CÓDE	NAME OF MODULE	TYPE
	LOW DIMESNIONAL SYSTEMS AND NANOSTRUCTURES	M

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 COURSE IS INTENDED TO PROVIDE A GENERAL INTRODUCTION TO THE MOST IMPORTANT NANOSTRUCTURES IN NANOSCIENCE AND NANOTECHNOLOGY, ATTENDING TO THEIR DIMENSIONALITY (2D, 1D AND OD). THE MOST IMPORTANT PHENOMENA EMERGING IN LOW DIMENSIONAL SYSTEMS WILL BE DESCRIBED.
FINALLY SPECIAL ATTENTION WILL BE PAID TO CARBON AND OTHER INORGANIC NANOSTRUCTURES, WHICH EXIST IN ALL DIMENSIONS (DIAMOND, GRAPHITE, NANOTUBES, FULLERENES).

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)

THE TIME ESTIMATED TO TEACH THIS MODULE IS OF 75 HOURS. ABOUT 23 HOURS WILL BE USED FOR LECTURES AND 14 HOURS TO SOLVE EXERCISES PROPOSED DURING THE LECTURES. SOME EXERCISES WILL BE SOLVED WITH THE AID OF THE COMPUTER. THE REST OF THE TIME WILL BE DEVOTED TO THE PERSONAL WORK OF THE STUDENT AND WILL BE DISTRIBUTED AMONG STUDY OF THE THEORY, SOLVING EXERCISES, BIBLIOGRAPHIC SEARCH AND PREPARING AN ESSAY AND ITS ORAL PRESENTATION.
THIS COURSE IS A CONTINUATION OF THE INTRODUCTORY MODULE "NANOSCIENCE, A HISTORICAL PERSPECTIVE". SOME SKILLS ON "FUNDAMENTALS OF QUANTUM MECHANICS" AND FUNDAMENTALS OF SOLID STATE" ARE REQUIRED. ON THE OTHER HAND, THIS MODULE WILL BE REQUIRED FOR THE MODULES ON "MODELLING NANOSTRUCTURES", "NANOSTRUCTURAL PROPERTIES" AND "FROM NANOSCIENCE TO NANOTECHNOLOGY".

3.3.2.2. ECTS credit value (and time)

1 ECTS credit = 25 hours UPV/EHU

TYPE OF LECTURE[1]	Theory		Practice							Evaluation	
										Periodic Grading	Final Grading
	M[2]	S	PA	PL	PO	TA	TAI	PCL	PCC		
Classroom lectures	18	5	7		7						5
Personal work [3]	15		8		10						
TOTAL	33	5	15		17						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	LENGTH SCALES AND LOW DIMENSIONALITY
Lecture 2	ELECTRONIC STATES AND QUANTUM CONFINED SYSTEMS
Lecture 3	TWO DIMENSIONAL SYSTEMS: SURFACES AND HETEROJUNCTIONS, QUANTUM WELLS AND SUPERLATTICES, QUANTUM HALL EFFECT.
Lecture 4	ONE DIMENSIONAL SYSTEMS: QUANTUM WIRES, THE PEIERLS TRANSITION AND QUANTUM TRANSPORT.
Lecture 5	ZERO DIMENSIONAL SYSTEMS: QUANTUM DOTS AND METAL CLUSTERS. ELECTRONIC AND OPTICAL PROPERTIES. COULOMB BLOCKADE AND SINGLE ELECTRÓN DEVICES.
Lecture …	CARBON AND OTHER INORGANIC NANOSTRUCTURES: FULLERENES AND CARBON NANOTUBES.

3.3.2.4. Bibliography.

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

- "The Physics and Chemistry of Solids", Stephen Elliot, Wiley, 2000.(Capítulo 8)
- "Introduction to Modern Solid State Physics", Y. M. Galperin, (electronic, pdf on line)
-"Introduction to Solid State Physics", Charles Kittel, 8th edition, Wiley internacional, 2005.
"The Physics of low dimesnional semiconductors", J.H. Davies, Cambridge Univ. Press, 1998.
- "Quantum semiconductor structures", C. Weisbuch and B. Vinter, Academia Press 1991.
-"Low dimensional semiconductors", M.J. Nelly, Oxford Science Public. 1995
- "Electronic transport in mesoscopic systems", Supriyo Datta,Cambridge University Press, 1995.
- "Transport in Nanostructures", D.K. Ferry and S. M. Goodnick, Cambridge University Press, 1999.
- "Mesoscopic Physics and electronics", T. Ando, Y. Arakawa, F. Furuya, S. Komiyama and H. Nakashima, Spinger, 1998.
- "Mesoscopic systems. Fundamentals and Applications", Yoshimasa Murayama, Wiley-Vch, 2001.
- "Structure and properties of Atomic Nanoclusters", J.A. Alonso, Imperial College Press, 2005.
- "Carbon Nanotubes, Síntesis, Structure, Properties and Applications", M. S. Dresselhau, G. Dresselhaus and P. Avouris, Springer-verlag, 2001.
- "Quantum properties of atomic-sized conductors",N. Agrait, A. Levy yeyati and J.M. Van Ruitenbeek, Physics Reports 377, 81 (2003).

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)

TO EVALUATE THE LEARNING PROCESS THE PRESENCE AND PARTICIPATION IN THE LECTURES WILL BE CONSIDERED. MARKS WILL BE BASED ON THE RESOLUTION OF THE EXERCISES PROPOSED, AS WELL.
FINALLY A GENERAL TEST AND A WRITTEN ESSAY WITH ORAL PRESENTATION ON A MONOGRAPHIC TOPIC WILL BE CONSIDERED FOR THE EVALUATION.

3.3.4. Learning resources

THE STUDENTS WILL HAVE ACCESS TO THE BIBLIOGRAPHIC MATERIAL OF THE LIBRARIES OF THE CHEMISTRY FACULTY AND THE DIPC CENTRE. ON THE OTHER HAND, COMPUTERS WILL BE AVAILABLE IN ORDER TO ACCESS OTHER RESOURCES THROUGH THE INTERNET OR SOFTWARE PACKAGES. (IN PARTICULAR ACCESS TO THE ETSF SOFTWARE WILL BE PROVIDED; HTTP://NANO-BIO.EHU.ES)

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
9.294.488 G	ANGEL RUBIO SECADES	1.5
22.725.895 D	NEREA ZABALA UNZALU	1.5

DNI	Teacher other institutions	Number of credits