COURSE PROGRAM

Academic Year: 2024/2025

Identification and characteristics of the course				
Code	401088		ECTS Credits	6
Course name (English)	Transmission and Signal Processing in Communication and Multimedia Systems			
Course name (Spanish)	Tratamiento y Transmisión de Señales en Sistemas de Comunicaciones y Audiovisuales			
Degree programs	Master in Telecommunications Engineering			
Faculty/School	School of Technology			
Semester	Second	Type of course	Mandatory	
Module	Telecommunication technologies			
Matter	Communication Systems and Technologies			
Lecturer/s				
Name		Office	E-mail	Web page
José Vicente Crespo		26 Telecom. Lab. Vídeo	jvcrespo@unex.es	
Subject Area	Signal Theory and Communications			
Department	Computers and Communication Technologies			
Coordinating Lecturer (If more than one)	José Vicente Crespo			

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.
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.
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

* The sections concerning competencies, course outline, educational activities, teaching methodologies, learning outcomes and assessment systems must conform to that included in the ANECA verified document of the degree program.

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
CTT01. Ability to apply methods of information theory, adaptive modulation and channel coding, and advanced techniques of digital signal processing for communication and audio-visual systems.
Cross-curricular competencies
CT01. Innovative and entrepreneurial spirit.
CT04. 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.
CT07. 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.
CT11. Autonomous learning capacity.
CT12 Ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts.
CT13. Ability to integrate knowledge and face the complexity of formulating opinions from incomplete or limited information.
Contents
Course outline*
Digital signal processing applied to digital communications systems. Coding and digital modulation in communication systems. Video encoding and video compression.
Course syllabus
Name of lesson 1: Random signal and stochastic processes characterization in communication system. (Large Group: 6 hours; weeks: 1st, 2nd). Contents of lesson 1: Stochastic processes analysis, Statistical moments, stationary stochastic processes, probability density functions of the stochastic processes, Power spectral density, Time-domain filtering, Frequency-domain filtering. Description of the practical activities of lesson 1: - Stochastic processes analysis (2 hours)

Name of lesson 2: Channel Equalization and adaptive techniques. (Large group: 15 hours; weeks: 3rd, 4th, 5th, 6th, 7th). Contents of lesson 2: Introduction to optimal adaptive filtering techniques. Optimal solution of Wiener. Gradient descent. LMS algorithm, RLS algorithm. Other adaptive techniques. Channels in digital communication systems. Channel equalization.

Description of the practical activities of lesson 2:
- Adaptive filtering I (2 hours).
- Adaptive filtering II (2 hours).

Name of lesson 3: Advanced digital modulation and synchronization in digital receivers. Video compression

(Large group: 21 hours; weeks: 8th, 10th, 11th, 12th, 13th, 14th, 15th).
Contents of lesson 3: OFDM modulation. CDMA modulation. Advanced Digital modulations. Synchronization in digital receivers. Frequency and phase synchronization, symbol synchronization. Coding for error protection. MIMO systems. OFDMA and SC-FDMA. LTE. Video compression algorithms.

Description of the practical activities of lesson 3:
- Digital modulations (3 hours).
- Digital modulations (3 hours).

Educational activities *

Student workload in hours by lesson		Lectures	Practical activities				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
1	15	6		2				7
2	42	15		4				23
3	61	21		6				34
Homework and problems	17					3		14
Assessment **	15	3						12
TOTAL	150	45		12		3		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 Methodologies*

1. **Lectures, oral presentation (LG)**. Educational classroom activity for the entire group. The teachers will present concepts, procedures and applications relating to syllabus themes. The concepts and procedures will be introduced mainly using oral presentations with the aid of video projector, slideshow, and occasionally the use of demo-software. The professors promote the discussions in order to improve the students' participation/interaction. The slides will be available prior to their explanation.

2. **Practical laboratory sessions (S/L).** Laboratory activities that take place in groups of 15 students. The activities consist of practice using computers and specific software for digital signal processing in digital communication systems.

3. **Problem solving and a case study approach (S/L).** Activities that take place in groups of 15 students. This activity will include: a) the resolution of several practical problems in classroom hours, and the proposal of new

** Indicate the total number of evaluation hours of this subject.

problems to be solved in non-classroom hours, or b) The initial approach or initial guide of a case study proposed by professors to be developed in non-classroom hours.

4. **Non-classroom activities (PS).** Activities to be carried out by the student outside the classroom to achieve intended competences. This block includes the following activities: a) Study and review of the concepts developed in the lecture classes b) The study of the laboratory activities prior to their realization in the laboratory, and the preparation of a final report on them c) Activities focused on solving problems, solving practical cases, and writing up reports d) The preparation of evaluation activities.

Learning outcomes *

The acquisition of knowledge specified in the detailed contents of the course (Themes and Contents sections) will also contribute to the acquisition and/or reinforcement of the following capabilities:

1. Ability to plan, calculate and design products, processes and facilities in all areas of telecommunications engineering.
2. Ability to lead, plan and supervise multidisciplinary teams
3. 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..
4. Capacity for the overall direction, technical direction and project management research, development and innovation, in companies and technology centers.
5. 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.6. 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
7. Possess skills for self-directed and autonomous lifelong learning.
8. Knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Telecommunication Engineer.

Assessment systems *

Continuous assessment and Final Global assessment: Course evaluation will be carried out by the following assessment method:

1. Practice of laboratory (20%). Assessment that takes into account the work of the student in carrying out the practice of computer simulations. To evaluate this activity the student will write up a report on the practice and this report should be prepared individually by each student or by the group of students, alternatively (mandatory for Global assessment) he can be evaluated with a multiple-choice test or a set of short questions on the laboratory sessions, the teachers will choose between either of these two criteria at the beginning of the course.
   The students should submit the report before the deadline specified by teachers. In any case, the reports (or multiple-choice test) can be submitted

on the official dates set by the Polytechnic School in May/June and June/July.

2. Practical case study and problems (10%). Assessment that takes into account the homework of the student while developing practical case study or problem solving in non-classroom time. To assess this activity the student will write up a report (original of each student) which should be submitted before the deadline specified by teachers. In any case, the reports can be submitted on the official dates set by the Polytechnic School in May/June and June/July.

3. Theoretical exam (70%). In order to assess the acquisition and comprehension of the theoretical concepts, at the end of the course and at the official dates, the students will do a two-hour exam. This test consists of a set of questions to develop and/or problems or multiple-choice test. This exam will take place on the official dates set by the Polytechnic School (May/June and June/July).
   It is necessary to attend at least 50% of the classes at the classroom, or scheduled remotely if applicable. If a student is not going to attend a minimum of 50% of the classes at the classroom, the student must request the "Final Global Assessment", which will involve both the theory part and the practical part.

Each of these activities shall be individually assessed (unweighted) on a scale of 0 to 10.

Requirements to pass the course. To pass the Course will be necessary to meet simultaneously the following three requirements:

a) Obtain a Final Grade for the Course greater or equal than 5.0
b) Obtain a Grade for the Theoretical exam greater or equal than 5.0
c) Obtain a Grade for the Practices of laboratory greater or equal than 4.0

The Overall Grade will be a weighted mean of the grade for: "the Practices of laboratory", "the Practical case study and problems" and the "the Theoretical exam", with weighting coefficients of 0.2, 0.1 and 0.7 respectively.

Overall Grade =
Grade for the Practices of laboratory * 0.2+ Grade for the Practical case * 0.1+ Grade for the Theoretical exam * 0.7

If the three requirements for passing the course are met, the Final Grade for the Course matches the overall grade. In case of Grade for the Theoretical exam is less than 5.0 or the Grade for the Practices of laboratory is less than 4.0, the Final Grade for the Course will be the lowest among the overall Grade and 4.5.

Final Global Assessment:

The choice of Final Global Assessment modality corresponds to the students. At the beginning of the course, a query will be enabled in the Virtual Campus. In case of absence of express request by the student, the assigned modality will be continuous assessment. The date of this exam will coincide with the dates of the official announcement (School of Technology-Escuela Politécnica). Course evaluation will be carried out by the following assessment method: A) Theoretical exam (70%), this exam is the same as the one specified in point 3. B) An oral/instrumental exam of the laboratory practices (30%)

Requirements to pass the course. To pass the Course will be necessary to meet simultaneously the following three requirements:

d) Obtain a Final Grade for the Course greater or equal than 5.0
e) Obtain a Grade for the Theoretical exam greater or equal than 5.0
f) Obtain a Grade for the Practices of laboratory greater or equal than 4.0

The Overall Grade will be a weighted mean of the grade for: "the Practices of laboratory" and the "the Theoretical exam", with weighting coefficients of 0.3, and 0.7 respectively.

Overall Grade =
Grade for the Practices of laboratory * 0.3+ Grade for the Theoretical exam * 0.7

If the three requirements for passing the course are met, the Final Grade for the Course matches the overall grade. In case of Grade for the Theoretical exam is less than 5.0 or the Grade for the Practices of laboratory is less than 4.0, the Final Grade for the Course will be the lowest among the overall Grade and 4.5.

Bibliography (basic and complementary)

[1] A.V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing" Prentice Hall, 1989

[2] González, Woods "Digital Image Processing" Second Edition, Prentice Hall, 2002

[3] S. Haykin, "Adaptive Filter Theory", Prentice Hall Information and System Sciences Series, 3rd. Edition, 1996

[4] Digital Modulation Techniques. Artech House Publishers, 2000

[5] J. G. Proakis, "Digital Communications", 4 Ed., Mc. Graw-Hill, EEUU, 2001.

[6] S. G. Wilson, "Digital Modulation and Coding", Prentice-Hall, EEUU, 1996.

Other resources and complementary educational materials

In the website of the course at the Virtual Campus **(http://campusvirtual.unex.es/**) can be found the necessary material to follow the course (class schedules, transparencies, manuals and practice guide, papers).