Subject:	**Nanoelectronics and NEMS**
Semester:	**Spring**
Credits ECTS:	2,5
Professors:	**Dr. Blas Garrido**
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Department / Faculty:	**Departament de Electronica**
	Facultad - Física
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Objectives:

In this subject the students would get a perspective of the microelectronic evolution towards the nanoelectronics, taking special attention in the nanoelectomecanical systems (NEMs). The student should be able to identify the evolution of the elemental devices, for instance the MOSFET, and its projection to the future; know what the limitations of these devices are the most important ones based in quantum effects. About NEMs, these elements would have functions that allow them to capture information through nanosensor, signal process and actuator devices. It is pretend to emphasize how the scale reduction in these devices offers new paradigms, and open new possibilities in properties and applications.

Recommendations / Required Background:

It is required that the students hold at least a basic knowledge of Electronics and MOS devices.

Contents:

1) Microelectronic Evolution

a. The Integrated circuit and Microelectronics

b. Evolution in Complexity of microprocessor and memories.

c. Submicron Technologies.

2) Size reduction technologies and MOSFETs in the nanometric scale.

a. Nanometric scale MOSFET, Short channel effect.

b. Fabrication technologies and limitations

3) Low dimensional mesotropic systems

a. Band structure and transport in several dimensions

b. Fluctuation and Aharonov-Bohm effect.

c. Ballistic transport and Coulomb blockage phenomena.

d. Optical Properties in low dimensional.

4) Quantum effect based devices.

a. Single Electron Devices.

b. Resonant tunnelling effect devices

c. LEDs and Wells based LASERs, Nanowires and Quantum dots.

5) MEMs and NEMs.

a. Basic Structure of electromechanical systems: nanoelectromecanics

b. New effects in NEMS

6) Nanohandles and Nanoresonators.

a. Fabrication and Characterization.

b. Applications: Signal Process and mass sensor.

Practices: Laboratory Sessions.

1) Practice 1: Short channel effects simulation with ISE.

2) Practice 2: Nano-optoelectronics devices simulation with FULLWAVE

Plan:

Lectures:	**20 hours**
Laboratory:	**6 hours**
Independent work:	**14 hours**
Study:	**29 hours**

References

1) M.J. Kelly: "Low-dimensional semiconductors. Materials, Physics, Technology and Devices". Oxford Science Publications.
2) S.M. Sze (Ed.): "Modern Semiconductor Device Physics". John Wiley and Sons.

3) S. Luryi, A. Zaslavsky (Eds.) "Future Trends in Microelectronics: Reflections on the road to nanotechnology". Kluwer Editions.
4) S. Sugano, H. Koizumi: "Mesoscopic Physics". Springer Verlag Series on Materials Science.
5) S.D. Senturia, "Microsystem design", Kluwer Academic Publ., 2001.
6) M. Wilson et al. "Nanotechnology: basic science and emerging technologies", Chapman&Hall/CRC, 2002.
7) A. N. Cleland, "Foundations of nanomechanics: from solid-state theory to device applications", Springer Verlag, 2002.