

## 26941 - Micro- and Nano-Systems

### Syllabus Information

**Academic year:** 2023/24

**Subject:** 26941 - Micro- and Nano-Systems

**Faculty / School:** 100 - Facultad de Ciencias

**Degree:** 447 - Degree in Physics

**ECTS:** 5.0

**Year:**

**Semester:** Second semester

**Subject type:** Optional

**Module:**

### 1. General information

The objective of this subject is to acquire basic skills in analysis, design and simulation techniques of micro and nano physical systems, and to learn about the manufacturing processes and the most important applications of these devices. Special emphasis will be placed on electromechanical systems as they are the basis of smart sensors with countless applications.

Micro and nano technology applied to sensorics is of undoubted scientific and economic interest.

The experimental physicist must know not only the physical principle and operation, but also the designing and manufacturing process.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (<https://www.un.org/sustainabledevelopment/es/>):

- Goal 4: Quality Education.
- Goal 9: Industry, Innovation and Infrastructure.

### 2. Learning results

- Is able to describe the manufacturing process of a micro-device type.
- Is capable of analytically modelling an electro-mechanical micro-system through the use of approximations.
- Is able to operate a simulator for the modelling and simulation of a MEMS/NEMS.
- Is capable of simulating simple electronic microcircuits in nanometer technologies.
- Is capable of experimentally characterizing a commercial MEMS.

### 3. Syllabus

Topic 1. Manufacturing technologies and processes.

Topic 2. Physical fundamentals of micro and nano electro-mechanical systems (MEMS and NEMS).

Topic 3. Electronic microcircuits.

Topic 4. Microsystems and nanotechnology: sensors, processors and on-chip actuators.

Topic 5. Applications of micro and nano systems: smart sensors.

Topic 6. Introduction to design software tools: silicon compilers and simulators of MEMS and NEMS.

#### Laboratory practices:

Session 1: Introduction to a simulation environment.

Session 2: Electronic modelling and simulation.

Session 3: Physical modelling and simulation.

Session 4: Experimental characterization of a commercial MEMS.

### 4. Academic activities

The teaching-learning methodologies proposed to achieve the objectives set and to acquire the following competences are:

- Theory classes: 30 hours of participative master class and 30 hours of personal work.
- Types of problems: 10 hours of in-class problem solving and 25 hours of personal work.
- Laboratory classes: 10 hours of experimental development in the laboratory and 20 hours of personal work . Activities related to personal work include: 5 hours of resolution of previous questions and 15 hours of report preparation.

## 5. Assessment system

The student must demonstrate that they have achieved the intended learning results by means of the following assessment activities

### Activity 1 (50%)

Completion of a theoretical-practical test on a date pre-established by the teacher. With this part students can achieve up to 5 points, but it is necessary to obtain a minimum of 2.5.

### Activity 2 (20%)

Resolution of exercises derived from the theoretical classes, their delivery on the dates marked and the possible presentation in class. Exercises not submitted on time will be graded with 0 points. With this part students can achieve up to 2 points, but it is necessary to obtain a minimum of 1.

### Activity 3 (30%)

Resolution of the questionnaire corresponding to each practical session and its delivery on the dates marked. The questionnaires not submitted on time will be graded with 0 points. With this part students can achieve up to 3 points. A minimum of 1.5 must be obtained.

### Passing the subject by means of a single global test

The student who has not passed the subject by the previous proposed activities, or who wishes to raise the grade may choose to do some assignments similar in nature and dedication or to sit for a theoretical-practical exam established in the official exam calendar.