
Academic Year of Degree: 2025/26

23977 - Radio Communication Systems

Teaching Guide Information

Academic Course: 2025/26

Academic Center: 337 - Engineering School

Study: 3379 - Bachelor's degree in Telecommunications Network Engineering

Subject: 23977 - Radio Communication Systems

Credits: 5.0

Course: 3

Teaching languages:

Theory: Group 1: English

Seminar: Group 101: English

Teachers: Rafael Pous Andres

Teaching Period: Second term

Presentation

Radio Communication Systems is a basic course on antennas and propagation, with a clear practical and hands-on orientation. The students will learn:

- Antenna parameters
- Power calculations in a radio link
- Basic antenna types (wire, patch, aperture, reflectors)
- Antenna design and simulation
- Principles of antenna measurements

This subject does not have the intention of being a comprehensive course on antennas and propagation. Several important topics are left out (radiation integrals, numerical methods, etc.), but the fundamental principles will be covered, and the student will gain a basic understanding of the main topics relevant to antenna characterization, design and measurements. This basic understanding will be enough for those students interested in the subject to use some of the very good textbooks available to dig deeper in his or her particular areas of interest.

Associated skills | General learning outcomes

Basic competences:

CB1. That the students have proved to possess and understand knowledge in a study area which comes from the basis of general secondary education, and are usually in a level which, although it is supported on advances text books, it also includes some aspects which imply knowledge coming from their study field's innovation;

CB2. That the students can apply their knowledge to their work or vocation of a professional form and possess the competences which are usually proved by means of the elaboration and defense of arguments and solving of problems within their study area;

CB3. That the students have the ability of collecting and interpreting relevant data (normally within their study area) to issue judgements which include a reflection about relevant topics of social, scientific or ethical nature;

CB4. That the students can transmit information, ideas, problems and solutions to a public both specialized and non specialized;

CB5. That the students have developed those learning abilities necessary to undertake later studies with a high degree of autonomy.

Transversal competences:

CT1. Working in a group in international and interdisciplinary contexts.

CT2. Applying leadership and coordination and proving initiative.

CT3. Applying with flexibility and creativity the acquired knowledge and adapting it to new contexts and situations.

CT4. Communicating in academic and professional contexts orally and writing in English.

CT5. Generating new ideas and incorporating them in daily work.

Learning outcomes | Specific learning outcomes

CE1. Solving the mathematical problems which can be set out in engineering and apply the knowledge on: linear algebra; differential and integral calculus; numerical methods, numerical algorithms, statistics and optimization.

RA.CE1.1 Applying linear algebra knowledge to solve problems which can be set out in the engineering

RA.CE1.2 Proving knowledge of differential and integral calculus to solve problems which can be set out in engineering.

RA.CE1.3 Using knowledge of numerical methods to solve problems which can be set out in engineering.

CE2. Mastering the basic concepts of fields and waves and electromagnetism, theory of electric circuits, electronic circuits, physical principle of the semiconductors and logic families, electronic and photonic devices, and their application for solving typical problems of the engineering.

RA.CE2.1 Applying basic knowledge of fields and waves and electromagnetism to solve problems which can be set out in engineering.

RA.CE2.2 Managing basic concepts of linear systems and the functions and transformations related to solving typical problems in engineering.

CE7. Designing, building and assessing electronic systems and circuits.

RA.CE7.1 Recognizing the mechanisms of propagation and transmission of electromagnetic and acoustic waves, and their corresponding emitting and recipient devices.

RA.CE7.2 Solving typical problems of the engineering applying advanced concepts of linear systems and the related functions and transformed.

RA.CE7.3 Assessing communications systems specifying its fundamental parameters, from the point of view of the signal space, the disturbances and the noise.

RA.CE7.4 Analyzing transmission and reception systems in radio, microwave and optical frequencies.

RA.CE7.5 Analyzing and designing wireless communications systems, both cellular and short range, applying fundamental knowledge on its functioning.

CE11. Developing and using analysis, simulation and experimentation methods in the design, assessment and optimization of telecommunication networks and systems.

RA.CE11.1 Analyzing and designing networks applying methodology of modelling and simulation.

Contents

The subject is organized around 6 content blocks:

- **Content block 1. - Antenna parameters. Antenna radiation pattern.**
 - Antenna input impedance
 - Antenna bandwidth
 - Antenna radiation efficiency
 - Antenna directivity, effective aperture, and gain
 - Antenna radiation pattern, beam-width, F/B ratio, and side-lobe level
 - Antenna polarization
- **Content block 2. - Link power calculations. Antenna temperature and SNR.**
 - Antenna as a transmitter, as a receiver, and reciprocity
 - Link power calculations and the Friis transmission equation
 - Antenna temperature and noise calculations
 - SNR calculation
- **Content block 3. - Linear wire and loop antennas.**
 - Infinitesimal dipole
 - Small dipole, resonant dipole, and monopole
 - Small loop, resonant loop
 - Yagi-Uda antennas
- **Content block 4. - Antenna arrays.**
 - Two-element and N-element arrays
 - Array factor and visible margin
 - Non-uniform amplitude arrays
 - Phased arrays
- **Content block 5. - Aperture and patch antennas**
 - Infinitesimal aperture
 - Rectangular aperture
 - Horns
 - Patch antennas
- **Content block 6. - Reflector antennas and antenna measurements**
 - Parabolic reflectors
 - f/D ratio, illumination efficiency and spillover
 - Off-set and Cassegrain reflectors
 - Antenna measurement principles

Sustainable Development Goals

4 - Quality Education

8 - Decent Work and Economic Growth

11 - Sustainable Cities and Communities

Evaluation and grading system

There will be a single continuous evaluation itinerary based on for this subject based on:

- **Laboratory (50%):** there will be three lab assignments (besides an introductory lab session). The lab assignments will be done in groups of two students, and there will be a single qualification for both group members (only in exceptional circumstances will this principle be changed). Each lab assignment may consist of one or more deliverables (e. g. pre-lab, and post-lab). All assignments will be turned in in PDF format and through the Aula Global e-learning platform. No assignments will be accepted in other formats, through other channels, or delivered after the deadline (as enforced by the Aula Global). An assignment not delivered, delivered not according to the above requirements, or delivered late, will be graded with a 0/10. Attendance to the laboratory sessions is a strict requirement. More than two unjustified missed laboratory sessions will be a cause for a 0/10 laboratory grade. A minimum average laboratory grade of 5/10 is required to pass the course. A laboratory grade lower than the minimum will mean that the student will have to take the class all over again, since laboratories cannot be passed in the July examination.
- **Final exam (50%):** the final exam will include exercises and questions related to both the classroom and the lab sessions. A minimum average grade of 5/10 is required to pass the course. A grade lower than the minimum will mean that the student will have to take the July exam (given that the laboratory grade is equal or higher than the

minimum). In this case, the July exam will have the same weight as the final exam.

- **July exam** (50%): in case the student has reached the minimum Laboratory grade, and has not passed either because the average course grade is below 5/10, or the exams grades is lower than the minimum, or both, the July exam will substitute the exams grade, and will be a second opportunity to pass by either increasing the average above 5/10, increasing the exam grade above the minimum, or both.