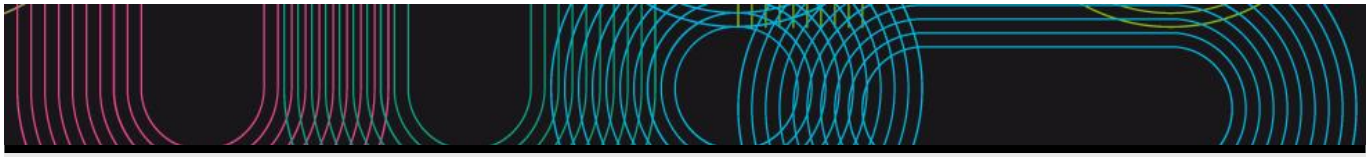

(*)Escola de Enxeñaría de Telecomunicación

(*)Páxina web

(*)

www.teleco.uvigo.es

(*)Presentación

(*)

A Escola Enxeñaría de Telecomunicación oferta para o curso académico 2017-18 un grao e dous másteres totalmente adaptados ao Espacio Europeo de Educación Superior, verificados pola ANECA axustándose á Orde Ministerial CIN/352/2009. A continuación indícanse os enlaces de acceso aos dípticos informativos dos tres títulos.

Grao en Enxeñaría de Tecnoloxías de Telecomunicación

http://teleco.uvigo.es/images/stories/documentos/gett/diptico-uvigo-eet-grao-gal.pdf

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

Máster en Enxeñaría de Telecomunicación

http://teleco.uvigo.es/images/stories/documentos/met/diptico-uvigo-eet-master-gal.pdf

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

Máster Interuniversitario en Matemática Industrial

http://teleco.uvigo.es/images/stories/documentos/promocion/M2i_Presentacion.pdf

www: http://m2i.es

(*)Equipo directivo

(*)

EQUIPO DIRECTIVO DEL CENTRO

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Coordinador do Plan de Acción Titorial: Artemio Mojón Ojea (teleco.pat@uvigo.es)

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Coordinadora Xeral: María José Moure Rodríguez (teleco.master@uvigo.es)

COORDINACIÓN DO MESTRADO INTERUNIVERSITARIO EN MATEMÁTICA INDUSTRIAL

Coordinador Xeral: José Durany Castrillo (durany@dma.uvigo.es)

Degree in Telecommunications Technologies Engineering - Teaching in English

Subjects

Year 1st

Code	Name	Quadmester	Total Cr.
V05G303V01101	Business: Company Fundamentals	1st	6
V05G303V01102	Physics: Fundamentals of Mechanics and Thermodynamics	1st	6
V05G303V01103	Informatics: Computer Architecture	2nd	6
V05G303V01104	Mathematics: Linear algebra	1st	6
V05G303V01105	Mathematics: Calculus 1	1st	6
V05G303V01201	Physics: Analysis of Linear Circuits	2nd	6
V05G303V01202	Physics: Fields and Waves	2nd	6
V05G303V01203	Mathematics: Calculus 2	2nd	6
V05G303V01204	Mathematics: Probability and Statistics	2nd	6
V05G303V01205	Programming I	1st	6

IDENTIFYING DATA				
Business: Company Fundamentals				
Subject	Business: Company Fundamentals			
Code	V05G303V01101			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	English			
Department	Business Organisation and Marketing			
Coordinator	Fernández Arias, Mª Jesús González Vázquez, Beatriz			
Lecturers	Fernández Arias, Mª Jesús González Vázquez, Beatriz			
E-mail	jarias@uvigo.es bgonza@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject has like objective give to know the organisation, management and institutional frame of the company.			

Competencies	
Code	
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.
B8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
C5	CE5/FB5: The necessary knowledge of business concepts, of law and institutional frameworks. business organization and management .
D2	CT2 Understanding Engineering within a framework of sustainable development.

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Manage the requirements and the products of team to reduce the time of realisation of the projects, and improve the coherence and the precision in the business surroundings.	B8	C5
Propose the solutions of improvement and control the set up.	B4	D2
Establish the guidelines on the metric and indicators that will be used to allow to the Direction of the company the evaluation and the follow-up of the computer systems	B4	D2

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

Subject 4: THE SYSTEM OF PRODUCTION II	4.1 The costs of production. 4.2 Threshold of profitability. 4.3 Decision to produce or buy. 4.4 Operational leverage. 4.5 Analyses PERT.
Subject 5: THE SYSTEM OF COMMERCIALISATION	5.1 The market. 5.2 The competition. 5.3 The system of commercialisation. 5.4 Marketing-mix.
Subject 6: THE SYSTEM OF *ADMINISTRAtION	6.1. The system of direction. 6.2. Human Resources.
	Practical 1: Typology and nature of the company Practical 2: Surroundings TIC Practical 3: Structure and economic analysis-financial Practical 4: Sources of Finance I Practice 5: Finance II Practice 6: Investment I Practice 7: Decisions of investment in the company II. Practical 8: Production Practical 9: Productivity Practical 10: Costs of Productivity Practical 11: Capacity of production Practical 12: PERT Analysis Practical 13: The plan of company

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	56	84
Computer practices	24	36	60
Case studies	2	2	4
Objective questions exam	1	0	1
Essay 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	Master lesson with material of support and audiovisual means.Realise an exhibition of the main contents of the matter so that the student can understand the scope of the same and facilitate his understanding. Through this methodology the competencies CG8, CE5, CT2 are developed.
Computer practices	Classes where the students will work of individual form or in couple the practical contents of the subject.They will realize activities of application of the knowledges to concrete situations. In this methodology work of practical way the competitions CG4 and CE5.
Case studies	Methodology of analysis qualitative in the that the student works in one marry concrete, exploring diverse contents of the subject. With this methodology work the competitions CG8, CE5, CT2.

Personalized attention

Methodologies	Description
Lecturing	In the sessions the professor will attend, will orient and will resolve the doubts to the students on the contents tackled in the theoretical classes. The students will have occasion to attend to the coaching personalised in the office of the professor in the schedule that the professors will establish to such effect in the principle of the course and that will publish. These coaching are allocated to resolve the doubts and orient to the students on the development of the contents tackled in the theoretical classes, and in the practical classes. Likewise, also it will keep a constant communication between the educational and the students through the Network by means of the platform Fear in Faitic.
Case studies	In the study of case the professor will attend a in the doubts that the students have envelope the case posed.
Computer practices	In the practica lsesions the professor will attend the doubts that the students have envelope the contents of the exercises or problems posed.

Assessment

	Description	Qualification	Training and Learning Results		
Objective questions exam	Proofs scored that will realise along the course, distributed of uniform form and programmed so that they interfere the less possible in the rest of the matters.	40	B4 B8	C5	D2
Essay questions exam	Final proof that can contain partial or totally the contents of the matter developed in the classes of theory and of practices.	60	B4 B8	C5	D2

Other comments on the Evaluation

Following the proper guidelines of the degree will offer two systems of evaluation: continuous evaluation (with two options) and only evaluation at the end of the quarter. In any of the two systems of evaluation, this is individual and all the competitions of the subject remain evaluated.

1. Continuous evaluation

The continuous evaluation will consist of two intermediate tests developed throughout the course, and which will be completed with an exam at the end of the semester. The tests will consist of two exams, with dates that will be planned in the Academic Committee of Degree and will be available at the beginning of the semester. These tests do not release material, but each of them will deal with the contents seen until the time of the test, both in theory classes and practices, which is why the last test will be given a greater weight in the calculation of the qualification with respect to the previous one, so that the first test weighs 40%, and the second test 60%.

If the student has passed the last test, and obtained a weighted average with a grade of 5, he / she will be exempt from taking the exam at the end of the semester. The grade obtained by the student in this case will be the weighted average grade of the two tests.

Students who do not pass the subject through the two intermediate tests, will have to complete the continuous assessment by taking an exam at the end of the semester that will consist of a test that will represent 60% of the grade that will be added to the grade obtained in the continuous evaluation (40% of the weighted average of the intermediate proofs).

These tests are not recoverable, that is, if a student does not perform them on the stipulated day, the teacher does not have the duty to repeat them (unless there is a cause of force majeure). A student will be considered to have opted for continuous assessment when participating in the second test.

2. Students that opt by unique evaluation

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

3. About the second oportunity

Stop the second opportunity the student chooses and communicates by writing (a week before the exame) wishes be evaluated again entirely envelope to maximum possible note or follow him applying the procedure of continuous evaluation stipulated in the subject keeping the note obtained in the previous tasks. Default, to the student save him the results of the proofs realized in this course.

4. Qualification Of No Presented

A student will consider no presented if, how maximum, took part in the first proof of continuous evaluation. In any another marry, the student will consider presented and will receive his corresponding note.

5. About the extraordinary final year oportunity

It will consist of an exam that includes the theoretical and practical contetns of the subject.

Important notice

In the case of detection of copy in any of the proofs, the final qualification will be of Fail (0), and the fact will be communicated to the direction of the Centre.

Sources of information

Basic Bibliography

Pérez Gorostegui, E., **Curso de introducción a la economía de la empresa**, 2009

Madura, Jeff, **Introduction to Business**, 2010

Diez-Viel, I., Martin de Castro, G., Montoro Sanchez, M.A., **Introduction to Business Administration**, 2012

Complementary Bibliography

Barroso Castro, C. (Coord.), **Economía de la empresa**, 2012

Fernández Sánchez, E. y otros, **Iniciación a los negocios para ingenieros. Aspectos funcionales**, 2008

García Márquez, F., **Dirección y Gestión Empresarial**, 2013

Iborra Juan, M.; Dasi Coscollar, A.; Dolz Dolz, C.; Ferrer Ortega, C.,, **Fundamentos de dirección de empresas. Conceptos y habilidades directivas,**, 2014

Moyano Fuentes, J.; Bruque Cámara, S.; Maqueira Marín, J.M.; Fidalgo Bautista, F.A.; Martínez Jurado, **Administración de empresas: un enfoque teórico-práctico**, 2011

Recommendations

IDENTIFYING DATA

Physics: Fundamentals of Mechanics and Thermodynamics

Subject	Physics: Fundamentals of Mechanics and Thermodynamics			
Code	V05G303V01102			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	English			
Department	Applied Physics			
Coordinator	Chiussi , Stefano			
Lecturers	Boutinguiza Larosi, Mohamed Chiussi , Stefano Fernández Doval, Ángel Manuel Testa Anta, Martín			
E-mail	schiussi@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Introduction to the basic concepts on the general laws of Mechanics and Thermodynamics as well as to their application to the resolution of problems in engineering.			

Competencies

Code	
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.
B6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
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.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Understanding and mastering of the basic concepts on the general laws of Mechanics and Thermodynamics.	B3 B11 B12 B20 B23 B26	C3	
Ability to use the basic instrumentation to measure physical quantities.	B3 B5 B6 B11 B12 B20 B23 B26	C3	D3

Ability to evaluate experimental data.	B1 B3 B3 B4 B5 B6 B17 B24 B25 B26	C3 C5 C8 C9 C11
Ability to solve the elementary technical problems in engineering.	B3	C3

Contents
Topic
1.- Physical quantities and units. The International System.
2.- Vectorial tools for Mechanics.
3.- Point Kinematics.
4.- Point Kinetics.
5.- Statics.
6.- Oscillations.
7.- Wave motion.
8.- Zero principle of Thermodynamics. Temperature.
9.- First principle of Thermodynamics.
10.- Second principle of Thermodynamics.
Lab 1.- Measurement instruments. Error and uncertainty. Estimation of uncertainties in direct measurements.
Lab 2.- Measurement of the reaction time to a given stimulus. Measurement of the gravitational acceleration by means of a pendulum. Estimation of uncertainty in indirect measurements.
Lab 3.- Verification of Hooke's Law. Linear fit.
Lab 4.- Longitudinal and transversal standing waves. Measurements by linearization of non-linear relations and linear fit. Graphical representation of measurement results.
Lab 5.- Simple harmonic motion. Free standing oscillation of a spring. Measurements by linearization of non-linear relations and linear fit. Graphical representation of measurement results.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	34	62
Problem solving	15.5	46.5	62
Laboratory practices	9	13.5	22.5
Essay questions exam	1	0	1
Problem solving	1.25	0	1.25
Practices report	1.25	0	1.25

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

Methodologies
Description

Lecturing	Prior personal work: -Preliminary reading of the proposed bibliography on the subject. During the lectures: -Presentation of theoretical concepts. -Application of the theoretical concepts to simple cases and situations. -Experimental demonstrations. -Audiovisual presentations. Ulterior personal work: -Revision of theoretical concepts. -Solving of questions and exercises from the bibliography. -Consult the bibliography. -Identification of weak points which require tutorial aid. Through this methodology, competencies CG3, CE3, CG5, CG6 are worked out.
Problem solving	(Problem solving) Solving of average-difficulty problems involving one or more theoretical concepts. During the lectures: -Presentation of solving strategies and techniques by solving example-problems. Personal work: -Solving of problems from the bibliography. -Identification of weak points which require tutorial aid. Through this methodology, competencies CG3, CE3, CG5, CG6 are worked out.
Laboratory practices	Prior personal work: -Preparation of the practical session by studying the corresponding guide and reviewing the theory. During the practical session: -Description of the experiment highlighting which theoretical concepts are involved. -Training on material and instrumentation handling. -Execution of the experiment. -Preliminary result processing. Ulterior personal work: -Processing and analysis of the results. -Weak-point identification. -Consult the bibliography. Through this methodology, competencies CG3, CE3, CG5, CG6 and CT3 are worked out.

Personalized attention

Methodologies	Description
Lecturing	Questions will be solved by the lecturers in their respective tutorial-aid time. Tutorial aid will be given: individually or in small groups (typically of two or three students), by appointment to the corresponding lecturer (unless stated otherwise) and, preferably, in the place and timetable of the corresponding lecturer which will be published at the beginning of the semester. The appointment shall be arranged either by e-mail or in person at the beginning or end of a lecture.
Problem solving	Questions will be solved by the lecturers in their respective tutorial-aid time. Tutorial aid will be given: individually or in small groups (typically of two or three students), by appointment to the corresponding lecturer (unless stated otherwise) and, preferably, in the place and timetable of the corresponding lecturer which will be published at the beginning of the semester. The appointment shall be arranged either by e-mail or in person at the beginning or end of a lecture.
Laboratory practices	Questions will be solved by the lecturers in their respective tutorial-aid time. Tutorial aid will be given: individually or in small groups (typically of two or three students), by appointment to the corresponding lecturer (unless stated otherwise) and, preferably, in the place and timetable of the corresponding lecturer which will be published at the beginning of the semester. The appointment shall be arranged either by e-mail or in person at the beginning or end of a lecture.

Assessment

	Description	Qualification	Training and Learning Results

Essay questions exam	Solving of questions related to the theoretical concepts of the topics in both the classroom and laboratory syllabi.	30	B3 B5 B6		
Problem solving	(Problem solving) Solving of simple exercises related to the theoretical concepts of the topics in the syllabus. Solving of problems involving one or more theoretical topics.	52	B3 B5 B6	C3	
Practices report	Execution of real and simulated measurements. Real- and simulated-measurement result processing.	18	B3 B5 B6		D3

Other comments on the Evaluation

(This is a translation, in case of any discrepancy or dispute, the original Spanish version shall prevail.)

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

It will be assumed that a student chooses continuous assessment if he or she takes and hands the third assessment exercise in (see §1.1) and that he or she chooses single assessment if he or she does not hand the aforementioned exercise in. Once the results of this exercise are handed in, it will be understood that the student has taken the current term's examination call and he or she will be qualified in the first assessment chance of the regular call according to the criteria that are detailed in §2.1, regardless of whether he or she takes the End of Semester Examination or not.

Proper ethical behaviour is requested from the students. In the event that the lecturers in charge of the assessment notice unethical behaviour (cheating, plagiarism, introduction or use of means not permitted by the rules and instructions for the assessment exercises and tests, etc.), the student will be regarded as not meeting the necessary requirements to pass the subject. In this case, the student will be assigned an overall mark of 0 (zero points) for the current academic year and the fact will be communicated to the head of the Centre to take appropriate measures.

1. ASSESMENT TESTS

1.1. CONTINUOUS ASSESSMENT INTERMEDIATE EXERCISES

The schedule of the exercises will be approved in a "Comisión Académica de Grado" (CAG) and made available by the beginning of each semester. These exercises are not retakeable, i.e., they can be only taken in the scheduled dates. The examinations (§1.2) allow recovering part of the lost marks up to reach the maximum overall mark (see §2.1).

As a general rule, the marks of each exercise will be published before the next one. The marked exercises may be revised, during the tutorial-aid hours of the corresponding lecturer , along the fourteen days following the publication date of the marks.

The marks obtained in the exercises will be only valid for the two assessment chances of the regular call (see §2.1) of the academic term the exercises have been taken.

Three exercises will be scheduled:

LC1 and LC2) Experimental laboratory exercises comprising the execution of actual measurements and the processing of the results, consisting in taking an experimental laboratory class, individually processing (during the last 30 minutes) the assessable results which will be specified in the corresponding experiments guide and handing them in at the end of the class (marks LC1 and LC2 between 0 and 1 point for each of the exercises).

TC) Combined individual test with questions and exercises. Questions about theoretical concepts and solving of elementary cases and situations related to the topics in the classroom syllabus (mark TC between 0 and 1 point). Length: 30 minutes during one of the theory or problem-solving lectures.

The exercises not taken by the student will be marked with 0 (zero points).

1.2. EXAMINATIONS

Combined individual tests with:

Tx) Questions and exercises, (mark Tx between 0 and 5 points distributed among them).

Px) Solving of one or two problems, (mark Px between 0 and 3,4 points distributed between them).

Lx) Solving of a laboratory problem comprising the execution of real or simulated measurements and the processing of the results (mark Lx between 0 and 1,6 points).

The parts of the examination that the student does not hand in will be marked with 0 (zero points).

Length: 2 hours in each of the dates officially assigned for the subject in the examinations schedule of the Centre.

1.2.1. Regular examinations

- First assessment chance: End-of-Semester Examination x = F (marks TF, PF, LF)

- Second assessment chance: Resit Examination x = R (marks TR, PR, LR)

1.2.2. Special examination

- End-of-studies call: End-of-Studies Examination x = E (marks TE, PE, LE)

2. REGULAR ASSESSMENT CALL GRADING

2.1. CONTINUOUS ASSESSMENT option

2.1.1. Combined experimental laboratory mark (LLx)

For each of the assessment chances the combined experimental laboratory mark will be calculated as the sum of marks LC1 and LC2 from continuous assessment (§1.1) and mark Lx from the corresponding examination. If this sum results greater than 2 (two points) its value will be truncated to 2 (two points).

LLx = min {LC1 + LC2 + LLx , 2}

2.1.2. Overall grade

For each of the assessment chances the overall grade will be calculated as the sum of the marks of:

Tx) The questions and exercises part of the corresponding examination (§1.2.1).

TC) The questions and exercises continuous assessment test (§1.1).

Px) The problem solving part of the corresponding examination (§1.2.1).

LLx) The corresponding combined experimental laboratory mark (§2.1.1).

If this sum results greater than 10 (ten points) its value will be truncated to 10 (ten points).

OVERALL_x = min {Tx + TC + Px + LLx , 10}

2.2. SINGLE ASSESSMENT option

For each of the assessment chances the overall grade will be calculated as the sum of the marks of the corresponding examination (§1.2.1).

OVERALL_x = Tx + Px + Lx

3. SPECIAL END-OF-STUDIES CALL GRADING

The overall grade will be calculated as the sum of the marks of the End-of-Studies Examination (§1.2.2).

OVERALL_E = TE + PE + LE

4. CALCULATIONS AND ROUNDING

I) All of the aforesaid calculations to obtain the marks will be performed with a resolution equal to or better than one hundredth of a point (0,01 point).

II) The overall marks will be rounded to the nearest multiple of 0,1 point (one tenth of a point); if the two nearest multiples of 0,1 point are equidistant, the overall mark will be rounded to the higher of them.

III) The mark scale is established on the understanding that the minimum overall mark necessary to pass the subject is 5,0 points.

Sources of information
Basic Bibliography
H.D. Young y R.A. Freedman, **Sears-Zemansky. Física Universitaria**, 9, 11, 12 o 13, Addison-Wesley,
H.D. Young y R.A. Freedman, **University Physics**, 9, 11, 12 or 13, Addison-Wesley,

Profesorado presente y pasado de la asignatura., **Guiones de las prácticas de «Física Fundamentos de Mecánica y Termodinámica»**, 2018-2019, 2018

Present and past lecturers of this subject, **Laboratory Notes for "Physics: Fundamentals of Mechanics and Thermodynamics""**, 2018

Oficina Internacional de Pesas y Medidas (BIPM), **Sistema Internacional de Unidades SI**, 8, Centro Español de Metrología, 2008

Bureau Internationale des Poids et Mesures (BIPM), **SI Brochure: The International System of Units (SI)**, 8, Bureau Internationale des Poids et Mesures (BIPM), 2008

Complementary Bibliography

I.N. Bronshtein, K.A. Semendiaev, **Manual de Matemáticas para Ingenieros y Estudiantes**, (cualquier edición), MIR,

Raymond A. Serway, John W. Jewett, **Física, Tomo 1**, 3, Thomson, 2003

Paul A. Tipler, **Física, Tomo 1**, 5, Reverté, 2005

W. Edward Gettys, et al., **Física Clásica y Moderna**, Mc Graw-Hill, 1991

Douglas C. Giancoli, **Física para universitarios, Tomo 1**, 3, Prentice-Hall, 2002

Marcelo Alonso, Edward J. Finn, **Física**, Addison-Wesley, 1995

Susan M. Lea, John R. Burke, **Física. La naturaleza de las cosas, Tomo 1**, Paraninfo, 2001

Ambler Thompson, Barry N. Taylor, **NIST Special Publication 811, «Guide for the Use of the International System of Units (SI)»**, 2008, Narional Institute of Standards and Technology, 2008

Comité Conjunto para las Guías en Metrología (JCGM), **Vocabulario Internacional de Metrología VIM**, 3, Centro Español de Metrología, 2012

Recommendations

Subjects that continue the syllabus

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

Subjects that are recommended to be taken simultaneously

Mathematics: Linear algebra/V05G300V01104
Mathematics: Calculus 1/V05G300V01105

Other comments

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

IDENTIFYING DATA				
Informatics: Computer Architecture				
Subject	Informatics: Computer Architecture			
Code	V05G303V01103			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	English			
Department	Telematics Engineering			
Coordinator	Llamas Nistal, Martín			
Lecturers	Anido Rifón, Luis Eulogio Costa Montenegro, Enrique Llamas Nistal, Martín Ramos Merino, Mateo Santos Gago, Juan Manuel			
E-mail	martin@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Computers have become an essential tool. This fact is even more clear while studying the "Bachelor of Engineering in Telecommunications Technology" (Grado en Ingeniería de Tecnologías de Telecomunicación), where computers are not only manipulated from a user's --or specialized user's-- point of view, but also from the engineering perspective, as tools to be designed or to be integrated in more complex systems. Hence, the main motivation for the "Computer Architecture" (Arquitectura de Ordenadores) course is to provide students with an understanding of basic computer operation by studying the lower abstraction levels (over the electronic level). The subject "Computer Architecture" (Arquitectura de Ordenadores) is focused on the conventional machine level, describes the operating machine level and shows an example application for the Symbolic Machine domain through the introduction of the Database Management Systems.			

Competencies	
Code	
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.
C2	CE2/FB2: The basic knowledge about using and programming computers, operative systems, databases and Engineering applied software.
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.

Learning outcomes				
Expected results from this subject	Training and Learning Results			
Knowledges of the main concepts related with the architecture of the computers and capacity for his handle through models.		B3 B20 B21	C3 C9 C13 C17	
Capacity for the handle of the systems of representation of the information used in the computers	A1 A2 A3 A4 A5	B3	C3 C4 C5 C8 C14 C17	D7 D15 D22

Knowledges of the types of instructions more representative and variations more notable and capacity to determine the implications of his use by part of the programmer of conventional machine		B3 B4 B14	C2 C4 C15 C17	
Knowledges of the main ways of addressing modes in assembler language and capacity for the efficient handling of these.	A1 A2	B2 B3 B4 B11 B12 B13 B15 B16 B25 B26	C2 C24	
Acquisition of skills on the design of algorithms and the construction of programs to level of conventional machine	A1 A2 A3 A4	B1 B3 B4 B4	C1 C2	D1 D2 D3 D3 D11 D18
Knowledge of the principles and fundamental components of the operating systems	A1 A3 A4 A5	B3	C1 C2 C3 C4 C18 C27 C33	D3 D9
Understanding of the main functions of the operating systems	A1 A2 A3 A5	B2 B3	C2 C16 C19	D1 D2 D3 D3 D7 D8 D9 D13 D14 D17 D18 D21
Knowledge of the fundamental aspects of the databases.	A1 A2 A3 A4 A5	B1 B2 B3 B3	C2 C2 C3 C8 C13 C22 C24	D1 D2 D3 D3 D4 D8 D9 D11 D12 D14 D16 D18 D19
Understanding of the distinct models of organisation of the information in databases	A1 A2 A3 A4 A5	B3	C2 C3 C4 C5 C8 C14 C17 C18 C21 C27 C32	D3 D7 D9 D14 D15 D22 D23

Acquisition of basic skills on the languages of query to databases	A1 A2 A3 A5	B2 B3 B4	C2 C16 C19	D1 D2 D2 D3 D3 D7 D8 D9 D13 D14 D17 D18 D21

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practices	22	27.5	49.5
Introductory activities	5	5	10
Problem solving	10	17.5	27.5
Lecturing	12	24	36
Self-assessment	0	3	3
Laboratory practice	4	8	12
Short answer tests	3	9	12
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Laboratory practices	The course includes programming practices that will performed using a simple computer (SIMPLEZ) and a regular computer. Through this methodology the competencies CG3, CG4, CT2, CT3 and CE2 are developed.
Introductory activities	Presentation of the course contents, methodology, office hours, evaluation, usage of the labs, and any other issue related to the subject. Through this methodology the competences CG3 and CT3 are developed.
Problem solving	Programming, information representation, and other problems and exercises will be solved during the classes. Some must be solved by students previously at home, and they will participate actively in the solution of some other problems. Through this methodology the competencies CG, CT2 and CE2 are developed.
Lecturing	Theoretical concepts and their practical application will be introduced during the classes. Students will be encouraged to participate by alternating lectures with problem and exercise solving. Therefore, sessions will include lectures and time for exercises and problems. Through this methodology the competencies CG3, CT3 and CE2 are developed.

Personalized attention	
Methodologies	**Description**
Lecturing	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Laboratory practices	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.
Problem solving	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.

Assessment				
	Description	Qualification	Training and Learning Results	
Self-assessment	Exam questions will be available for students, in order to perform autoevaluation.	0	B3 B4	C2
Laboratory practice	They will realise three practical exercises in the laboratory of continuous evaluation, and other three short exercises in each turn of laboratory.	50	B3 B4	C2
Short answer tests	They will realise in theory roughly 12 exercises of continuous evaluation, divided in two parts.	50	B3 B4	C2

Other comments on the Evaluation

ASSESSMENT

This subject is organized in two parts: Theory and Practice.

We consider:

-the Harmonic Average of A and B as HA(A,B)=2*A*B/(A+B). If A=B=0 then HA(A,B)=0

-the Arithmetic Average of A and B as AA(A,B)=(A+B)/2

We use the Mixed Average MA(A,B) in order to obtain grade in two different parts (A and B):

If A >= 5 and B >=5 then MA (A,B) =AA(A, B)

else {

if HA(A,B) > 3 then MA(A,B) = HA(A,B)

else MA(A,B) = AA(A,B), max. 3 (i.e. if AA(A,B)>3 then MA(A,B)=3)

}

In words, MA(A,B) is the arithmetic average if A and B are greater or equal to 5. Otherwise, MA(A,B) is the harmonic average. Besides, if the harmonic average is less than 3 then we apply the arithmetic average with a maximum possible score of 3.

The final grade for the course (FG) is as follows, according to theory grade (TG) and Practice Grade (PG): FG = MA(TG, PG). The assessment is individual.

To pass the course, FG must be greater than or equal than 5.

Both parts can be evaluated by Continuous Assessment (CA) or by Eventual Assessment (EA).

The EA will consist of Theory and Practice, and will take place in date and time officially established.

CA will consist of the tasks described in this guide, and they are not recoverable, i.e., if a student cannot follow them during the stipulated period the teacher does not have the obligation of repeating them.

If one of the parts (Theory or Practice) is passed in the First Call, the note is kept for the Second Call in which the student will only have to examine of the other part.

The CA tasks grades are only valid for the current academic course, being discarded in case the student fails the course.

THEORY

The Theory part is divided into two sub-parts: T1 and T2. T1 covers approximately 66% of the syllabus (up to theme 5 included), while T2 the 100% of the syllabus.

The Theory uses the Blended Flipped Classroom (BFC) method. In a week, one hour class takes place outside the classroom watching videos, and the other hour in the classroom answering questions, solving exercises and assessing.

* FIRST CALL EXAMS

. CONTINUOUS ASSESSMENT (CA).

In CA, the student needs to do short exercises (around 10 or 15 minutes) during the weekly class time. The grade in T1 and T2 is calculated using arithmetic average of the exercises proposed for each part (approximately 7 and 5). All of these exercises will take place in the classroom and never during the exam period. If a student does not attend to some of these exercises, they will not be repeated.

Usually almost all the weeks a short exercise will be done: those weeks that the short exercise is not done, it will be postponed for the following week, where two short exercises will be done, or one alone but with double weight.

The theory CA grade at First Call is TG=MA(T1,T2).

If a student does not pass the theory, but passes one of the two parts (T1 or T2), he/she keeps the grade of the part passed for the Second Call Exams. If he/she does not pass the two parts, he/she will have to go to the Eventual Assessment at Second Call.

. EVENTUAL ASSESSMENT

All student that have not followed the CA will have to go to the Eventual Assessment (EA). The EA consists of two exercises T1 and T2 (one of each of the parts), to be done in 90 minutes, and a test exam (TEST) to be done in 20 minutes.

The final score is: TG=0,8*MA(T1, T2) + 0,2*TEST

* SECOND CALL EXAM

The Second Call Exam has the same structure that the First Call one.

If CA was not followed, the student will have to do T1, T2 and TEST exercises, regardless of the grades in each exercise in First Call Exam.

If the student did not pass the CA but passed T1 or T2, he/she can attend to the exam of the failed part. In this way, the grade obtained in CA is deleted, keeping the grade in the passed part. The calculation grade in theory is similar to the CA: TG=MA(T1,T2). In other case (both T1 and T2 failed), the student will have to do the Eventual Assessment (T1, T2 and TEST).

* EXTRAORDINARY CALL

It will consist of a exam similar to the one for the Eventual Assessment in the First Call.

PRACTICE

* FIRST CALL

. CONTINUOUS ASSESSMENT (CA)

The CA of Practice consists of 3 exercises P1, P2 and P3. P1 will be about Simple Computer, P2 about Basic Computer (around 60% of the syllabus) and P3 about Complete Computer (100% of the syllabus). The exercises will be done in the laboratory and will last approximately 1 hour. P1 will be around the 4th week, P2 around the 8th and P3 at the final exam day (the exam will be different for those who follow CA than for those who decide to go by EA). P1 and P2 will be held in afternoon shifts. 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 Practice CA grade is the weighted average of these exercises: PG=0,20*P1+0,35*P2+0,45*P3

. EVENTUAL ASSESSMENT

All the students that have not followed the CA will have to present to the Eventual Assessment (EA).

The EA of Practice will consist in an exercise on the Complete Computer to be done in the laboratory in 1h (approximately).

In this case, the Practice Grade is the grade of the Eventual Assessment.

* SECOND CALL EXAM

The student will have a Second Call Exam similar to the Eventual Assessment Exam of the First Call. All the students who did not pass the practical part, having followed the CA or not, will have to go to this exam.

*EXTRAORDINARY CALL

It will consist of a exam similar to the Eventual Assessment in First Call.

GENERAL QUESTIONS

All exercises and exams of the subject are scaled from 0 to 10. The TEST Exam of Theory can be negative.

ELECTION OF CONTINUOUS ASSESSMENT:

If a student does any of the exercises of CA (Theory or Practice), then it is considered that this part is being followed by CA, not being able to go to the Eventual Assessment of First Call of this part. Note that a student can follow, if he/she wants, a part (Theory or Practice) by CA, and the another part (Practice or Theory) by Eventual Assessment.

ACTS: Students who have attended any of the CA exercises (both practice and theory) will be considered as presented and their grade will be obtained by applying the corresponding formulas.

EXAMS: To take any theory exam (T1, T2 and Eventual Assessment) or practice (P1, P2, P3 and Eventual Assessment), in first, second or extraordinary calls, all students must register through the corresponding software tool, which will be notified with a minimum of 5 calendar days.

Note: Prior to an exercise or an exam, the date and procedure for the grade review will be published sufficiently in advance.

COMMUNICATIONS WITH STUDENTS: All communications of the teaching organization will be done through the informatics tools used in the course (FAITIC, BeA and e-mail). It is understood that all students read their e-mail (e-mail registered in FAITIC) at least once a day.

ETHICAL CODE: 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. All students are expected to have an ethical behavior in all exams, ensuring equal opportunities for all students. If an infraction is detected in an exam, the score obtained in that test will automatically be zero (0) and a report will be issued to the School Direction to take actions. These are some examples of unethical behavior: use of electronic devices (mobile phones, tablets, computers, etc.), copy from another peer, use of unauthorized material in an exam, etc.

Sources of information

Basic Bibliography

Gregorio Fernández Fernández, **Curso de Ordenadores. Conceptos básicos de arquitectura y sistemas operativos.**, 5ª,
Silberschatz, H.F. Horth y S. Sudarshan, **Fundamentos de Bases de Datos.**, 2ª,

Complementary Bibliography

A. S. Tanenbaum, **Organización de Computadoras. Un enfoque estructurado.**, 4ª,
J.L. Hennessy y D.A. Patterson, **Arquitectura de los Computadores. Un enfoque cuantitativo**,
Martín Llamas Nistal, Fernando A. Mikic Fonte y Manuel J. Fernández Iglesias, **Arquitectura de Ordenadores: Problemas y Cuestiones de Teoría**, 1ª,
Alberto Gil Solla, **Ejercicios resueltos sobre Fundamentos de los Ordenadores**, 1ª,
Alberto Gil Solla, **Problemas resueltos de programación en ensamblador**, 1ª,
Fernando A. Mikic Fonte y Martín Llamas Nistal, **Arquitectura de Ordenadores: Problemas de Programación en Ensamblador**, 1ª,
C. Costilla Rodríguez, **Introducción a las Bases de Datos Modernas**,
V.C. Hamacher, Z.G. Vranesic, S.G. Zaky,, **Organización de Computadoras**, 2ª,
D. A. Patterson y J.L. Hennessy (Traducido por J.M. Sánchez), **Organización y diseño de Computadores. La interfaz hardware/software**,
Stephen Welsh and Peter Knaggs, **ARM: Assembly Language Programming**, 2003
Gregorio Fernández Fernández, **Elementos de Sistemas Operativos, de representación de la información y de procesadores hardware y software**, 2015
Sergio Barrachina Mir, Maribel Castillo Cata- lán, Germán Fabregat Llueca, Juan Carlos Fernández Fer, **Introducción a la arquitectura de computadores con QtARMSim y Arduino**,
Sergio Barrachina Mir, Maribel Castillo Cata- lán, Germán Fabregat Llueca, Juan Carlos Fernández Fer, **Prácticas de inntroducción a la arquitectura de computadores con QtARMSim y Arduino**,

Recommendations

IDENTIFYING DATA

Mathematics: Linear algebra

Subject	Mathematics: Linear algebra			
Code	V05G303V01104			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish			
Department	Applied Mathematics II			
Coordinator	Martín Méndez, Alberto Lucio			
Lecturers	Martín Méndez, Alberto Lucio Prieto Gómez, Cristina			
E-mail	amartin@dma.uvigo.es			
Web	http://faitic.uvigo.es/			
General description	The subject Linear Algebra is taught in the first quadmester of the first course of the Grado en Ingeniería de Tecnologías de Telecomunicación, with the main objective of providing students with a clear understanding of the complex numbers, systems of linear equations and elementary techniques of matrix algebra as well as an introduction to the fundamental concepts of Vector Spaces which will be needed in later subjects. It will be paid special attention to the applications of Linear Algebra.			

Competencies

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.
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
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.

Learning outcomes

Expected results from this subject	Training and Learning Results			
To know of the basic techniques of linear algebra and matrix algebra which are needed in other subjects that should be studied subsequently in the programme.	A1 A2 A3 A4	B1 B2 B3 B4 B6	C1 C2 C13 C17	D1 D2 D2 D3 D3 D4 D5 D8 D16 D18
Skill development the basic operations of matrix algebra.	A2	B1 B2 B3 B4	C1 C4 C5 C6 C13 C23	D2 D2 D3 D8 D9 D12

Knowledge of numerical methods for solving systems of linear equations and knowledge of the basic concepts involving vector spaces and linear maps.	A1 A2 A3 A4 A5	B1 B3 B3 B4 B6 B7 B8 B9 B10 B12	C5 C9 C11 C14 C15 C21 C26 C36 C38	D1 D2 D3 D3 D4 D5 D6 D7 D8 D14 D15 D16 D22
Knowledge of the properties of vector spaces with inner product.	A1 A2 A3 A4 A5	B1 B5 B6 B7 B11	C1	D1 D2 D3 D4 D5 D6 D7 D8 D14 D15 D16 D22
Skill development some applications of linear algebra: the method of least squares, singular value decomposition and classification of quadratic forms	A1 A2 A3 A4 A5	B1 B3 B3 B4 B6 B7 B8 B9 B10 B12	C1 C5 C9 C11 C14 C15 C21 C26 C36 C38	D1 D2 D3 D3 D4 D5 D6 D7 D8 D14 D15 D16 D22
To know the arithmetic of complex numbers.		B3 B4	C1 C9	D2 D3 D8

Contents	
Topic	
Topic 1. Complex numbers.	Operations with complex numbers. Geometric concepts associated with complex numbers. Euler's formula and its consequences.
Topic 2. Matrices, determinants and systems of linear equations	Matrix operations: addition, scalar multiplication and product of matrices. Matrix inverse. LU decomposition. Block matrices. Determinants. Systems of linear equations. The matrix equation Ax=b. Solution set of a system of linear equations. The matrix of a system of linear equations. Elementary row operations and Gauss' method. Numerical methods for the systems of linear equations.
Topic 3. Vector Spaces and Linear transformations	Linear independence. Subspaces. Basis. Dimension. Rank of a system of vectors and rank of a matrix. Introduction to linear transformations. Matrix of a linear transformation. Composition of linear transformations and the product of matrices.
Topic 4. Matrix diagonalization.	Eigenvalues and eigenvectors. Eigenspace. Matrix diagonalization and diagonalizable matrices.
Topic 5. Orthogonallity.	Real Euclidean inner product. Complex Hermitian inner product. Orthogonallity. Gram-Schmidt. Unitary Diagonalization. Singular value decomposition. Matrix rank reduction. The method of least squares. Quadratic forms.

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practices	2	2	4

Lecturing	38	76	114
Problem solving	9	9	18
Problem solving	5	5	10
Essay questions exam	2	2	4

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

Methodologies

	Description
Laboratory practices	Solving assigned exercises and model problems. Use of the computer tool MATLAB. Individual. Through this methodology the competences CG3, CG4, CE1, CT2 and CT3 are developed.
Lecturing	Explanation and development by the teacher of the contents of the various topics in the syllabus. Individual. Through this methodology the competences CG3, CE1 and CT3 are developed.
Problem solving	Resolution by part of the professor of suitable exercises adapted to each topic. Individual. The students will also have to take part in the resolution of exercises in order to strengthen their knowledge. Through this methodology the competences CG3, CG4, CE1, CT2 and CT3 are developed.

Personalized attention

Methodologies	**Description**
Problem solving	Personalized tutoring will be available from all the teachers of the subject. They will be held in the respective offices of the teachers unless announced otherwise.
Laboratory practices	Personalized tutoring will be available from all the teachers of the subject. They will be held in the respective offices of the teachers unless announced otherwise.
Lecturing	Personalized tutoring will be available from all the teachers of the subject. They will be held in the respective offices of the teachers unless announced otherwise.
Tests	**Description**
Problem solving	Personalized attention will be available for assistance in the revision of tests and exams.

Assessment

	Description	Qualification	Training and Learning Results	
Problem solving	Continuous evaluation consists in four short tests to be given in the class hour and also on homework to be turned-in in class. The approximate planning will be the following: Four one hour tests: 1. Exam of topic 1. Individual assessment. 2. Exam of topic 2 and 3. Individual assessment. 3. Exam of topic 4. Individual assessment. 4. Exam of topic 5. Individual assessment. Each of these tests will have a weight of 10% in the final grade. Homework will have a weight of 10% in the final grade. The total weight of the continuous evaluation in the final grade will therefore be of 50%. The planning of the different intermediate evaluation tests will be approved in an Academic Commission of Degree and it will be available at the beginning of the semester.	50	B3 B4	C1
Essay questions exam	A written two-hour exam of topics 1, 2, 4, and 5 at the end of the semester in date, time and venue determined in the official exams calendar of the School. Individual assessment.	50	B3 B4	C1

Other comments on the Evaluation

First call:

Continuous assessment:

A student who chooses to be graded by continuous evaluation must do it in writing way in the manner and date indicated by the professors of the subject. In that case the final grade is calculated by the formula:

$$N = ((E1 + E2 + E3 + E4) + P + 5\ EF) / 10$$

where E1, E2, E3 y E4 are the points, in a scale 0 to 10, obtained in the four test of the continuous evaluation, P represents the total points, in a scale 0 to 10, obtained in the homework and where EF represents the points, in a scale 0 to 10, obtained in the final exam. A passing grade is N greater or equal to 5. Before doing each test, the procedure and date of revising the grading of that test will be announced. After the test, the grades will be announced in a reasonable amout of time. If a student □for any circumstance□ cannot attend a particular test on the date for which it is scheduled, he or she will miss that test and it will not be repeated.

The points obtained in the tests of continuous evaluation will be valid only for the academic year in which they are obtained.

Eventualassessment**:**

The students who do not choose to be graded by continuous evaluation, will be graded by means of a final exam (which will not be necessarily the same as the one for the students who choosed continuous evaluation) of all the topics of the subject. This exam will be graded in a scale of 10 points and the passing grade cutoff will be 5. Individual assessment.

Second call:

The students who at the end of the semester do not obtain a passing grade will have the opprtunity of writing a second final exam on date, time and venue determined in the official exams calendar of the School. This exam will cover topics 1, 2, 3, 4 and 5. On the day of this second final, the students who were graded by continuous evaluation may choose to be graded exclusively by the second final or to be graded taking into account the points obtained in their continuous evaluation by the same formula used earlier, that is:

$$NR = ((E1 + E2 + E3 + E4) + P + 5\ EFR) / 10$$

where now EFR is the grade, in a scale 0 to 10, in the second final. Again, the passing grade cutoff will be 5.

The students who choose to be graded exclusively by the second final will write an exam (which will not be necessarily the same as the one for the students who made the opposite choice) covering topics 1, 2, 3, 4 and 5 which will be graded in a scale of 10 points and the passing grade cutoff will be 5. Individual assessment.

"No presentado":

A student will obtain a cualification of "No Presentado" in the first edition of the final grades if and only if that student did not choose the continuous evaluation and did not attend the final exam.

A student will obtain a cualification of "No Presentado" in the second edition of the final grades if and only if that student obtained "No Presentado" in the first editin and did not attend the second final.

Extraordinary call:

The students which attend the Extraordinary call will write an exam covering topics 1, 2, 3, 4 and 5 which will be graded in a scale of 10 points and the passing grade cutoff will be 5. Individual assessment.

Éthical Behavior:

It is expected a correct and ethical behavior of all students in all written tests and exams, which are meant to truly reflect the knowledge and abilities attained by each studen. Any unethical behavior detected in a particular test (such as copying or using prohibited material) will result in a grading of 0 in that test and the issue of the corresponding report for the School Director's Office.

Sources of information
Basic Bibliography
D. Poole, **Álgebra lineal: Una introducción moderna**, 2º,
L. Merino; E. Santos, **Álgebra lineal con métodos elementales**, 1ª,
J. de Burgos, **Álgebra lineal y geometría cartesiana**, 2ª,
Complementary Bibliography
D. C. Lay, **Álgebra lineal y sus aplicaciones**, 3ª,

Recommendations
Subjects that continue the syllabus
Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202

Mathematics: Calculus 2/V05G300V01203
Mathematics: Probability and Statistics/V05G300V01204
Digital Signal Processing/V05G300V01304
Computer Networks/V05G300V01403

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus 1/V05G300V01105

IDENTIFYING DATA

Mathematics: Calculus 1

Subject	Mathematics: Calculus 1			
Code	V05G303V01105			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish Galician			
Department	Applied Mathematics II			
Coordinator	Calvo Ruibal, Natividad			
Lecturers	Calvo Ruibal, Natividad Fernández Manin, Generosa González Rodríguez, Ramón Loureiro García, Marcos			
E-mail	nati@dma.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim of this subject is to introduce the student in the basic techniques of Differential Calculus in one and several real variables and its applications. At the end of the semester it is expected that students have achieved the understanding of the basic concepts, handle the usual differential operators of the mathematical physics and learn the techniques of differential calculus for the determination of extremes local approximation of functions and numerical solution of systems of equations. Besides, he will learn to handle some computer programs of symbolic calculation and graphic representation.			

Competencies

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.
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
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.

Learning outcomes

Expected results from this subject	Training and Learning Results			
Understanding of the basic concepts of the differential calculation in one and several variables.	A1 A4	B1 B3 B4	C1 C1 C14	D2 D3 D3
Knowledge and handle of the usual differential operators of the mathematical physics.	A2 A3 A5		C1 C10 C14	D2 D5 D6 D9
Knowledge and handle of the technicians of differential calculation for the research of extremes, the local approximation of functions and the numerical resolution of systems of equations.	A1 A2 A3 A4 A5	B1 B2 B4 B5 B10	C1 C21	D1 D2 D5 D7 D11
Knowledge of some computer program of symbolic calculation and graphic representation.		B3 B9		D3

Contents	
Topic	
Topic 1. Introduction.	Sets of numbers and functions of one variable.
Topic 2. n-dimensional space.	Scalar product, norm. Vector product. Polar, cylindrical and spherical coordinates.
Topic 3. Continuity of functions of one variable.	Limit of a function in a point. One-sided limits. Continuity. The intermediate value theorem. Bolzano's theorem. The bisection method.
Topic 4. Continuity of functions of several variables.	Functions of several variables. Limits. Continuity. Bolzano's theorem.
Topic 5. Derivatives of functions of one variable.	Derivatives of a function in a point. Derivative function, successive derivatives, properties. Chain rule. Implicit differentiation. Derivative of inverse functions.
Topic 6. Applications of the derivative.	Maxima and minima. Mean value theorem. L'Hopital's rule. Local study of the graph of a function. Taylor polynomials. Newton's method.
Topic 7. Differential of functions of several variables.	Directional derivatives. Partial derivatives. Jacobian matrix. The chain rule. Higher order derivatives. Differential operators.
Topic 8. Applications of the differential calculation.	Extreme values. Extreme values with equality constraints. Newton's method.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	38	66.5	104.5
Problem solving	10	14	24
Laboratory practices	2	1.5	3.5
Problem solving	4	8	12
Problem solving	2	4	6
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	The teacher will expose the theoretical contents of the matter. Through this methodology competencies CG3, CE1 and CT3 are developed.
Problem solving	The teacher will solve problems and exercises of each of the topics and the student will have to solve similar exercises. Through this methodology competencies CG3, CG4, CE1, CT2 and CT3 are developed.
Laboratory practices	The students will use computer tools (Maxima and/or Matlab) to solve exercises and apply the knowledge achieved in the theoretical classes. Through this methodology competencies CG3, CG4, CE1, CT2 and CT3 are developed.

Personalized attention	
Methodologies	**Description**
Lecturing	The teacher will attend personally the doubts and queries of the students in the schedule of personal tutorials at the teacher's office or by email.
Problem solving	The teacher will attend personally the doubts and queries of the students in the schedule of personal tutorials at the teacher's office or by email.

Assessment			
	Description	Qualification	Training and Learning Results

Problem solving	First session (1 hour): Topic 1.	5	B3 B4	C1
	Second session (1 hour): Topics 2, 3 and 4.	17.5		
	Third session (1 hour): Topics 5 and 6.			
	Fourth session (1 hour): Topic 7.	10		
	The four previous sessions give 50% of the course mark.	17.5		
	Individual assessment.	50		
Problem solving	Final exam on topics 7 and 8 of the subject. Its grading will be 50% of the course mark.	50	B4	C1
	Individual assessment.			

Other comments on the Evaluation

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

1. Continuous assessment

In order to opt for continuous assessment student should complete a registration form for this type of evaluation and deliver it to the corresponding teacher by September 22nd. After then it will not be possible to change the option of evaluation. Continuous assessment consists of the previous four one-hour sessions detailed and a final exam on topics 7 and 8. If a student cannot attend a particular test on the date for which it is scheduled, he or she will miss that test.

In this case, the final grading for a student is given by the formula:

N = (1/10) x C + (5/10) x E

C: grading, between 0 and 50, obtained as the sum of the marks of the four one-hour sessions.

E: grading, between 0 and 10, obtained in the final exam on the topics 7 and 8 of the subject.

In this mode, a student has successfully completed the course whenN is greater than or equal to 5. Gradings obtained in the tests will be valid only for the academic year in which they are done.

2. Eventual assessment and extraordinary call

Those students who do not choose to be graded by continuous assessment, will be graded by means of a final exam (topics: 1, 2, 3, 4, 5, 6, 7, and 8) which will not necessarily be the same as the one for the students who choosed continuous assessment. This exam will be graded in a scale of 10 points and the passing grade cutoff will be 5.

3. Second call

On the day of this second final exam, the students who were graded by continuous evaluation may choose to be graded exclusively by this second exam or to be graded taking into account the points obtained in their continuous evaluation by the same formula used earlier, that is:

NR= (1/10) x C + (5/10) x D

C: Mark, between 0 and 50, obtained as the sum of the gradings of the one-hour sessions.

D: Mark, between 0 and 10, obtained in an exam on the topics 7 and 8 of the subject.

In this mode, a student has successfully completed the course when **NR** is greater than or equal to 5.

Those students who choose to be graded exclusively by the second final exam on topics: 1, 2, 3, 4, 5, 6, 7, and 8 which will not necessarily be the same as the one for the students who made the other choice. This exam will be graded in a scale of 10 points and the passing gradecutoff will be 5.

4. Qualification of ''No Presentado''

A student will obtain a qualification of ''No Presentado'' if he did not choose continuous evaluation and did not attend the final exams.

5. Ethical behaviour

It is expected a correct and ethical behavior of all students in all written tests and exams, which are meant to truly reflect the knowledge and abilities attained by each student. Any unethical behavior detected in a particular test (such as copying or using prohibited material) will result in a grading of 0 in that test and the issue of the corresponding report for the School Director's Office.

Sources of information
Basic Bibliography
J. Stewart, **Cálculo de una variable: conceptos y contextos.**, 4ª edición,
E. Marsden y A.J. Tromba, **Cálculo vectorial**, 6ª edición,
Complementary Bibliography

Recommendations
Subjects that continue the syllabus
Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Mathematics: Calculus 2/V05G300V01203
Mathematics: Probability and Statistics/V05G300V01204
Digital Signal Processing/V05G300V01304
Electromagnetic Transmission/V05G300V01303
Subjects that are recommended to be taken simultaneously
Mathematics: Linear algebra/V05G300V01104

IDENTIFYING DATA

Physics: Analysis of Linear Circuits

Subject	Physics: Analysis of Linear Circuits			
Code	V05G303V01201			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	English			
Department	Signal Theory and Communications			
Coordinator	García Mateo, Carmen			
Lecturers	Cardenal López, Antonio José García Mateo, Carmen García-Tuñón Blanca, Inés Gómez Araújo, Marta Prol Rodríguez, Miguel			
E-mail	carmen.garcia@uvigo.es			
Web	http://www.faitic.uvigo.es			
General description	The course introduces the fundamentals of the lumped circuit principles and abstractions on which the design of electronic systems is based. These include lumped circuit models for sources, resistors, inductors, and capacitors. It intends to present some techniques to analyze (to determine currents and voltages) such systems: conventional analysis (integer-differential analysis, phasors and impedances in sinusoidal regime) and linear systems theory based analysis (by using the Laplace and Fourier transforms).			

Competencies

Code	
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.
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.
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.

Learning outcomes

Expected results from this subject	Training and Learning Results			
To know the elements and laws involved in lumped circuit analysis.		B1 B5 B6 B14	C4 C7 C12	
To show the ability to analyse linear circuits in different circumstances: -. to know how to choose among different alternatives when solving a problem. -. to know simplifying techniques, their constraints, and how to decide which ones must be used.	A1 A2 A3 A4 A5	B1 B2 B3 B4	C2 C3 C4 C8 C13 C22 C24	D1 D2 D2 D3 D4 D8 D9 D11 D12 D14 D16 D18 D19

To translate the time domain into the transformed domains, by using transforms basic concepts.	A2	B1 B2	C4 C4 C5 C6 C13 C23	D2 D8 D9 D12
To be able to qualitatively justify the role played by circuit elements and their interactions.		B3	C4 C6 C12 C14 C15	D3
To master the language and symbolism of the discipline		B3	C4 C6 C12 C14 C15	D3

Contents	
Topic	
Presentation and Introduction.	
I: DC Steady-State Response	Fundamental and derived magnitudes. Active and passive elements and their functional relationships. Kirchhoff's laws. Analysis by the technique of mesh voltages. Analysis by the techniques of node currents. Simplifying techniques; Thévenin and Norton equivalent circuits.
II: Sinusoidal Steady-state Response	Definition and parameters. Concepts of phasor and impedance. Mesh and node analysis of steady-state sinusoidal regime networks. Divisor circuits. Autoinductance and mutual inductance. Linear and ideal transformers. Power expressions. Thévenin and Norton equivalent circuits.
III: Two-Port Circuits	Definition of a two-port circuit. Characteristic parameters. Combining two-ports. A two-port in a circuit.
IV: Transient Response	Transient regime origin. Conditions of study. Inductors and capacitors in steady-state continuous regime. Single reactive element circuits.
V: Signals and Systems	Types of signals. Some relevant signals: step function, unit impulse function, exponential function, sinusoidal function. Types of systems. System properties; linear, time invariant systems; impulse response.
VI: The Laplace Transform	Definition. Direct transforms. Inverse transform determination. Application to linear circuits. The transfer function. Steady-state response in a circuit. Response to a sinusoidal input.
VII: Frequency Selective Filters	Filter concept. Filter types. Filter responses.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	24	48	72
Problem based learning	19.5	19.5	39
Laboratory practices	3	3	6
Problem solving	4.5	13.5	18
Laboratory practice	1	3	4

Essay questions exam	2	8	10

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

Methodologies	
	Description
Introductory activities	Presentation of the course: syllabus, bibliography, teaching methodology, and assessment and grading procedures. Through this methodology the competencies CT2 and CT3 are developed.
Lecturing	The goal of this methodology is the presentation of the theoretical contents and the practical assessment about students learning abilities. Different exercises and problems related to the specific subject will be solved during these sessions, by the Professor or the students with his/her support, either individually or working in a group. Through this methodology the competencies CG3, CG4, CE4, CT2 and CT3 are developed.
Problem based learning	Theses sessions will consist on a supervised either individual or team problem solving of practical applications related to the theoretical content of the subject. The solutions could be analyzed, checked and compared using computational tools. At the end of 3 sesions, students will solve a evaluable task in a individual way. Through this methodology the competencies CG3, CG4 and CE4 are developed.
Laboratory practices	Two practical sessions will be carried out in the hardware lab, assembling and measuring circuits tasks will be covered. Out of the total of 4 hours, 1 hour will be dedicated to the evaluation of these sessions. Through this methodology the competencies CG3, CG4 and CE4 are developed.

Personalized attention	
Methodologies	**Description**
Lecturing	Needs and study matter queries of students will be addres by the instructors on office hours.
Laboratory practices	Instructors set the pace of the session and resolve any questions that arise during the realization of practice. Also on the office hours, instructors address the needs and queries of the students related to laboratory practice.

Assessment				
	Description	Qualification	Training and Learning Results	
Problem solving	There will be 3 tests in Group A schedule: ECA1, ECA2 and ECA3. The score of each of these three tests will be: 1.5, 3 and 3 points, respectively. To pass the subject by continuous evaluation, it is compulsory to attend all three tests and obtain at least 0.75 points in the ECA3 test. In 3 of the 11 sessions of Group B the resolution of an evaluable task (ECB1, ECB2, ECB3) with a maximum score of up to 0.5 points each will be considered, which means a total of 1.5 points. The schedule of the tests will be approved in the CAG and will be available at the beginning of the semester.	90	B3 B4	C4
Laboratory practice	This test (ECHW) is done during Group B hours in the hardware laboratory. The specific day will be approved by the academic board (CAG) and will be available at the beginning of the semester. It is a test related to assembly and measurement of circuits, and will have a maximum score of 1 point. In these exercises the ability to work in groups, the adjustment to the design specifications and the presentation of results will be evaluated. In order to pass the subject by continuous evaluation, attendance at the two lab sessions (hardware) and its corresponding one is mandatory. evaluation.	10	B3 B4	C4

Essay questions exam	Additionally to the continuous evaluation system based on the results achieved on the aforementioned tests, the students will have the option of a final examination. This final exam can include test type and/or reasoning questions, problem solving and/or exercises, as well as the development of practical cases. The maximum mark achieved on this exam will be 10 points.	0	B3 B4	C4

Other comments on the Evaluation

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

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

- The marks in all the evaluation tests are individual.
- Students only doing the continuous evaluation (addition of the ECA1,ECA2,ECA3,ECB1,ECB2,ECB3 and ECHW scores): they are graded with the points obtained in the continuous evaluation.
- Students doing both the continuous evaluation and the exam: they are graded with the best of both qualifications.
- Students only doing the final exam: they are graded with the points obtained in the exam.

2. Second opportunity (or Extraordinary Exam). Students that do not reach the minimum grade at the end of the semester will have the option to do a final extraordinary exam of the full content of the subject, theory and practice. The extraordinary exam can include test type and/or reasoning questions, problem solving and/or exercises, as well as the development of practical cases. The maximum mark achieved on this exam (between 0 and 10) will be the final grade. It will replace the grade obtained during continuous evaluation (sum of the grades obtained during tests and final exam).

Additional comments:

- Students must attend to the group B assigned at the beginning of the semester.
- Group B attendance control will be carried out.
- Doing ECA2 or sucessives tests and/or the final exams will prevent the student to get the "Not presented" mark.
- The mark obtained during continuous evaluation will only be valid only for the corresponding academic year.
- It will be considered that the subject has been passed if the final mark is equal or above 5.

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

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

Sources of information

Basic Bibliography

James W. Nilsson, **Electric Circuits**, 10,
Material docente, **Página web**, faitic.uvigo.es,

Complementary Bibliography

J.H. McClellan, R.W. Schafer, M.A. Yoder, **Signal Processing First**,

Recommendations

Subjects that continue the syllabus

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

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus 2/V05G300V01203

Subjects that it is recommended to have taken before

Mathematics: Linear algebra/V05G300V01104
Mathematics: Calculus 1/V05G300V01105

Other comments

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

IDENTIFYING DATA

Physics: Fields and Waves

Subject	Physics: Fields and Waves			
Code	V05G303V01202			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	English			
Department	Signal Theory and Communications			
Coordinator	Pino García, Antonio			
Lecturers	Fraile Peláez, Francisco Javier Gómez Araújo, Marta González Valdés, Borja Lorenzo Rodríguez, María Edita de Obelleiro Basteiro, Fernando Pino García, Antonio Rubiños López, José Óscar Vazquez Alejos, Ana Vera Isasa, María			
E-mail	agpino@uvigo.es			
Web	http://faitic.uvigo.es			
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.			

Competencies

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.

Learning outcomes

Expected results from this subject	Training and Learning Results			
Resolve problems applying the laws of Ampère, Gauss and Faraday.	A1	B3	C1 C3	D3
Know and apply the Maxwell Equations		B3 B3	C1 C3 C19	D3
Calculate the main parameters of the electromagnetic waves: frequency, wavelength, propagation constant, polarization, Poynting vector, phase constant, attenuation constant.	A1	B3	C3	D3
Analyze the propagación of waves in media with and without losses.		B3 B3 B4	C3 C4	D1 D2 D3 D3 D9 D16

Contents

Topic

1. Vector and differential analysis of fields	1.1 Scalar and vector fields 1.2 Systems of coordinates in space 1.3 Vector Algebra 1.4 Integral Operators 1.5 Differential operators 1.6 Properties of operators
2. Electrostatic fields	2.1 Sources of the electrostatic field 2.2 Equations of the electrostatic field, electric potential 2.3 Electrostatic fields produced by charge distributions 2.4 Equations of Poisson and Laplace 2.5 Electrostatic field in material media
3. Magnetostatic fields	3.1 Sources of magnetostatic field 3.2 Magnetostatic field equations 3.3 Magnetostatic field produced by current distributions 3.4 Magnetostatic filed in material media
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 Energy balance of the electromagnetic field 4.5 Harmonic time variation 4.6 Harmonic time variation in material media
5. Wave equation and its solutions	5.1 Wave equation for time harmonic fields 5.2 Propagation, attenuation and phase constants 5.3 Solutions in rectangular coordinates 5.4 Progressive, stationary and evanescent waves in lossy and losseless media
6. Uniform plane waves	6.1 Expressions of the fields 6.2 Characteristic impedance 6.3 Poynting Vector 6.4 Polarization
7. Waves in the presence of obstacles	7.1 Incident wave, scattered wave and transmitted wave 7.2 Standing waves 7.3 Standing wave pattern 7.4 Polarization and power

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	16	24	40
Case studies	20	30	50
Computer practices	4	6	10
Problem solving	10	15	25
Essay questions exam	2	10	12
Case studies	2	4	6
Problem solving	2	5	7

*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 CG3, CE1 and CT3 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 CG3, CE1, CE3 and CT3 are developed.
Computer practices	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 CG3, and CE3 and are developed.
Problem solving	Problems and/or exercises related with the subject are formulated. The student has to develop the suitable or correct solutions by development of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. It is a complement of the lectures. Through this methodology the competencies CG3, CE1, CE3 and CT3 are developed.

Personalized attention	
Methodologies	**Description**
Lecturing	The student will receive personalized attention during the tutoring hours.
Problem solving	The student will receive personalized attention during the tutoring hours.
Case studies	The student will receive personalized attention during the tutoring hours.
Computer practices	The student will receive personalized attention during the tutoring hours.
Tests	**Description**
Essay questions exam	The student will receive personalized attention during the tutoring hours.
Case studies	The student will receive personalized attention during the tutoring hours.
Problem solving	The student will receive personalized attention during the tutoring hours.

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.	40	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.	40	B3 C1 C3 D3
Problem 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	20	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 evaluation and evaluation at the end of the term.

In all the evaluation tests, the competences CG3, CE1 and CE3 will be evaluated.

1. CONTINUOUS ASSESSMENT.

- The system of continuous assessment (EC) will consist of:
    - a) A problem solving test. The qualification will be ECa, with maximum score of 1 points.
    - 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 test. The qualification will be ECc, with maximum score of 1 poins.
    - d) A problem solving session on topics 4 to 7. The score will be ECd, and the subtotal EC2 = ECc + ECd can have a maximum value of 5 points. This last test will coincide in the calendar and schedule with the official exam date in the first opportunity evaluation.
- The final score of the first opportunity for students who follow continuous assessment (CE) is obtained by adding the two previous subtotals: EC = EC1 + EC2.
- 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 "b" test for continuous assessment.

2. UNIQUE END-OF-TERM EVALUATION.

- It will be mandatory for students who do not follow continuous assessment to be able to pass the subject at first opportunity.
- It will consist of a problem solving session on topics 1 to 7. The score will be EF.

3. SECOND OPPORTUNITY EVALUATION.

- Students who followed the continuous assessment:
  - The second oportunity exam will be divided into two parts: EX1 (items 1 to 3) with a maximum value of 5 points, and EX2 (items 4 to 7) 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 parties. 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 7). The score will be EF.

4. EXTRAORDINARY END OF CAREER CALL

- It will have the same format as the unique end-of-term evaluation.

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.
- In case of detection of plagiarism in any of the tests, the final grade will be SUSPENSE (0) and the fact will be communicated to the Center Head for the appropriate purposes.

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

Complementary Bibliography

D. K. Cheng, **Fundamentals of Engineering Electromagnetics**, New International Edition, Pearson, 2013
J. R. Reitz, F. J. Milford, R. W. Christy, **Fundamentos de la Teoría Electromagnética**, 4ª Edición, Addison Wesley, 1996
David J. Griffiths, **Introduction to Electrodynamics**, 4ª Edición, Pearson Education Limited, 2012
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 continue the syllabus

Electromagnetic Transmission/V05G300V01303

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus 2/V05G300V01203

Subjects that it is recommended to have taken before

Mathematics: Linear algebra/V05G300V01104
Mathematics: Calculus 1/V05G300V01105

IDENTIFYING DATA				
Mathematics: Calculus 2				
Subject	Mathematics: Calculus 2			
Code	V05G303V01203			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department	Applied Mathematics II			
Coordinator	Martínez Varela, Áurea María			
Lecturers	Fernández Manin, Generosa García Lomba, Guillermo Martínez Varela, Áurea María Prieto Gómez, Cristina			
E-mail	aurea@dma.uvigo.es			
Web	http://faitic.uvigo.es/			
General description	The matter of Calculus II of the Degree in Engineering of Technologies of Telecommunication provides basic and common training to the branch of the telecommunication. Such as it figures in the memory of the degree, students should be able to formulate, to solve and to interpret mathematically problems within engineering of telecommunication at the end of the lectures. For this, they should know how to calculate integrals of functions of one and several variables and its meaning and they should handle the basic numerical methods of approximation for this kind of integrals. On the other hand, they should become familiar with the developments of functions in Fourier series. Also, they will have to know how to solve differential equations of first and second order. Finally, they should know to handle the Laplace transform in order to solve differential equations. All of these contents are notable for several matters that they must to study simultaneously or later in the degree.			

Competencies	
Code	
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.
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
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.

Learning outcomes				
Expected results from this subject	Training and Learning Results			
Understanding the basic theory of integration of functions of one and several variables.	A2	B3 B4	C1	D2 D3
Managing the transformation of Laplace as a tool of analysis of the linear systems.	A1 A2 A3 A4	B3 B3 B4 B5 B7	C1 C5 C12	D2 D3
Knowledge of the necessary theoretical bases for the analysis of Fourier.		B1 B3 B4 B5 B8 B9 B10 B13	C1 C12	D2 D3

Knowledge and handle of the simple techniques for the integration of ordinary differential equations.	A2	B3 B4	C1	D2 D3

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Problem solving	17	17	34
Laboratory practices	3	6	9
Lecturing	28	56	84
Problem solving	7	14	21
Laboratory practice	1	1	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Problem solving	In these hours of work the professor will solve problems of each one of the subjects and will enter new methods of solution no contained in the master classes from a practical point of view. The student also will have to solve problems proposed by the professor with the aim to apply the obtained knowledges. Through this methodology the competencies CG3, CG4, CE1, CT2 e CT3 are developed.
Laboratory practices	In these practices, the computer tools MATLAB or MAXIMA will be used to study and to apply the numerical methods of approximation of integrals described in the Theme 2 of the matter. Through this methodology the competencies CG4, CE1, CT2 e CT3 are developed.
Lecturing	The professor will expose in this type of classes the theoretical contents of the matter. Through this methodology the competencies CG3, CE1, CT2 e CT3 are developed.

Personalized attention	
Methodologies	**Description**
Lecturing	The professor will attend personally the doubts and queries of the students. He will solve doubts in his office, in the classes of problems, and in the laboratory. Also the Web platform Faitic will be used to help the students. They will have occasion of to attend tutorial sessions in a timetable established at the beginning of the course and which will be published in the Web page of the department.
Problem solving	The professor will attend personally the doubts and queries of the students. He will solve doubts in his office, in the classes of problems, and in the laboratory. Also the Web platform Faitic will be used to help the students. They will have occasion of to attend tutorial sessions in a timetable established at the beginning of the course and which will be published in the Web page of the department.
Laboratory practices	The professor will attend personally the doubts and queries of the students. He will solve doubts in his office, in the classes of problems, and in the laboratory. Also the Web platform Faitic will be used to help the students. They will have occasion of to attend tutorial sessions in a timetable established at the beginning of the course and which will be published in the Web page of the department.

Assessment				
	Description	Qualification	Training and Learning Results	
Problem solving	Five "one hour sessions". 1st session: Theme 1 (4th week aprox.) 2nd session: Theme 3 (8th week aprox.) 3rd session: Theme 4 (11th week aprox.) 4th session: Theme 5 (13th week aprox.) 5th session: Theme 6 (15th week aprox.) These five sessions account for 35% of the score with the following weights: First: 10% (1 point) Second: 10% (1 point) Third: 5% (0,5 points) Forth: 5% (0,5 points) Fifth: 5% (0,5 points) Final exam: 60% (6 points) Individual assessment	95	B3 B4	C1
Laboratory practice	The students will do a practice of laboratory of the Theme 2 using MATLAB or MAXIMA (8th week aprox.) Its value will be of 5% (0,5 points) Individual assessment	5		C1

Other comments on the Evaluation

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

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

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

1. Continuous assessment.

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

N = C + E

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

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

2. Final evaluation of the semester.

Those students who fail to continuous assessment may be submitted to a final exam of all topics in the subject on the same date that the final exam of continuous assessment.

These students will be evaluated from 0 to 10 points and **theywill pass the subject when the obtained score is greater than or equal to 5**.

3. Second chance and final chance.

Previously to the exam students who chose continuous assessment may choose, if desired, for an exam of the items 3, 5, 6 and 7. The final grade is obtained as

NR = C + ER

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

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

If they do not choose that option, the student will be assessed in all the issues on the subject.

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

4. Qualification of not presented.

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

5. Final chance.

The student will be assessed in all the issues on the subject.

Sources of information

Basic Bibliography

D. Zill & W.S. Wright, **Cálculo de una variable**, 4ª,
E. Marsden & A.J. Tromba, **Cálculo vectorial**, 5ª,
D.G. Zill & M.R. Cullen, **Ecuaciones diferenciales**, 3ª,

Complementary Bibliography

A. Quarteroni & F. Saleri, **Cálculo científico con Matlab y Octave**, 1ª,

Recommendations

Subjects that are recommended to be taken simultaneously

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

Subjects that it is recommended to have taken before

Mathematics: Linear algebra/V05G300V01104
Mathematics: Calculus 1/V05G300V01105

IDENTIFYING DATA

Mathematics: Probability and Statistics

Subject	Mathematics: Probability and Statistics			
Code	V05G303V01204			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	English			
Department	Signal Theory and Communications			
Coordinator	Fernández Bernárdez, José Ramón			
Lecturers	Alonso Alonso, Ignacio Fernández Bernárdez, José Ramón Mojón Ojea, Artemio Prol Rodríguez, Miguel			
E-mail	jramon.fernandez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim of this subject is to study some basic concepts of statistics, probability and random processes. These concepts are necessary in order to easily follow other subsequent subjects.			

Competencies

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.
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
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.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Learn how to distinguish between deterministic or random models	B1 B4 B5 B8 B9 B10 B13	C1 C12	D2
Identify a probabilistic model that fits with the needs of a specific problem	B3 B4	C1	D2 D3
Propose solutions to simplify statistical models by using deterministic parameters	B3 B4	C1	D2 D3

Contents

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

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

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Problem solving	13.5	28	41.5
Computer practices	14	7	21
Problem solving	1.5	6	7.5
Objective questions exam	0.5	2	2.5
Other	0.5	1	1.5
Essay questions exam	2	26	28

*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 course is divided in five main topics. Each topic will have a theoretical part that will be exposed by the teacher in big group. The students will be required to perform a previous reading of the contents. Through this methodology the competencies CG3, CE1 and CT3 are developed.
Problem solving	Each topic will be complemented with problem resolution. The problems could be developed and solved in big or small group. The students will be required to work previously on these problems. Through this methodology the competencies CG3, CG4, CE1, CT2 and CT3 are developed.
Computer practices	Each topic will be completed with one or several sessions of computer practices. For this, a software developed by the teachers and specific questionnaires for each topic will be used. The students will be required to perform a previous reading of the contents. Through this methodology the competencies CG3, CG4, CE1, CT2 and CT3 are developed.

Personalized attention

Methodologies	Description
Lecturing	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. These timetables will be published on the subject website.
Problem solving	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. These timetables will be published on the subject website.
Computer practices	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. These timetables will be published on the subject website.

Assessment				
	Description	Qualification	Training and Learning Results	
Problem solving	Students must solve a problem individually, two occasions along the course	25	B3 B4	C1
Objective questions exam	Students must answer a multiple choice test individually.	12.5	B3 B4	C1
Other	Students must solve a problem individually. (part 1) In a later class, each student will correct individually a solution to the same problem made by somebody else (part 2).	12.5	B3 B4	C1
Essay questions exam	Individual final exam.	50	B3 B4	C1

Other comments on the Evaluation

Following the guidelines of the degree, two evaluation systems will be offered to the students: continuous evaluation or unique evaluation.

Continuous evaluation is based on several assessed tasks.

It is assumed that a student follows the continuous evaluation system if she/he participates in task 2 (approximately in the seventh week of the semester) or any later task. Task 1 (both, part 1 and part 2) may be performed without engaging the student with the continuous evaluation system.

Students who choose continuous evaluation:

Several tasks are evaluated with a grade between 0 and 10. The planning for the different intermediate evaluation tasks will be approved by the Degree Academic Board (CAG) and it will be available at the beginning of the semester. A brief description of the tasks and the weight of each one in the final grade is listed below.

Task 1: Weight 12.5%. Two parts, both with the same weight:

Part 1: Individual resolution of a problem

Part 2: Correction of the task 1(part 1) from somebody else

Task 2: Individual resolution of a multiple choice test. Weight 12.5%

Task 3: Individual resolution of a problem. Weight 12.5%

Task 4: Individual resolution of a problem. Weight 12.5%

Last Task: Final exam. A reduced version of the exam to be carried out by the students who chose unique evaluation. Weight 50%

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

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

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

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

The final grade for students who opt for continuous evaluation will be calculated as the mean between the final exam and the average of the previous tasks marks. To minimize the impact of a possible miss on a task, the average of these will be computed excluding the worst obtained grade.

Students who choose for unique evaluation or extraordinary call:

For this evaluation system the students will carry out a unique final exam. This exam will be rated between 0 and 10, and this will be the final grade obtained.

Second chance

Previously to the exam (or at its beginning), all students will be asked to choose to be evaluated by continuous evaluation

system or unique evaluation system as they have been described before.

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

Sources of information

Basic Bibliography

JR Fernández, I. Alonso y A. Mojón, **Apuntes de Probabilidad y Estadística**, 9 ed, 2019

A Mojón, I. Alonso y JR Fernández, **Vídeos de la asignatura de Probabilidad y Estadística**, 1 ed, 2014

X. Rong Li, **Probability, Random Signals and Statistics**, 1 ed, 1999

R. Cao y otros, **Introducción a la estadística y sus aplicaciones**, 1 ed, 2001

Complementary Bibliography

H. Stark y J.W. Woods, **Probability, Random Processes, and estimation theory for engineers**, 2 ed, 1994

D. Peña, **Estadística, modelos y métodos. Tomo 1: Fundamentos**, 2 ed, 1991

P. Peebles, **Principios de probabilidad, variables aleatorias y señales aleatorias**, 4 ed, 2006

A. Papoulis, **Probability, random variables and stochastic processes**, 4 ed, 2002

A. Blanco y S. Pérez-Díaz, **Modelos aleatorios en ingeniería**, 1 ed, 2015

Recommendations

Subjects that continue the syllabus

Data Communication/V05G300V01301
Computer Networks/V05G300V01403
Signal Transmission and Reception Techniques/V05G300V01404
Basics of bioengineering/V05G300V01915

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus 2/V05G300V01203

Subjects that it is recommended to have taken before

Mathematics: Linear algebra/V05G300V01104
Mathematics: Calculus 1/V05G300V01105

IDENTIFYING DATA				
Programming I				
Subject	Programming I			
Code	V05G303V01205			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	English			
Department	Telematics Engineering			
Coordinator	Rodríguez Hernández, Pedro Salvador			
Lecturers	Arriba Pérez, Francisco de García Palomares, Ubaldo Manuel Gil Solla, Alberto López Bravo, Cristina Pazos Arias, José Juan Rodríguez Hernández, Pedro Salvador Sousa Vieira, Estrella			
E-mail	pedro.rodriguez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim of the course is to provide students with basic skills to program in a high level language.			

Competencies	
Code	
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.
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.
C6	CE6/T1: The ability to learn independently new knowledge and appropriate techniques for the conception, development and exploitation of telecommunication systems and services
C12	CE12/T7: The knowledge and use of basics in telecommunication networks, systems and service programming.
D2	CT2 Understanding Engineering within a framework of sustainable development.
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.

Learning outcomes				
Expected results from this subject	Training and Learning Results			
Express the solution of a simple problem by means of algorithms using top-down design.	A4		C1 C4 C11 C12 C12 C18 C22 C25 C27 C30 C32	D2 D15 D23
Identify the data needed to solve a problem and associate them with appropriate datatypes based on their features (size, range, associated operators)	A1 A2 A3 A4 A5	B4	C5 C9 C10 C12	D1

Code simple algorithms using the basic types of statements: assignment, selection and iteration.		B2 B6 B8 B12	C1 C2 C4 C12 C13 C55 C56	D1 D3 D5 D7 D11
Declare and define functions with a proper use of parameters.		B1 B2 B3	C7 C12 C17 C20 C30	D1 D2 D3
Handle I/O operations and file management.		B1 B2 B3 B5 B6	C4 C5 C10 C12 C22	
Define and use structured data types.		B1 B2 B3 B5 B6	C4 C5 C10 C12 C22	
Define and manage dynamic data structures (lists, stacks, queues and trees).			C1 C6 C12	
Create modules and library functions and use them in programs.		B2	C6 C12	
Predict the result of a sequence of statements, knowing the input data.	A1 A2 A3 A4 A5	B4	C1 C2 C3 C4 C5 C6 C8 C12	D1 D2 D3 D4 D5 D6
Handle basic tools in an integrated development environment: text editor, compiler, linker, debugger and documentation tools.	A2 A3 A4	B1 B2 B4 B5 B6 B7 B8 B9 B11 B12	C6 C10	D2 D4
Develop a small scale project following all the phases: requirements analysis, design, implementation, testing and documentation.	A2 A3 A4	B1 B2 B4 B6 B9	C1 C2 C3 C4 C5 C6 C6 C12 C12 C14 C16	D1 D2 D3 D4 D4 D5 D9

Contents
Topic

Lecture 1: The algorithm and the programming languages.	1. The algorithm and its different representations: flowchart, pseudocode, natural language. 2. Algorithm implementation by means of a programming language. Programming paradigms: modular programming and structured programming. 3. C language and the function main(). Source code and object code. The compiler and the interpreter. 4. Input/output exercises: human-computer interface. The standard input/output files: stdin, stdout. The #include<stdio.h> directive. Library functions.
Lecture 2: Grammar and basic elements of C language.	1. The alphabet. Recursive derivations of sintactically valid sequences. Identifiers, numbers. Symbolic constants: The #define directive and macros. Use of the const qualifier. 2. Variables and their attributes: name, value, address, types. Pointer variables. Declaration of simple variables and pointers: the direction & and reference * operators. 3. The sizeof operator. Arithmetical operators. The assignment operator. Automatic type conversion and by means of the cast operator. 4. Syntactic notation for expressions and statements. Simple and compound statements.
Lecture 3: Sequential, iteration and selection statements	1. Evaluation of expressions with relational operators and boolean operators. 2. Decision statements: switch, if, nested if. The ternary operator (?:) 3. The iterative statements and their importance in modular programming: while, do while and for. The break and continue statements.
Lecture 4: Arrays	1. Declaration of array variables. Memory allocation for multidimensional arrays. 2. Unidimensional arrays and pointers: pointer arithmetic. Arrays of characters: the end of string character. Library functions for dealing with arrays of characters. 3.Variable length arrays in standard C99. 4. Dynamic memory allocation for 1 and 2 dimension arrays: the malloc(), calloc(), realloc() functions.
Lecture 5: Functions	1. Functions declaration and definition. Local, static and global variables. Function return value. 2. Actual and formal parameters. Parameter passing by value and by reference: use of pointers. Command line arguments passing to function main( ). 3. Creation and use of function libraries. Library functions for strings handling. 4. Modular compilation. The conditional directives in a header file. 5. Recursive functions: advantages and disadvantages.
Lecture 6: struct variables	1. struct variables: global declaration. Fields of a struct. Pointers to struct. The . (Point) and -> (arrow) operators. 2. struct and a pointer to struct as a funcion parameter and return value. 3. typedef with non trivial declarations. 4. More complex data structures: nested structs, array of structs. 5. Dynamic management in creating linear lists, circular lists and trees. 6. Insertion and removal of variables in a list.
Lecture 7: Files	1. Text files: fopen() and fclose() functions. 2. Different file input/output functions: fprintf (), fscanf(), fgets(), feof(). 3. Functions with direct access to files. 4. Information management between files and lists. 5. Node structure in simple linked lists. 6. File to list conversion and vice versa.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	0	2
Lecturing	22	27	49
Laboratory practices	12	12	24
Project based learning	10	28	38
Laboratory practice	5	15	20
Other	5	10	15
Practices report	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	Introduction to theoretical and practical activities.
Lecturing	Professors present the main theoretical contents related to the subject These sessions will include the development of works and programs by the students. Through this methodology the competencies CE12 and CT2 are developed.
Laboratory practices	During the first part of the term the student codifies, compiles and documents simple programs guided by the instructor. Some of these activities will require the submission of a report in order to be evaluated. Through this methodology the competencies CG4, CE12 and CT2 are developed.
Project based learning	In the last part of the term, the student must complete a low complexity project, under the instructor supervision, which includes individual and in group activities. Through this methodology the competencies CG4, CG9, CE6, CE12, CT2 and CT4 are developed.

Personalized attention	
Methodologies	**Description**
Lecturing	The professors will provide individual attention to the students along the term, solving their doubts and questions. Questions will be answered during the master sessions or during tutorial sessions. The professors will establish timetables for this purpose at the beginning of the term. This schedule will be published on the subject website.
Laboratory practices	The professors will provide individual attention to the students along the term, solving their doubts and questions about the laboratory practises. Questions will be answered during the lab sessions or during tutorial sessions. The professors will establish timetables for this purpose at the beginning of the term. This schedule will be published on the subject website.
Project based learning	The professors will provide individual attention to the students along the term, solving their doubts and questions about the project. Questions will be answered during the supervising sessions or during tutorial sessions. The professors will establish timetables for this purpose at the beginning of the term. This schedule will be published on the subject website.

Assessment					
	Description	Qualification	Training and Learning Results		
Project based learning	The student will develop a project in the last weeks of the term, and will submit the C code implementing it The project will be assessed individually in the final laboratory test.	25	B4 B9	C6 C12	D4
Laboratory practice	Every 4 weeks, the student will take a practical individual test in the laboratory. At the end of the term, the student will take a final practical test. All of them will consist in the development of a program in the computer. Those tests will assess the student's progress with the laboratory practices and with the project.	20	B4	C12	
Other	Every 4 weeks, the student will take a theory exam that may consist of: - short answer questions - multiple choice questions - troubleshooting and / or exercises This exam will assess individually the student's mastership of the concepts introduced in the master sessions. At the end of the term, the student will take a final exam on the whole contents of the subject.	50	B4	C12	
Practices report	After the second week in the project development, the student will submit a description of its design, in the form of a pseudocode or a flowchart. At the end of the term, the student will submit a report, including the project's documentation, that will be assessed individually.	5	B4	C12	D4

Other comments on the Evaluation

The **course planning in lectures** and the estimated time of the **most important assessment milestones** is detailed below (the dates provided for both the theory and the laboratory tests are tentative: 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).

- Week 1: Theory introduction + Lectures 1 and 2
- Week 2: Lecture 3 | Practice introduction + Practice 1

- Week 3: Lectures 3 and 4 | Practice 2
- Week 4: Lecture 4 + **Theory Test 1** (PT1) | **Laboratory Test 1** (PP1)
- Week 5: Lecture 4 | Practice 3
- Week 6: Lecture 5 | Practice 4
- Week 7: Lecture 5 | Practice 45
- Week 8: Lecture 5 + **Theory Test 2** (PT2) | **Laboratory Test 2** (PP2)
- Week 9: Lectures 5 and 6 | Practice 6
- Week 10: Lecture 6 | Practice fulfilment + Project (1h)
- Week 11: Lecture 6 | Project (2h) + Project design submission (pseudocode or flowchart)
- Week 12: Lecture 7 + **Theory Test 3** (PT3) | Project (1h) + **Laboratory Test 3** (PP3)
- Week 13: Lecture 7 | Project (2h)
- Week 14: Project (2h)
- Before the final exams, project submission (coding and documentation)
- Finals: **Final Theory Test** (PTF) - **Final Laboratory Test** (PPF)

In all courses the School offers two evaluation modes: **Continuous evaluation** and **eventual evaluation**.
The student must opt to the latter one explicitily, no latter than the week before the Laboratory Test 2 (PT2) is taken.
The **continuous evaluation** will be considered as "passed" if the final grade (NFC) obtained by the student is at least 5.
This final grade is the weighted geometric mean between the theory, laboratory and project tests grades, calculated as follows:
NFC = NTC^0.5 * NPC^0.2 * NPR^0.3
where:

- Theory Grade by Continuous Evaluation: NTC = 0.1*PT1+0.1*PT2+0.2*PT3+0.6*PTF
- Practice Grade by Continuous Evaluation: NPC = 0.25*PP1+0.25*PP2+0.5*PP3
- Project Grade : NPR = 0.9*PPF+0.1*PDD

The Final Theory Test (PTF) is an exam that may consist of short answer questions and/or multiple choice questions and/or troubleshooting and/or exercises. It assesses the mastership of the contents introduced in the lectures.
The Final Practice Test (PPF) assesses the proper coding in C to deal with a medium level project. While the project development is a group activity, it is assessed individually. Indirectly, the PPF also assesses the mastership of the contents introduced in the lectures and the laboratory practices.
The **Design and Documentation Test** (PDD) assesses the quality of the pseudocode or the flowchart describing the project's design (submitted the 11th week), and project's documentation report submitted before the final exams
The use of the weighted geometric means implies that the course is not passed if either NPC or NTC or NPR is graded cero.
No test in the continuous evaluation mode is repeatable; that is, the instructor has no obligation to reschedule an evaluated activity missed by a student.
The date and procedures for the revision of the grades will be known before the evaluation tests. The students will have the chance of reviewing the grades preferably within two weeks after the evaluation.
In order to pass the course by the **eventual evaluation mode**, the final grade obtained by the student (NFF) must be at least 5.
This mode will consist of the same exams as the continuous evaluation one (although with different weight in the final grade), that is, an exam that may consist of short answer questions and/or multiple choice questions and/or troubleshooting and/or exercises (PTF) and a laboratory test (PPF, which will include the evaluation of the project). The final grade is the weighted geometric mean between the theory and project grades, calculated as follows:
NFF = NTF^0.5 * NPR^0.5

Both the **continuous evaluation grade** (NFC) and the **eventual evaluation grade** (NFF) will be computed to all students that take the final tests (theory and practice). The final grade will be the higher one.
A "No Present" grade will be granted:

- If the student opts for the continuous evaluation mode, when no test is taken after the Laboratory Test 1 (PP1)
- If the student opts for the eventual evaluation mode, when no final test (PTF and PPF) is taken.

University regulations allow students to take an additional test to pass the course (second call evaluation). In order to pass the course using this second call evaluation, the final grade obtained by the student (NFS) must be at least 5.
This second call evaluation will consist of an exam that may consist of short answer questions and/or multiple choice questions and/or troubleshooting and/or exercises (Second Call Theory Test: PTS) and a laboratory test which will include the evaluation of the project (Second Call Laboratory Test: PPS). The final grade is the weigthed geometric mean between the theory and practice grades, calculated as follows:
NFS = NTS^0.5 * NPS^0.5
where:

- Theory Grade by second call Evaluation (NTS): if the student takes the Second Call Theory Test, NTS will be the grade achieved in that test:

  NTS = PTS

  Otherwise, NTS will be the theory grade obtained for the theoretical tests in his/her first chance evaluation.

- Practice Grade by second call Evaluation (NPS): if the student takes the Second Call Laboratory Test, NPS will be the weighed addition of the grade achieved in that test plus the grade obtained in the design and documentation test:

  NPS = 0.9*PPS+0.1*PDD
  Otherwise, NPS will be the practice grade obtained for the practical tests in his/her first chance evaluation.

In order to pass the course using the (end of degree) extraordinary evaluation system, the final grade obtained by the student (NFG) must be at least 5.
This Extraordinary evaluation will consist of an exam that may consist of short answer questions and/or multiple choice questions and/or troubleshooting and/or exercises (Extraordinary Theory Test: PTG) and a laboratory test which will include the evaluation of the project (Extraordinary Laboratory Test: PPG). The final grade is the weigthed geometric mean between the theory and practice grades, calculated as follows:
NFG = NTG^0.5 * NPG^0.5

All the partial and final grades will only be valid for the term the student is enrolled to, that is, in case the student repeates the subject, he or she will not retain any of the grades of the previous year.

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
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Sources of information

Basic Bibliography

Brian W. Kernighan & Dennis M. Ritchie, **The C Programming Language**, 1995, Prentice Hall, 1983

Brian W. Kernighan & Dennis M. Ritchie, **El Lenguaje de Programación C**, 1995, Prentice Hall, 1983

Manuel Caeiro Rodríguez, Enrique Costa Montenegro, Ubaldo García Palomares, Cristina López Bravo, J, **Practicar Programación en C**, 2014,

Complementary Bibliography

Ignacio Alvarado Aldea, Jose María Maestre Torreblanca, Carlos Vivas Venegas, Ascensión Zafra Cabeza, **100 Problemas Resueltos de Programación en Lenguaje C para Ingeniería**, 2017, Paraninfo, 2017

Stephen G. Kochan, **Programming in C**, 2014, 2005

Osvaldo Cairo Battistuti, **Fundamentos de Programación**, 2006,

José Rafael García-Bermejo Giner, **Programación Estructurada en C**, 2008,

James L. Antonakos & Kenneth C. Mansfield Jr., **Programación Estructurada en C**, 2004, 1997

Jorge A. Villalobos S. & Rubby Casallas G., **Fundamentos de Programación: Aprendizaje Activo Basado en Casos**, 2006,

Recommendations

Subjects that continue the syllabus

Programming II/V05G300V01302

Subjects that it is recommended to have taken before

Informatics: Computer Architecture/V05G300V01103

Other comments

Programming II course continues this course in the second year.