COURSE DATA

Data Subject	
Code	34900
Name	Mobile and wireless communications
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	4	Second term

Subject-matter

Degree	Subject-matter	Character
1403 - Degree in Telematics Engineering	19 - Optional subjects	Optional

Coordination

Name	Department
BOTELLA MASCARELL, CARMEN	240 - Computer Science

SUMMARY

The course “Advanced Communications I” belongs to the fourth year, second semester of the Grado en Ingeniería Telemática. This elective course establishes the basic principles that control the functioning of wireless communication systems. The aim of the course is to acquire both theoretical and practical knowledge about the techniques and algorithms that are used to design and implement digital communication links in wireless and mobile communications, illustrating the concepts and designs through practical examples taken from current modern systems, such as GSM, UMTS, LTE, 5G-NR, IEEE 802.16 WiMAX and IEEE 802.11 WiFi.

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 specific restrictions have been specified with respect to other courses of the Study Plan

OUTCOMES

LEARNING OUTCOMES

This course allows for the following key learning outcomes:

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

- Ability to follow the technological progress of transmission, commutation and process to improve the telematic networks and services.

- 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.

In addition to the above results, this subject also to acquire the following social skills and techniques:

- Identify process models that guide the design of existing telecommunication systems.

- To communicate in an effective way new autonomously acquired knowledge, related to current telecommunication systems

DESCRIPTION OF CONTENTS

1. Introduction to wireless and mobile communication systems

Historical perspective and evolution of wireless and mobile communication systems, technical challenges, wireless spectrum, general overview of current wireless systems.

2. Channel modeling of wireless channels

Path-loss and large-scale fading (shadowing), small-scale multi-path fading, flat and frequency selective fading, statistical fading models. Key parameters: delay spread, coherence bandwidth, coherence time, Doppler spread. Discrete-time complex baseband equivalent channel representation of wireless channels. 5G-NR channel models.

3. Transmission and Reception Techniques in Wireless Networks

Channel capacity (with and without channel state information); diversity techniques, antenna diversity (transmit and receive diversity, Alamouti scheme). Impact of available channel state information. Systems with multiple inputs and multiple outputs (MIMO): channel parallelization, capacity calculations, beamforming and diversity-multiplexing trade-off. Space-time codes.

4. Multiple access and Interference management in cellular systems

Uplink channels vs. downlink channels. Spread spectrum techniques (DSSS, FHSS). Multicarrier communications (OFDM). Multiple access (TDMA, FDMA, CDMA, SDMA, hybrids). Random access techniques (ALOHA, slotted ALOHA, CSMA). Cellular concept and architecture, co-channel interference, frequency reuse, sectorization, channel assignments, mobility and hands-off.

Evolution of cellular systems. Standards (GSM, UMTS, LTE, WiMAX and mobile WiMAX). Future of cellular communications (5G-NR and beyond).

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	10,00	0
Study and independent work	20,00	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	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

1) In-class work in the course:

1. Theory sessions, including short activities for the students.
2. Problem solving sessions, to practice the concepts from the theory sessions.
3. Lab sessions, understanding by means of simulations the most important concepts from the theory sessions.
4. Oral topic presentation.

2) Student's own work:

1. Homework and exposition in class of the solution.
2. Exam preparation.
3. Lab sessions preparation, reading the lab description and the related theoretical concepts.

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)

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

Individual project (15% of the final mark)

Lab sessions (15% of the final mark)

Homework (15% of the final mark)

Exam (45% of the final mark)

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, homeworks and project 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, the grades corresponding to the lab sessions, project and homeworks are kept. Students must inform the teaching staff before taking the exam if they wish to increase the weight of the final exam to 55%, thus leaving out the 10% associated with attendance and participation.

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 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 project). 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 project.

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

- Wireless Communications by Andrea Goldsmith (Cambridge University press, 2005). https://www.vlebooks.com/Vleweb/Product/Index/365634?page=0
- Principles of Mobile Communications by G. L. Stuber. Third Ed. Kluwer Academic Publishers, 2012

Additional

- Fundamentals of Wireless Communication by D. Tse and P. Viswanath, Cambridge University Press, 2005
  https://ebookcentral.proquest.com/lib/univalencia/detail.action?pq-origsite=primo&docID=237613
- Wireless communications by Andreas Molisch, Wiley-IEEE Press, 2nd Ed. 2011