Exam:

In special call exam (end of degree), we will proceed as in the case of students who have not completed the continous assesment.

Sources of information

Basic Bibliography

Finn Jacobsen et al., **FUNDAMENTALS OF ACOUSTICS AND NOISE CONTROL**, Technical University of Denmark, 2001

Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, **Digital image processing using MATLAB**, Gatesmark Publishing, 2009

Günther Wyszecki, W.S. Stiles, **Color science: concepts and methods, quantitative data, and formulae**, John Wiley & Sons,

Complementary Bibliography

Lawrence Kinsler, Austin Frey, Alán Coppens, James Sanders, **FUNDAMENTALS OF ACOUSTICS**, John Wiley &, 1999

Alan V. Oppenheim, Alan S. Willsky with S. Hamid Nawab, **Signals and systems**, Prentice-Hall, 1997

Alan V. Oppenheim, Ronald W. Schafer., **Discrete-time signal processing**, Pearson Prentice Hall, 2010

Rafael C. Gonzalez, Richard E. Woods, **Digital image processing**, Pearson Prentice Hall, 2018

R.J. Clarke, **Digital compression of still images and video**, Academic Press, 1995

Recommendations

Subjects that continue the syllabus

Room Acoustics/V05G301V01330
Design of audiovisual installations/V05G301V01334
Fundamentals of Acoustics Engineering/V05G301V01327
Fundamentals of Image Processing/V05G301V01333
Sound Processing/V05G301V01328
Interactive Audio Systems/V05G301V01331
Imaging Systems/V05G301V01332
Video and Television/V05G301V01329

Subjects that it is recommended to have taken before

Physics: Fundamentals of Mechanics and Thermodynamics/V05G301V01103
Digital Signal Processing/V05G301V01205

IDENTIFYING DATA				
Computer Networks				
Subject	Computer Networks			
Code	V05G301V01210			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	López Ardao, José Carlos Rodríguez Pérez, Miguel			
Lecturers	López Ardao, José Carlos Rivas Costa, Carlos Rodríguez Pérez, Miguel Rodríguez Rubio, Raúl Fernando Sousa Vieira, Estrella			
E-mail	jardao@det.uvigo.es miguel@det.uvigo.gal			
Web	http://moovi.uvigo.gal/			
General description	Operating principles, architecture, technology and norms of computer networks, especially of Internet. Design-oriented course, complemented by practical skills			

Training and Learning Results	
Code	
B1	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.
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	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.
B6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
B9	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.
C11	CE11/T6: The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact.
C17	CE17/T12: The knowledge and usage of concepts of communication network architecture, protocols and interfaces.
C18	CE18/T13: The ability to differentiate the concepts of access and transport networks, packet and circuit switched networks, mobile and fixed networks, as well as distributed newtwork application and systems, voice, data, video, audio, interactive and multimedia services.
C19	CE19/T14: The knowledge of methods of networking and routing, as well as the fundamentals of planning and network evaluation based on traffic parameters.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.
D4	CT4 Encourage cooperative work, and skills like communication, organization, planning and acceptance of responsibility in a multilingual and multidisciplinary work environment, which promotes education for equality, peace and respect for fundamental rights.

Expected results from this subject	Training and Learning Results		
Comprise the general organization and the basic aspects of operation of communication networks, and particularly of computer networks	B3	C17	D2
Identify and know employ the concepts of switching, access and transport networks and wired and wireless networks	B3	C18	
Comprise the principles and the organization of distributed applications and services, either data or media oriented	B3	C17	

Comprise and know how to analyze the operation of the Internet: the architecture, the service model, the data transport, the routing methods and inter-networking, error control and congestion control	B3 B6	C11 C17 C19	D2 D3
Dominate the technical standards and the fundamental protocols of the Internet	B3 B4 B6	C17 C18 C19	
Practical capacity to design, handle and configure computer networks, from the point of view of data switching and transport	B1 B9	C11	D4
Specify common telecommunications infrastructures and structured cabling in buildings	B1 B6	C11	

Contents	
Topic	
1. Introduction	1.1. Network elements, types of links, services and protocols 1.2. Switching techniques: circuits, messages and packets 1.3. Reference models and service modes
2. Packet switching (I): Link Transmission	2.1. Packet framing and Frame transmission 2.2. Forwarding techniques. 2.3. Generalized forwarding. Correspondence and action 2.4. Statistical multiplexing 2.5. ARQ Techniques 2.6. Flow control
3. Packet switching (II): Path Transmission	3.1. Fundamental performance metrics: delay, losses, equivalent capacity 3.2. Reliability (hop-by-hop vs. end-to-end)
4. The data plane (I): IEEE 802.x networks	4.1. Link lawyer. Link types 4.2. IEEE 802 project 4.3. Flat addressing in iEEE 802 4.4. Bridges IEEE 802 4.5. IEEE 802.3: Ethernet 4.6. IEEE 802.11: WiFi
5. The data plane (II): IP networks	5.1. Internet and IP 5.2. Hierarchical addressing. Structure of IP addresses 5.3. Routers and forwarding tables 5.4. Correspondence in IP (longest prefix match) 5.5. The IP protocol. IPv4 and IPv6 5.6. Addressing scopes. Private networks 5.7. NAT
6. Interconnection of link networks	6.1. IP as interconnection network 6.2. Routers vs. bridges 6.3. Translation between link and network addresses: NDP/ARP 6.4. Fragmentation in IP
7. The control plane (I): IEEE 802.X networks	7.1. Data and control planes. Distributed and centralized control. 7.2. Control plane in IEEE 802 networks 7.3. Backward Learning 7.4. Spanning Tree Control (STP)
8. The control plane (II): IP networks	8.1. The problem of routing. Key elements: Algorithms, protocols, RIB 8.2. Hierarchical routing on the Internet: Autonomous systems and domains 8.3. Format of the RIB. Obtaining the FIB 8.4. Intra-domain routing. Main IGPs: RIP and OSPF 8.5. Inter-AS routing: BGP
9. The Transport Layer	9.1. Multiplexing, reliability and transmission modes 9.2. Transport protocols 9.3. UDP 9.4. TCP: Connection management. Ordered delivery. ARQ and flow control in TCP
10. Congestion control	10.1. The problem of congestion 10.2. Congestion control: objectives, requirements, types of mechanisms 10.3. Congestion Control in TCP. The AIMD algorithm 10.4. Classic implementations: Tahoe, Reno 10.5. Delay-based mechanisms. Vegas
11. Internet Security	11.1. Secure communication systems 11.2. Confidentiality. Symmetric and asymmetric cryptography 11.3. Authenticity and integrity. Hash functions. Digital signatures 11.4. Availability. DDoS Attacks 11.5. Secure Transport: TLS over TCP

Lab Sessions	In the lab sessions we will do practicals using various network tools and utilities (GNS3, WireShark, ping, traceroute, dig, etc.) to reinforce the contents learnt in the lecturing classes. Software to be used: GNS3, WireShark, Java. Besides, there will be several sessions to explain related programming concepts (sockets, network utilities).

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	31	45	76
Problem solving	8	8	16
Laboratory practical	12	6	18
Autonomous problem solving	0	12	12
Practices through ICT	8	12	20
Gamification	0	4	4
Essay questions exam	2	0	2
Objective questions exam	1	0	1
Objective questions exam	1	0	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Exposition of the ideas, concepts, technics and algorithms related to the thematic units of the course. With this methodology we will work the competences D2, D3, B3, B4, C11, C17, C18 and C19.
Problem solving	Resolution in the classroom by the professor of problems and exercises related with the contents of the master lessons. With this methodology students work the competences B3, B4, C11, C17, C18 and C19.
Laboratory practical	Networking laboratory practices, using various network tools and utilities (GNS3, WireShark, ping, traceroute, dig, etc.) to reinforce the contents learnt in the lecturing classes. Software to be used: GNS3, WireShark, Java. With this methodology, the competencies B1, B9, C17 and C19 are worked on.
Autonomous problem solving	Completion and delivery, more or less weekly, of online activities. These are self-evaluation tests and small tasks or problems to be carried out before or after the practical classes. It also includes the delivery of a small basic network program, as a training for the final network program. With this methodology we will work the competencies B4, B6, B9, C11, C17, C18, C19, D2, D3, D4
Practices through ICT	The goal is to develop small network programs in an autonomous and individual way. There will be several sessions to explain related programming concepts (sockets, network utilities), and also to solve doubts with the teacher, and to test and debug the programs in the laboratory where they will be evaluated. With this methodology we work with the competencies B1, B6, B9, C11, C17 and C19.
Gamification	In the virtual classroom, a gamification system will be used that includes activity points, mechanics and gamification elements to encourage the performance of online graded activities and to participate in a meaningful way in help forums. This will allow the student to obtain rewards to be used in the exams or in the continuous evaluation. The discussion forums will be the preferred way of answering questions and doubts related to the contents of the subject. The gamification will encourage peer support and collaborative resolution of doubts in the forums. Besides contributing to the increase of motivation, with this methodology we will also work on the competences B9, D3 and D4

Personalized assistance	
Methodologies	**Description**
Lecturing	Personalized attention will be given individually, in a face-to-face meeting or by videoconference, during the tutorial schedule that will be made public at the beginning of the course. Students can ask for tutoring sessions following the instructions provided in the Moovi profile pages of the teacher of this subject at https://moovi.uvigo.gal/
Problem solving	Personalised attention will be given individually, in a face-to-face meeting or by videoconference, during the tutorial schedule that will be made public at the beginning of the course. Students can ask for tutoring sessions following the instructions provided in the Moovi profile pages of the teacher of this subject.
Practices through ICT	Personalised attention will be given individually, in a face-to-face meeting or by videoconference, during the tutorial schedule that will be made public at the beginning of the course. Students can ask for tutoring sessions following the instructions provided in the Moovi profile pages of the teacher of this subject.

Autonomous problem solving	In the case of tasks, the detailed solution will be provided in the virtual classroom. In the case of self-assesmemt tests, suitable feedback for the wrong questions will be provided to the student. In any case, personalised attention will be given individually, in a face-to-face meeting or by videoconference, during the tutorial schedule that will be made public at the beginning of the course. Students can ask for tutoring sessions following the instructions provided in the Moovi profile pages of the teacher of this subject.
Gamification	In addition to individually personalized face-to-face attention, the professor will be monitor the discussions in the forums making suitable answers when necessary or explaining the answers of the students. The forums in the virtual classroom are the preferred way to request asynchronous attention for doubts and questions related to the contents of the subject.
Laboratory practical	Personalized attention will be given individually, in a face-to-face meeting or by videoconference. Students can ask for tutoring sessions following the instructions provided in the Moovi profile pages of the teachers of this subject.

Assessment

	Description	Qualification	Training and Learning Results
Autonomous problem solving	During the course, with an approximately weekly periodicity, tasks, resolution of exercises, questions and self-evaluation tests will be proposed in the virtual classroom that must be carried out by the students individually, autonomously and not presencially, always with a deadline. These tasks have an overall weight of 10% for the student who chooses option B of continuous assessment. Those who choose option A of continuous assessment can do the tasks but the score does not count for the final mark, being only indicative for their self-assessment.	0-10	B4 C11 D2 B6 C17 D3 B9 C18 D4 C19
Practices through ICT	The student must develop several small network programs. There will be several classroom sessions for the explanation of the related programming concepts (sockets, network utilities) and also for tutoring with the teacher and for the development, testing and debugging of the programs in the laboratory, where it will be evaluated. The mark obtained for these programs will be multiplied by the mark obtained in a question about them in the final exam, with a value between 0 and 1.	10	B1 C11 B6 C17 B9 C19
Essay questions exam	Final exam covering the whole subject. It has a weight of 60% but a minimum mark of 4 out of 10 is required to pass the subject.	40	B3 C11 D2 B4 C17 C18 C19
Objective questions exam	One-hour multiple-choice tests to check the progress on the subject. It has a weight of 20% for the students who choose option B of continuous evaluation and 25% for the students who choose option A	20-25	B3 C11 D2 B4 C17 C18 C19
Objective questions exam	One-hour multiple-choice tests to check the progress on the subject. It has a weight of 20% for the students who choose option B of continuous evaluation and 25% for the students who choose option A	20-25	B3 C11 D2 B4 C17 C18 C19

Other comments on the Evaluation

Students can choose the method of Assessment:

Continuous or Global Assessment.

Continuous Assessment (CA)

There will be **two possible ways or options to go through Continuous Assessment, which we call A and B.** Students must choose the option in the subject virtual classroom during first month, one day before the first assessment exam. After this deadline, the chosen continuous assessment option cannot be changed. Students who do not make any explicit choice follow the global assessment.

Given the necessary collaborative and social character of option B, groups that do not reach a minimum of 30 students, will only have option A for continuous assessment.

Continuous Assessment consists of four types of activities or tests:

- **Qualifying activities in the virtual classroom**. During the course, with an approximately weekly periodicity, tasks, resolution of exercises, questions and self-evaluation tests will be proposed in the virtual classroom for the students to carry out after school hours individually, autonomously. All activities will have a strict deadline. The

completion of these activities allows students to obtain "merit points" (**MP**) up to a maximum of 100 points (in the case of the correct completion of all of them). **The mark in this part will be calculated as the amount of MP divided by 100**. In order to facilitate the achievement of the maximum number of points, it will be possible to obtain a certain amount of PM through rewards, and in tasks with submissions, peer evaluation will be used, which will allow students to obtain additional PM.

The Merit Points only count for students who have chosen option B of continuous assessment. Those who chose option A of continuous assessment can also do the tasks and tests, but the MP obtained do not count for the final mark, being only indicative of their self-assessment.

- **Network programs (PR):** Students will have to develop several small network programs in an individual and autonomous manner during the course. Several practical sessions will be dedicated to explain the related network programming projects needed to make the programs (sockets, network utilities…), and also to solve doubts with the teacher, and to test and debug the programs in the lab before being delivered for evaluation. The mark obtained by these programs **(PR)**, between 0 and 10, will be multiplied by the mark obtained in a question about the programs that is part of the final exam **(CR)**, with a range between 0 and 1.
- **Two intermediate one-hour multiple-choice tests to assess the progress of the subject (C1 and C2)**. Each control test has a weight of 25% on the final mark (FG) for students who chose option A of continuous assessment and 20% for those who opt for option B. The schedule of the different intermediate evaluation tests will be approved by the *Comisión Académica de Grado* (CAG) and will be available at the beginning of the term.
- **A final exam (FE) covering all contents,** has a weight of 60% of the Final Grade (FG). A minimum qualification of 4 points over 10 is required to pass the subject. Included in the final exam there will be a question about the network programming projects (CR) but its mark, between 0 and 1, will not be part of the final exam and will only be used to ponder the qualification obtained in the network programming projects.

The final mark of the continuous assessment evaluation will be, according to the chosen evaluation method, A or B:

FG-CA-A = 0.25 × (C1+C2) + 0.1 × CR × PR + 0.4 × FE, if FE ≥ 4

FG-CA-A = 0.2 × (C1+C2) + MP/100 + 0.1 × CR × PR + 0.4 × FE, if FE ≥ 4

If FE < 4, the Final Mark will be equal to min{4, FG-CA} where FG-CA would be the final mark of the continuous assessment evaluation calculated before (FG-CA-A or FG-CA-B)

As said above, it is mandatory to choose the CA option, A or B, in the established period, that will be until the day before the C1 control test. Students that do not make any explicit choice will be subjected to global assessment (EA).

Failure to take any of the control tests, C1 or C2, implies a mark of "0" on the test. These tests are not recoverable.

Global Assessment (EA)

Students who do not made any choice of continuous assessment within the stipulated time period are required to take the Global Assessment (EA)

The Global Assessment will consist of the same FE at the end of the term, including the additional question (**CR**) about the network programming projects. The final mark is calculated as:

FG-EA = 0.9 x FE +CR

Extraordinary exam

In the official dates, a new extraordinary exam (FE) will be done only for students that failed in the ordinary call. This exam will also include the question about the network programming projects (CR).

These EF and CR tests of the extraordinary call are an opportunity to raise the mark in these two tests with respect to the ordinary call. In the calculation of the Final Grade, the highest mark obtained in these tests between the two attempts will prevail.

Those students who had chosen continuous assessment and that want to change to global assessment in this extraordinary call, must communicate it to the subject coordinator in written form before 8pm on the day before the review session of the first call. In this case, the conditions to pass the subject will be identical as those of students who had chosen global evaluation on the first place. In particular, it will not be possible to use in the exam any of the rewards obtained during the term as part of the continuous assessment.

The final marks are obtained in the same way as in the first-call evaluation.

End-of-program exam

The same procedure as for the global assessment will be used for the end-of-program call.

Other comments

All students presenting to any FE are considered to be presented to the subject. The marks for all exams, intermediate or final, and activities will only have effects on the current academic year.

The virtual classroom platform has tools to detect possible anomalous and dishonest behaviors in self-assessment tests (tests carried out among several people, previously known answers, etc.), as well as to detect plagiarism in written works or in software programs.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the works/test/exams, including the virtual platform activities, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

All the official communications of the Subject will be published in the News Forum of the virtual classroom, to which all the students are necessarily subscribed by email. It is assumed that all students reads these messages and are properly informed of their content.

In the event of any contradiction that may have occurred between the different versions of this guide, due to any error in the translation, the prevailing version will be the Galician language version, except for English group, for which the English version of the Guide will be considered.

Sources of information

Basic Bibliography

J.F. Kurose, K.W. Ross, **Computer networking: a top-down approach**, 8,

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

Complementary Bibliography

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

Peterson, Brakmo, and Davie, **TCP Congestion Control: A Systems Approach**,

Larry Peterson and Bruce Davie, **Computer networks: a systems approach**, 6.2-dev,

Recommendations

Subjects that it is recommended to have taken before

Data Communication/V05G301V01204

Other comments

To take the course, in order to carry out the network programs, it is very important to have a certain programming skills in an object-oriented language such as Java (or C ++). The skill level obtained after passing the Programming II course is enough.