CÓDE	NAME OF MODULE	TYPE
	FUNDAMENTALS OF QUANTUM MECHANICS	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.)

The laws of Quantum Mechanics are the laws that describe the phenomenon taking place at the nanoscale. This module is thought to address the fundamentals of quantum mechanics, i.e., the formalism from which quantum theory was built, as well as the basic physical problems that are only understood within this theory.

The student will learn crucial concepts and tools, such as the probabilistic meaning of the wave function, the idea of operators and observables, the Schrödinger equation that describes the evolution of a system, and approximation methods that allow to solve the Schrödinger equation when the exact solution is not possible.

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 course consists of 45 hours of lectures and seminars.

The course is offered for the first term and first year in Master program. The schedule takes into account that the central concepts and ideas given in this course are the basic background to other courses in the Master:

Fundamentals in Solid State Physics
Low dimensional systems and nanostructures
Fundamentals of nanoscale characterization
Nanostructural properties

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 ures	20	10									3
Personal work (3)											
TOTAL	30	15									

(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	THE ORIGINS OF QUANTUM THEORY
Lecture 2	THE POSTULATES OF QUANTUM MECHANICS
Lecture 3	OBSERVABLES: OPERATORS IN QUANTUM MECHANICS
Lecture 4	POSITION AND MOMENTUM OPERATORS. UNCERTAINTY PRINCIPLE
Lecture 5	SCHRÖDINGER EQUATION. STATIONARY STATES. TIME EVOLUTION OF QUANTUM SYSTEM
Lecture 6	ONE-DIMENSIONAL PROBLEMS
Lecture 7	THE ONE-DIMENSIONAL HARMONIC OSCILLATOR
Lecture 8	GENERAL THEORY OF ANGULAR MOMENTUM
Lecture 9	ORBITAL ANGULAR MOMENTUM
Lecture 10	SPIN ANGULAR MOMENTUM
Lecture 11	PARTICLE IN A CENTRAL POTENTIAL. THE HYDROGEN ATOM
Lecture 12	APPROXIMATION METHODS FOR STATIONARY AND TIME-DEPENDENT PROBLEMS
Lecture 13	IDENTICAL PARTICLES: FERMIONS AND BOSONS
Lecture 14	SCATTERING THEORY

3.3.2.4. Bibliography.

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

C. COHEN TANNOUDJI, B. DIU, AND F. LALOË, "QUANTUM MECHANICS", ED. JOHN WILEY AND SONS
F.J YNDURAIN "MECÁNICA CUÁNTICA", ARIEL CIENCIA
B.H. BRANSDEN AND C.J.JOACHAIN "QUANTUM MECHANICS", PEARSON EDUCATION
L. I. SCHIFF, "QUANTUM MECHANICS", ED. MCGRAW-HILL
A. MESSIAH, "QUANTUM MECHANICS", ED. DOVER
R. EISBERG AND R. RESNICK, "QUANTUM PHYSICS", ED. JOHN WILEY AND SONS
L. D. LANDAU AND E. M. LIFSHITZ, "QUANTUM MECHANICS (NON RELATIVISTIC THEORY)", ED. BUTTERWORTH-HEINEMANN

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)

The concepts of quantum mechanics are crucial to follow most of the modules given in this Master. For this reason, the method used to evaluate the learning process of the student will be a final exam that will represent 75% of the final grade. In this final exam the student will have the opportunity to show his/her familiarity with the basic concepts of quantum mechanics. The 25% of the grade left will evaluate the student's personal work. In particular, the student will be asked to solve a few problems related with the concepts explained during the lectures.

3.3.4. Learning resources

The student will have access to the bibliographical resources available in the University of the Basque Country, "Centro de Física de Materiales", and "Donostia International Physics Center".

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
0069057-X	Andrés Arnau Pino	1.5

DNI	Teacher other institutions	Number of credits
16269816F	Maite Alducin Ochoa	1.5