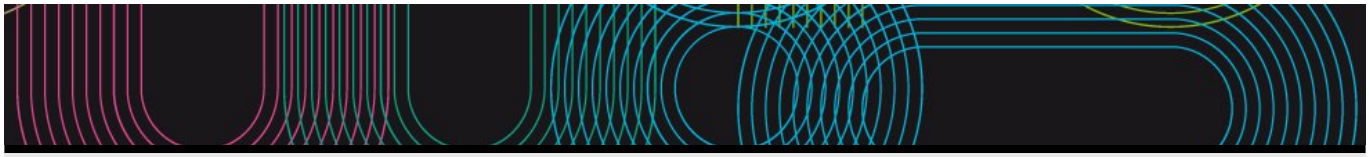

IDENTIFYING DATA				
Physics: Fields and Waves				
Subject	Physics: Fields and Waves			
Code	V05G303V01202			
Study programme	Degree in Telecommunications Technologies Engineering - Teaching in English			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	English			
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	C3	D1
	B3	C4	D2
	B4		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