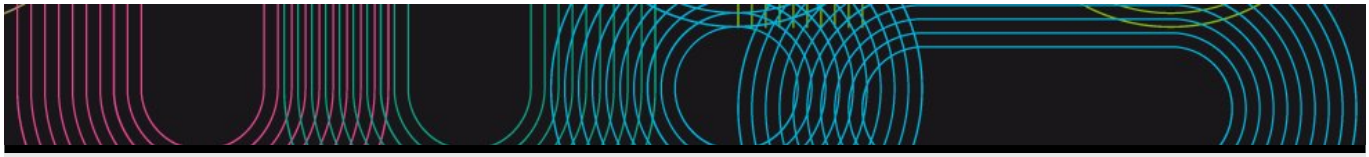
Universidade Vigo

Subject Guide 2023 / 2024



IDENTIFYING DATA				
Quantum mechanics I				
Subject	Quantum mechanics I			
Code	V05M198V01101			
Study programme	(*)Máster Universitario en Ciencia e tecnoloxías de información cuántica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Paredes Galán, Ángel			
Lecturers	Paredes Galán, Ángel			
E-mail	angel.paredes@uvigo.es			
Web	http://quantummastergalicia.es/info			
General description	This course presents the formalism and basic elements of the quantum mechanics, and more in particular the most adapted to the quantum treatment of the information. It covers the introductory subjects that they will be required by the distinct subjects. It is focused to students that come from of degrees or *másteres in which it have not seen never Mechanical Quantum: engineering, mathematical, etc. Will begin with a review of mathematical methods and will continue with a study in great depth of the axioms of the Quantum Mechanics and his practical consequences.			

Training and Learning Results	
Code	
A1	Understand the domain, concepts, methods and basic techniques of quantum mechanics: mathematical formalism, postulates, operators, matrices, Bloch sphere, photonic states.
B1	To nnow the theoretical foundations of quantum mechanics, the mathematical formalism, the axioms and simpler systems.
B2	To acquire knowledge about quantum systems with many degrees of freedom as a means of storing and processing information.
C1	To analyze and break down a complex concept, examine each part and see how they fit together
C2	To classify and identify types or groups, showing how each category is different from the others
C3	To compare and contrast and point out similarities and differences between two or more topics or concepts

Expected results from this subject	
Expected results from this subject	Training and Learning Results

New	A14 A1 A14 A14 B1 B2 C1 C18 C2 C3 C18 C18 C18 D18 D18

Contents	
Topic	
Historical perspective.	Basic experiments.
Complex Hilbert spaces.	Mathematical tools. Elements of linear algebra. Dirac notation.
Operators, eigenvalues and eigenvectors.	Linear operators and matrix notation. External product. Identity operator. Hermitian, unitary and normal operators. Trace of an operator. Commutators. Spectral decomposition. Pauli matrices.
Postulates of quantum mechanics.	Postulates. Measurement. Expected values. Heisenberg uncertainty. Two level systems. Spin states.
Temporal evolution	Hamiltonian operator. Stationary states. Evolution operators.
Density matrix	Pure states and mixed states. Expectation values
Wave mechanics.	Schrodinger equation.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	13	0	13
Seminars	9	0	9
Introductory activities	1	0	1
Autonomous problem solving	0	45	45
Problem and/or exercise solving	0	5	5
Objective questions exam	1	0	1
Problem and/or exercise solving	1	0	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	The professor exposes the contents of the syllabus to the students.
Seminars	Sessions based in the resolution of problems.
Introductory activities	Introduction of the subject.
Autonomous problem solving	Study of the contents and resolution of the proposed exercises.

Personalized assistance	
Methodologies	**Description**

Lecturing	Resolution of doubts in the classroom and in tutorials. To make an appointment for tutorials, write to angel.paredes@uvigo.gal Online tutorials on demand: https://campusremotouvigo.gal/public/961623215 student password: ZuT8euJW
Seminars	Resolution of doubts in the classroom and in tutorials. To make an appointment for tutorials, write to angel.paredes@uvigo.gal Online tutorials on demand: https://campusremotouvigo.gal/public/961623215 student password: ZuT8euJW
Introductory activities	Resolution of doubts in the classroom and in tutorials. To make an appointment for tutorials, write to angel.paredes@uvigo.gal Online tutorials on demand: https://campusremotouvigo.gal/public/961623215 student password: ZuT8euJW
Autonomous problem solving	Resolution of doubts in tutorials. To make an appointment for tutorials, write to angel.paredes@uvigo.gal Online tutorials on demand: https://campusremotouvigo.gal/public/961623215 student password: ZuT8euJW

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	Autonomous problem solving to show the achievement of the learning results and the development of competences.	60	A1	B1 B2	C1 C2 C3
Objective questions exam	Examination consisting of objective questions to evaluate the acquired knowledge.	20	A1	B1 B2	C1 C2 C3
Problem and/or exercise solving	Examination based on problem solving.	20	A1	B1 B2	C1 C2 C3

Other comments on the Evaluation

Continuous evaluation:

It will consist of three tests:
Resolution of problems outside the classroom 1: Value 30%. Resolution of problems related to the first half of the subject. Continuous attendance and participation in class will be taken into account.
Resolution of problems out of the classroom 2: Value 30%. Resolution of problems related to the second half of the subject. Continuous attendance and participation in class will be taken into account.
Final examination. Value 40%. It will consist of a part of objective questions (20%) and a part of resolution of problems (20%).

Global evaluation:
A single examination consisting of objective questions (20%) and resolution of problems (80%), which will amount to 100% of the qualification of the subject.
This evaluation scheme is valid for both the ordinary and the extraordinary opportunities.
Ethical Commitment: The student is expected to exhibit appropriate ethical behavior. In case of detecting unethical behavior (copying, plagiarism, use of unauthorized electronic devices, etc.), it will be considered that the student does not meet the necessary requirements to pass the subject. In this case, the final grade in the corresponding evaluation opportunity will be 0.0

Sources of information

Basic Bibliography

Notes of the subject,

Complementary Bibliography

David A.B. Miller, **Quantum Mechanics for Scientists and Engineers**, 978-0-521-89783-9, Cambridge University Press, 2008

Michael A. Nielsen and Isaac L. Chuang, **Quantum computation and quantum information**, 0-521-63503-9, Cambridge University Press, 2002

Michel Le Bellac, **Quantum physics**, 978-1107602762, Cambridge University Press, 2006

Recommendations

Subjects that continue the syllabus

Fundamentals of quantum information/V05M198V01103
Quantum mechanics II/V05M198V01102