COURSE PROGRAM

Academic year: 2024/2025

Identification and characteristics of the course					
Code	401090			ECTS Credits	6
Name	Guided and Satellite Communication Systems Design				
Name (Spanish)	Implementación de Sistemas de Comunicación por línea y vía satélite				
Master	Master in Telecommunications Engineering				
Centre	School of Technology				
Semester	Second	Character	Mandatory		
Module	Communication technologies				
Material	Communication technologies and systems				

Lecturers			
Name	Office	e-mail	Web page
Juan Francisco Izquierdo León	No. 22-Telecom.	jfizquierdo@unex.es	https://www.unex.es/conoce-la-uex/centros/epcc/centro/profesores/info/profesor?id_pro=jfizquierdo
Jesús Rubio Ruiz	No. 29-Telecom.	jesusrubio@unex.es	https://www.unex.es/conoce-la-uex/centros/epcc/centro/profesores/info/profesor?id_pro=jesusrubio

Subject Area	Teoría de la señal y comunicaciones
Department	Tecnología de computadores y de las comunicaciones
Coordinating lecturer	Juan Francisco Izquierdo León

Competencies

Basic competencies

CB6 - Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.

CB7 - Ability to apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

CB8 - Ability to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.

CB9 – Skills to communicate conclusions, and the knowledge and rationale underpinning these, to specialized and non-specialized audiences in a clear and unambiguous way.

CB10 - Learning skills that enable to continue studying in a way that will be largely self-directed or autonomous.

General competencies

CG1 - Ability to plan, calculate and design products, processes and facilities in all areas of telecommunications engineering.

CG4 - Capacity for mathematical modeling, calculation and simulation in technology centers and engineering companies, particularly in research, development and innovation in all areas related to the Telecommunications Engineering and related multidisciplinary fields.

CG8 - Ability to apply the acquired knowledge and solve problems in new or unfamiliar environments in broader and multidisciplinary contexts, being able to integrate this knowledge.

CG11 - Ability to learn to communicate (oral and written) findings, and the knowledge and rationale underpinning these, to public-skilled and unskilled in a clear and unambiguous way.

Specific competencies

CETT3 - Ability to implement cable systems and satellite systems in fixed and mobile communications environments.

CETT13 - Ability to design communication components such as routers, switches, hubs, transmitters and receivers in different bands

Cross-curricular competencies

CT1 - Innovative and entrepreneurial spirit.

CT4 - Skills to communicate conclusions, along with the knowledge and the reasons behind them, to specialized and non-specialized audiences, both orally and in writing, in Spanish and English.

CT5 - Ability to work as a team member

CT7 - Critical thinking skills and creativity as a means to have the opportunity to be original in the generation, development and / or application of ideas in a research or professional context

CT10 - Focus on quality and continuous improvement.

CT13 - Ability to integrate knowledge and face the complexity of formulating opinions from incomplete or limited information.

Themes and Syllabus

Brief description of the syllabus

[Block A] General concepts about guided communication and optical fiber. Digital optical communications systems. Analog optical communications systems. Advanced optical communications systems.
[Block B] General concepts about satellite communications: historical development, orbits, space subsystems, ground subsystems, telecontrol and telemetry systems. Radio links via satellite. Multiple access. VSAT networks. Mobile Communications via satellite. Satellite Navigation Systems: GPS and Galileo.

Course Syllabus

BLOCK A. GUIDED COMMUNICATION SYSTEMS

Chapter 1: General concepts of guided transmission systems.
General concepts of guided communications: introduction to terrestrial information systems. Cable and fiber optic transmission systems. Cabled networks technologies. Switched network hierarchy.

Chapter 2: Optical communications systems.
Optical communication systems. General information about fiber optics. Optical wiring. General considerations on the design of a digital optical communications system. Intensity-modulation and direct-detection systems (IMDD). Global power profile. Global time-rise profile. Feasibility criteria. Dispersion Shifted Fibers.

Chapter 3. Advanced optical communication systems. Multichannel systems.
Advanced optical communications systems. Multichannel technologies. Channel routing technologies. Long-haul optical transmission links. Fiber-to-the-Home (FTTH). Wavelength-division multiplexing (WDM). Optical Time-Division Multiplexing (OTDM). Subcarrier Multiplexing (SCM).

Chapter 4. Other detection and modulation schemes in optical communications. Direct and coherent detection. Direct and external modulation. Other analog and digital modulation schemes.
BLOCK B. SATELLITE COMMUNICATION SYSTEMS
Chapter 1: General concepts on satellite communications Historical development, orbits, space subsystems, ground subsystems, control subsystems.
Chapter 2: Radio links via satellite Frequency bands. Link power budget. Antennas. Propagation. Noise modeling. C/N. Interferences. Intermodulation
Chapter 3: Multiple access in satellites Traffic routing. Multiple access techniques. Multiple access control.
Chapter 4: Satellite communication networks Basic characteristics. Multibeam networks. Inter-satellite links. Connectivity in the satellite. VSAT networks. Mobile Communications via satellite.
Chapter 5: Satellite Navigation Systems: Introduction to satellite navigation systems. GPS and Galileo systems.

Laboratory Sessions

During the course, the study, development and simulation of a real communication system will be requested (either using a guided link or a satellite link). The Matlab environment and its Simulink extension will be used.

Three dates are important: i) work title + brief summary; ii) delivery of .mdl and .m files used in the design of the system; iii) public defence of the student's work.

Session 1: Introduction to Simulink for simulation of systems.
Session 2: Simple example of communications in Simulink.

Other laboratory sessions: development of the full communication (sub)system.

Sessions will be held in instrumentation laboratories for the measurement and characterization of real communication systems (if it is needed).

Educational activities

Student workload in hours by lesson		Lectures	Practical activities				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
A.1	13,5	4		2				7,5
A.2	20,5	6		2				12,5
A.3	20,5	6		2				12,5
A.4	12,5	4		1				7,5
B.1	24	7		2				15
B.2	16	4		2				10
B.3	15	4		1				10
B.4	12	3,5		1				7,5
B.5	12	3,5		1				7,5
Assessment	4	3		1				
TOTAL	150	45		15				90

L: Lectures (85 students)
HI: Hospital internships (7 students)
LAB: Laboratory or field practices (15 students)
COM: Computer room or language laboratory practices (20 students)
SEM: Problem classes or seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

Teaching methodology

Training activities and methodology.

- Expository and participatory classes (LG). Classroom activities for the large group. The methodology followed in these activities combines participatory lectures with solving problems in class according to the Project Based Learning methodology (PBL). The content of each chapter will be available for students in the virtual campus or in reprography, prior to the explanation. The exhibitions will be made using video cannon and blackboard. A work evaluable by block will be proposed.
- Laboratory sessions (S/L). Laboratory sessions will be carried out in groups of two students. There will be sessions where students will use the Matlab and Simulink software tools. Activities will be evaluable and will require non-classroom work. This activity follows a methodology of Cooperative and Collaborative Learning based on Projects.
- Classes of explanation of laboratory activity (GG). The professor will provide the students, prior to the classroom work, with a script of the introductory practice to Simulink. The explanation of the practices will be done in a large group, again with the help of the video projector. During the laboratory activity, professor will describe the statement of the practice and simply act as counselor. In each phase of these sessions, students must carry out their own learning to develop the requested project.
- Exhibition of works. There will be an exhibition of the evaluable practice, in group and in the classroom, with a duration previously set by the professor. Video cannon will be available to facilitate presentations. Students will have self-evaluation and co-evaluation rubrics.
- Non-classroom work (PS). This block includes all the activities carried out by the student during non-classroom hours, especially the development of the evaluable practices and the proposed work. Student must review the concepts presented in the classroom and the corresponding exercises.

Learning Outcomes

The acquisition of the knowledge indicated in the specific contents of the course (Themes and Syllabus section) will also contribute to the acquisition and/or reinforcement of the following capacities:

1. Ability to project, calculate and design products, processes and facilities in all areas of Telecommunication Engineering.

2. Ability to manage, plan and supervise multidisciplinary teams.

3. Ability for mathematical modeling, calculation and simulation in technology and business engineering centers, particularly in research, development and innovation tasks in all fields related to Telecommunication Engineering and related multidisciplinary fields.

4. Capacity for the preparation, strategic planning, management, coordination, technical and economic management of projects in all areas

5. Capacity for general management, technical direction and direction of research, development and innovation projects in companies and technology centers.

6. Capacity for the start-up, management and management of manufacturing processes of electronic and telecommunications equipment, with security guarantee for people and goods, the final quality of the products and their homologation.

7. Ability to apply acquired knowledge and solve problems in new or unfamiliar environments within broader and multidisciplinary contexts, being able to integrate knowledge.

8. Ability to apply the principles of the economy and the management of human resources and projects, as well as the legislation, regulation and standardization of telecommunications.

9. Ability to know how to communicate (orally and in writing) the conclusions- and the knowledge and ultimate reasons that sustain them- to specialized and non-specialized publics in a clear and unambiguous way.

10. Possess abilities for continuous, self-directed and autonomous learning.

11. Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Telecommunications Engineer.

Evaluation System

The course is divided into two parts: theory and practices. To pass the subject, student must:

- Demonstrate the acquisition, comprehension and mastery of the main concepts of the course.
- Develop and properly understand the practices of the course

Both parts, theory and practice, must be approved separately. Below are the criteria for each part, as well as the percentages in the final grade.

Regardless of whether the student chooses continuous or partial assessment, at the end of the semester there will be a single test for each part (theory and practice) that evaluates the activities carried out during the course.

• **Evaluation of the LG training activities**: There will be a single written test of 3 hours, maximum duration. In this test, students will have to demonstrate the knowledge acquired during the development of the subject. This test will be done in the classroom. The written tests will have two parts: theory and problems. It will be necessary to obtain at least 40% in both the theoretical contents and the problems part. (Percentage of the student's final grade: 70%).

It will be necessary to obtain in this test at least 4 points out of 10 in order to be able to pass the subject in each part (part of the satellite and part of the line) and obtain a final grade greater than or equal to 5.

• **Evaluation of laboratory activities** (LS): Is the 30% of the final grade of the subject. This percentage will be distributed as follows:

1. Development of the practical part: 10%
2. Technical quality of the practice memory: 10%
3. Oral presentation: 10%

Oral examinations of the practices may be carried out. It will be necessary to obtain at least 4 points out of 10 in order to pass the subject. The evaluation will be carried out individually according to the teachers' instructions.

To pass the subject it will be necessary to pass both items (theory and practice).

• **Optional or mandatory work** may be proposed, with a maximum mark of one point. This mark will be added to the final grade, provided that students pass both parts.

• **Continuous assessment**: two partial exams will be carried out that will allow to free matter from the theory exam. A partial will examine the topics of the part of communication by line and another part of the part of communications via satellite. In the case that a partial is approved, the student will not have to take the final exam of that part. The written tests will have two parts: theory and problems. It will be necessary to obtain at least 40% in both the theoretical contents and the problems part. In order to be able to take the continuous assessment exams, class attendance of at least 50% of the classes corresponding to each part will be required.

Bibliography

Guided Communication system

[Abe2007] D.P. Abellán, F. Ramos y J. Capmany: Sistemas de Comunicaciones ópticas. Ed. Univ. Politéc. Valencia, 2007.

[Sen1990] J.M. Senior: Optical Fiber Communications: Principles and Practice, Prentice Hall 1990

[Van1991] Van etten, Van Der Plaats: Fundamentals of Optical Fiber Communications, , Prentice Hall 1991

Complementary Bibliography

[Lat1998] B.P. Lathi: Modern Digital And Analog Comunication Sistems, Oxford University Press, 1998

Satellite Communications Systems

[Mar2009] Gerard Maral, Michel Bousquet, Zhili Sun: Satellite Communications Systems: Systems, Techniques and Technology, 5th Edition. Ed. Wiley. 2009.

[Per1995] Félix Pérez Martínez: Sistemas de navegación por satélite, Servicio de publicaciones de la ETSIT. UPM. 1995.

Other resources

The virtual space of the course will be used on the website of the Virtual Campus of the University of Extremadura. On this website, different files will be hosted with material. The web space will also be used to exchange opinions, doubts, etc. about the course.

In addition to the bibliography that is specified, you can also consult other books related to the subject on the web http://books.google.com