Degree competences to which the subject contributes

Specific:
1. Knowledge of experimental techniques and procedures in the field of physics, engineering and nanotechnology. Ability to design experiments using the scientific method and criteria of efficiency, rationality and cost.

Generical:
5. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.
6. ABILITY TO CONCEIVE, DESIGN, IMPLEMENT, AND OPERATE COMPLEX PHYSICAL ENGINEERING SYSTEMS. Ability to conceive, design, implement, and operate complex systems in the fields of micro and nano technology, electronics, advanced materials, photonics, biotechnology, and space and nuclear sciences.
3. 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:
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
2. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
5. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most
After the course Physical Engineering Projects 2, the student should be able to:

- Work with various professional laboratory equipment.
- Know the basics of experimental data treatment and extract reasoned conclusions based on these data.
- Consider experimental problems, design experiments appropriate for their resolution and analyze the results thereof.
- Teamwork.

### Study load

<table>
<thead>
<tr>
<th><strong>Total learning time:</strong> 150h</th>
<th>Hours large group:</th>
<th>13h</th>
<th>8.67%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours small group:</td>
<td>30h</td>
<td>20.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>101h</td>
<td>67.33%</td>
</tr>
</tbody>
</table>

There will be six practical sessions in research laboratories (to choose between several options). To perform these laboratory experiments, that will be carried out in small groups, the students will have a working script with all the necessary information prior to the correct understanding and implementation of the practice.

Also in small groups, each one will carry out a different project (to choose from the list) during six weeks in which it should work independently.
## Content

| 0. Physical Engineering Projects | Learning time: 10h  
Theory classes: 10h |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Course presentation, working groups formation and group distribution between the several experiments in laboratories.</td>
</tr>
</tbody>
</table>

| 1. Thermodynamical, cristalographic and dielectric characterization of amorphous materials | Learning time: 12h  
Laboratory classes: 6h  
Self study: 6h |
|-------------------------------------------|---------------------|
| **Description:**                          | Location: GCM laboratory in EEBE  
Person in charge: Maria del Barrio |

| 2. Optical and surface characterization of materials | Learning time: 12h  
Laboratory classes: 6h  
Self study: 6h |
|-----------------------------------------------------|---------------------|
| **Description:**                                     | Location: GCM laboratory in EEBE  
Person in charge: Trinitat Pradell i Daniel Crespo |

| 3. Infrared Spectroscopy | Learning time: 12h  
Laboratory classes: 6h  
Self study: 6h |
|-------------------------|---------------------|
| **Description:**        | Location: Barcelona Research Centre in Multiscale Science and Engineering (EEBE)  
Person in charge: Jordi Llorca |
### 4. Organic Thin-Film Transistors (TFT)

**Description:**
Location: Laboratory of the micro and nano-Technologies group (Campus Nord)
Person in charge: Joaquim Puigdollers

**Learning time:** 12h
- Laboratory classes: 6h
- Self study: 6h

### 5. Maxwell at Work. The Doppler Radar

**Description:**
Location: RSLab laboratory in Campus Nord
Persons in charge: Albert Aguasca and Jordi Romeu

**Learning time:** 12h
- Practical classes: 6h
- Self study: 6h

### 6A. Unveiling properties of matter: microscopy, optical trapping and diffraction

**Description:**
Location: ICFO (Castelldefels)
Persons in charge: David Artigas

**Learning time:** 12h
- Laboratory classes: 6h
- Self study: 6h

### 6B. Photovoltaic efficiency measurement for a given solar cell

**Description:**
Location: ICFO in Castelldefels
Persons in charge: David Artigas

**Learning time:** 12h
- Laboratory classes: 6h
- Self study: 6h
### 7A. Photonics in fiber telecommunications

**Learning time:** 12h  
Laboratory classes: 6h  
Self study: 6h

**Description:**  
Location: GCO laboratory in Campus Nord  
Person in charge: José Antonio Lázaro and Joan Gené

### 7B. From quantized energy levels to a telecommunications revolution

**Learning time:** 18h  
Theory classes: 6h  
Laboratory classes: 6h  
Self study: 6h

**Description:**  
Location: GCO laboratory in Campus Nord  
Person in charge: José Antonio Lázaro and Joan Gené

### 8A. Laser Range Finder

**Learning time:** 12h  
Laboratory classes: 6h  
Self study: 6h

**Description:**  
Location: DONLL laboratory in Terrassa Campus.  
Persons in charge: Crina Cojocaru and Jose Trull

### 8B. Nd:Y AG-Laser

**Learning time:** 12h  
Laboratory classes: 6h  
Self study: 6h

**Description:**  
Location: DONLL laboratory in Terrassa Campus.  
Persons in charge: Crina Cojocaru and Jose Trull
9. Fluid physics in microgravity

Learning time: 12h
- Laboratory classes: 6h
- Self study: 6h

Description:
Location: Laboratori de microgravetat a Castelldefels (EETAC)
Person in charge: Ricard González

9. Projects

Learning time: 68h
- Guided activities: 6h
- Self study: 62h

Description:
The students can choose between several projects that change from academic year to academic year and they can propose own projects if they are coherent with the subject aims.

Some of the most done projects in the past years (in parenthesis the person in charge):

a) Design and aerodynamics measures of objects (Jordi Gutierrez)
b) Electronic plastics. Fabrication of organic devices (Joaquim Puigdollers)
c) Design, constructions and application of an Erbium-fiber laser for the study of carcinogenic cells (José Antonio Lázaro)
d) Extragalactic nova explosions (Glòria Sala)
e) Design, simulation and measures of a microwave circuit (María Concepción Santos)

You can find all the past projects in the web:
https://enginyeriafisica.etsetb.upc.edu/ca/estudis/pla-estudis/pef2

Qualification system

The six laboratory experiments have a weight of 50% on the final mark while the project will have the remaining 50%.

The final score (N) will be obtained from each of the 6 laboratory experiments (Prn where n=1,2,…,6) and from the Physical Engineering Project (PEF) according to the following expression:

\[ N = 0.5 \times (Pr1 + Pr2 + Pr3 + Pr4 + Pr5 + Pr6)/6 + 0.5 \times PEF \]
Bibliography

Basic:

Complementary: