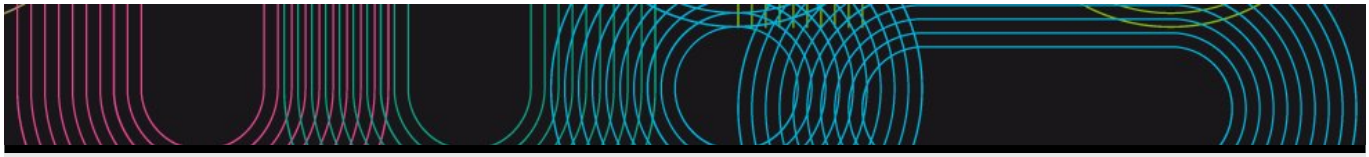

IDENTIFYING DATA				
Electromagnetic Transmission				
Subject	Electromagnetic Transmission			
Code	V05G306V01207			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	English			
Department				
Coordinator	Lorenzo Rodríguez, María Edita de			
Lecturers	Díaz Otero, Francisco Javier Lorenzo Rodríguez, María Edita de			
E-mail	edita.delorenzo@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	Fundamentals of electromagnetic guided and unguided transmission. Analysis of the operating principles of different transmission media models and their characterization in telecommunication engineering. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
B5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
C9	CE9/T4: The ability to analyze and specify the main parameters of a communications system.
C13	CE13/T8: The ability to understand the electromagnetic and acoustic wave mechanisms of propagation and transmission, and their corresponding receiving and transmitting devices.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

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

Contents
Topic

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

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	1	2
Lecturing	20	30	50
Autonomous problem solving	14	30	44
Laboratory practical	18	12	30
Problem solving	6	12	18
Problem and/or exercise solving	4	0	4
Self-assessment	0	2	2

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

Methodologies

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

Personalized assistance

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

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

Assessment

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

Other comments on the Evaluation

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

Continuous assessment

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

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

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

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

To pass the subject through this evaluation system, it is necessary to pass the self-assessment tests and obtain 30% of the maximum grade in tests T2 and T4. If any of these conditions are not met, the official rating will never be higher than 4.5.

Global assessment

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

Extraordinary exam

It consists of a single problem solving exam.

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

End-of-program exam

It consists of a single problem solving exam.

Copy

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

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

Sources of information

Basic Bibliography

F.T. Ulaby, **Fundamentals of Applied Electromagnetics**, 7ª, Pearson, 2015
S.M. Wentworth, **Applied electromagnetics. Early transmission line approach**, 1ª, Wiley, 2007
D. K. Cheng, **Fundamentos de electromagnetismo para ingeniería**, Addison-Wesley, 1997

Complementary Bibliography

N.N.Rao, **Elements of engineering electromagnetics**, 6ª, Pearson, 2004
J.D. Krauss, **Electromagnetismo con aplicaciones**, McGraw-Hill, 2000
Y.H. Lee, **Introduction to Engineering Electromagnetics**, Springer, 2013
S. Balaji, **Electromagnetics Made Easy**, Springer, 2020

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Calculus 1/V05G301V01101
Mathematics: Calculus 2/V05G301V01106
Physics: Fields and Waves/V05G301V01202