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.
- CE13. Ability to apply advanced knowledge in photonics, optoelectronics and high-frequency electronic
- CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

Transversal:
- 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.

Learning objectives of the subject

Learning objectives and results:
Learning objectives: The aim of this course is to train the students in using advanced equipment to measure, characterize and/or evaluate sophisticated fiber-optic devices and systems.

Learning results:
1. Ability to operate, characterize and design optical transmitters, optical receivers, optical amplifiers, optical filters and multiplexers/demultiplexers.
2. Ability to evaluate the quality of a fiber-optic digital transmission.
3. Ability to carry out measurements of optical fiber characterization.
4. Ability to use fiber-optic-specific software to simulate and/or design both devices and systems.

**Study load**

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

<table>
<thead>
<tr>
<th>1. Introduction to Fiber-optics Laboratory</th>
<th>Learning time: 5h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study: 2h</td>
</tr>
</tbody>
</table>

**Description:**
- Introduction to Fiber-optics Lab.
- Description:
  1. Description of the practices to be performed
  2. Explanation of the equipment to be used
  3. Introduction to the simulation software to be used

<table>
<thead>
<tr>
<th>Practice 1: Optical Amplifiers</th>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Self study: 14h</td>
</tr>
</tbody>
</table>

**Description:**
- Description: Operation of optical amplifiers
- Characterization of:
  1. A semiconductor optical amplifier (SOA)
  2. An erbium-doped fiber amplifier (EDFA)
- Design of:
  1. An EDFA (hardware)
  2. Raman optical amplifier (software)

<table>
<thead>
<tr>
<th>Practice 2: Optical Modulators</th>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Self study: 14h</td>
</tr>
</tbody>
</table>

**Description:**
- Description: Operation of optical modulators
- Characterization of: A Mach-Zehnder optical modulator
- Design of:
  1. An optical intensity modulator (hardware)
  2. An optical IQ modulator (software)
### Practice 3: Optical Filters, Multiplexers-Demultiplexers and Switches

**Description:**
Description: Operation of optical filters, multiplexers-demultiplexers and switches
Characterization of:
1. An optical filter
2. An optical multiplexer-demultiplexer
3. A wavelength-selective switch (WSS)
Design of:
1. An optical cross-connect (software)

**Learning time:** 20h
- Laboratory classes: 6h
- Self study: 14h

### Practice 4: Digital Transmission System

**Description:**
Description: Operation of:
1. Bit error testers
2. Optical oscilloscopes
Characterization of:
1. An optical transmitter
2. An optical receiver
Evaluation of: An intensity-modulation with direct detection system (hardware)
Design of: An advanced optical modulation system (software)

**Learning time:** 20h
- Laboratory classes: 6h
- Self study: 14h

### Practice 5: Wavelength Division Multiplexing (WDM)

**Description:**
Description: Operation of: Ethernet-SDH data generators
Evaluation of:
1. A DWDM System (hardware)
2. A coarse WDM system (hardware)
Design of: A flex-grid optical network (software)

**Learning time:** 20h
- Laboratory classes: 6h
- Self study: 14h
Practice 6: Control Plane-driven connectivity provisioning

Description:
Operation of: Control plane-based approach of connectivity provisioning.
Evaluation of: Connectivity provisioning according to different requirements (latency, QoS, etc).

Learning time: 20h
Laboratory classes: 6h
Self study: 14h

Qualification system
Individual assessments: 20%
Laboratory assessments: 80%

Bibliography

Basic:

Complementary: