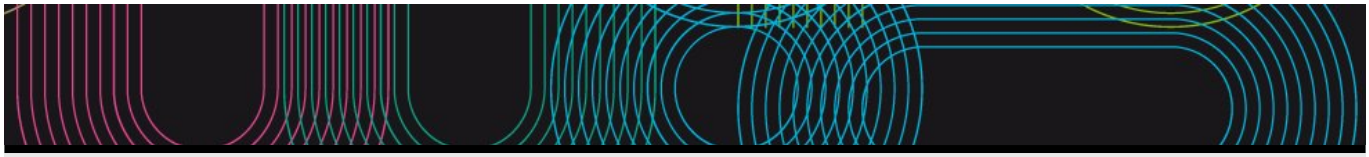

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Electromagnetic Transmission** | | | | |
| Subject | Electromagnetic Transmission | | | |
| Code | V05G300V01303 | | | |
| Study programme | (*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Mandatory | 2nd | 1st |
| Teaching language | Spanish | | | |
| Department | | | | |
| Coordinator | Vera Isasa, María | | | |
| Lecturers | Díaz Otero, Francisco Javier<br>García-Tuñón Blanca, Inés<br>Gómez Araújo, Marta<br>Lorenzo Rodríguez, María Edita de<br>Santalla del Río, María Verónica<br>Vazquez Alejos, Ana<br>Vera Isasa, María | | | |
| E-mail | mirentxu@uvigo.es | | | |
| Web | http://faitic.uvigo.es | | | |
| 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. | | | |

| Competencies | |
|---|---|
| Code | |
| B3 | CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update 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. |
| C8 | CE8/T3: The ability to use software tools for bibliographical resources search or information related with electronics and telecommunications. |
| 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. |
| C20 | CE20/T15: The knowledge of national, European and international telecommunication regulations and laws. |
| 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 |
| Transmissionm line specification: two-wire line, coaxial wire, coaxial models, twisted pair, optical fibre. | B3 | C8<br>C9 |
| Analysing waves of tension and current and stationary wave. | B5 | C9<br>C13 |
| Proposing impedance matching solutions. | B4 | |
| Crosstalk problems evaluation. | B5 | C13 |

| | | | |
|---|---|---|---|
| Antenna radiated field calculation and related parameters: radiation pattern, gain, beam-width, impedance, polarisation, effective area. | B5 | C9<br>C13 | |
| Resolving problems of propagation and reception of electromagnetic waves. | B3<br>B4 | C20 | D2<br>D3 |

| **Contents** | |
|---|---|
| Topic | |
| 1. Introduction | Types of transmission media, advantages and disadvantages, characterisation. |
| 2. Transmission lines | Getting started with some of the most commonly used transmission lines: two-wire, coaxial, twisted pair.<br>Circuit model of distributed parameters ,general equations, characteristic parameters (characteristic impedance, propagation velocity, attenuation and phase coefficients).<br>Attenuation, dispersion and crosstalk.<br>Transmission line in circuit (reflection coefficient, standing wave ratio, input impedance).<br>Smith Chart. |
| 3. Optical fiber. | Structure and types.<br>Numerical aperture and acceptance cone.<br>Attenuation and dispersion.<br>Optical sources and receptors. |
| 4. Radiowaves and antennas | Characteristics of radiowaves: far field, radiation integral.<br>Antenna concept and fundamental parameters (radiation pattern, secondary lobe level, beamwidth, directivity, gain, polarisation, impedance).<br>Reception: power balance in free space (Friis equation), polarization loss factor.<br>Center feed dipoles.<br>Antenna arrays. |
| Labs | - Management of software tools to search information: technical, scientific and regulation of telecommunications.<br>- Measurement and analysis of voltage and current waves and standing waves.<br>- UTP and coaxial.<br>- Basic matching technics.<br>- Radiation pattern plots.<br>- Measurement of antenna basic parameters.<br>- Problem resolution. |

| **Planning** | | | |
|---|---|---|---|
| | Class hours | Hours outside the classroom | Total hours |
| Introductory activities | 1 | 2.5 | 3.5 |
| Master Session | 17 | 25.5 | 42.5 |
| Laboratory practises | 12 | 6 | 18 |
| Practice in computer rooms | 8 | 4 | 12 |
| Presentations / exhibitions | 2 | 16 | 18 |
| Autonomous troubleshooting and / or exercises | 12 | 24 | 36 |
| Troubleshooting and / or exercises | 2 | 8 | 10 |
| Multiple choice tests | 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 | Activities focused to take contact and get information about the students and to introduce the subject. |
| Master Session | Presentation by the teacher of the contents of the subject of study (theoretical basis).<br>Through this methodology the competencies CG3, CE9,CE13,CE20 y CT2 are developed. |
| Laboratory practises | Application of knowledge to specific situations and acquisition of basic skills and procedures. They are developed in laboratories with specialized equipment.<br>Through this methodology the competencies CG5 y CT3 are developed. |
| Practice in computer rooms | Activities of acquisition of<br>basic skills related with the matter.<br>Through this methodology the competencies CG3, CE8, CE20 y CT3 are developed. |

| | |
|---|---|
| Presentations / exhibitions | Student presentation of the results of a group work.<br>Through this methodology the competencies CE20 y CT3 are developed. |
| Autonomous troubleshooting and / or exercises | 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.<br>Through this methodology the competencies CG4, CE9 y CE13 are developed. |

**Personalized attention**

| Methodologies | Description |
|---|---|
| Master Session | Students will have the opportunity to attend personalized tutoring in the schedule that teachers establish for this purpose at the beginning of the course and will be published in the course website. The teacher will resolve in the classroom the doubts that arise in the moment of the class and in the tutoring schedule those that arise when realising the autonomous study. |
| Autonomous troubleshooting and / or exercises | Students will have the opportunity to attend personalized tutoring in the schedule that teachers establish for this purpose at the beginning of the course and will be published in the course website. The teacher will resolve in the classroom the doubts that arise in the moment of the class and in the tutoring schedule those that arise when realising the autonomous study. |

**Assessment**

| | Description | Qualification | Training and Learning Results | | |
|---|---|---|---|---|---|
| Laboratory practises | Performing lab practices that require instrumentation handling. | 20 | B5 | | D3 |
| Presentations / exhibitions | Performing lab practices of software tools to search of information and a work about telecommunication regulation. | 10 | | C8<br>C20 | D2 |
| Troubleshooting and / or exercises | Proof in which the student has to solve a series of problems in a time and conditions established by the teacher, applying the acquired knowledge. | 40 | B3<br>B4 | C9<br>C13 | |
| Multiple choice tests | Tests for evaluation of acquired skills including direct questions about a particular aspect. Students must respond directly and briefly based on their subject knowledge. | 30 | B3 | C9<br>C13 | |

**Other comments on the Evaluation**

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

Continuous assessment includes a series of tasks performed during the course (70%) and a multiple-choice test (30%) performed on date according to the official exam schedule. To pass the subject by this evaluation system, 1/3 of the maximum score of each item in the above table must be obtained (except for the multiple choice test) and 50% minimum of the global score (sum of the four blocks) must be reached.

The tasks in the course include the active participation in ordinary classroom and laboratory sessions, autonomous working, information search, development and submission of a report and two tests of problem solving (the first scheduled at the middle of the term and the second by the end). These tasks are **not recoverable**, ie if a student cannot fulfill on time the teacher has no obligation to repeat them and will **only be valid for the academic year in which they are made**.

The students must decide if they choose the ongoing evaluation after the realization of the first test of problem solving on the 8 th - 9 th week of class, in which case they receive a grade that corresponds, independently that they present to other tasks or not. If the score is high as 50% without getting 1/3 in some of the items, the official grade will be 4.5

**Evaluation by final exam**

In addition to the continuous assessment system described above, the student may choose to perform one final exam that will have three parts:
- Part I: practice and report (pass or fail).
- Part II: questions (40%).
- Part III: problem solving (60%).

It is necessary to pass the first part to be submitted to the other two. Obtaining a "fail" translates into a 2 official grade. If you have made the qualifying practices and the oral presentation of the report (essential) and have passed the third corresponding to, you do not need to perform the first part of the final exam.

**Second chance**

It consists of a final exam with the same characteristics and weights as indicated in the previous section.

Students who want to preserve the grade obtained in the first tasks of the continuous assesment (70%) can elect to perform only the multiple-choice test (30%) provided that minimum requirements had been got.

To pass the subject at least 50% in the total qualification must be obtained in any of the evaluation systems and calls.

## Sources of information


F.T. Ulaby, **Fundamentals of Applied Electromagnetics**, 6ª,

S.M. Wentworth, **Applied electromagnetics. Early transmission line approach**, 1ª,

D. K. Cheng, **Fundamentos de electromagnetismo para ingeniería**,


**Additional references:**


B.M. Notaros, **Electromagnetics**, Pearson 2011.

N.N.Rao, **Elements of engineering electromagnetics**, Pearson, 6ª ed., 2004.

J.D. Krauss, **Electromagnetismo con aplicaciones**, McGraw-Hill 2000.

D. K. Cheng. **Field and Wave Electromagnetics,** Addison-Wesley, 2ª ed.,1989.


## Recommendations

### Subjects that continue the syllabus

Fundamentals of Sound and Image/V05G300V01405
Signal Transmission and Reception Techniques/V05G300V01404
Microwave Circuits/V05G300V01611
Radio Frequency Circuits/V05G300V01511
Optical Telecommunication Infrastructures/V05G300V01614
Wireless Systems and Networks/V05G300V01615
Radio Communication Systems/V05G300V01512

### Subjects that are recommended to be taken simultaneously

Digital Signal Processing/V05G300V01304

### Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Mathematics: Calculus I/V05G300V01105
Mathematics: Calculus II/V05G300V01203