### Degree competences to which the subject contributes

**Specific:**
1. Ability to design radio-navigation and location systems, as well as radar systems.

2. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.

3. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.

**Transversal:**
4. 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.

5. 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.

6. 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

Lectures

Group work (distance)

Oral presentations of the group work results.

### Learning objectives of the subject

Learning objectives of the subject

The learning objectives of the course are the fundamentals of systems used for detection, guidance and positioning using
radio waves. These principles will be studied in a number of representative systems such as primary and secondary radars, satellite positioning systems (GPS, Galileo), and navigation and guidance aids used in civil aviation (VOR, DME, ILS).

Learning results of the subject:

- Ability to grasp an overall system perspective of modern radar, navigation and positioning systems, with the ability to predict their performance from the fundamental system parameters.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 39h</th>
<th>31.20%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 86h</td>
<td>68.80%</td>
</tr>
</tbody>
</table>
# Content

## 1. Basic principles

**Learning time:** 22h
- Theory classes: 9h
- Self study: 13h

**Description:**
- Types of navigation.
- Mathematical models for representing the Earth.
- Propagation effects.

## 2. Terrestrial systems

**Learning time:** 22h
- Theory classes: 9h
- Self study: 13h

**Description:**
- Hyperbolic systems Loran C, Decca, Omega.
- Air traffic support systems: Primary and Secondary radar, ILS, MLS, VOR, DME, TACAN.

## 3. Satellite systems

**Learning time:** 81h
- Theory classes: 19h
- Practical classes: 2h
- Self study: 60h

**Description:**
- Orbits and geometry.
- Principles of satellite navigation. Observables. Integration with inertial sensors.
- GPS and Galileo.
Planning of activities

**PRACTICE**

**Description:**
Use of a handheld GPS in campus. Observation of number of available satellites and Expected Position Error in various reception scenarios.

**ORAL PRESENTATION**

**Description:**
Presentation of a work group.

**SHORT ANSWER TEST (TEST)**

**Description:**
Partial evaluation test with theoretical questions and short exercises.

Qualification system

The final mark is the highest between:

* The mark from the final examination.
* The mark obtained by averaging: 60 % Final examination + 40 % Work assignment.

For the work assignment, 70 % is the written report and 30 % the oral presentation.

Regulations for carrying out activities

Short answer test (Test)

Bibliography

**Basic:**


**Complementary:**
