



IDENTIFYING DATA

Radio Communication Systems

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|---------------------|--|----------|------|------------|
| Subject | Radio Communication Systems | | | |
| Code | V05G300V01512 | | | |
| Study programme | Degree in Telecommunications Technologies Engineering | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Optional | 3rd | 1st |
| Teaching language | Spanish | | | |
| Department | | | | |
| Coordinator | Rubiños López, José Óscar | | | |
| Lecturers | Arias Acuña, Alberto Marcos Rubiños López, José Óscar | | | |
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| General description | This course is devoted to the study of the fundamentals of radio communications systems, including the antennas, the link budget as well as those factors that limit the correct reception such as noise and interference. | | | |

Competencies

| | |
|------|---|
| Code | |
| B2 | CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws. |
| 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. |
| C21 | CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems. |
| C22 | CE22/ST2 The ability of applying the basic techniques of telecommunication networks, services and applications for mobile and fixed environments, personal, local or long distance, with different bandwidth, including telephony, radio broadcasting, TV and data, from the point of view of transmission systems. |
| C25 | CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation. |
| D2 | CT2 Understanding Engineering within a framework of sustainable development. |

Learning outcomes

| Expected results from this subject | Training and Learning Results | | |
|---|-------------------------------|-----|----|
| Know the rights **fundamentis recognised in the Spanish Constitution and the systems of guarantee of these rights and the applicable norms. Know interpret and apply the norms that regulate the fundamental rights **asi like his guarantees and the generals of the Constitution. | | | |
| Ability to apply the techniques underlying radio communications systems in fixed and mobile communication services in local or long-distance links at different bandwidths. | B4 | C22 | D2 |
| Ability to understand the concept of systems limited by noise, as well as the types of noise and interferences. | B2 | | D2 |
| Ability to understand the mechanisms of propagation and how to model the propagation channel. | B2 | C25 | |
| Ability to understand the foundations of antennas. | B2 | C25 | |
| Ability to know and characterize the different types of antennas. | | | |

| | | | |
|--|----|-----|----|
| Ability to understand and specify the foundations of terrestrial and satellite broadcast services. | B2 | C21 | |
| Ability to understand the foundations of the radio links. | B2 | C21 | |
| Ability to understand the concept of coverage and to apply it to the radio link and broadcasting services. | B2 | C22 | D2 |
| | | C25 | |
| Ability to analyse the coverage in order to specify the quality of service. | B4 | C21 | D2 |

Contents

| Topic | |
|---------------------------|--|
| 1. RADIATION FUNDAMENTALS | 1.1 Electromagnetic Fundamentals 1.2 Antenna parameters in transmission 1.3 Antenna parameters in reception 1.4 Types of antennas |
| 2. LINK BUDGET | 2.1 Friis transmission equation 2.2 Propagation losses. 2.3 Band frequencies. |
| 3. NOISE | 3.1 Thermal noise. 3.2 Noise in antennas. 3.3 Noise factor and noise-equivalent temperature of a receiver. |
| 4. INTERFERENCE | 3.1 Concept and types of interference 3.2 Characterization of interference |
| 5. AVAILABILITY | 5.1 Concepts of availability, fading and diversity 5.2 Noise-limited Systems 5.3 Interference-limited Systems |
| 6. RADIOWAVE PROPAGATION | 6.1 Propagation at very low frequencies 6.2 Surface wave propagation 6.3 Ionospheric propagation 6.4 Tropospheric Propagation |

Planning

| | Class hours | Hours outside the classroom | Total hours |
|---------------------------------------|-------------|-----------------------------|-------------|
| Master Session | 14 | 14 | 28 |
| Troubleshooting and / or exercises | 7 | 7 | 14 |
| Laboratory practises | 5 | 10 | 15 |
| Autonomous practices through ICT | 0 | 8 | 8 |
| Case studies / analysis of situations | 10 | 40 | 50 |
| Reports / memories of practice | 0 | 15 | 15 |
| Troubleshooting and / or exercises | 4 | 8 | 12 |
| Long answer tests and development | 2 | 6 | 8 |

*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 | Presentation, by the professor, of the contents of the course (theoretical basis, guidelines for solving exercises/problems or developing a radio communication project). Through this methodology the competencies CG2, CE21, CE22, CE25, CT2 are developed. |
| Troubleshooting and / or exercises | Resolution, by the student, of problems and/or exercises related with the course. The student not only has to get the suitable or correct solutions by the application of the theory previously explained but also has to interpret correctly the results. Through this methodology the competencies CG4, CE21, CE22, CE25, CT2 are developed. |
| Laboratory practises | Application of knowledge to specific situations and acquisition of basic skills and procedures in the related field. They are developed in laboratories with specialized equipment. Through this methodology the competencies CG4, CE21, CE22, CE25 are developed. |
| Autonomous practices through ICT | Application through ICT of the knowledge and the procedural skills that the student has acquired in the course to specific situations. Through this methodology the competencies CG4, CE21, CE22, are developed. |
| Case studies / analysis of situations | Study and analysis of problems based on real events in order to know them, think about them, interpret them, generate hypothesis, contrast data ... and train in the use of different procedures of solution. Through this methodology the competencies CG4, CE21, CE22, CE25, CT2 are developed. |

Personalized attention

| Methodologies | Description |
|----------------|--|
| Master Session | In this methodology, all the questions that each student can ask will be answered. |

Troubleshooting and / or exercises Each student will be attended in an individual way.

Case studies / analysis of situations Each student will be attended in an individual way.

Laboratory practises Each student will be attended in an individual way.

Autonomous practices through ICT Each student will be attended in an individual way.

Assessment

| | Description | Qualification | Training and Learning Results |
|---------------------------------------|---|---------------|-------------------------------|
| Case studies / analysis of situations | Technique that consists of monitoring the student, who will be assessed from his autonomously solving of the proposed tasks (case studies / analysis of situations). | 10 | B2 C25 D2 B4 |
| Reports / memories of practice | Evaluation of: - the preparation and development of the lab practices - the reports and memories on lab practices | 10 | B4 C21 D2 C22 C25 |
| Troubleshooting and / or exercises | Two examinations in which the student has to solve a number of exercises by applying the acquired knowledge in the time and conditions established by the professor. The student can take them during the course or together with the final examination, depending on the evaluation system chosen. | 40 | B2 C22 B4 |
| Long answer tests and development | Final examination: evaluation of the skills acquired by the student. He/she has to develop, relate, organise and present the knowledge acquired in the course. | 40 | B2 C22 B4 C25 |

Other comments on the Evaluation

According to the guidelines of the degree, the student can choose between two evaluation systems: continuous assessment or only final examination. Previously to the final examination (or at the entrance of the session), the student will decide the evaluation system. Before performing each task or delivery, the procedure and dates for the review of the qualifications will be published within a reasonable period of time.

1. The continuous assessment includes a series of tasks performed during the course (70%). They are not recoverable, i.e., if a student can not fulfilled them in the time established, the professor is not bound to repeat them. The obtained qualification will be valid only for the current academic course.

The continuous assessment consists of:

- two examinations (approximately in the weeks 4 and 9);
- delivery (in the last weeks of the course) of memories of the lab and autonomous-ICT practices;
- autonomous tasks (case studies / analysis of situations);
- the final examination.

2. FINAL EXAMINATION at the end of the semester.

FORMULA OF QUALIFICATION

E1=score obtained in the mandatory part of the final examination (up to 10 points).

PM=score obtained in the lab practices (attendance, quality of the reports...) (up to 10 points).

PEC=score obtained in both exams (continous assessment) (up to 10 points).

S=score obtained in the autonomous tasks (case studies / analysis of situations) (up to 10 points).

Continuous evaluation:

If $PEC < 4$ points, Qualification = PEC

If $PEC \geq 4$ points, Qualification = $0.5 * E1 + 0.4 * PEC + 0.07 * PM + 0.01 * S$

No continuous Evaluation: Qualification = E1

4. RECOVERY IN the JULY SESSION. Previously to the exam (or at the entrance of the session) the students choose the

evaluation system. The qualification formulas are the same.

5. STUDENTS PRESENTED AT THE COURSE. A student is considered "presented" if he/she receives the final exam or both exercises of the continuous assessment.

Sources of information

Basic Bibliography

Marcos Arias Acuña, Oscar Rubiños López, **Radiocomunicación**, 1ª, Andavira Editora, 2011

José María Hernando Rábanos, **Transmisión por Radio**, 7ª, Editorial Universitaria Ramón Areces, 2013

Complementary Bibliography

John Griffiths, **Radio Wave Propagation and Antennas. An Introduction**, 1st, Prentice Hall, 1985

Robert E. Collin, **Antennas and Radiowave Propagation**, 1st, Mc Graw Hill, 1985

Constantine A. Balanis, **Antenna Theory. Analysis and design**, 4th, Wiley, 2016

Thomas A. Milligan, **Modern Antenna Design**, 2nd, Wiley, 2005

Angel Cardama, L. Jofre, J.M. Rius, S. Balnch, M. Ferrando, **Antenas**, 2ª, Ediciones UPC, 2002

ITU-R, **Recommendations**,

Recommendations

Subjects that continue the syllabus

Wireless Systems and Networks/V05G300V01615

Subjects that are recommended to be taken simultaneously

Radio Frequency Circuits/V05G300V01511

Subjects that it is recommended to have taken before

Physics: Fields and Waves/V05G300V01202

Signal Transmission and Reception Techniques/V05G300V01404

Electromagnetic Transmission/V05G300V01303