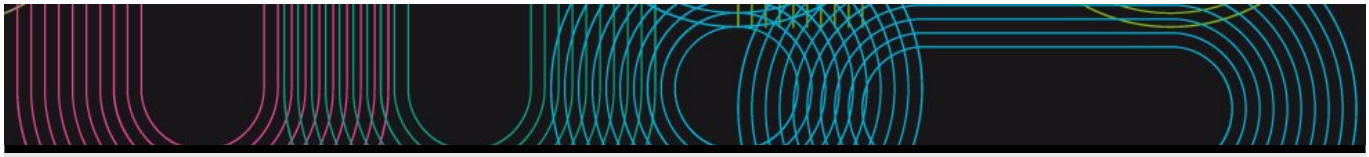

IDENTIFYING DATA				
Physics: Fields and Waves				
Subject	Physics: Fields and Waves			
Code	V05G300V01202			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Obelleiro Basteiro, Fernando			
Lecturers	Gómez Araújo, Marta Obelleiro Basteiro, Fernando Pino García, Antonio Rubiños López, José Óscar Vera Isasa, María			
E-mail	obi@com.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. 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	25	37.5	62.5
Case studies / analysis of situations	12	18	30
Troubleshooting and / or exercises	16	24	40
Troubleshooting and / or exercises	1	2.5	3.5
Long answer tests and development	2	12	14

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

Methodologies

	Description
Master Session	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. Through this methodology the competencies CG3, CE1, CE3 and CT3 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. I 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.

Assessment

	Description	Qualification	Training and Learning Results		
Master Session	(*)dfghdfghdfgh	0	B3	C1	D3
Troubleshooting and / or exercises	Proof in which the students have to solve series of problems and/or exercises in a time/condition established by the professor. In this way, the students have to apply their knowledge.	40	B3	C1 C3	
Long answer tests and development	Final examination: 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 (CE) will consist in a problems/questions solving test on units/topics 1, 2 and 3 of he syllabus. It will be takenaround the 8th week of the term. The weight of this test will be the 40% of the final grade, with a maximum score of 4 points.
- 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 (CE1) will be valid only for the current academic course.
- It will be understood that a student follows the CE system whenever he takes the test CE1.

2. END OF THE TERM EXAM

- The exam will 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.
- All the students must take this exam in order to pass the course on first call.
- Two cases must be considered:
    - Students that did not follow the continuous evaluation:
        - The grade will be straightforwardly obtained from the final exam (FE) as the sum of the grades of the two parts of the exam: FE = EX1 + EX2.
    - Students that followed the continuous evaluation:
        - They must take the second part of the exam (EX2). EX2 will be graded from 0 to 6 points and will be saved as the second part of the continuous evaluation (CE2) until the July exam (CE2 = EX2).
        - The student may choose to do the first part of the exam (EX1); if so, it only will be taken into account when the grade obtained improves the result obtained in the continuous evaluation test (CE1).
        - Thus, the final grace will be obtained as: FE = max (EX1, CE1) + EX2.

3. RECOVERY EXAM.

- 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.
- Regarding the students that did not follow the continuous evaluation, their final grade will be straightforwardly obtained from this final exam as the sum of the grades of the two parts of the exam: FE = EX1 + EX2.
- The students that followed the continuous evaluation will choose to do: only EX1, only EX2, or both parts. The final grade will be: FE = max(EX1, CE1) + max(EX2, CE2), being EX1 and EX2 the grades obtained in each part of the

recovery exam, CE1 the continuous evaluation grade, and CE2 the continuous evaluation grade corresponding to the second part of the course (obtained in the second part of the end of term exam).

4. NOTES

- It is considered that a student has taken the course when he has done the continuous evaluation test (CE1) or any of the two exams (end of term exam or recovery exam). Any student who takes the continuous evaluation test (CE1) will be graded, regardless of he/she takes or not the other two exams (end of term exam or recovery exam).
- In order to pass the course, students must receive a grade of 5 or above.

Sources of information
David J. Griffiths, **Introduction to Electrodynamics**, 4ª Edición,
D. K. Cheng, **Fundamentos de Electromagnetismo para Ingeniería**,
F. Dios, D. Artigas, et all., **Campos Electromagnéticos**,
J. R. Reitz, F. J. Milford, R. W. Christy, **Fundamentos de la Teoría Electromagnética**,
D. K. Cheng, **Field and Wave Electromagnetics**, 2ª Edición,
U. S. Inan, A. S. Inan, **Electromagnetic Waves**,
W. H. Hayt, J. A. Buck, **Teoría Electromagnética**, 7ª Edición,
W. H. Hayt, J. A. Buck, **Teoría Electromagnética**, 8ª Edición,
M. F. Iskander, **Electromagnetic Fields and Waves**, 2ª Edición,

All the required material (notes, exercises compilations, visualization tools in JAVA and Matlab, etc.) will be availabe in FAITIC.

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