Learning objectives:
The aim of this course is to introduce new subjects and technologies related to wireless communication systems, focusing on those used as access networks. The main objective is to introduce concepts and technologies and to offer the analytical tools to understand its performance and to be able to dimension its capacity.

Learning results:
- Ability to design radio systems for providing voice and data services, at any time and place.
- Ability to understand the behaviour and dimension certain wireless systems used commonly.
## Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 26h</th>
<th>20.80%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
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</tr>
<tr>
<td></td>
<td>Hours small group: 13h</td>
<td>10.40%</td>
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<td></td>
<td>Guided activities: 0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study: 86h</td>
<td>68.80%</td>
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</tbody>
</table>
# 230618 - WAN - Wireless Access Networks

## Content

<table>
<thead>
<tr>
<th></th>
<th>Learning time: 11h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Laboratory classes: 1h</td>
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<tr>
<td></td>
<td>Self study : 8h</td>
</tr>
</tbody>
</table>

### 1. Introduction to Wireless Access Networks

**Description:**
- Parts of a network.
- Wireless Access Networks.
- Radioelectric spectrum.
- Spectrum division techniques: TDMA, FDMA, CDMA, OFDMA.
- Duplexing techniques: TDD and FDD.

### 2. Resources Allocation Strategies.

**Description:**
- Frequency reuse.
- Code reuse.
- Optimized systems.
- Examples of use.

### 3. LPWAN Networks.

**Description:**
- Sigfox.
- Lora.

### 4. Point to Multipoint Systems.

**Description:**
- WiMAX.
# 230618 - WAN - Wireless Access Networks

## 5. Trunking Systems.

**Learning time:** 22h  
Theory classes: 4h  
Laboratory classes: 2h  
Self study: 16h

**Description:**  
- Analog technologies.  
- Digital technologies. TETRA.  
- Dimensioning.

## 6. Delay Tolerant Networks (DTN).

**Learning time:** 11h  
Theory classes: 2h  
Laboratory classes: 1h  
Self study: 8h

**Description:**  
- Architecture.  
- Routing.  
- Applications.


**Learning time:** 11h  
Theory classes: 2h  
Laboratory classes: 1h  
Self study: 8h

**Description:**  
- GEO (Geostationary Orbit).  
- MEO (Medium Earth Orbit).  
- LEO (Low Earth Orbit).


**Learning time:** 37h  
Theory classes: 10h  
Laboratory classes: 5h  
Self study: 22h

**Description:**  
- Topologies and advantages.  
- Ad-hoc networks and mesh networks.  
- Routing protocols.  
- Application examples.
# Planning of activities

## LABORATORY

**Description:**
- LoRa Networks analysis.
- Implementation and analysis of ad-hoc and mesh networks with linux embedded devices.

**Hours:** 7h  
Laboratory classes: 7h

## EXERCISES

**Description:**
- Design, dimensioning and evaluation exercises focused on the technologies studied during the course.

**Hours:** 6h  
Laboratory classes: 6h

## SHORT ANSWER TEST (CONTROL)

**Description:**
- 1st Mid term control.
- 2nd Mid term control.
- Final exam.

**Hours:** 7h  
Theory classes: 7h

## Qualification system

Final exam: 60%  
Midterm controls: 25%  
Individual assessments: 15%

## Bibliography

### Basic: