VNIVERSITAT DE VALÈNCIA

Course Guide
43853 Digital communication theory

COURSE DATA

Data Subject	
Code	43853
Name	Digital communication theory
Cycle	Master's degree
ECTS Credits	5.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2174 - Master's Degree in Telecommunications Engineering	School of Engineering	1	First term

Subject-matter

Degree	Subject-matter	Character
2174 - Master's Degree in Telecommunications Engineering	7 - Digital communication theory	Obligatory

Coordination

Name	Department
BOTELLA MASCARELL, CARMEN	240 - Computer Science
SEGURA GARCIA, JAUME	240 - Computer Science

SUMMARY

In Digital Communication Theory, we present the key ideas driving the design of digital contemporary communication systems. We also provide a number of fundamental mathematical tools convenient for the performance analysis of these digital systems, making a strong link with information theory. Special emphasis will be paid to DSL and cellular systems, which will show how the concepts presented in theory are translated into practical, state-of-the-art commercial systems

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

No particular requirements, other those that grant access to the Master.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

2174 - Master's Degree in Telecommunications Engineering

- To have critical thinking capabilities to investigate independently and self-critically, and to search and utilize information for documenting ideas.
- To have the ability of standing up for fair criteria with rigor and arguments, reporting them publicly in a clear way and in a multilingual environment.
- To have the ability to participate in diffusion forums, journals, conferences, etc. and to work cooperatively and effectively in transnational teams.
- To have the capability to identify and solve the critical points to conduct an effective technology transfer, transforming theoretical results into products and services that are useful for the society.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Be able to access to information tools in other areas of knowledge and use them properly.
- To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.
- Ability to apply information theory methods, adaptive modulation and channel coding techniques, as well as advanced signal processing techniques to audiovisual and communication systems.
- Ability to implement cable, transport and satellite systems in wired and mobile environments.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

By successfully taking this subject, students will learn to:

- Identify the key elements of modern digital communication systems and describe their interactions, both in general terms and in practice;
- Model communication channels in a mathematically convenient, yet accurate, form. Relate the model with the fundamental variables that characterize the performance of communication systems: power, bandwidth, and error probability;
- Use information theory in order to derive the fundamental limits for the rate at which information can be reliably transmitted.
- Know the main techniques in advanced modulation / demodulation, coding and equalization,

present in modern wired and wireless communication, understanding the tradeoffs between bit rate, power, and bandwidth, and the restrictions affecting these commitments.
- To design, model, analyze and implement different types of wired and wireless networks and advanced mobile communication and audiovisual systems.

Next to the technical dimension, this subject also helps developing a number of social and working skills:

- Teamwork: collaboration, planning, leadership, negotiation, respect;
- Personal organization;
- Communication skills in English, both written and oral;
- Initiation to research and development for academic and industrial purposes, respectively

DESCRIPTION OF CONTENTS

1. Introduction

Course overview: objectives and methodology
Review of background material (probability theory).Channel models for wired and wireless digital communication systems. Bandwidth and power.

2. Digital modulation

Digital modulation. Transmission and reception considerations. Probability of error. Coherence modulations in phase and amplitude. Differential modulation. Pulse shaping

3. Channel capacity

Channel capacity, minimum energy per bit
Parallel-channel capacity: waterfilling solutions

4. Equalization

Channel equalization for inter-symbol interference. Matched filter bound. Linear equalizers: ZF and MMSE. Nonlinear equalizers: DFE, MLSE

5. OFDM

Review of DFT. Cyclic prefix. Multicarrier transmission. PAPR. Synchronization

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	25,00	100
Tutorials	10,00	100
Laboratory practices	9,00	100
Classroom practices	6,00	100
Development of individual work	20,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	17,00	0
Preparation of practical classes and problem	19,00	0
Resolution of case studies	4,00	0
TOTAL	**125,00**	

TEACHING METHODOLOGY

MD1.-Actividades teóricas. The lectures will develop the subjects in a progressive manner, building on existing knowledge whilst introducing new material in a well-paced manner, emphasizing the most important elements, their relevance for academia and industry. Student participation, being fundamental for the transfer of knowledge during lecture hours, will be actively sought.Individual exams will be taken by the students under the supervision of the professor.

MD 2- Actividades prácticas. These assignments complement the lectures, allowing the students to apply the concepts and tools learnt in the lectures, as well as their own readings.

Two activities are scheduled:

- Problems sessions in class
- Lab sessions

Personal work. This autonomous task involves preparation of material before the lectures, for the assignments, as well as for the exam.

Aula Virtual. UV's e-learning platforms (Aula Virtual) will be used to communicate with students. They will also provide access to the material used in the lectures, such as slides, and to the homework assignments.

EVALUATION

The final grade will be computed as a weighted average of the following items:

SE1 – Final exam, consisting of several theoretical-practical questions, as well as problems.

SE2 – Evaluation of the practical activities through the handling of lab reports and homeworks.

SE3 – Evaluation of each student based on in-class participation, taking into account the attendance to the class sessions and scheduled activities during the course.

The final grade, from a maximum of 10, is obtained from the expression:

Grade= 0.65 * SE1 + 0.3 * SE2 + 0.05 * SE3

Criterion SE2 is graded assuming a 50% for the solution of homeworks and a 50% for the handling of the lab sessions' reports.

The minimum mark required to pass the course is 3.5 over 10 in the final exam. The remaining items are not subjected to a minimum.

In the second evaluation of the course, the percentages of the final grade are kept.

If a student is unable to attend the lectures, he/she should contact the lecturer to find an alternative grading method

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

- Wireless Communications, Andrea Goldsmith, Cambridge University Press, 2005
- Lecture slides

Additional

- Coding for Wireless Channles, Exio Biglieri, Springer, 2005.Texto referencia
- Fundamentals of Wireless Communications, David Tse, Pramod Viswanath, Cambridge University Press, 2005