

## Course guide

### 330119 - SC - Communication Systems

**Last modified:** 25/04/2024

<b>Unit in charge:</b>	Manresa School of Engineering	
<b>Teaching unit:</b>	750 - EMIT - Department of Mining, Industrial and ICT Engineering.	
<b>Degree:</b>	BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject). BACHELOR'S DEGREE IN ICT SYSTEMS ENGINEERING (Syllabus 2010). (Optional subject). BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Optional subject).	
<b>Academic year:</b> 2024	<b>ECTS Credits:</b> 6.0	<b>Languages:</b> Spanish. English

#### LECTURER

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**Coordinating lecturer:** ILKER DEMIRKOL

**Others:**

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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##### Specific:

- E.30. Knowledge of the architecture of communication networks and their application, as well as the ability to design, deploy and manage communication networks, especially computer networks.
- E.31. The ability to describe, program, use, evaluate and optimize communication protocols and interfaces for the different levels of a network architecture
- E.32. Knowledge of the main network services and their application, as well as the ability to design and implement new services.
- E.51. The ability to specify, analyze, design and evaluate communication circuits and systems as well as the knowledge of the principles and subsystems involved in communications systems using radio and optical waves.

##### Transversal:

- E.70. The knowledge and ability to use existing tools and instrumentation for the analysis, design, development and verification of electronic, computer and communications systems.
- E.71. The ability to perform the typical activities of the degree, taking into account the corresponding standards, rules and regulations.
- E.72. Ability to model and simulate systems in the field of the degree and apply the results to problem solving within this field.
- 3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
- 4. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
- 5. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
- 6. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
- 7. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

## TEACHING METHODOLOGY

The course consists of face-to-face activities consisting of 2 hours a week in the classroom (large group) and 2 hours a week in the laboratory (small group). The student performs learning through various mechanisms. In the participatory lecture classes the contents of the subject are presented, where teaching methods of cooperative learning and active learning are used. These methods will allow interaction among students and between the students and the teacher.

In the laboratory classes, the students carry out a previous work that helps to put in context the work that is intended to be carried out in the laboratory. The laboratory activity itself is carried out in groups of two students and allows student to experiment with certain aspects developed in the subject.

Through the course project, students will practice problem-based learning. The project will provide students with the opportunity to develop a solution to a realistic engineering problem, without placing too many restrictions on the chosen solution. The writing of the report and the presentation of the project at the end of the course allows working the oral and written communication skills.

## LEARNING OBJECTIVES OF THE SUBJECT

At the end of the Communication Systems course, with a focus on wireless networks, the student will be able to:

- Contrast different wireless network system solutions for a given application
- Design wireless network protocols for different OSI layers
- Classify wireless network architectures
- Elaborate on the past / future evolution of wireless networks
- Analyze a wireless communication channel
- Explain the different components of wireless communication systems.

It is advisable that the student has taken the Communication Networks course, since the basic knowledge of networks explained in that course is required.

## STUDY LOAD

Type	Hours	Percentage
Hours small group	24,0	16.00
Self study	90,0	60.00
Hours large group	36,0	24.00

**Total learning time:** 150 h

## CONTENTS

### 1. Wireless network fundamentals

#### Description:

Types of wireless networks:

WLAN, WPAN, WWAN, LP-WAN, Mobile Networks

The evolution of communication systems

Main processes of a communication system: modulation, channel coding, propagation of radio signals, etc.

#### Related activities:

All the relevant ones.

#### Full-or-part-time: 35h

Theory classes: 8h

Laboratory classes: 6h

Self study : 21h

## 2. Medium access control for wireless networks (ENG)

### Description:

Random access techniques: ALOHA, CSMA

Collision avoidance techniques: CSMA/CA, RTS/CTS

### Related activities:

All the relevant ones.

**Full-or-part-time:** 20h

Theory classes: 6h

Laboratory classes: 2h

Self study : 12h

## 3. Mobile Networks

### Description:

Evolution of mobile networks

Fundamental concepts: Cells, handover, frequency reuse, ...

The future: 5G, 6G

### Related activities:

All the relevant ones.

**Full-or-part-time:** 35h

Theory classes: 8h

Laboratory classes: 6h

Self study : 21h

## 4. Wireless Local Area Networks (WLAN)

### Description:

Standards: WiFi/IEEE 802.11

Alternative WLAN technologies

### Related activities:

All the relevant ones.

**Full-or-part-time:** 30h

Theory classes: 6h

Laboratory classes: 6h

Self study : 18h

## 5. Wireless personal area networks (WPAN)

### Description:

Bluetooth  
IEEE 802.15.4, ZigBee  
NFC/RFID

### Related activities:

All the relevant ones.

### Full-or-part-time: 15h

Theory classes: 4h  
Laboratory classes: 2h  
Self study : 9h

## 6. Low Power Wide Area Networks (LP-WAN)

### Description:

LoRA  
SigFox  
NB-IoT

### Related activities:

All the relevant ones.

### Full-or-part-time: 15h

Theory classes: 4h  
Laboratory classes: 2h  
Self study : 9h

## ACTIVITIES

### 1. Lectures

#### Description:

In the lectures, the theoretical aspects of the subject will be developed. We will use the methodologies of cooperative learning and active learning. These methods will allow interaction among the students, and between the student and the teacher.

#### Specific objectives:

At the end of these activities, the student will be able to:

- Design wireless network protocols for different OSI layers
- Elaborate on past / future evolution of wireless networks
- Analyze a wireless communication channel
- Explain the different components of wireless communication systems

#### Material:

Recommended bibliography  
Published teaching material

#### Delivery:

Regular quizzes will be conducted, which will contribute proportionally to the QUIZ variable.

### Full-or-part-time: 36h

Theory classes: 36h

## 2. Study of the contents

### Description:

The study of the contents is the individual and/or collective activity that leads to understand and attain the knowledge, vocabulary and techniques that are part of the contents of the subject.

### Specific objectives:

At the end of these activities, the student will be able to:

- Contrast different wireless network system solutions for a given application
- Classify wireless network architectures

### Material:

Recommended bibliography  
Published teaching material

**Full-or-part-time:** 60h

Self study: 60h

## 3. Laboratory classes

### Description:

Laboratory practices will be carried out in groups of two people. The laboratory will have a computer equipped with the necessary software to simulate communication systems. At the same time, it will have the necessary hardware to experiment with commercial digital devices. The teacher will monitor the evolution of the students.

### Specific objectives:

Upon completion of these activities, he / she may:

- Evaluate different wireless network system solutions for a given application
- Develop wireless network protocols for different OSI layers
- Analyze a wireless communication channel

### Material:

Information on the practice to be carried out.  
Laboratory equipment and/or PC's.  
Recommended bibliography.  
Published teaching material.

### Delivery:

Before carrying out the practice, the students will do an individual prior study for the practice to be done.

During the session the achievement of the objectives of each laboratory session will be assessed taking into account the degree of understanding of the work demonstrated for each student.

At the end of each practice, each group will give the practice teacher a report explaining the work done and the knowledge gained.

The evaluation in these activities defines the LAB variable in the overall grading.

**Full-or-part-time:** 24h

Laboratory classes: 24h

#### 4. Term project

**Description:**

The project consists of the implementation and testing of a communication network solution with the objective announced during the course. This activity is carried out in groups of two and also involves writing an exposition of the project in the last class of the course.

**Specific objectives:**

At the end of these activities, the student will be able to:

- Develop and evaluate wireless network system solutions for a given application
- Design wireless network protocols for different OSI layers
- Analyze a wireless communication channel
- Explain the different components of wireless communication systems

**Material:**

Project statement  
Report example

**Delivery:**

1. The project report.
2. The source code resulting from the project.
3. A presentation in the last class of the course the evaluation of these activities defines the PRJ variable in the overall grading.

**Full-or-part-time:** 20h

Self study: 20h

#### 5. Exams

**Description:**

At the end of the course, a final globalizing test of the acquired knowledge will be carried out.

**Specific objectives:**

At the end of these activities, the student will be able to:

- Contrast different wireless network system solutions for a given application
- Interpret about past / future evolution of wireless networks
- Classify wireless network architectures
- Explain the different components of wireless communication systems
- Assess wireless network protocols for different OSI layers
- Analyze a wireless communication channel

**Material:**

Exam  
The compilation of the entire course

**Delivery:**

The final exam score defines the variable FIN

**Full-or-part-time:** 10h

Self study: 10h

## GRADING SYSTEM

The final grade for the course will be obtained as follows:

Final grade =  $0.30 * \text{QUIZ} + 0.20 * \text{PRJ} + 0.25 * \text{LAB} + 0.25 * \text{FIN}$

## EXAMINATION RULES.

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All activities are compulsory.

If any of the activities of the subject are not carried out, it will be graded with zero.

The completion of laboratory activities is a necessary condition to pass the subject.

The dates, formats and other delivery conditions that are established will be mandatory.

## BIBLIOGRAPHY

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### Basic:

- Beard, Cory; Stallings, William. Wireless communication networks and systems [on line]. Global ed. Boston: Pearson Education Ltd, 2016 [ Consultation: 31/05/2022 ]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5186231>. ISBN 9781292108711.

- Agrawal, Dharma P; Zeng, Qing-An. Introduction to wireless and mobile systems. Fourth edition. International edition. Australia: Cengage Learning, 2016. ISBN 9781305259621.

### Complementary:

- Goldsmith, Andrea. Wireless communications [on line]. Cambridge ; New York: Cambridge University Press, 2005 [ Consultation: 07/06/2024 ]. Available on : <https://www-cambridge-org.recursos.biblioteca.upc.edu/core/books/wireless-communications/800BA8A8211FBECB133A7BB77CD2E2BD>. ISBN 9780521837163.

- Rappaport, Theodore S. Wireless communications : principles and practice. Second edition. Noida: Pearson India Education Services, 2010. ISBN 9788131731864.