**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.
- CE2. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.
- CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

**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.
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 technology.

Learning results of the subject:
- Learn to use equipment for measuring physical layer parameters of radio communications systems including instrumentation equipment for functional analysis of terminals, and communication networks.
- Acquire a practical working knowledge of key technologies and mobile communications systems, mainly LTE (4G) technology
- Develop the ability to identify, analyze and solve engineering problems in the context of mobile communications systems.
- Develop the ability to perform simulations or experiments and evaluate the results by comparing theoretical and experimental results and evaluate performance of radio communications systems in controlled and / or real environments.
- Learning to use commercial tools for planning, design and performance analysis of mobile communication systems.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours small group:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>39h</td>
<td>86h</td>
</tr>
<tr>
<td></td>
<td>31.20%</td>
<td>68.80%</td>
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</tbody>
</table>
## Course Introduction

**Learning time:** 5h  
- Theory classes: 3h  
- Self study: 2h

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

## Area#1. Planning and optimisation of LTE networks

**Learning time:** 40h  
- Laboratory classes: 12h  
- Self study: 28h

**Description:**  
Create a nominal plan for an LTE access network in a given real environment  
- Geographical information and its management  
- Socio-economic issues (types of users, #inhabitants,...)  
- Existing technical requirements (ITU, 3GPP, IEEE recommendations)  
- Technical issues (power budget calculations, propagation model,...)  
- Develop LTE network with ATOLL (create network, analyse coverage, analyse capacity, ...)  
- Optimisation

## Area#2. Drive test

**Learning time:** 40h  
- Laboratory classes: 12h  
- Self study: 28h

**Description:**  
Monitoring real LTE mobile networks with Qualipoc and analysis tools  
- Introduction to monitoring tools  
- Configuration parameters of 4G (LTE) systems  
- Network Signalling / basic procedures  
- Drive tests  
- Post processing work
Area#3. Experimental implementation and testing of LTE radio interface

<table>
<thead>
<tr>
<th>Description:</th>
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</thead>
<tbody>
<tr>
<td>- LTE Downlink Structure</td>
</tr>
<tr>
<td>- Synchronization and Signal Acquisition</td>
</tr>
<tr>
<td>- MIMO</td>
</tr>
<tr>
<td>- Link Adaptation</td>
</tr>
<tr>
<td>- Downlink/Uplink Resource Allocation</td>
</tr>
</tbody>
</table>

Learning time: 40h
Laboratory classes: 12h
Self study: 28h

Qualification system

Final examination (Short answer test): 15%
Exercises (Previous works): 15%
Laboratory assessments (Finals reports): 60%
Individual assessment (attendance, attitude,...): 10%

Bibliography

Basic:

Complementary: