COURSE DATA

DATA SUBJECT

Code: 34891
Name: Communication theory
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1403 - Degree in Telematics Engineering	Escola Tècnica Superior d'Enginyeria	3	First quarter
1935 - Double Degree Program in Mathematics-Telematics Engineering	Facultat de Ciències Matemàtiques	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1403 - Degree in Telematics Engineering	Digital communications	COMPULSORY
1935 - Double Degree Program in Mathematics-Telematics Engineering	Cuarto curso	COMPULSORY

COORDINATION

BOTELLA MASCARELL CARMEN

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

The following courses are recommended:

Mathematics I
Mathematics II
Mathematics III
Signals and Linear Systems
Mathematical Foundations of Communications

COMPETENCES / LEARNING OUTCOMES

1403 - Degree in Telematics Engineering

Ability for self-learning of new knowledge and techniques appropriate for the conception, development and exploitation of telecommunications systems and services.

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.

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.

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.

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.

R8 - Ability to understand the mechanisms of propagation and transmission of electromagnetic and acoustic waves, and their corresponding transmitting and receiving devices.

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

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Laboratory	20,00
Classroom practices	10,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	15,00
Preparation of lessons	25,00
Preparation for assessment activities	20,00
Resolution of case studies	10,00
Total hours	**90,00**

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 following items and assessments are taken into account:

Attendance and participation assessment (5% of the final grade) (G4, R1)

Midterm exam results (15% of the final grade) (G5, G6, R4, R5, R8, E1, E5)

Attendance, completion (5%) and final lab practice test (15% of the final grade) (G1, G4, G5, G6, R1, R4, R5, R8, E1, E5)

Completion of proposed exercises (15% of the final grade) (G1, G4, G5, G6, R1, R4, R5, R8, E1, E5)

Final exam (45% of the final grade) (G5, G6, R4, R5, R8, E1, E5)

It is considered that a student regularly attends class when he/she attends at least 80% of the hours of theory and problems or when he/she adequately justifies the impossibility of attending the rest of the hours necessary to reach the percentage.

The attendance to the laboratory classes will be mandatory for the evaluation of the same. Failure to attend more than one session without justification will result in a zero in the laboratory part of the evaluation. Students who, for justified reasons, cannot systematically attend the laboratory sessions, must inform the professors before the beginning of the sessions and, if necessary, an alternative evaluation will be agreed upon. The practices and the resolution of proposed exercises are not recoverable activities, since they are items related to the continuous evaluation.

In the second call, the student can choose between two options:

- Final exam (60%)

- Model of the first call

This choice must be communicated to the faculty before the exam of the second call. The percentages and grades corresponding to the non-recoverable activities of the practices and resolution of proposed exercises are maintained.

For students who cannot attend class regularly, an alternative model is offered in which the evaluation of attendance and participation will be substituted by additional work with an equivalent total percentage. This circumstance must be communicated to the faculty at the beginning of the course.

The minimum required to pass the course will be the equivalent of a 4 out of 10 in the final exam. The rest of the evaluable items are not subject to a minimum. If the minimum required 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, proposed exercises and partial test). If the grade obtained in this way exceeds 5, the final grade of the course will be the one obtained in the items of laboratories, proposed exercises and partial exam.

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the

ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020).

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

- Comunicaciones digitales, A. Artés, F. Pérez, Pearson-Prentice Hall, 2007, ISBN: 978-84-8322-348-2
- Introduction to data compression, K. Sayood, Morgan Kaufmann, 2006, ISBN: 978-0126208627 https://www.sciencedirect.com/book/9780126208627/introduction-to-data-compression
- 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
- 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