

**COURSE DATA****Data Subject**

<b>Code</b>	34900
<b>Name</b>	Mobile and Wireless Communications
<b>Cycle</b>	Grade
<b>ECTS Credits</b>	6.0
<b>Academic year</b>	2020 - 2021

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
1403 - Degree in Telematics Engineering	School of Engineering	4	Second term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
1403 - Degree in Telematics Engineering	19 - Optional subjects	Optional

**Coordination**

<b>Name</b>	<b>Department</b>
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.

**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
<b>TOTAL</b>	<b>150,00</b>	

**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 minimum required is not reached, the final grade of the course will be the one obtained in the final exam.

In the event of a closure of the facilities due to the health situation that affects all or part of the classes of the subject, these will be replaced by non-presential sessions following the established schedules. If the closure affects a course evaluation test, it will be replaced by a test of a similar nature that will be carried out in virtual mode through the University of Valencia's institutional support tools. The percentages of each assessment test will remain unchanged, as established by this guide.

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](http://www.uv.es/graus/normatives/2017_108_Reglament_avaluacio_qualificacio.pdf)).

## REFERENCES

### Basic

- Wireless Communications by Andrea Goldsmith (Cambridge University press, 2005).
- 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
- Wireless communications by Andreas Molisch, Wiley-IEEE Press, 2nd Ed. 2011

## **ADDENDUM COVID-19**

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

### **Contents**

The contents initially included in the teaching guide are maintained.

### **Workload and temporary teaching planning**

The different activities described in the teaching guide are maintained with the planned dedication.

The material for the follow-up of the theory / problem classes allows to continue with the teaching time planning both in the case of face-to-face teaching and non-face-to-face teaching.

### **Teaching methodology**

In classroom theory and practices, students will tend to have the maximum physical attendance possible, always respecting the sanitary restrictions that limit the capacity of the classrooms as indicated by the competent public health authorities to the estimated percentage of their usual occupation.

Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. If this situation arises, each group will attend classroom theory and practical sessions with physical presence in the classroom by rotating shifts, thus ensuring compliance with the criteria for occupying spaces.

The rotation system will be established once the actual enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same.

With respect to laboratory practices, attendance at sessions scheduled in the schedule will be totally face-to-face.

Once the actual enrollment data is available and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject, establishing in said model the specific conditions in which it will be developed teaching the subject.

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the subject, these will be replaced by non-contact sessions following the established schedules.



## **Evaluation**

The evaluation system described in the teaching guide of the subject in which the different evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.

If there is a closure of the facilities for health reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the Universitat de València.

The contribution of each evaluable activity to the final grade for the course will remain unchanged, as established in this guide.

## **Bibliography**

The bibliography recommended in the teaching guide.