CÓDE	NAME OF MODULE	TYPE
	NANOSCIENCE: A HISTORICAL PERSPECTIVE	E

M = mandatory
E = elective

3.3.1. Learning goals of the module.

(List the specific learning goals that the current module should provide to the student; goals can focus on content, skills, or attitudes.)

This module intends to be a general introduction to the *Master's in Nanoscience* contents. The main goal is to motivate the student and provide him/her with a general picture of nanoscience and nanotechnology, before facing more specific courses. An historical perspective of the development of nanoscience in different scientific disciplines will be presented. Research in the XIX and XX centuries will be emphasized and reinterpreted in terms of our current knowledge of the nanoscale. References to older periods of time will be also made. Key discoveries in the history of nanoscience will be selected and carefully explained, also in terms of their later impact in the field. Historical, scientific and social contexts for the development of nanoscience in the last decades will be also discussed.

3.3.2. Methodology: learning activities and credit value of the module (ECTS).

3.3.2.1. Learning activities.

(Time required to teach the module; links to other modules included in the MSc Program and suggested chronological sequence with the latter)

Taking into account the motivating character of this course, it is essential that it is taught at the beginning of the Master's course.
To develop all subjects, 20 classroom lectures (1 hour each) will be necessary. Among them, 12 lectures will be on the general subjects of the program and 8 lectures will be devoted to more specific topics.
From the point of view of the student, the course will be used to develop advanced skills in the search and acquisition of scientific literature from different means, in particular from on-line resources. In addition, further working time would be needed to prepare individual presentations on topics related to the subject of the course. All in all, students would require approximately 50 hours to fulfill these tasks.
At the end of the course, students will be required to develop a scientific report on a subject of their choice (among those suggested by the teachers). An individual presentation of 20 minutes will be required as well. Time allocated for the presentations themselves and subsequent discussion is 5 hours. Assessment of the course will be based both on the report and the presentation.

3.3.2.2. ECTS credit value (and time)

1 ECTS credit = 25 hours UPV/EHU

TYPE OF LECTURE[1]	Theory		Practice							Evaluation	
	M[2]	S	PA	PL	PO	TA	TAI	PCL	PCC	Periodic Grading	Final Grading
Classroom lectures	12	8									5
Personal work [3]	25	25									
TOTAL	37	33									5

(1) M (standard lecture); S (seminar); PA (practical exercises in classroom); PL (practical exercises in laboratory); PO (practical exercises with computers); TA (non-industrial workshops); TAI (industrial workshops); PCL (clinical practice); PCC (field practice); the acronyms are taken from the Spanish wording.

(2) M = maximum allowed is 60% of the full classroom lectures .

(3) Personal work = time that the student would use to prepare and develop individual and group assignments.

3.3.2.3. Module Program.

(*Lectures)*

Lecture 1	What is nanoscience? What is nanotechnology? Impact of nanotechnology in society
Lecture 2	What are things made of? Reductionism. From classical to modern science. Small is different
Lecture 3	Historical development of surface science.
Lecture 4	Feynman's talk. DNA. Manipulation of atoms
Lecture 5	Invention of transistor. Miniaturization in electronics
Lecture 6	Nanostructures of Carbon. Quantum Dots. Other nanomaterials

3.3.2.4. Bibliography.

(Basic and specialized bibliographies, journal references, internet addresses, etc.)

-"Understanding nanotechnology", Warner books, from the editors of Scientific American, 2002.

-"Springer Handbook of Nano-technology", Brushton Editor, Springer-verlag, 2004.

- "Nanotechnology: A Gentle Introduction to the Next Big Idea", M. A. Ratner, D. Ratner, Prentice Hall PTR, 2002.

- Richard Feynman's historical talk: http.//www.its.caltech.edu/˜feynman/

- CD's NANOPOLIS encyclopaedia series ('Exploring matter with synchrotron light', 'Exploring matter with neutrons', and 'Exploring nanotechnology'); http://www.nanopolis.net.

- "Societal Implications of Nanoscience and Nanotechnology",ed. Mihail C. Roco and William Sims Bainbridge, Kluber Academic Publishers, 2002.

- "Multidisciplinary, interdisciplinary, and patterns of research collaboration in nanoscience and nanotechnology", J. Schummer, Scientometrics, vol. 59, n. 3, 2004, p. 425-465.(Online)

- "Nanotechnology: Science, Innovation, and Opportunity", Lynn E. Foster, Prentice Hall PTR, 2005.

-"The Global Technology Revolution", P. S. Antón, R. Silberglitt, J. Schneider, RAND, 2001.

-"Nanotechnology: Basic Science and Emerging Technologies",M. Wilson, K. Kannangara, G. Smith, M. Simmons and B. Raguse, Chapman&Hall/CRC, 2000.

3.3.3. Criteria and methods for evaluation and grading

(Analysis of the methodology that will be used to evaluate the learning process of the student)

Each student will be asked to deliver a scientific report on a subject of his/her choice. An oral presentation will be also required to defend the report. Marks will be mostly based on both activities.

Attendance, attitude and participation in the classroom lectures will be also taken into account.

3.3.4. Learning resources

Students will have access to all bibliographic resources from the UPV/EHU Chemistry Faculty, the Centro de Física de Materiales CSIC-UPV/EHU, and the Donostia International Physics Center DIPC. Online access to the scientific literature from these centers will be also guaranteed.

3.3.5. Language and number of groups attending the module

1	NUMBER OF GROUPS
x	LANGUAGE: ENGLISH

3.3.6. Fields of science and technology to which the module is related

CODE	FIELD
	PHYSICS OF CONDENSED MATTER
	APPLIED PHYSICS

3.3.7. Department in charge of the Program

CODE	DEPARTMENT [1]
	DEPARTMENT OF MATERIALS PHYSICS

3.3.8. Teachers in charge of the module

DNI	Teacher UPV/EHU	Number of credits
15.769.378 A	Pedro Miguel Echenique Landiribar	1.5

DNI	Teacher other institutions	Number of credits
50.836.672 W	Ricardo Díez Muiño	1.5