Degree competences to which the subject contributes

Generical:

10 ECI N2. They will have acquired knowledge related to experiments and laboratory instruments and will be competent in a laboratory environment in the ICC field. They will know how to use the instruments and tools of telecommunications and electronic engineering and how to interpret manuals and specifications. They will be able to evaluate the errors and limitations associated with simulation measures and results.
230253 - LCM - Mobile Communications Laboratory

Teaching methodology

The course is developed through practical activities in person at the laboratory, complemented by the activities of preparation of previous works and the preparation of the corresponding final report for each practice. For each content block, the teacher will give some lectures and provide basic information and references necessary to allow the student to acquire the level of knowledge necessary for the proper development sessions. For each content block, the student must complete a previous study following a model that will be provided for each practice. Practice sessions are held in groups of 2 or 3 people. In practical sessions, activities aimed at developing the ability to perform simulations or experiments and evaluate the results, compare theoretical results with practical assess performance in real environments and work together in a group, will be performed. At the end of each practice, students must complete and submit a report of the work carried out in the laboratory.

- Lectures
- Laboratory classes
- Individual work (distance)
- Exercises
- Short answer test (Final Exam)
- Other activities.

Learning objectives of the subject

- Learning the use of equipment to measure parameters of the physical layer of radio communications systems and instrumentation for the analysis of the operation of terminals and mobile communication networks.
- To acquire a working knowledge of the operation of the main technologies and mobile communication systems (2G/3G/4G cellular networks).
- Developing the ability to identify, analyse and solve engineering problems in the context of mobile communication systems.
- Developing the ability to perform simulations or experiments and evaluate the results, compare theoretical results with practical and evaluate in real environments and work together in a group.
- Learning to use commercial tools used in the planning, design and performance analysis of mobile communication systems.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 13h</th>
<th>8.67%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours small group:</td>
<td>39h</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>98h</td>
</tr>
</tbody>
</table>
## Content

### 1. Theoretical Foundations of mobile communication systems

<table>
<thead>
<tr>
<th>Description:</th>
<th>Introduction to mobile communication systems 2G, 3G and 4G, a description of the physical parameters and of the measurements procedures.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related activities:</td>
<td>Theory classes.</td>
</tr>
<tr>
<td>Specific objectives:</td>
<td>Understand the main characteristics of mobile communication systems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>31h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>13h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>0h</td>
</tr>
<tr>
<td>Self study :</td>
<td>18h</td>
</tr>
</tbody>
</table>

### 2. Practical planning and dimensioning of mobile networks

<table>
<thead>
<tr>
<th>Description:</th>
<th>Introduction to planning and dimensioning of 2G / 3G and 4G mobile systems, basics of cellular systems and steps for planning.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific objectives:</td>
<td>Learn the steps to plan and dimensioning mobile communications systems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>45h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>0h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>15h</td>
</tr>
<tr>
<td>Self study :</td>
<td>30h</td>
</tr>
</tbody>
</table>
The final mark will be obtained from continuous assessment mark (works proposed by the teacher throughout the course and lab) and the final exam, according to the following criteria:

Final examination, attendance and attitude in class: 25%
Exercises (Previous works): 15%
Laboratory assessments (Finals reports): 60%

3. Practices monitoring operational networks with "drive testing" tools

**Learning time:** 44h
- Theory classes: 0h
- Laboratory classes: 14h
- Self study: 30h

**Description:**
Introduction to real mobile networks monitoring, settings of 2G (GSM), 2.5G (GPRS), 3G (UMTS), 3.5G (HSPA), 4G (LTE), network signaling and basic procedures.

**Related activities:**
Monitoring and signaling GSM / GPRS networks with TEMS Investigation, an analysis tool of the radio interface. Monitoring and signaling UMTS / HSDPA and LTE networks with QualiPoc Drive Test tool from SwissQual and Romes tool from Rohde Schwarz.

**Specific objectives:**
Learn how to monitor real mobile networks.

4. Practical with RF testing equipment and mobile phones protocols

**Learning time:** 30h
- Theory classes: 0h
- Laboratory classes: 10h
- Self study: 20h

**Description:**
Study of physical parameters and measurements procedures of 2G (GSM), 3G (HSPA and UMTS) and 4G (LTE) systems.

**Related activities:**
Performance measures of commercial GSM mobile phones with the equipment HP8922. Measures of the performance of mobile phones with commercial UMTS Radio Analyzer Rhode & Schwarz CMU200. Performance measures of commercial LTE mobile phones with Qualipoc.

**Specific objectives:**
Understand and learn how to measure the physical parameters of the GSM, UMTS and HSPA, and LTE systems, as well as signaling involved.

Qualification system
Regulations for carrying out activities

The presentation of the previous works is a prerequisite to carry out training sessions. During the sessions, they must fill out questionnaires to the evaluation of progress in the work. The final report will be submitted once the practice session was finished.

Bibliography

**Basic:**


**Complementary:**


**Others resources:**

User manuals of the equipment and software used in the laboratory.