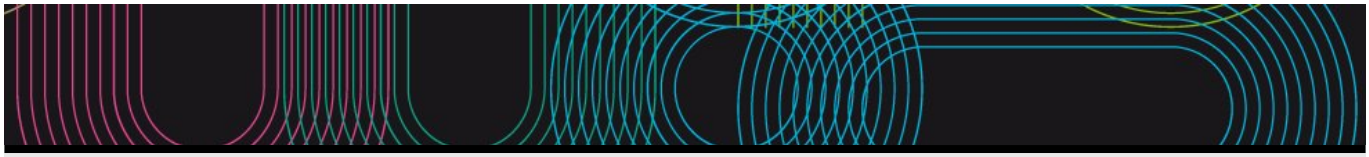

IDENTIFYING DATA				
Physics: Fields and Waves				
Subject	Physics: Fields and Waves			
Code	V05G300V01202			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Pino García, Antonio			
Lecturers	Gómez Araújo, Marta González Valdés, Borja Obelleiro Basteiro, Fernando Pino García, Antonio Rubiños López, José Óscar 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.	B3	C1 C3	D3
Know and apply the Maxwell Equations	B3	C1 C3	D3
Calculate the main parameters of the electromagnetic waves: frequency, wavelength, propagation constant, polarization, Poynting vector, phase constant, attenuation constant.	B3	C3	D3
Analyze the propagación of waves in media with and without losses.	B3	C3	D3

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
Master Session	16	24	40
Case studies / analysis of situations	21	31.5	52.5
Practice in computer rooms	4	6	10
Troubleshooting and / or exercises	12	18	30
Multiple choice tests	1	4.5	5.5
Long answer tests and development	2	10	12

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

Methodologies

	Description
Master Session	Exhibition by the professor of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student. Through this methodology the competencies CG3, CE1 and CT3 are developed.
Case studies / analysis of situations	Analysis of a fact, problem or real event with the purpose to know it, interpret it, resolve it, generate hypothesis, contrast data, think about it, complete knowledges, diagnose it and train in alternative procedures of solution. This metodology will be used both in large and medium size groups. Through this methodology the competencies CG3, CE1, CE3 and CT3 are developed.
Practice in computer rooms	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.
Troubleshooting and / or exercises	Problems and/or exercises related with the subject are formulated. The student has to develop the suitable or correct solutions by development of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. It is a complement of the lectures. Through this methodology the competencies CG3, CE1, CE3 and CT3 are developed.

Personalized attention

Methodologies	Description
Master Session	The student will receive personalized attention during the tutoring hours.
Troubleshooting and / or exercises	The student will receive personalized attention during the tutoring hours.
Case studies / analysis of situations	The student will receive personalized attention during the tutoring hours.
Practice in computer rooms	The student will receive personalized attention during the tutoring hours.

Assessment

	Description	Qualification	Training and Learning Results	
Troubleshooting and / or exercises	Proof in which some 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.	35	B3	C1 C3
Multiple choice tests	Tests for assessment of acquired skills that include questions with response alternatives (true / false, multiple choice, matching elements ...). Students select an answer from a limited number of possibilities.	5	B3	C1 C3
Long answer tests and development	Proof for evaluation of the skills that includes open questions on a subject. The students have to develop, relate, organise and present their knowledge about the subject in an extensive answer.	60	B3	C1 C3

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 EVALUATION.

- The system of continuous evaluation (EC) will consist of:
    - a) A problem solving test that will be taken around the 4th week of the term. The qualification will be ECa, with maximum score of 0.5 points.
    - b) A multiple choice test that will be taken around the 8th week of the term. The qualification will be ECb, with maximum score of 0.5 points.
    - c) a problems/questions solving test on units/topics 1, 2 and 3 of he syllabus. It will be taken around the 8th week of the term. The effective qualification will be ECc=(4-ECa-ECb)·X/10, where X is the score of this last test in a range from 0 to 10.
- The final qualification of the continuous evaluation (EC) will be obtained as EC1=ECa+ECb+ECc, with a maximum score of 4 points. This way of qualification makes that the student arriving to the test "c" has as minimum Eca+Ecb and he/she can obtain up to 4 points with the test "c".
- Before the completion or delivery of the test, the date and procedure for the review of the obtained grades will be indicated. Students will have the option to know the status of the test and review the correction within a reasonable period of time.
- This test is not recoverable, what means that if a student cannot fulfill it in the stipulated period and terms, teachers will not be committed to repeat it.
- The grade obtained in the continuous evaluation test (EC1) will be valid only for the current academic course.
- It will be understood that a student follows the EC system whenever he takes any of the tests "b" or "c" of the continuous evaluation.

2. END OF THE TERM EXAM

- All the students must take this exam in order to pass the course on first call.
- Students that did not follow the continuous evaluation: their final score will be that of the complete final exam (EF).
- Students that followed the continuous evaluation:
    - They will take only the part of exam corresponding to topics 4 to 7 (EX2), that will be graded from 0 to 6

points and will be saved as the second part of the continuous evaluation (EC2) until the Recovery exam of July (EC2 = EX2).

- The final score will be EF=EC1+EC2

3. RECOVERY EXAM.

- Students that did not follow the continuous evaluation: the final score will be that of the complete final exam (EF).
- Students that followed the continuous evaluation.
  - The recovery exam will also be divided in two parts: EX1 (topics 1 to 3) with a maximum value of 4 points, and EX2 (topics 4 to 7) with a maximum value of 6 points.
  - The students that followed the continuous evaluation will choose to do: only EX1, only EX2, or both parts. The final grade will be: EF = max(EX1, EC1) + max(EX2, EC2), being EX1 and EX2 the grades obtained in each part of the recovery exam, and EC1, EC2 as described before.

4. NOTES

- It is considered that a student has taken the course when he/she has followed the continous evaluation or has taken any of the two exams (end of term exam or recovery exam). If an student who followed continuous evaluation does not take any of the other two exams (end of term/recovery) he/she will be graded with EC1.
- In order to pass the course, students must receive a grade of 5 or above.

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