Degree competences to which the subject contributes

**Generical:**
2. 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.

**Transversal:**
1. **EFFICIENT ORAL AND WRITTEN COMMUNICATION** - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

Teaching methodology

- Application classes
- Lectures
- Laboratory classes
- Group work (learning)

Learning objectives of the subject

Students will learn the basic techniques of analysis and design of microwave circuits and must know the various technologies used in this frequency range.

Learning outcomes:

1. Analyze the components and specifications for guided and unguided communications systems.
2. Knows and can select circuits and systems, RF subsystems, microwave, broadcast, link radio and radiodetermination.
3. Study with books and papers in English and can write a report or technical work in English, and participate in a technical meeting conducted in this language.
Use independently tools, instruments and software applications available in the laboratories of basic and advanced subjects. Learn how it works and its limitations.

Use strategies to write documents with consistent content, structure, style appropriate, good level of spelling and grammar.

Makes tasks based on the guidelines of teachers deciding the time and resources required. Assesses own strengths and weaknesses and act accordingly.

Use strategies to texts and documents with consistent content, structure and style appropriate level and good spelling and grammar.

Makes tasks based on the guidelines of teachers deciding the time and resources required. Assesses own strengths and weaknesses and act accordingly.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>Hours small group:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong></td>
<td>150h</td>
<td>52h</td>
<td>85h</td>
</tr>
<tr>
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<td>13h</td>
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<td>34.67%</td>
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<td>8.67%</td>
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<tr>
<td></td>
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<td>56.67%</td>
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</table>
# Content

<table>
<thead>
<tr>
<th>(ENG) Tema 1. Introduction and basic concepts</th>
<th>Learning time: 4h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study : 2h</td>
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</tbody>
</table>

**Description:**
The transmission line in sinusoidal steady-state

<table>
<thead>
<tr>
<th>(ENG) Tema 2. Microwave Networks analysis techniques</th>
<th>Learning time: 43h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Practical classes: 14h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 4h</td>
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<tr>
<td></td>
<td>Self study : 25h</td>
</tr>
</tbody>
</table>

**Description:**
Planar lines (microstrip and stripline)
Amplitude waves. Generalized reflection coefficient
S. Parameters Definition and properties
Biports analysis. Examples
Waveguide discontinuities

<table>
<thead>
<tr>
<th>(ENG) Tema 3. Passive Networks</th>
<th>Learning time: 72h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 24h</td>
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<tr>
<td></td>
<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Self study : 42h</td>
</tr>
</tbody>
</table>

**Description:**
Networks 3 ports splitters and circulators
Networking 4-ports hybrids and couplers
PIN diodes: switches, attenuators, modulators and phase shifters
Schottky diodes: detectors and mixers
Microwave Filters

<table>
<thead>
<tr>
<th>(ENG) Tema 4. Active Networks</th>
<th>Learning time: 25h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 8h</td>
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<tr>
<td></td>
<td>Laboratory classes: 2h</td>
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<tr>
<td></td>
<td>Self study : 15h</td>
</tr>
</tbody>
</table>

**Description:**
Microwave amplifiers
Microwave oscillators
## Planning of activities

### (ENG) Short answer exams (Test)

**Description:**
2 exams

**Hours:** 2h  
Theory classes: 2h

### (ENG) Exercises

**Description:**
Previous study of the practices and final report

**Hours:** 6h  
Self study: 6h

### PRACTICE 1: TRANSMISSION LINES AND IMPEDANCE MATCHING

**Description:**
- Review the basics of transmission lines (TL).
- Using the Smith chart representation and calculation of reflection coefficients and impedances in LT.
- LT microstrip design.
- Introduction to the ADS program and use the program to calculate the reflection coefficients and adaptive network based on LT microstrip.

**Hours:** 2h  
Laboratory classes: 2h

### PRACTICE 2: BI PORTS STUDY

**Description:**
- Inverter design and comparison of its parameters \([S]\) simulated with an ideal inversor.
- Design of a symmetrical attenuator.
- Verifying matching network Practice 1 (simultaneous input and output conjugate match).
- Measure an attenuator with the network analyzer

**Hours:** 2h  
Laboratory classes: 2h

### PRACTICE 3: STUDY OF 3 PORTS DEVICES (dividers / combiners)

**Description:**
- Simulation of S parameters as a function of frequency.
- Comparison of a Wilkinson divider with another divider with no isolated outputs.
- Measurement of S parameters of a divider with Network Analyzer.

**Hours:** 2h  
Laboratory classes: 2h

### PRACTICE 4: STUDY OF 4 PORTS DEVICES (HYBRID)

**Hours:** 2h  
Laboratory classes: 2h
230052 - MICROS - Microwaves

**Description:**
Design of a 90° hybrid of ideal transmission lines.
S parameters simulation of the ideal hybrid as a frequency function.
Obtaining the layout of a 90° hybrid designed with microstrip lines.
Making hybrid microstrip 90° and measurement with Network Analyzer.

**PRACTICE 5: FILTERS**

**Description:**
Design a bandpass filter with coupled lines.
Simulation of the filter based on the frequency.
Obtaining the layout of the filter made ??with coupled microstrip lines.
Making filter, and measurement by the network analyzer.

**Hours:** 2h  
Laboratory classes: 2h

**PRACTICE 6: AMPLIFIERS**

**Description:**
Unilateral amplifier design
Amplifier simulation as a frequency function.
Comparison of simulated and specified characteristics.
Verification of the stability of the amplifier.

**Hours:** 2h  
Laboratory classes: 2h

**Final exam with long answers**

**Description:**
Final exam

**Hours:** 3h  
Theory classes: 3h

**Qualification system**

Final exam: 60%
Two control tests during the year: 10% and 10%
Laboratory work 15%
Proposed problems: 5%

This course will assess generic skills:
- Effective oral and written (Middle Level)
- Experimentation and knowledge of tools and instruments (High Level)
Bibliography

**Basic:**