COURSE DATA

Data Subject	
Code	34891
Name	Communication theory
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1403 - Degree in Telematics Engineering	School of Engineering	3	First term

Subject-matter

Degree	Subject-matter	Character
1403 - Degree in Telematics Engineering	14 - Digital communications	Obligatory

Coordination

Name	Department
BOTELLA MASCARELL, CARMEN	240 - Computer Science

SUMMARY

The course “Teoría de la Comunicación” takes place in the third course, first term of the “Grado en Ingeniería Telemática”. This course is part of the common core “Comunicaciones Digitales” and it states the basics of the course “Transmisión de Datos”, which is taught in the third course, second term.

“Teoría de la Comunicación” reviews the main concepts and techniques about source coding, digital modulation, and channel coding. The performance of these techniques is analysed based on parameters such as the bitrate, bandwidth or signal to noise ratio, and compared to the theoretical limits obtained through information theory.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Matemáticas I
Matemáticas II
Matemáticas III
Señales y Sistemas Lineales
Fundamentos Matemáticos de las Comunicaciones

OUTCOMES

1403 - Degree in Telematics Engineering

- R4 - Ability to analyze and specify the fundamental parameters of communication systems.
- R5 - Ability to assess the advantages and drawbacks of different technological alternatives for the deployment and implementation of communications systems, from the point of view of signal space, perturbations and noise and analogue and digital modulation systems.
- R1 - Ability for self-learning of new knowledge and techniques appropriate for the conception, development and exploitation of telecommunications systems and services.
- G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.
- G5 - Knowledge to carry out measurements, calculations, assessments, evaluations, loss adjustments, studies, reports, task planning, and other analogous work in the specific field of telecommunications.
- G6 - Ability in the handling of specifications, regulations and norms of compulsory compliance.
- R8 - Ability to understand the mechanisms of propagation and transmission of electromagnetic and acoustic waves, and their corresponding transmitting and receiving devices.
- G1 - Ability to write, develop and sign projects in the field of Telecommunication Engineering aimed - according to the knowledge acquired in section 5 of CIN/352/2009 regulation - at the conception and the development or the exploitation of networks, services and applications of telecommunications and electronics.
- E1 - Ability to construct, exploit and manage telecommunication networks, services , processes and applications, understood as systems for the acquisition, transport, representation, processing, storage, management and presentation of multimedia information, from the perspective of telematics services.

- E5 - Ability to follow the technological progress of transmission, commutation and proccess to improve the telemactic networks and services.

LEARNING OUTCOMES

At the end of the course, students should be able to:

- Acquire, in an autonomous way, new concepts and techniques suitable for the design, development and exploitation of systems and telecommunication services.(G4, R1)

- Analyse coding and modulation techniques in order to transmit multimedia information, using digital signal processing techniques.(G1,G5,G6,R4,R5,R8, E1,E5)

The course also provides the following complementary social skills and techniques:

- Calculation of probabilities and moments.

- Clearly communicate the advantages related to digital communication systems.

- Identify everyday situations in communication systems and networks where coding and modulation techniques are actually used.

- Promote team work and the task splitting ability.

DESCRIPTION OF CONTENTS

1. Introduction to digital communication systems

Overview of a digital communication system. Digital communications vs. analog communications.

2. Source coding

Lossless source coding for discrete sources:

Variable length prefix-free codes, Kraft inequality, probability models for discrete sources, minimum average codeword length, entropy for discrete sources, Huffman coding algorithm, Shanon-Fano-Elias coding, arithmetic coding, Lempel-Ziv coding.

Coding for analog values:

scalar and vector quantization, design of optimum scalar and vector quantizers, the Lloyd-Max algorithm, compression based on transforms, related standards.

3. Channels, modulation and theoretical limits

Channel models. Introduction to information theory (mutual information, channel capacity). Complex baseband representation. Passband transmission. Nyquist pulses. Basic digital modulation (PAM, QAM, PSK). Optimum coherent detection (maximum likelihood). Performance of uncoded digital modulations with respect to capacity bounds.

4. Block codes

Coding gain. Basic definitions for linear coding block codes. Performance. Error detection and correction. Syndrome decoding. Minimum distance decoder. Bounded distance decoder. Hamming codes. Characterizing the error detecting and correcting capabilities. Erasure decoding. Modifications to linear codes.

5. Algebraic Cyclic codes

Algebraic description and properties of algebraic cyclic codes. Algebraic Structure. Systematic and nonsystematic encoding. Benefits of algebraic cyclic codes. Related standards.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of individual work	20,00	0
Study and independent work	15,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	15,00	0
Resolution of case studies	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

1)Work at the course:

a) Theory sessions, including short activities for the students. (G5,G6,R1,R4,R5,R8,E1,E5)

b) Problem solving sessions, to practice the concepts from the theory sessions. (G1,G4,G5,G6,R4,R5,R8,E1,E5)

c) Lab sessions, understanding by means of simulations the most important concepts from the theory sessions. (G1,G4,G5,G6,R4,R5,R8,E1,E5)

2)Student's own work:

a) Homework and exposition in class of the solution. (G1,G4,G5,G6,R1,R4,R5,R8,E1,E5)

b) Exam preparation. (G5,G6,R1,R4,R5,R8,E1,E5)

c) Lab sessions preparation, reading the lab description and the related theoretical concepts. (R1)

3) Consulting sessions: A certain number of hours are established each week, which the students can attend in order to solve doubts.

EVALUATION

The course evaluation follows a modified conventional approach, not reaching a full continuous-time evaluation. The following items are considered:

Attendance to the course lessons (5% of the final mark) (G4)

Positive disposition when attending the course lessons (5% of the final mark) (G4,R1)

Result from the 1st exam (15% of the final mark) (G5, G6,R4, R5,R8, E1, E5)

Lab sessions (15% of the final mark) (G1,G4,G5,G6,R1,R4,R5,R8,E1,E5)

Homework (15% of the final mark) (G1,G4,G5,G6,R1,R4,R5,R8,E1,E5)

Exam (45% of the final mark) (G5, G6,R4, R5,R8, E1, E5)

To evaluate the attendance, the student needs to attend at least 80% of the course lessons. An adequate document proving the need for the absence is required otherwise.

The attendance to the laboratory classes will be mandatory for their evaluation. Failure to attend more than one session without due justification will lead to a zero in that part of the evaluation. Students who, for justified reasons, cannot systematically attend laboratory sessions, must notify teachers before the beginning of the sessions and, if appropriate, an alternative evaluation will be agreed upon.

The lab sessions and homeworks are course activities that are regarded as ‘no recuperables’, meaning that they should be carried out during the course as part of the continuous evaluation.

In the second evaluation of the course, two options are possible:

- Final exam (60%)

- Partial exam (15%) + Final exam (45%)

The student must choose this option before taking the second exam. The grades corresponding to the lab sessions and homeworks are kept.

For the students who cannot attend the course lessons, an alternative evaluation is proposed, where the attendance is replaced by solving additional homework. This should be notified to the professor at the beginning of the course.

The minimum mark required to pass the course is 3.5 over 10 in both the final exam and the homework. The remaining items are not subjected to a minimum. If the required minimum is not reached, it will not be possible to make average with the rest of the evaluable items and the final grade of the course will be the one obtained in the items of continuous evaluation (attendance, participation, laboratories, homeworks and partial exam). If the grade obtained in this way exceeds 5, the final grade of the course will be the one obtained with the items of continuous evaluation laboratories, problem papers and partial exam.

According to the Universitat de València’s regulation, copying or performing any fraudulent action during the exams will turn out in a zero qualification and the beginning of the process according to the University regulation.

In any case, the system of evaluation will be ruled by the established in the Regulation of Evaluation and Qualification of the University of Valencia for Degrees and Masters. (http://www.uv.es/graus/normatives/2017_108_Reglament_avaluacio_qualificacio.pdf).

REFERENCES

Basic

- Comunicaciones digitales, A. Artés, F. Pérez, Pearson-Prentice Hall, 2007, ISBN: 978-84-8322-348-2
- Principles of digital communication, R.G. Gallager, Cambridge University Press, 2008, ISBN: 978-0521879071
- Error correction coding: mathematical methods and algorithms, Todd K. Moon, Wiley-Interscience, 2005, ISBN: 978-0471648000

Additional

- Introduction to data compression, K. Sayood, Morgan Kaufmann, 2006, ISBN: 978-0126208627 https://www.sciencedirect.com/book/9780126208627/introduction-to-data-compression
- Modem theory: an introduction to telecommunications, R.E. Blahut, Cambridge, 2010, ISBN: 978-0521780148
- Digital communications, J.G. Proakis, M. Salehi, McGraw-Hill, 5th edition, 2009, ISBN: 978-0071263788