Degree competences to which the subject contributes

Specific:
1. Research, design, develop and characterization of complex systems dynamics that have to be controlled during the its operation such as security, motion restriction or failures in the control system.

Transversal:
2. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Learning objectives of the subject

The aim of this class is not only to make students familiar with recent developments and process technology of the microsensors, MEMS, and smart devices in the classroom. In the classroom, the first part of this lecture will review briefly on various application fields of the microsensors, MEMS, and smart devices. Then we will concentrate on the materials and on processes required to make different kinds of the microdevices. Most of these technologies have been derived from silicon integrated circuit (IC) technologies, so the standard microelectronics technology to produce ultra large-scale integrated circuits and package them will also be reviewed. Then, the new techniques that have been developed to make
microsensors and microactuators, such as bulk and surface silicon micromachining will be followed. In addition, the emerging technology of microstereolithography that can be used to form true three-dimensional micromechanical structures will be included and the softlithography used in bio applications will be also covered.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>31h</th>
<th>24.80%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours small group:</td>
<td>14h</td>
<td>11.20%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>80h</td>
<td>64.00%</td>
</tr>
</tbody>
</table>
## Content

### Module 1 MEMS/ NEMS Introduction

**Description:**
Module 1 MEMS/ NEMS Introduction

**Related activities:**
Activity 1-2-3

**Specific objectives:**
- Scaling benefits
- Fabrication processes:
  - Oxidation, film deposition, lithography, etching, ion implantation and diffusion
  - Surface micromachining
  - Bulk Micromachining

**Learning time:** 62h 30m
- Theory classes: 5h
- Practical classes: 4h
- Self study (distance learning): 25h
- Theory classes: 11h
- Practical classes: 2h 30m
- Self study: 15h

### Module 2.- Micromechanics

**Description:**
Module 2.- Micromechanics

**Related activities:**
Activity 1-2-3

**Specific objectives:**
- Mechanics of materials
- Microstructural elements
- Energy methods

**Learning time:** 29h
- Theory classes: 11h
- Practical classes: 3h
- Self study (distance learning): 15h

### (ENG) m3

**Learning time:** 38h
- Theory classes: 10h
- Practical classes: 3h
- Self study (distance learning): 25h
### 220621 - Nano & Microtechnology

<table>
<thead>
<tr>
<th>(ENG) m4</th>
<th><strong>Learning time:</strong> 24h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
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<tr>
<td></td>
<td>Practical classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study (distance learning): 15h</td>
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</tbody>
</table>

### (ENG) -

**Degree competences to which the content contributes:**
### Planning of activities

<table>
<thead>
<tr>
<th></th>
<th><strong>Hours:</strong> 49h</th>
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<tbody>
<tr>
<td><strong>THEORY SESSIONS</strong></td>
<td>Theory classes: 29h</td>
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<tr>
<td></td>
<td>Self study: 20h</td>
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</tbody>
</table>

**Description:**
- Description in class of the theoretical contents of the subject

**Support materials:**
- Basic and specific bibliography
- Atenea Handouts

**Descriptions of the assignments due and their relation to the assessment:**
- This activity is graded through two written exams: midterm (activity 3) and final (activity 4)

**Specific objectives:**
- After these classes, the student should have consolidated and acquired all the knowledges enumerated in the general learning goals of subject.

<table>
<thead>
<tr>
<th></th>
<th><strong>Hours:</strong> 34h</th>
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<tbody>
<tr>
<td><strong>LAB SESSIONS</strong></td>
<td>Theory classes: 14h</td>
</tr>
<tr>
<td></td>
<td>Self study: 20h</td>
</tr>
</tbody>
</table>

**Description:**
- In this activity the student will set up practical experiments related to the subject contents

**Support materials:**
- Bibliography and Lab guide

**Descriptions of the assignments due and their relation to the assessment:**
- Lab report

**Specific objectives:**
- Improve and use concepts related to MEMS design and manufacturing

<table>
<thead>
<tr>
<th></th>
<th><strong>Hours:</strong> 16h</th>
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<tbody>
<tr>
<td><strong>MIDTERM EXAM</strong></td>
<td>Theory classes: 1h</td>
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<tr>
<td></td>
<td>Self study: 15h</td>
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</tbody>
</table>

**Description:**
- Individual test related to the acquired contents.

**Support materials:**
- Exam and handouts provided

**Descriptions of the assignments due and their relation to the assessment:**
- Solved exam is handed to the professor
- It is part of continuous evaluation systems

**Specific objectives:**
- Contents related to module 1 and 2.
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<table>
<thead>
<tr>
<th>FINAL EXAM</th>
<th>Hours: 26h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study: 25h</td>
</tr>
</tbody>
</table>

**Description:**
Individual test related to the acquired contents.

**Support materials:**
Exam and handouts provided

**Descriptions of the assignments due and their relation to the assessment:**
Solved exam is handed to the professor
It is part of continuous evaluation systems

**Specific objectives:**
Contents related to module 3 and 4

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**Qualification system**

Activity 1 (Resolution of exercises), weight: 10%
Activity 2 (Lab sessions), weight: 30%
Activity 3 (Midterm), weight: 35%
Activity 4 (Final), weight: 35%

The subject will foresee procedures that allow recovering unsatisfactory results obtained in the first evaluation. For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.

If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

**Regulations for carrying out activities**

All the activities are compulsory

**Bibliography**