Course guide
230689 - WLAB - Wireless Laboratory

Last modified: 11/04/2025

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: ANNA UMBERT JULIANA

Others: Primer quadrimestre:
RAMON ANTONIO FERRUS FERRE - 11
ANNA UMBERT JULIANA - 11

PRIOR SKILLS

Basic knowledge of wireless communications

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE1. Ability to apply information theory methods, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing to communication and audiovisual systems.
CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.
CE2. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.

Transversal:
CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

- Preparatory work to get familiar with the topics to be covered. This work is done before attending laboratory sessions. Individual work. This work is not evaluated.
- Laboratory work to get familiar with equipment and tools. This work is supported by means of tutorials and manuals. Team work. This work is not evaluated.
- Laboratory work to solve a number of case studies in different areas. Team work. A report is delivered for each analysed case study. This work is evaluated.
- Final Exam. General exam done at the end of the semester. It covers points addressed during the case studies. Individual work.

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:
The aim of this course is to train students in wireless technologies by using planning and optimization tools, drive-test tools, radio-testers, or wireless communications simulation platforms. At the end of the course, the student must be able to measure the most relevant parameters of radio access networks and evaluate the system performances of mobile communications systems, with especial emphasis in LTE and 5G technologies.

Learning results of the subject:
- Acquire a practical knowledge of mobile communications concepts and technologies.
- Develop the ability to identify, analyze and solve engineering problems in the context of mobile communications systems.
- Develop the ability to conceive, plan and carry out numerical simulations and testing activities in controlled and / or real environments, including the critical assessment of results.
- Acquire hand-on experience on the use of professional tools for planning, design and performance analysis of mobile communication systems.

STUDY LOAD

Type	Hours	Percentage
Self study	86,0	68.80
Hours small group	39,0	31.20

Total learning time: 125 h

CONTENTS

Course Introduction

Description:
- Presentation of the different areas
- Laboratory organisation (equipment, tools, location,?)
- Groups and schedule

Full-or-part-time: 5h
Theory classes: 3h
Self study : 2h

Area#1. Mobile Network Planning and Optimization

Description:
Design and evaluate the performance of a 4G/5G radio access network deployment in a given area.
Aspects covered:
- Use of geographical information (Digital Terrain Models, Cluster Classes, Buildings maps, etc.)
- Service and traffic modelling (service performance requirements, subscriber densities, etc.)
- Selection of technology capabilities (channel bandwidth, frequency band, CA, MIMO, beamforming, etc.)
- Infrastructure configuration (site/transmitter deployment, macro/small cells, antenna types)
- Performance assessment (propagation model, link budgets, coverage analysis, capacity analysis, etc.)
- Network Optimization (e.g. transmitter parameters such as antenna tilt, azimuth, heights)

Case studies:
- Network deployment in a rural / suburban area in Catalonia
- Network deployment in an urban area in Barcelona

Full-or-part-time: 40h
Laboratory classes: 12h
Self study : 28h

Area#2. Mobile Network Testing

Description:
Carry out measurements and tests for the analysis and characterization of procedures and performance of a commercial network in the Campus Nord area.
Aspects covered:
- Monitoring capabilities of the MNT tools. Extracted information (identifiers, channels, signal level, quality, cell neighbours, signalling, etc.)
- Tests/Measurement campaign configuration (e.g. call tests, data transfer tests, idle mode tests, etc.)
- Analysis of measurement files with post-processing tools (data visualization, statistics extraction, etc.)

Case studies:
- Analysis of signalling procedures in a live commercial network (network attach, session establishment, handover, voice call, etc.)
- Characterization of the cell sites and key operational settings of a commercial network (detected cell identities, used frequencies, cells, supported features, etc.)
- Performance assessment of services in a commercial network (e.g. transfer data rates in uplink and downlink at different locations within the campus and forcing different radio access technologies).

Full-or-part-time: 40h
Laboratory classes: 12h
Self study : 28h

Area#3. Radio Interface Performance Simulation

Description:
Simulation and performance assessment of 4G/LTE and 5G/NR waveforms.
Aspects covered:
- Generation and analysis of the radio waveforms
- Time-frequency grid structures
- Physical channels and reference signals
- Link layer simulations and throughput assessments
- Multi-antenna transmission modes (Transmit Diversity, Spatial Multiplexing)
- Link Adaptation, Scheduling operation

Case studies:
- 4G/LTE Interface Simulation
- 5G/NR Interface Simulation

Full-or-part-time: 40h
Laboratory classes: 12h
Self study : 28h

GRADING SYSTEM

Final Exam: 15%
Laboratory work assessments (case study reports): 75%
Participation assessment (attendance, attitude...): 10%

BIBLIOGRAPHY

Basic:
- Holma, Harri; Toskala, Antti. LTE for UMTS : evolution to LTE-Advanced. 2nd ed. Chichester, UK: John Wiley, 2011. ISBN 9780470660003.
- Chris Johnson. Long Term Evolution in Bullets. 2nd edition. Createspace, 2012. ISBN 9781478166177.

Complementary:
- Agustí Comes, Ramon. LTE : nuevas tendencias en comunicaciones móviles. [S.l.]: Fundación Vodafone, 2010. ISBN 8493474045.
- Sallent Roig, Oriol; Pérez Romero, Jordi. Fundamentos de diseño y gestión de sistemas de comunicaciones móviles celulares [on line]. Barcelona: Universitat Politècnica de Catalunya. Iniciativa Digital Politècnica, 2014 [Consultation: 15/09/2015]. Available on: http://hdl.handle.net/2099.3/36630. ISBN 9788498804812.