



Course guide

300043 - MXS - Mobility, Networks and Services

Last modified: 22/01/2024

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 744 - ENTEL - Department of Network Engineering.

Degree: BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Compulsory subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

PRIOR SKILLS

- Knowledge about the principles of the transmission of radio frequency signals.
- Knowledge about the main mechanisms for controlling access to the medium.
- Knowledge about the fundamental characteristics of packet and circuit switching networks.
- Knowledge about the TCP / IP protocol stack from the network level to the application level (both included).
- Knowledge about the main parameters for evaluating the performance of a network.
- Use of Windows, Linux / Unix operating systems and familiarity with protocol analyzers.

REQUIREMENTS

Prerequisite:

- ONDAS ELECTROMAGNÉTICAS EN LOS SISTEMAS DE COMUNICACIÓN

Corequisite:

- ARQUITECTURA Y PROTOCOLOS DE INTERNET, EMISORES Y RECEPTORES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. CE 24 TEL. Capacidad de describir, programar, validar y optimizar protocolos e interfaces de comunicación en los diferentes niveles de una arquitectura de redes. (CIN/352/2009, BOE 20.2.2009.)

Generical:

5. EFFICIENT USE OF EQUIPMENT AND INSTRUMENTS - Level 2: Use the correct instruments, equipment and laboratory software for specific or specialized knowledge of their benefits. A critical analysis of the experiments and results. Correctly interpret manuals and catalogs. Working independently, individually or in groups, in the laboratory.

Transversal:

2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

4. 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.

6. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

TEACHING METHODOLOGY

The main in-class activities follow the lecture class methodology (although the participation of students will be encouraged), which provides the fundamental concepts of the subject. The teacher will use slide presentations and / or the blackboard as a means of support for these classes. The slide shows will be available on the ATENEA digital campus prior to the corresponding classes.

Part of the contents of the subject will be carried out through directed activities in a seminar format, in which students will work in groups on topics proposed by the teacher (which will extend and/or complement the knowledge provided in the lectures).

As for the laboratory classes, students will have a script for each activity on the ATENEA digital campus, which they must prepare prior to the corresponding activity. The practical sessions will be carried out in the presence of the teacher. The multihop network project will also have a support script that will make it easier for students to use the tools to use to evaluate their design.

LEARNING OBJECTIVES OF THE SUBJECT

By the end of the semester, the student must be able to:

- Explain the concept of mobility in a network, the different types of mobility that may exist, the problems and solutions that derive from its support, the impact of mobility on user communications, and new services that derive from it.
- Design basic aspects of a cellular network.
- Identify and compare the types of mobility, impact on user communications, and mobility support mechanisms in WWAN, WMAN, WLAN, wireless multihop networks, and heterogeneous networks.
- Identify basic performance parameters in the aforementioned networks and evaluate them based on these parameters.
- Identify and choose the most suitable improvement techniques to optimize the performance of user communications in the presence of mobility.
- Use a specific simulation environment used in the study of mobility in networks.

STUDY LOAD

Type	Hours	Percentage
Guided activities	20,5	13.67
Hours large group	26,0	17.33
Hours small group	19,5	13.00
Self study	84,0	56.00

Total learning time: 150 h

CONTENTS

INTRODUCTION

Description:

Concept and types of mobility.
Mobility support.
Impact of mobility and new services.

Related activities:

Theory, laboratory and directed activities (seminars).

Full-or-part-time: 23h 48m

Theory classes: 4h
Laboratory classes: 3h 30m
Guided activities: 3h
Self study : 13h 18m



CELLULAR NETWORKS

Description:

Basic concepts of a cellular network:

- Cell, frequency reuse, cluster.
- Reuse distance.

Common techniques and operations in cellular networks:

- Attach / dettach, location management (includes paging and location updates), and handover.
- Channel monitoring, silence suppression, power control and others.

Related activities:

Lectures and lab session

Full-or-part-time: 23h 48m

Theory classes: 4h

Laboratory classes: 3h 30m

Guided activities: 3h

Self study : 13h 18m

WIRELESS LOCAL AREA NETWORKS (WLAN)

Description:

Basic mechanisms of the IEEE 802.11 standard

- MAC layer (CSMA/CA i QoS)
- Physical layers: differences between first and modern IEEE 802.11 standards
- Effects of mobility, noise and interference

Advanced mechanisms in IEEE 802.11 networks

- Management of radio resources
- Mobility management
- Energy saving

Related activities:

Lectures, laboratory and directed activities (guided tour).

Full-or-part-time: 18h 41m

Theory classes: 2h

Laboratory classes: 3h 30m

Guided activities: 2h 40m

Self study : 10h 31m

WIRELESS WIDE AREA NETWORKS (WWAN)

Description:

2G networks (GSM / GPRS)

3G networks (UMTS / HSPA)

4G networks (LTE / LTE-A)

Evolution

Related activities:

Lectures, laboratory and directed activities (guided tour).

Full-or-part-time: 38h 22m

Theory classes: 10h

Guided activities: 6h 50m

Self study : 21h 32m



MULTIHOP WIRELESS NETWORKS

Description:

Mobile Ad-hoc Networks (MANETs) and Wireless Mesh Networks (WMNs):

- Features
- Applications
- Routing: reactive and proactive protocols

Wireless Sensor Networks (WSNs):

- Features
- Applications
- Radio interfaces
- Routing
- Solutions based on IP, Internet of Things (IoT)

Related activities:

Lectures, laboratory and directed activities (guided tour).

Full-or-part-time: 40h 48m

Theory classes: 4h

Laboratory classes: 9h

Guided activities: 5h

Self study : 22h 48m

IMPACT OF MOBILITY: IMPROVEMENT TECHNIQUES

Description:

Techniques at the physical level

Link-level techniques

Techniques at the network level and higher levels:

- End-to-end improvements
- Performance improvement proxies

Related activities:

Lectures

Full-or-part-time: 4h 32m

Theory classes: 2h

Self study : 2h 32m

ACTIVITIES

(ENG) TÍTOL ACTIVITAT 1: VISITES GUIADES I/O XERRADES DE PROFESSIONALS DEL SECTOR

Full-or-part-time: 9h

Guided activities: 9h

(ENG) TÍTOL ACTIVITAT 2: LABORATORI D'INTRODUCCIÓ A LES XARXES MÒBILS

Full-or-part-time: 3h

Laboratory classes: 3h



(ENG) TÍTOL ACTIVITAT 3: LABORATORI DE XARXES CEL·LULARS

Full-or-part-time: 3h

Laboratory classes: 3h

(ENG) TÍTOL ACTIVITAT 4: LABORATORI DE WLAN

Full-or-part-time: 3h

Laboratory classes: 3h

(ENG) TÍTOL ACTIVITAT 5: EXAMEN DE LABORATORI

Full-or-part-time: 1h 30m

Laboratory classes: 1h 30m

(ENG) TÍTOL ACTIVITAT 6: PROJECTE DE XARXA MULTISALT SENSE FILS

Full-or-part-time: 9h

Laboratory classes: 9h

(ENG) TÍTOL ACTIVITAT 7: SEMINARIS

Full-or-part-time: 12h

Guided activities: 12h

GRADING SYSTEM

The evaluation of the course is as follows:

- Two exams
 - A laboratory test
 - Project on wireless multihop networks
 - Seminars
 - Subjective score
- o By default, it will be equal to the average of the rest of the grades.

EXAMINATION RULES.

All the proposed activities are mandatory. Consequently, any activity that has not been carried out by the student will be scored with a zero.

Exams and tests will be carried out individually. Other activities such as seminars and wireless multihop project will include individual assessment and group assessment components.

In order for the student to be evaluated of the laboratory part (including the wireless multihop network project):

- Attendance during laboratory hours is mandatory
- Failure to attend must be justified.



BIBLIOGRAPHY

Basic:

- Gast, Matthew S. 802.11 wireless networks : the definitive guide [on line]. 2nd ed. Beijing [etc.]: O'Reilly, 2005 [Consultation: 26/07/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=540752>. ISBN 0596100523.
- Molisch, Andreas F. Wireless communications. West Sussex, England: John Wiley & Sons, 2005. ISBN 047084888X.
- Schiller, Jochen H. Mobile communications. 2nd ed. London: Addison-Wesley, 2003. ISBN 0321123816.

Complementary:

- Gómez, C.; Paradells Aspas, Josep; Caballero Herrero, José Eugenio. Sensors everywhere : wireless network technologies and solutions. [S.l.]: Fundación Vodafone España, 2010. ISBN 9788493474058.
- Perahia, Eldad; Stacey, Robert. Next generation wireless LANs : throughput, robustness, and reliability in 802.11n. New York: Cambridge University Press, 2008. ISBN 9780521885843.
- Holma, Harri; Toskala, Antti. WCDMA for UMTS - HSPA evolution and LTE. 4th ed. Chichester: John Wiley & Sons, 2007. ISBN 9780470319338.